IN THE UNITED STATES DISTRICT COURT
FOR THE DISTRICT OF DELAWARE

APPLERA CORPORATION, MDS INC., and APPLIED BIOSYSTEMS/MDS SCIEX,	)	
Plaintiffs,	)	
v.	)	Civil Action No. 00-105-RRM
MICROMASS UK LTD. and MICROMASS, INC.,	)	
Defendants.	)	

OPINION

Jack B. Blumenfeld, Esquire and Julia Heaney, Esquire, Morris, Nichols, Arsht & Tunnell, Wilmington, Delaware; Walter E. Hanley, Jr., Esquire, James Galbraith, Esquire, Lewis V. Popovski, Esquire, Jeffrey S. Ginsberg, Esquire, Mark A. Chapman, Esquire, and Huiya Wu, Esquire, Kenyon & Kenyon, New York, New York; counsel for plaintiffs.

Robert W. Whetzel, Esquire and Chad Shandler, Esquire, Richards, Layton & Finger, Wilmington, Delaware; James G. Hunter, Jr., Esquire, Kenneth G. Schuler, Esquire, and Kevin C. May, Esquire, Latham & Watkins, Chicago, Illinois; counsel for defendants.

May 23, 2002
Wilmington, Delaware

McKELVIE, District Judge

This is a patent infringement case. Plaintiff Applera Corporation, formerly known as PE Corporation, is a Delaware corporation with its principal place of business in Norwalk, Connecticut. Plaintiff MDS Inc. is a Canadian corporation with its principal place of business in Toronto, Canada. Plaintiff Applied Biosystems/MDS Sciex, formerly known as Perkin-Elmer Sciex Instruments, is a Canadian partnership formed under the laws of Ontario and having a place of business there. Applera and MDS are general partners of Applied Biosystems/MDS Sciex. MDS is the owner of U.S. Patent No. 4,963,736 (the '736 patent), entitled "Mass Spectrometer and Method and Improved Ion Transmission." Applied Biosystems/MDS Sciex is the exclusive licensee of the '736 patent. The plaintiffs will be collectively referred to as AB/Sciex.[1]

Defendant Micromass UK Ltd. is a British corporation with its principal place of business in Manchester, United Kingdom.[2] Micromass UK manufactures mass spectrometers, including the Quattro Ultima. Defendant Micromass, Inc. is a Massachusetts corporation with its principal place of business in Beverly, Massachusetts.

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[1]In the court's claim construction opinion, it distinguished between MDS, Inc., the owner of the patent and the party that prosecuted it before the PTO, and the other plaintiffs for purposes of the prosecution history discussion. For the sake of simplicity, the court will ignore this distinction and will refer to only AB/Sciex throughout this opinion.

[2]Because AB/Sciex and Micromass UK are Canadian and British companies, respectively, the court will preserve the English spelling conventions of their evidentiary submissions.

Micromass, Inc. distributes and sells mass spectrometers in the United States. The defendants will be collectively referred to as Micromass.

On February 18, 2000, AB/Sciex filed its complaint in this action alleging that Micromass's Quattro Ultima infringes one or more claims of the '736 patent. Micromass denied infringement, and raised affirmative defenses and counterclaims. Micromass's counterclaims seek a declaratory judgment that the '736 patent is invalid and unenforceable, and alleges that AB/Sciex has filed this suit in an improper effort to maintain monopoly power in violation of section 2 of the Sherman Act, 15 U.S.C. § 2, or attempted or conspired to do so.

In July 2001, Micromass introduced a redesigned Quattro Ultima, in which part of its allegedly infringing structure, a hexapole rod set, was replaced with a series of rings. AB/Sciex contends that the new Quattro Ultima, known as the "Ion Tunnel Quattro Ultima," infringes the '736 patent under the doctrine of equivalents. The original Quattro Ultima will be referred to as the "Hexapole Quattro Ultima."

On October 22 and 23, 2001, the parties filed dispositive motions. AB/Sciex sought summary judgment on Micromass's inequitable conduct defense and antitrust counterclaims. Micromass filed nine summary judgment motions. In five of those motions, Micromass contended that the Hexapole Quattro Ultima did not infringe the claims of the '736 patent. Micromass also sought summary judgment that: (i) the asserted claims of the '736 patent are invalid due to anticipation; (ii) the '736 patent is

invalid for indefiniteness; (iii) the '736 patent is unenforceable due to inequitable conduct; and (iv) the Ion Tunnel Quattro Ultima does not infringe the claims of the '736 patent under the doctrine of equivalents.

On December 13, 2001, the court held a hearing in accordance with Markman v. Westview Instruments, Inc., 517 U.S. 370 (1996), to construe the disputed claim terms. On February 6, 2002, the court issued a memorandum opinion construing the claim terms. Applera Corp. v. Micromass UK Ltd., 186 F. Supp. 2d 487 (D. Del. 2002). On February 7, 2002, the court held a hearing to address the summary judgment motions. At that hearing, Micromass moved for reconsideration of the court's claim construction. It also presented its summary judgment motions. The court took the motions under advisement and permitted the case to go to trial. The court will present its decision on Micromass's motion for reconsideration in this opinion.

The court bifurcated the trial into two components; a jury trial on the infringement and invalidity issues, and a bench trial on inequitable conduct and equitable estoppel. The ten-day jury trial began March 4, 2002. At the conclusion of that trial on March 15, 2002, Micromass moved for judgment as a matter of law under Federal Rule of Civil Procedure 50(b). The court reserved judgment. The jury unanimously found that the Hexapole Quattro Ultima literally infringed the two independent claims of the '736 patent, claims 1 and 14. The jury also found that: (i) the Ion Tunnel Quattro Ultima infringed claims 1 and 14 under the doctrine of equivalents; (ii) Micromass's

infringement was not willful; (iii) the claims of the '736 patent were not invalid[3]; and (iv) AB/Sciex's mass spectrometers were marked with notice of the '736 patent since February 1999. The jury awarded $47.5 million in damages, of which $41.3 million was attributable to the Hexapole Quattro Ultima.

On April 3, 2002, the court conducted a one-day bench trial on Micromass's inequitable conduct and equitable estoppel defenses. On inequitable conduct, Micromass contends that the '736 patent is unenforceable because AB/Sciex failed to present the PTO with material prior art, including an earlier European Patent application of one of the inventors of the '736 patent. Micromass also contends that AB/Sciex did not present certain experimental evidence to the PTO during the prosecution of the patent, and made false and misleading statements describing the prior art to the PTO during reexamination. With respect to equitable estoppel, Micromass contends that before it developed the Quattro Ultima, AB/Sciex led it to believe that the '736 patent would not be asserted against it because it was invalid. The parties have submitted proposed findings of fact and conclusions of law on those topics.

On April 1, 2002, Micromass filed its post-trial motion for judgment as a matter of law or for a new trial. That motion addresses the jury's verdicts on the validity of the

[3]By special interrogatory, the jury found that Micromass did not prove, by clear and convincing evidence, any of the following bases of invalidity for either claim 1 or claim 14: anticipation by any of a list of prior art references, that the invention was in public use prior to the '736 patent, that the invention was on sale prior to the '736 patent, that the invention was obvious, or that the patent failed to comply with the enablement, best mode, and written description requirements of 35 U.S.C. § 112.

asserted claims of ’736 patent, Micromass’s infringement, and damages. On validity, Micromass contends that it established at trial that the claims of the ’736 patent are anticipated by the European Patent application discussed earlier, and that its claims would have been obvious to one of skill in the art based on certain combinations of prior art references. With respect to infringement, Micromass alleges that AB/Sciex failed to prove that its devices met two of the claim limitations of the asserted claims of the ’736 patent and that the Ion Tunnel Quattro Ultima was infringed those claims under the doctrine of equivalents. On damages, Micromass argues that AB/Sciex is not entitled to lost profits damages as a matter of law, and that the jury could not reasonably accept AB/Sciex’s reasonable royalty estimates.

AB/Sciex has also submitted two post-trial motions. It moved for summary judgment on Micromass’s antitrust counterclaims as inconsistent with the jury’s verdicts on invalidity and infringement. It also moved to alter or amend the judgment to add pre-judgment interest and enjoin further infringement.

This is the court’s decision on all of motions described above.

I. FACTUAL AND PROCEDURAL BACKGROUND

The following facts are taken from the court’s earlier opinion, the ’736 patent and its prosecution history, and the evidence presented at both the jury and bench trials. For purposes of Micromass’s assertions of inequitable conduct and equitable estoppel, the following recitation comprises the court’s findings of fact.

1. Mass Spectrometry and the ’736 Patent

1. Background of the Technology

The ’736 patent discloses a technology used in mass spectrometers. Mass spectrometers are used to analyze the chemical composition of trace substances in a sample gas or liquid. They are useful in a number of endeavors, including pharmaceutical experimentation and testing food and drink for minimum quality standards. Mass spectrometers operate by applying an electrical charge to the molecules of the substance being analyzed, resulting in charged molecules known as ions. By applying an electrical field to the ions, the substance being analyzed can be separated into its constituent parts using the ratio of their molecular weight to the charge.

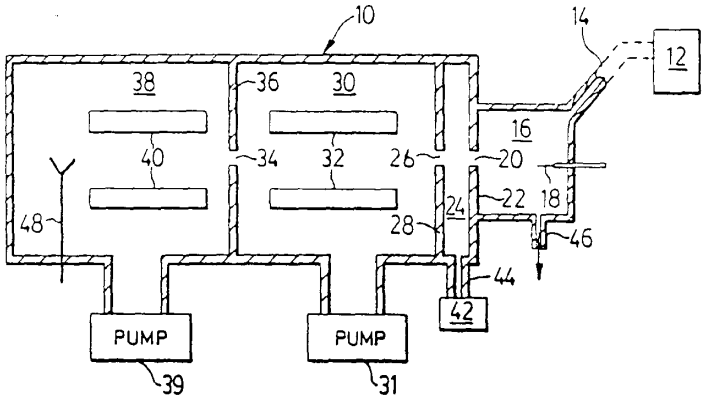

FIG. 1

The ’736 patent is directed to a typical type of mass spectrometer, referred to as a quadrupole mass spectrometer. Figure 1 of the ’736 patent is an example of a quadrupole mass spectrometer or two-stage mass spectrometer. It is comprised of four basic types of

structures – an ionization chamber, an ion guide, a mass analyzer, and a detector. Beginning at the right of Figure 1, the ionization chamber (16) contains a duct (14) for inputting the trace substance. The substance is ionized by applying an electric charge with an electric discharge needle (18). The ionization chamber is typically at atmospheric pressure. The ions proceed next through a curtain gas chamber (24) and into the ion guide (30). The ion guide is a set of electrode rods (32) in a vacuum chamber created by pumping out the ambient gas (31). The quadrupole mass spectrometer has four electrode rods, spaced apart in three dimensions to create an interior space through which the ions are directed, although more than four rods can be used (six in a hexapole, eight in a octopole, etc.). The ion guide uses an alternating current (AC) to channel the ions through the central space. The altering positive and negative charges in adjacent rods forces the ions to oscillate between the rods while traveling down their length. This is known as "strong focusing."

The focused ions, separated from the ambient gas, are directed through a small orifice (34) and into the mass filter chamber (38). The mass filter chamber is kept at an even lower pressure than the ion guide with a second vacuum pump (39). A second set of rods (40), known as the mass filter, applies both an AC voltage and a direct current (DC) voltage to select ions of a particular mass-charge ratio. Using a particular voltage in the mass filter separates the desired ions from the undesired, and permits the desired ions to continue on their path to a detector (48) that records their presence.

The basic structure of a quadrupole ion guide was well-known at the time of the application of the ’736 patent. It was disclosed in several papers, including the articles cited as prior art in the ’736 patent.

As plaintiff’s expert witness, Dr. Christie Enke, explained, one of the challenges in constructing quadrupole ion guides was that improving ion transmission through the device required a very low pressure in the vacuum chambers, also called cells. Because low pressures were only achieved by using powerful vacuum pumps, the quadrupole mass spectrometers on the market at the time the ’736 patent issued were large and expensive.

The inventors of the ’736 patent, Donald J. Douglas and John B. French, were aware of this problem. They described a “classical equation” for ion transmission in which “ion signal intensity (ion current) transmitted through the cell decreases with increasing gas pressure in the cell.” ’736 Patent, Col. 1, ln. 33-37. Douglas and French set out to solve this problem and it was their discovery that led to the ’736 patent.

2. The ’736 Patent

On November 15, 1989, Douglas and French filed United States Application Serial Number 07/437,047 with the United States Patent and Trademark Office (PTO). The application named Douglas and French as its inventors and MDS Health Group Limited, a predecessor entity of MDS, Inc., as assignee. The priority date was claimed from a Canadian patent application filed on December 12, 1988.

Douglas and French, and their representatives, cited three prior art references to the PTO Examiner in their application. Those references were: (i) U.S. Patent Number 4,328,420 (the ’420 patent), for which French was the inventor; (ii) Dr. R. Smith, et al., “On-line Mass Spectrometric Detection for Capillary Zone Electrophoresis,” Anal. Chem., Vol. 59, p. 1230 (Apr. 15, 1987) (the “1987 Smith Paper”); and (iii) Dr. R. Smith, et al. “Capillary Zone Electrophoresis – Mass Spectrometry Using an Electrospray Ionization Interface,” Anal. Cham., Vol. 60, p. 436 (Mar. 1, 1988) (the “1988 Smith Paper”).

The Douglas and French application describes a typical quadrupole mass spectrometer, using both an ion guide and a mass filter. They claimed that the novelty of the application, however, was the description of particular parameters of pressure, electrode rod length, and voltage designed to improve the transmission of ions through the ion guide at a pressure higher than previously used and with “a large enhancement in ion signal.” ’736 Patent, Abstract. According to the ’736 patent’s specification,

> The inventors have now discovered that the classical equation describing ion signal intensity does not in fact describe the situation accurately when dynamic focusing is used in the interstage region and that when the gas pressure in the region of the ion optic elements is increased within certain limits and when the other operating conditions are appropriately established, ion transmission is markedly increased.

’736 Patent, Col. 1, ln. 42-49. The gas pressure and other operating conditions of the ion guide were explained in the final two clauses of the two independent claims, claim 1 (a

product claim) and 14 (a method claim).[4] The penultimate clause of each claim, 1(j) and

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[4]Claim 1 recites:

1. A mass spectrometer system comprising:

(a) first and second vacuum chambers separated by a wall, said first vacuum chamber having an inlet orifice therein,

(b) means for generating ions of a trace substance to be analyzed and for directing said ions through said inlet orifice into said first vacuum chamber,

(c) a first rod set in said first vacuum chamber extending along at least a substantial portion of the length of said first vacuum chamber, and a second rod set in said second vacuum chamber, each rod set comprising a plurality of elongated parallel rod means spaced laterally apart a short distance from each other to define an elongated space there between extending longitudinally through such rod set, said elongated spaces of said first and second rod sets being first and second spaces respectively, said first rod set being located end to end with said second rod set so that said first and second spaces are aligned,

(d) an interchamber orifice located in said wall and aligned with said first and second spaces so that ions may travel through said inlet orifice, through said first space, through said interchamber orifice, and through said second space,

(e) means for applying essentially an AC-only voltage between the rod means of said first rod set so that said first rod set may guide ions through said first space,

(f) means for applying both AC and DC voltages between the rod means of said second rod set so that said second rod set may act as a mass filter for said ions,

(g) means for flowing gas through said inlet orifice into said first space,

(h) means for pumping said gas from each of said chambers,

(i) the pressure in said second chamber being a very low pressure for operation of said second rod set as a mass filter,

(j) the product of the pressure in said first chamber times the length of said first rod set being equal to or greater than 2.25×10^{-2} torr cm but the pressure in said first chamber

being below that pressure at which an electrical breakdown will occur between the rod means of said first rod set,

(k) and means for maintaining the kinetic energies of ions moving from said inlet orifice to said first rod set at a relatively low level, whereby to provide improved transmission of ions through said interchamber orifice.

Claim 14 recites:

14. A method of mass analysis utilizing a first rod set and a second rod set located in first and second vacuum chambers respectively, said first and second rod sets each comprising a plurality of rod means and defining longitudinally extending first and second spaces respectively located end-to-end with each other and separated by an interchamber orifice so that an ion may travel through said first space, said interchamber orifice and said second space, said method comprising:

(a) producing outside said first chamber ions of a trace substance to be analyzed,

(b) directing said ions through an inlet orifice in an inlet wall into said first space, first through said first space, said interchamber orifice and then through said second space, and then detecting the ions which have passed through said second space, to analyze said substance,

(c) placing an essentially AC-only RF voltage between the rod means of said first set so that said first rod set acts to guide ions therethrough, through,

(d) placing AC and DC voltages between the rod means of said second rod set so that said second rod set acts as a mass filter,

(e) admitting a gas into said first chamber with said ions,

(f) pumping said gas from said first chamber to maintain the product of the pressure in said first chamber times the length of said first rod set at or greater than 2.25×10^{-2} torr cm but maintaining the pressure in said first chamber below that pressure at which an electrical breakdown would occur between the rods of said first set,

(g) pumping gas from said second chamber to maintain the pressure in said second chamber at a substantially lower pressure than that of said first chamber, for effective mass filter operation of said second rod set,

14(f), explains those conditions as the product of the pressure in the chamber and the length of the electrode rods (P x L), which must be "equal or greater than 2.25 x 10^{-2} torr cm" and less than "that pressure at which an electrical breakdown will occur between the rod means of said first rod set." The final clauses of claims 1(k) and 14(h) describe a "means for maintaining" (claim 1) or "controlling" (claim 14) the kinetic energy of ions moving from the inlet to the first rod set "at a relatively low" level. The specification explains that this means for maintaining is a combination of the pressure in the ion guide vacuum chamber and a DC potential voltage applied to the inlet orifice that attracts ions into the ion guide. Together, these two claim limitations define the phenomenon of the invention, referred to as "dynamic focusing" or "collisional focusing."

While the inventors admitted that the reason for "collisional focusing" was "not entirely understood," they reasoned that higher pressures caused the ions to collide with more gas molecules as they approached and traversed the ion guide. These collisions reduce the energy of the ions. This loss of energy is called "cooling" or "thermalization." The result of the effect is that "ions are being forced toward the center line of the system and that the mechanism which is causing the [ion transmission] enhancement is a kind of collisional focusing or damping effect that concentrates the ion flux closer to the central

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(h) and controlling the kinetic energy of ions entering said first rod set to maintain such kinetic energy at a relatively low value,

whereby to provide improved transmission of said ions through said interchamber orifice.

axis." '736 Patent, Col. 6, ln. 64-68.

On May 8, 1990, the PTO Examiner issued a final Office Action allowing all 24 claims of the Douglas and French application. The PTO granted the application on October 16, 1990 and the application issued as the '736 patent.

2. Accusation of Infringement and the Reexamination History

In late 1996, Micromass scientist Dr. Patrick Turner and others published an article entitled "Interface Studies in the ICP-Mass Spectrometer" in Plasma Source Mass Spectrometry Developments and Applications (the "ICP Article"). The ICP Article described a device using a hexapole rod set and operating as both "a collision cell and for focusing ion beams in electrospray sources." A collision cell is a mass spectrometer in which high pressure gas is used to collide ions with gas molecules and cause them to fragment. The article also discussed the "thermalising properties" of the device, which resulted in "improved resolution in an analyser." The article did not give a detailed explanation of the structure of the ICP device, but simply suggested that it "thermalised[d] the ions produced in the ICP torch" and thus had a "low energy spread."

Dr. William Davidson, AB/Sciex's Vice President of Science and Technology, read the ICP Article and attended a trade conference at which the ICP device was discussed. He understood from the article and conference that the ICP device could be used both as a collision cell and to guide ions with increased focus. He also took note of the "thermalising" properties of the invention, which he understood to be another

description of the phenomenon of collisional focusing. Concerned that the ICP device might infringe the '736 patent, Dr. Davidson instructed AB/Sciex's attorney to send a letter to Micromass, warning them of his concern. On July 10, 1997, one of AB/Sciex's outside counsel, Richard J. Parr, sent a letter to Micromass. The letter referenced the ICP article and stated that "[i]t appears to us that this device, if sold, will infringe the claims of the above-identified Canadian and U.S. patents . . . ."

On April 16, 1997, Dr. David Yorke, Micromass's Intellectual Property Manager, responded by letter to AB/Sciex's correspondence. Dr. Yorke stated the ICP device "does not infringe any valid claim" of the '736 patent and cited four references of prior art. Those references were:

> (1) French, European Patent Application, Publication No. 0 023 826, February 11, 1981 (the "French application");
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> (2) Boitnott et al., Optimization of Instrument Parameters for Collision Activated Decomposition (CAD) Experiments for a Finnigan Triple Stage Quadrupole GC/MS/MS/DS, 1981 Pittsburgh Conference On Analytical Chemistry and Applied Spectroscopy, Abstract No. 782 (the "Finnigan abstract");
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> (3) Boitnott et al., Optimization of Instrument Parameters for Collision Activated Decomposition (CAD) Experiments for a Triple Stage Quadrupole (TSQ™ GC/MS/MS/DS, Finnigan Topic 8160 (the "Finnigan paper"); and
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> (4) Caldecourt et al., An Atmospheric-Pressure Ionization Mass Spectrometer/Mass Spectometer, International Journal of Mass Spectrometery and Ion Physics, Vol. 49, p. 233-251 (1983) (the "Caldecourt article").

Dr. Yorke also stated that "Micromass does not propose to seek a license under [the '736

patent] or its equivalents, at least in the foreseeable future."

On April 24, 1997, Parr wrote back to Dr. Yorke and requested copies of the references cited in his letter. There was no further communication between the parties until this suit was filed.

On September 30, 1997, AB/Sciex filed a Reexamination Request for the '736 patent with the PTO. AB/Sciex identified eight references of prior art as possibly raising substantial new questions of patentability, including the four references cited by Micromass. AB/Sciex identified those four references as collision cell references that were "discussed during license negotiations with Micromass UK Limited." The other four references AB/Sciex cited were:

> (1) Schaaf et al., Trapped Ion Density Distribution in the Presence of He-Buffer Gas, Applied Physics, Vol. 25, pp. 249-251 (1981) (the "Schaaf article");
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> (2) Vedel et al., "Influence of space charge on the computed statistical properties of stored ions cooled by a buffer gas in a quadrupole rf trap," 29 Physical Review, No. 4, pp. 2098-2101 (1984) (the "Vedel article");
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> (3) Stafford et al., "Recent Improvements in and Analytical Applications of Advanced Ion Trap Technology," International Journal of Mass Spectrometry and Ion Processes, Vol. 60, pp. 85-98 (1984) (the "Stafford Article"); and
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> (4) Stafford et al., European Patent Application, Publication No. 0 013 207, July 11, 1984 (the "Stafford application").

AB/Sciex described these four references as "ion trap" references.

1. Collision Cell References

With respect to the four references provided by Micromass, AB/Sciex described them as "tandem mass spectrometers." Tandem mass spectrometers, also called "triple stage mass spectrometers" are comprised of two AC-DC mass filters separated by a collision cell containing an AC-only rod set. In the figure below, taken from the French application and French's '420 patent, the ions move from the first mass filter (4), through the collision cell (14), and then into the second mass filter (8).

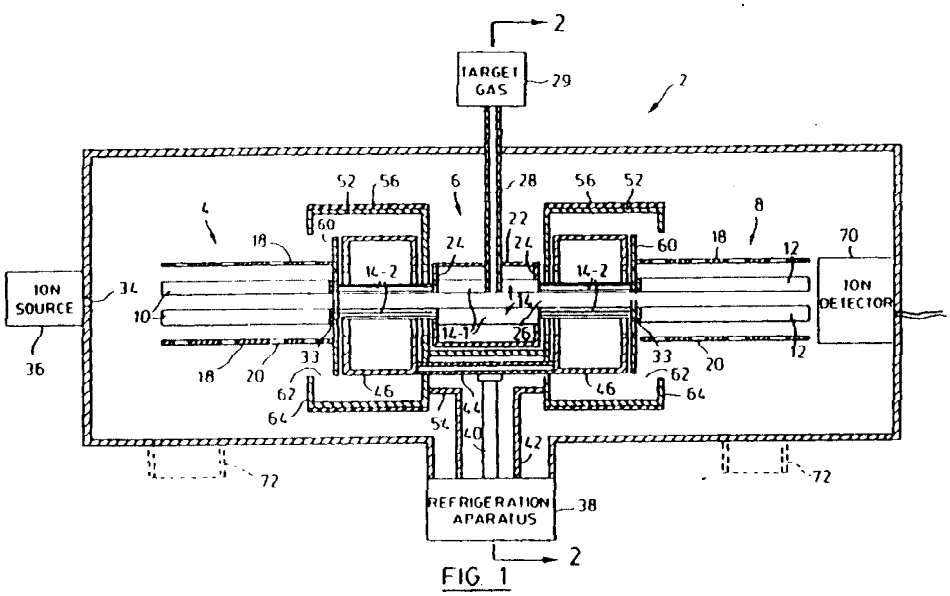


FIG 1

The collision cell accepts the ions not filtered out by the first mass filter, then collides those ions into a gas at a high energy, causing them to fragment. These fragments are called "daughter ions," and proceed into the second mass filter for further filtering.

AB/Sciex distinguished the tandem mass spectrometer references before the PTO Examiner by explaining that a collision cell operates differently from a two-stage

quadrupole mass spectrometer, such as the one described in the '736 patent. It stated that

> [a] collision cell, such as the one described in the French application, dissociates a parent ion into fragment ions by creating conditions whereby a high energy parent ion collides with a high pressure gas. . . . A mass spectrometer according to the invention, on the other hand, is intended to improve the transmission of ions through a cell. The mass spectrometer according to the invention uses an increased pressure to improve ion transmission and maintains "the kinetic energies of ions moving from said inlet orifice to said first rod set at a relatively low level" (claim 1). The French application would therefore teach away from the invention since it collides ions at high kinetic energies into a high pressure region to dissociate the ions into daughter ions, which is in contrast to the invention which uses low kinetic energy ions and an increased pressure to produce an improved transmission of ions entering the device.

Request for Reexamination at 13. AB/Sciex made a similar distinction for each of the tandem references. Id. at 15-16 (Finnegan abstract), 18 (Finnegan paper), 21-22 (Caldecourt article).

2. Ion Trap References

The ion trap references, including the Schaff article, disclose a mass spectrometer in which AC-only electrodes generate electric fields that trap ions within them for some period of time. The electric field can be varied to eject ions of different mass to charge ratios from the trap for study. The Schaff article discusses using a light buffer gas such as helium to cool the ions in an ion trap. "Another way to reduce ion temperature is the addition of a small amount of a light buffer gas. Collision[s] between the ions and the gas tend to cool the ions."

During reexamination, AB/Sciex contended that the use of collisional cooling in

ion traps would not have taught one of skill in the art to use the same damping effects to focus ions in an ion guide. AB/Sciex also distinguished the ion trap references from the '736 patent on the basis of the differing structures of the two types of mass spectrometers, including the absence of rod sets and an AC-DC mass filter.

3. The Reexamination

The PTO Examiner granted AB/Sciex's request for reexamination on November 20, 1997. The Examiner cited three of the four collision cell references, including the French application, the Finnigan abstract and the Finnigan paper, and concluded that those references raised "a substantial likelihood that a reasonable examiner would consider these teachings important in deciding whether or not the claims are patentable."

On February 3, 1998, the PTO Examiner rejected the claims of the '736 patent as obvious in light of the structure disclosed in the French application and the voltage parameters disclosed in the Finnigan abstract and paper. He stated, "it would have been obvious to a person having ordinary skill in the art to control the energies of the ions entering the French apparatus in accordance with the teaching of [the Finnigan abstract and paper] by providing DC voltage between the rods of the first quadrupole and the inlet wall." Because it is relevant to Micromass's anticipation and inequitable conduct contentions, the court will discuss the French application in some detail.

4. The French application and the '420 patent

The French European Patent Office application discloses a method for improving ion transmission in a tandem mass spectrometer. It is related to French's United States '420 patent and both depict Figure 1, shown above, as an embodiment of the invention. Both depict three rod sets through which ions travel. The first and third rod sets (10, 12) are mass filters utilizing AC-DC voltages and are located in sections (4 and 8) of a vacuum chamber (2). The second rod set (14) is a collision cell containing rods applying only AC voltages. A cross-section of the collision cell is shown in Figure 2. The collision cell has a target gas (29) input into the space between the rods (14) to dissociate the ions. That target gas is removed by a refrigerating mechanism (38), which acts as a pump to withdraw the target gas and lower the pressure. The AC-only rod set has two kinds of rods. Rods 14-1 are typical electrodes with solid centers. Rods 14-2 are called "open structure end extensions" and are placed on either side of the 14-1 rods. Open structure rod extensions are formed of thin stiff rods or wires "arranged in a curved configuration to simulate the shape of the outer portion of a normal quadrupole rod." Figure 5 depicts the typical solid rods with the open structure rod extension.

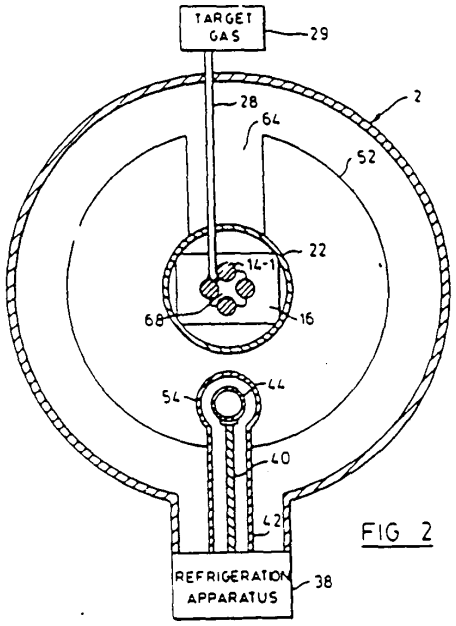


FIG 2

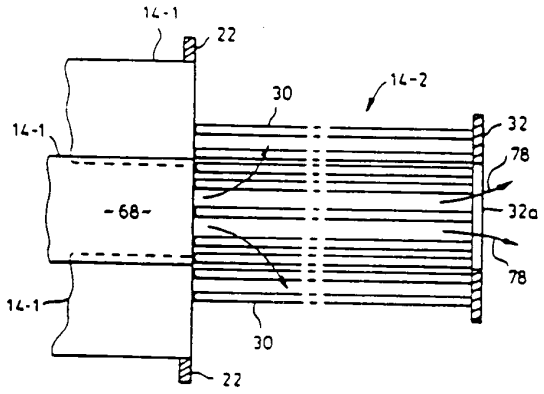


FIG. 5

The open structure rod extensions accomplish the purpose of the French application. As stated in the specification, in collision cells using solid AC-only rods, "relatively little gas can escape [between the rods], and therefore a substantial gap must be left between the ends of adjacent quadrupole sections," to permit the collision gas to be evacuated from the chamber without increasing gas pressure in the mass filters. These gaps decrease ion signal intensity. By using open structure rod extensions through which gas can flow, "only a small proportion of the target gas entering the centre quadrupole section 6 will travel into the end sections 4, 8." Because the gas can proceed through the open structure rod extensions (14-2), the mass filters (10, 12) can be located more closely to those AC-only rods (14). This "close coupling" of elements increases the ion transmission of the tandem mass spectrometer.

The specification of the French application explains that in a "typical" tandem mass spectrometer, the gas density in the "target region, i.e. in the space between rods 14-1," is between 10^{-2} torr and 10^{-4} torr. It also describes the length of the rod extensions (14-2) as equal to the length of the solid rods (14-1), which is explained to be "(e.g. 4 inches)." Because 4 inches is approximately 10.16 centimeters, the P x L product of the French application is as high as 10.16×10^{-2} torr cm.

Though otherwise directed to a tandem mass spectrometer, the final paragraph of the specification of French application states that "it may also be used with only two [quadrupole] sections in a series, namely an AC-only section and an AC-DC section." That paragraph goes on to state:

> Such an arrangement is shown and described in the co-pending application of Sciex Inc., the description and drawings of which are hereby incorporated by reference into this application. In such system ions entering a vacuum chamber are guided into a conventional AC-DC quadrupole mass spectrometer by an AC-only section arranged in series with the conventional section, the rods of the AC-only section being of open construction to permit gas entering with the ions to flow through the rods and escape. The same phase and spacing relationships as described previously apply.

Claim 1 of the French application then goes on to claim a mass spectrometer in which an AC-DC rod set precedes the AC-only rod set, but the two rod sets being arranged "closely longitudinally" to one another. Further dependant claims add the collision cell structure to the AC-only rod set.

The "co-pending application of Sciex Inc." referred to in the French application is

a similar application that resulted in French's '420 patent, which was cited by the inventors as prior art in their application for the '736 patent. The '420 patent also discloses a tandem mass spectrometer in which part of the AC-only rod set in the collision cell has an open structure and the rods are closely coupled to one another to improve ion transmission. However, claim 1 of the '420 patent reverses the two claimed rod sets, first an AC-only rod set with an open structure, and then an AC-DC mass filter. The tandem mass spectrometer embodiment, discussed throughout the specification, is only added by dependent claim 9, which adds a third rod set functioning as a mass filter before, in the path of ion travel, the collision cell. The specification of the '420 patent is similar to that of the French application. However, the pressure in the target region of the collision cell is described as 10^{-3} torr to 10^{-5} torr. Because the rods are the same length (4 inches), the highest P x L product disclosed is 10.16×10^{-3} torr cm, which is beneath the 2.25×10^{-2} torr cm limitation of the '736 patent.

Dr. Enke, AB/Sciex's technical expert, opined that the French application recites a gradient of pressures between the rods of the collision cell, such that the average pressure along the rods could be calculated using either an exponential decay expression or a cosine squared distribution. Dr. Raymond March, Micromass's expert, performed those calculations and concluded that the average pressure along the rods was 2.46×10^{-3} torr cm using exponential decay, resulting in a P x L product of approximately 2.46×10^{-2} torr over the 10 cm rods. Based on this calculation, Dr. Enke admitted at trial that the French

application's collision cell, even assuming that it discloses a gradient of operating pressures, had a maximum which exceeded the 2.25 x 10^{-2} torr cm claimed in the '736 patent.

5. The Reexamination Concludes

On March 11, 1998, the PTO Examiner met with Geoffrey Sutcliffe, AB/Sciex's attorney, and Dr. Douglas to discuss the patentability of the claims in the '736 patent. In his interview summary, the PTO Examiner indicated that he reached agreement with AB/Sciex on all claims. He stated:

> Applicant could remove French et al. as a reference by establishing that the product of the pressure and length of the AC only quadrupole described in the reference when that quadrupole was used as a collision cell between two mass analyzing quadrupoles to fragment ions was not intended to be used when that quadrupole was used only as an ion guide and not to fragment the ions.

DX 108 (Interview Summary Mar. 11, 1998).

Following the PTO Examiner meeting, on April 3, 1998, AB/Sciex submitted an Amendment to Non-Final Office Action, adding new dependent claims 25-30 to the patent.[5] The Amendment also addressed the prior rejection of claims 1-24 discussed at the March 11 interview and enclosed a Declaration from Dr. French supporting the patentability of those claims. The Amendment stated that the Declaration "establish[es] that the French application does not suggest that the claimed first chamber have [sic] the

[5]AB/Sciex did not assert claims 25-30 of the '736 patent against Micromass, and thus those claims will not be discussed here.

specified product of pressure and length and furthermore provide[s] additional reasons that the claims are in condition for allowance."

The French Declaration further distinguished AC-only rod sets in a collision cell from the same rod sets used in an ion guide. Paragraph 9 of the Declaration made the same point that Dr. Douglas had made in his meeting with the PTO Examiner. "The French application does not suggest that the recited pressure range and rod length may be used in a quadrupole section which acts as an ion guide and which is not intended to fragment the ions."

In Paragraph 6 of his Declaration, Dr. French also recited the pressure gradient theory that would later be introduced at trial by Dr. Enke. In describing the French application, he stated:

> The gas pressure in the second quadrupole 6 is higher than pressures in quadrupole sections 4 and 8 . . . . The density distribution of the target gas varies across a length of the second quadrupole 6 with the pressure peaking near a center of the quadrupole section 6 and falling off at either end of the quadrupole section 6. Page 7 of the French application recites a pressure range of 10^{-2} torr and the ends of the quadrupole section 6 would be at or below about 10^{-4} torr.

French Declaration ¶ 6.

On June 15, 1998, the PTO Examiner issued a final Office Action confirming that claims 1-24 were patentable, but rejecting claims 25-30 as indefinite. With respect to claims 1-24, the Examiner stated that the "declaration of Dr. French . . . establishes that the apparatus disclosed in the French application does not operate with a product of

pressure and rod length greater than or equal to 2.25×10^{-2} torr cm in a chamber containing a rod set operated with only AC voltages applied."

On August 12, 1998, AB/Sciex filed a Response After Final Office Action, in which it argued that claims 25-20 are patentable. AB/Sciex also continued to contend that claims 1-24 were not suggested by the French application and recited four reasons: "(1) the French application teaches away from the invention by suggesting that pressure be reduced in the first chamber, (2) the French application does not suggest the product of pressure and rod length in the first chamber, (3) the French application does not suggest collisional focusing, (4) the French application does not suggest improving the transmission of ions entering the first chamber."

Following further correspondence relating to the new claims, on May 25, 1999, the PTO issued a Reexamination Certificate confirming the patentability of claims 1-24 and allowing claims 25-30.

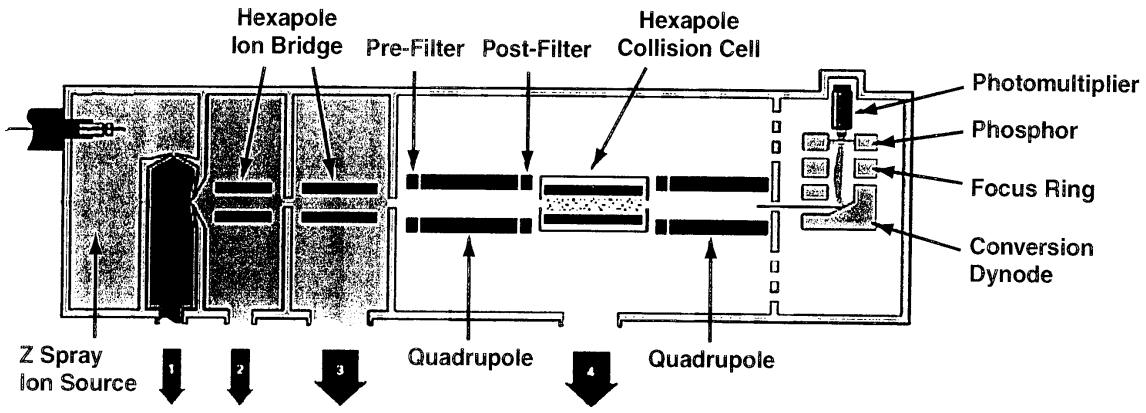
C. The Jury Trial

1. AB/Sciex's Infringement Presentation

AB/Sciex's first witness at trial was its expert, Dr. Enke. Dr. Enke explained what a mass spectrometer was and the purposes for which it was used. He explained the basic mechanics of ion motion, including how ions are guided by electric fields and the loss of energy caused by collisions with gas. Dr. Enke explained the traditional problems with low pressure ion guides. He also described the invention in the '736 patent and that it

was novel because it taught operating ion guides at a relatively high pressure in a manner that achieved increased ion transmission. Dr. Enke also explained the "collisional focusing" employed by the invention. He illustrated his testimony using a diagram of the API 3000, an AB/Sciex product that utilizes the '736 patent.

Dr. Enke also testified about Micromass's Quattro Ultima mass spectrometer. The Hexapole Quattro Ultima is a tandem mass spectrometer comprised of a quadrupole mass filter, a hexapole collision cell, and another quadrupole mass filter. These are all shown in the figure below within chamber 4. Preceding this structure are two hexapole ion bridges, contained in chambers 2 and 3, that function as ion guides. Ions are created with a Z spray in an atmospheric pressure chamber, are then directed into an empty chamber (chamber 1), and then enter the two hexapole ion bridges (chambers 2 and 3). The ions then proceed into chamber 4, where they encounter the tandem (or three-stage) mass spectrometer structure – a mass filter, collision cell, and another mass filter. Finally, the remaining ions are detected at the end of the process.



Dr. Enke testified that the two hexapole ion bridges were ion guides within the claim limitations of the ’736 patent, and that they directed ions into the mass filter that followed. He explained that by practicing the ’736 patent, the Hexapole Quattro Ultima achieved improved transmission of ions. In support of that conclusion, he discussed computer simulations that he ran using parameters taken from the Quattro Ultima. He also presented Micromass documents showing that even though the size of the orifice before the mass filter was reduced in size, a large percentage of ions continued into the mass filter. Based on this testimony, he opined that the Hexapole Quattro Ultima practices collisional focusing and contains all the limitations of claims 1 and 14 of the ’736 patent.

In July 2001, Micromass replaced the hexapole ion bridges with “ion tunnels.” The ion tunnels are comprised of 84 separate electrode rings, shaped like washers, with a hollow center. The rings are arranged sequentially so that ions proceed in a straight line down their center. The voltages in adjacent rings is alternated and the ions oscillate through their middle. Dr. Enke testified that the ion tunnel was the equivalent of the “first rod set” of the ’736 patent because in accomplishes the same function, in the same way, with the same result. That is, it guides ions through to the mass filter and accomplishes collisional focusing. He noted one distinction, however. While the ion rods only produce electric fields in two dimensions as the ions traverse their length, each ring creates an electric field in a third dimension, called the “axial” direction. The axial

direction is the direction of ion travel, both towards and away from the inlet and interchamber orifices. Dr. Enke testified that this axial electric field has a negligible effect because the number of rings cancels out any effect on ion travel.

On cross-examination, Dr. Enke was questioned on his understanding of several of the parameters of Quattro Ultima. He also explained differences between the '736 patent and several articles of prior art, including collision cell references such as the Caldecourt article and a tandem mass spectrometer named the TAGA 6000 that was manufactured by AB/Sciex. He also distinguished ion traps from the '736 patent.

AB/Sciex also presented the testimony of Dr. Donald Douglas, an AB/Sciex scientist and one of the inventors of the '736 patent. Dr. Douglas explained that his invention was achieved while trying to reduce the size of the vacuum pumps used in AB/Sciex's earlier TAGA 6000. He also testified concerning why his invention was novel compared to the prior art. AB/Sciex then presented the testimony of Gerald Mossinghoff, a former Commissioner of Patents, to explain the procedures for prosecuting patents and seeking reexamination before the PTO.

AB/Sciex also called Dr. William Davidson, a Vice President of Science and Technology at AB/Sciex. Dr. Davidson described AB/Sciex's TAGA 6000 product and explained that it had many shortcomings, including a large, refrigerated cryopump that was expensive and unreliable. The search for a smaller device without a cryopump resulted in the discovery of collisional focusing. Collisional focusing was incorporated

in several new mass spectrometers that lacked a cryopump and were thus were considerably smaller than the TAGA 6000, but had the same sensitivity. AB/Sciex also developed the API 3000, which it introduced in 1998. The API 3000 contains the technology of the '736 patent and has a high sensitivity. Dr. Davidson explained that there is a high demand for the API 3000 and that AB/Sciex has sold over one thousand of them. In the market for high sensitivity mass spectrometers, AB/Sciex's only real competitor is Micromass, although Dr. Davidson testified that another company named Finnigan had recently produced a high sensitivity mass spectrometer.

Laura Lauman, an Executive Vice President of AB/Sciex, testified that she supervised the marketing efforts for the API 3000. She explained that there was strong demand for the product and that it was more competitive than the Micromass product at the time, the Quattro LC. However, after the Quattro Ultima was introduced, Micromass began offering larger discounts on the API 3000 to remain competitive. Throughout the manufacture and marketing of the API 3000, Lauman explained, there was the capability of selling more API 3000 devices than AB/Sciex sold. AB/Sciex also called Joseph Anacleto, Director of the LCMS product line of mass spectrometers for AB/Sciex. Anacleto testified that AB/Sciex had the capability to manufacture more ABI 3000 devices from 1998 through the present.

Finally, AB/Sciex's damages expert, Dr. Marion Stewart, testified to both the profits allegedly lost by AB/Sciex from sales of the Quattro Ultima and a reasonable

royalty for the ’736 patent. Dr. Stewart discussed the demand for the API 3000’s sensitivity, its sales history, and the price erosion caused by the Quattro Ultima. He also concluded that the Quattro Ultima was the only competitive alternative to the API 3000 in terms of sensitivity for most of the period from 1998 until the trial. He took into account the recently introduced Finnigan product and attributed to it some of the sales that might have been made by AB/Sciex if the Quattro Ultima did not exist. He opined that AB/Sciex’s total lost profits were $52.3 million. If only the Hexapole Quattro Ultima infringed, lost profits were $45.6 million.

Dr. Stewart also testified that a reasonable royalty for the ’736 patent would be $225,000 per machine. He acknowledged that this was a high number, but explained that it was justified because AB/Sciex was unlikely to license the ’736 patent to its competitors. The total reasonable royalties calculated by Dr. Stewart amounted to $45.5 million. If the Ion Tunnel Quattro Ultima did not infringe, the total reasonable royalty for just the Hexapole Quattro Ultima was calculated to be $38.9 million. If Dr. Stewart assumed a lower measure of Micromass’s incremental profits, then he calculated the total reasonable royalties to be $34.1 million.

On cross-examination, Dr. Stewart was examined on the assumptions underlying his lost profits analysis, including whether there was demand for the sensitivity of the API 3000.

In conclusion, AB/Sciex presented deposition testimony of several Micromass

witnesses, including Micromass's technical director, Dr. Robert Bateman, another technical director, Dr. Kevin Giles, the Quattro Ultima Project Manager, Dr. Stuart Jarvis, the Managing Director of Micromass, Norman Lynaugh, and the Financial Director of Micromass, Paul Robinson. Their testimony related to the demand for sensitivity, and the development of the Hexapole and Ion Tunnel Quattro Ultimas. AB/Sciex also presented the video deposition of Micromass's Intellectual Property Manager, Dr. David Yorke, in which Dr. Yorke explained the correspondence between the parties relating to the ICP device in 1997.

2. Micromass's Noninfringement and Invalidity Presentations

Micromass's first witness was Micromass Technical Director Dr. Robert Bateman. Dr. Bateman testified that Micromass developed the Hexapole Quattro Ultima because it wished to improve upon the sensitivity of its prior device, the Quattro LC, and respond to AB/Sciex's API 3000. Dr. Bateman explained the changes he made to the Quattro LC, including increasing orifice sizes near the ion source, which increased the pressure in the subsequent chambers. This change to the ion source increased the sensitivity two and a half to three times. Dr. Bateman also made improvements to the detector, resulting in an increase in sensitivity of a factor of two. He also put small AC-only rods, called "stubbies," on either side of the mass filters to improve ion transmission, added an additional vacuum chamber near the ion source, and added an additional ion guide structure. In the resulting Quattro Ultima, the pressure in the ion guide was typically

around 1.5 to 2 torr, but Dr. Bateman operated the device at pressures as high as 10 torr. On cross-examination, Dr. Bateman admitted that the Hexapole Quattro Ultima operated at above 2.25×10^{-2} torr cm. He also explained a later change to the device in which the size of one of the interchamber orifices had been decreased from 2.5 to 1.2 mm, a reduction of 77% of orifice area, but stated that 80% of ions continued to pass through the orifice.

Dr. Bateman also testified about the development of the Ion Tunnel Quattro Ultima. Micromass developed that product after meetings with researchers doing similar work. They incorporated ion tunnels into the Quattro Ultima and found a 100% increase in ion signal intensity. Dr. Bateman explained that ion tunnel had 84 rings that alternated in current. The rings created electrical fields in three dimensions; one dimension (z) in the axis of ion travel and two dimensions (x and y) perpendicular to that axis. Because the rings, unlike rod sets, created an axial electric field, there was a space exactly halfway between any two rings at which the AC voltage was zero. Thus, the ions would oscillate in the axial field, and, if they traveled too slowly, would become trapped at that halfway point of zero voltage.

Micromass then introduced the video deposition of Dr. Bruce Thomson, one of AB/Sciex's chief research scientists, Laura Lauman, Micromass's Executive Vice President in charge of marketing, and Dr. Scott Tanner, another AB/Sciex research scientist. Dr. Thomson's testimony concerned the investigation he conducted on the

Hexapole Quattro Ultima at a customer's site in Nebraska to determine if the Quattro Ultima infringed. Lauman's testimony concerned her understanding of Dr. Thomson's results and what effect his discoveries concerning the Quattro Ultima, including the change to the ion source and increase in orifice size, would have on AB/Sciex's marketing. Dr. Tanner testified about ion traps and the fact that it was well known before the '736 patent that an input of gas into an ion trap would cause collisional cooling. Dr. Tanner also testified about the differences between electrodes that create electric fields in three dimensions, such as an ion trap, and those that do so in two dimensions, such as an ion guide rod set.

The next witness was Dr. Raymond March, Micromass's expert witness. Dr. March explained why, in his opinion, the '736 patent was invalid. Dr. March explained that the 1987 Smith article disclosed the structure of a two-stage mass spectrometer and that collisional cooling in ion traps was well-known prior to the '736 patent. He also discussed an article he wrote concerning the operation of gas in ion traps and a collision effect on ions, R.F. Bonner & R.E. March, "The Effects of Charge Exchange Collisions On The Motion Of Ions In Three-Dimensional Quadrupole Electric Fields. Part II. Program Improvements And Fundamental Results," 25 International Journal of Mass Spectrometry and Ion Physics 411 (1977) (the "1977 March article"). Dr. March also discussed a patent held by Dr. Enke, United States Patent No. 4,234,791 (the '791 patent), in which Dr. Enke disclosed collision cell technology and referenced an earlier

article by Dr. March concerning ion traps to support some of his conclusions. Dr. March also explained some of the collision cell prior art, including the Caldecourt article, AB/Sciex's TAGA 6000, the French application, which used P x L products higher than the limit of the '736 patent. Finally, Dr. March discussed an article by L. Hanley and S.L. Anderson, in which an ion guide is used and collisional cooling is observed. L. Hanley & S.L. Anderson, "Metal Cluster Ion Chemistry," Proceedings of Quebec Symposium on Optical and Optoelectronic Applied Sciences and Engineering – Subsymposium on Laser Applications in Chemistry, June 2-6, 1986 (the "Hanley and Anderson article").

Dr. March also testified that the stacked rings of the Ion Tunnel were substantially different from rod sets because they created a three-dimensional electric field, like an ion trap.

Micromass then presented the deposition testimony of one of AB/Sciex's principal research scientists, Dr. Covey. Dr. Covey explained that collision cells and ion guide are somewhat alike. Both use AC-only rod sets to guide ions through a space, but the collision cell also uses a high pressure air stream to dissociate ions into fragments.

Micromass also introduced the deposition testimony of Dr. French, one of the inventors of the '736 patent. Dr. French stated that the structure of a two-stage in guide was well-known at the time of the patent. He also discussed the prior art references he did not cite to the PTO, including the Caldecourt article and his French application.

When presented with the French application, he admitted that although he prepared a Declaration during reexamination of the ’736 patent concerning the French application, he did not remember seeing that application before preparation for his deposition in this matter.

Micromass next introduced the deposition testimony of Dr. Davidson of AB/Sciex. Dr. Davidson discussed AB/Sciex’s TAGA 6000, including its operating parameters and P x L product.

The next witness was Dr. David Yorke, Micromass’s Intellectual Property Manager. He testified about his correspondence with attorneys for AB/Sciex in 1997, his impression that the ’736 patent was made invalid by various prior art references concerning collision cells, and his belief that the patent would not be enforced.

Micromass next presented the deposition testimony of Dr. Allen, a research scientist with AB/Sciex. Dr. Allen’s testimony concerned the products initially manufactured by AB/Sciex containing the technology of the ’736 patent, including the API 300 and API 365. He explained that those devices realized only small improvements in ion sensitivity over their predecessor, the API III, which did not use the teachings of the ’736 patent. The API 300 and 365 had smaller pumps than the API III and were described by Dr. Allen as very different from their predecessor. Further development resulted in the API 3000 and API 4000, which each improved the sensitivities of their predecessors by factors of five to ten.

Micromass's final witness was its damages expert, Raymond Sims. Sims explained that, if Micromass were found liable, an award of lost profits was not warranted because there was no demand for collisional focusing, there were non-infringing alternatives to the '736 patent, and AB/Sciex was not likely to be able to make all the sales claimed by Dr. Stewart. Instead, he opined that a royalty of $6,000 per infringing device was reasonable, although significantly higher than other licensing patents in the industry. With a $6,000 royalty, the damages payable to AB/Sciex would be $1,242,000 in total, and $990,000 if only the Hexapole Quattro Ultima infringed.

3. AB/Sciex's Rebuttal Presentation on Validity

Following Micromass's presentation of its defenses, including the affirmative defense that the '736 patent was invalid, AB/Sciex presented rebuttal testimony on the invalidity defense. AB/Sciex's first witness was Dr. Enke. He addressed the prior art references that were discussed in the testimony of Dr. March, including the 1987 and 1988 Smith articles, the TAGA 6000, the French application, the Caldecourt article and his '791 patent. Dr. Enke distinguished collision cell references, explaining that they were not directed to the problem the inventors sought to solve – guiding ions through an AC-only rod set. Rather, collision cells operated at high pressure to cause dissociation. He also distinguished the Hanley and Anderson article as related to reducing the spread of kinetic energies in metal ions, and not guiding ions into a mass filter. Dr. Enke then addressed ion trap references, including Dr. March's 1977 article. He explained that

while those articles discussed collisional cooling, they did not suggest using collisional focusing to improve the transmission of ions in an ion guide. Finally, Dr. Enke disputed Micromass's contention that an ion tunnel was actually a series of ions guides. Dr. Enke explained that the purpose of ion tunnels is to guide ions through to a mass filter, and thus they do not trap ions between rings.

Micromass presented brief rebuttal deposition testimony from Dr. Neil Reed and Dr. Davidson of AB/Sciex. Those witnesses testified about the workings of the TAGA 6000.

4. The Jury's Verdict

The jury returned a verdict that the claims of '736 patent were not invalid. The jury found that Hexapole Quattro Ultima literally infringed the asserted claims of the '736 patent and that the Ion Tunnel Quattro Ultima infringed those claims under the doctrine of equivalents by. The jury awarded $47.5 million in damages to AB/Sciex, $41.3 million of which was attributable to the Hexapole Quattro Ultima.

D. The Bench Trial

Following the jury trial, the court conducted a one-day bench trial on inequitable conduct and equitable estoppel. Micromass supplemented the evidentiary record on both subjects.

1. Inequitable Conduct

Micromass contends that AB/Sciex misled the PTO during prosecution of the '736

patent by failing to cite the French application as prior art and failing to introduce the results of experiments done by Dr. Douglas at P x L products below 2.25×10^{-2} torr cm. Micromass also contends that AB/Sciex misled the PTO during reexamination by failing to disclose that it had accused Micromass's ICP device of infringing and by mischaracterizing the French application. Most of those topics were covered during the jury trial, but Micromass presented additional evidence to the court regarding Dr. Douglas's low-pressure experiments.

During the jury trial, Dr. Douglas testified that he arrived at the P x L parameter of the '736 patent because he did several experiments and found "interesting increases in ion signal consistently above a pressure of about 1.5 millitorr" using a rod length of 15 cm. "So 15 cm times 1.5 millitorr gives 2.25×10^{-2} torr cm." He also recounted conducting at least one experiment at a pressure lower than 1.5 millitorr in which he recorded an increased ion signal, but described that result as "rather small."

At the bench trial, Micromass presented deposition testimony from Dr. Douglas about these experiments conducted below the 2.25×10^{-2} torr cm threshold. In that testimony, Dr. Douglas recounts an increase in ion signal of 4.41 times when he increased pressure from 5.3×10^{-4} torr to 1.27×10^{-3} torr. The 1.27×10^{-3} torr figure, assuming a 15 cm rod set, results in a P x L product of 1.8×10^{-2} torr cm. Micromass also submitted Dr. Douglas's Laboratory Notebook No. 42, used between September 29, 1988 and October 28, 1988, which confirmed these results.

Micromass questioned Dr. Douglas about a 1992 article he wrote with Dr. French entitled "Collisional Focusing Effects in Radio Frequency Quadrupoles," published in the Journal of the American Society for Mass Spectrometry. Dr. Douglas explained that Figure 5 of the article depicts experiments he did showing ion signal enhancement between 5.0×10^{-4} torr and 1.27×10^{-3} torr. Dr. Douglas could not remember, however, whether the data for those experiments discussed in the article resulted from tests he performed in 1988, before the '736 patent application was filed, or whether those experiments were conducted later.

2. Equitable Estoppel

Micromass contends that AB/Sciex's correspondence with it in 1997 led Micromass reasonably to believe that AB/Sciex agreed the claims of the '736 patent were invalid and would not be enforced. Dr. Yorke testified during the bench trial to supplement the evidence he had already given concerning his interaction with AB/Sciex in 1997. He testified that after he responded to AB/Sciex's January 10 letter with his own letter on April 16, 1997, he concluded that AB/Sciex agreed with him that "the patent was not valid" and that the ICP device "did not infringe any valid claim of the patent." He then had no contact with AB/Sciex for three years, until the February 2000 filing of this suit. At some point during those three years, Dr. Yorke instructed the Micromass development team, including Dr. Bateman, "that the patent can be ignored." He testified that he would not have so instructed the development team had AB/Sciex

indicated to him that it believed the '736 patent to be valid. Development of the Quattro Ultima was a $1.5 million project. Dr. Yorke testified that rather than risk losing this investment, the performance levels of the Quattro Ultima could have been achieved in "innumerable" other ways, including keeping the pressure low and improving the detector. Dr. Yorke testified that after Micromass learned that the '736 patent would be asserted, it developed the Ion Tunnel Quattro Ultima, which it believed would not infringe.

On cross-examination, Dr. Yorke testified that he did not confirm whether AB/Sciex continued to make fee payments to the PTO on the '736 patent after 1997, although such information is publicly available. AB/Sciex also introduced deposition testimony from Dr. Yorke, in which he is asked to explain what he meant by his statement in the April 16, 1997 letter that the ICP instrument "does not infringe any valid claim of these patents." AB/Sciex attempted to show that, by this statement, Dr. Yorke was ambiguous about whether he was stating that the ICP device did not infringe, or whether the claims of the '736 patent were invalid. Dr. Yorke testified that he believed both.

II. MICROMASS'S MOTION FOR RECONSIDERATION OF THE COURT'S CLAIM CONSTRUCTION OPINION

Following the issuance of this court's claim construction opinion, see Applera Corp. v. Micromass UK Ltd., 186 F. Supp. 2d 487 (D. Del. 2002), Micromass moved for

reconsideration of the court's construction of "first" and "second," as those terms are used throughout claims 1 and 14. First and second are used in '736 patent to designate the claim elements "first vacuum chamber" (30),[6] "second vacuum chamber" (38), "first rod set" (32), "second rod set" (40), "first space" (between 32), and "second space" (between 40).

During claim construction, AB/Sciex argued that the use of first and second had no significance other than to identify and differentiate the different structures from one another. Micromass took the opposite position – that the "first vacuum chamber" must be the very first chamber, in the path of ion travel, with less than atmospheric pressure, and the "second vacuum chamber" must be the very next vacuum chamber. Because the Quattro Ultima had additional, empty vacuum chambers and used more than one ion guide, adoption of Micromass's claim construction would have foreclosed literal infringement.

While Micromass described its position as consistent with the plain meaning of "first" and "second," the court rejected this assertion and noted that "first" and "second" are defined only by the context in which they are used. Furthermore, Micromass's construction would have excluded one of the preferred embodiments of the invention – Figure 12, which depicted an additional, empty vacuum chamber that preceded "first

[6]The particular identifying numbers, which correspond to Figure 1 of the '736 patent, are not relevant to claim construction, but are included for the reader's convenience.

vacuum chamber" (30) and "first rod set" (32).

Micromass also purported to find support for its construction of "first" and "second" in the prosecution history. During reexamination, AB/Sciex distinguished tandem mass spectrometers, such as that in the French application, on several different bases. One of the distinctions drawn by AB/Sciex was structural. It argued that tandem mass spectrometers were different from the claimed invention because the "first" rod set in the "first" vacuum chamber of a tandem mass spectrometer was an AC-DC mass filter, and not an AC-only rod set as required by the claims of the '736 patent. Likewise the "second" rod set and "second" vacuum chamber of a tandem mass spectrometer was an AC-only collision cell, whereas the claims of the '736 patent require an AC-DC mass filter.

Based on this distinction, the court concluded that AB/Sciex was using "first" and "second" as more than mere identifiers of separate elements, but as descriptions of location in the path of ion travel. It therefore declined to adopt AB/Sciex's claim construction of these terms in full. However, the court concluded that "first" and "second" only required that, of the two claimed elements, the "first rod set" in the "first vacuum chamber" (the ion guide) must precede the "second rod set" in the "second vacuum chamber." The court concluded that other vacuum chambers and rod sets in other positions were irrelevant. This "relative positioning" construction of "first" and "second," the court believed, was consistent with the patent's preferred embodiments,

including Figure 12, and the prosecution history. Therefore the court construed "first vacuum chamber" as "a vacuum chamber," and "second vacuum chamber," as "a vacuum chamber coming after, in the path of ion travel, the first vacuum chamber." The "rod set" and "space" elements were construed similarly.

Following issuance of the claim construction opinion, Micromass moved for reconsideration on the basis that the court misconstrued the use of the terms "first" and "second" Micromass explained that if AB/Sciex used "first" and "second" in a "relative positioning" sense during reexamination, than it failed to distinguish the tandem mass spectrometer prior art. Tandem mass spectrometers have an AC-DC rod set, then an AC-only collision cell, and finally another AC-DC set. Had AB/Sciex been employing a "relative positioning" understanding of "first rod set" and "first vacuum chamber," then the "first" of each would be the AC-only collision cell and the "second" would be the AC-DC mass filter. Thus, the claims of the '736 patent would read on, and not be distinguished from, the structure of a tandem mass spectrometer asserted to be prior art. Therefore, Micromass asserted that AB/Sciex must have been using "first" and "second" in an absolute sense – referring to the "very first" rod set and vacuum chamber and the "very next" rod set and vacuum chamber.

Micromass is correct that AB/Sciex could not have been using "first" and "second" in a relative sense and successfully distinguished the structure of the tandem mass spectrometer from the claimed invention on this basis. However, the court

concludes that its "relative positioning" construction of the claims remains correct. AB/Sciex did successfully distinguish the tandem mass spectrometer references on other grounds. Even if AB/Sciex's argument uses the "first" and "second" in an absolute sense, it does not follow that the claims of the patent have to be construed in that manner. Prosecution histories are useful in claim construction because they often contain "contemporaneous exchanges between the patent applicant and the PTO about what the claims mean." Digital Biometrics, Inc. v. Identix, Inc., 149 F.3d 1335, 1334 (Fed. Cir. 1998). Prosecution histories are also useful because they indicate when a patentee has disclaimed a particular construction. Southwall Techs. Inc. v. Cardinal IG Co., 54 F.3d 1570, 1576 (Fed. Cir. 1995) ("The prosecution history limits the interpretation of claim terms so as to exclude any interpretation that was disclaimed during prosecution."). AB/Sciex's use of the terms "first" and "second" was neither an exchange regarding the meaning of those terms nor a disclaimer of any particular construction. Furthermore, AB/Sciex's comment was not a "definitive statement" on the meaning of the claim terms, and thus was unlikely to be relied upon by the public. Digital Biometrics, Inc., 149 F.3d at 1347 (focusing on the public's right to rely on definitive statements construing claim terms made during prosecution).

More importantly, the court concludes that a "relative position" construction of "first" and "second" is consonant with what the inventors claimed as their invention. The '736 patent is directed to achieving improved ion transmission in an ion guide by using

certain parameters of pressure, voltage, and rod length. The purpose of the invention is guiding ions into a mass filter. Thus, the only reasonable construction of the "first vacuum chamber" and "first rod set" – the ion guide structure – is a construction that places those elements at some point before the mass filter. Likewise, the only reasonable construction of "second vacuum chamber" and "second rod set" – the mass filter structure – is that it must follow the ion guide. Put differently, of the two rod sets and vacuum chambers mentioned in the claims of the '736 patent, the "first" must precede the "second" in the path of ion travel. The existence of other rod sets and vacuum chambers either preceding, intervening, or following those two structures is immaterial to the working of the invention and is thus should be irrelevant to infringement of it. The preferred embodiment in Figure 12 of the '736 patent illustrates this point by having an additional, empty vacuum chamber that precedes either the ion guide or the mass filter. For these reasons, the court will deny Micromass's motion for reconsideration.

III. MICROMASS'S MOTION FOR JUDGMENT AS A MATTER OF LAW OR FOR A NEW TRIAL ON THE VALIDITY OF THE '736 PATENT

A. Applicable Standards under Federal Rules of Civil Procedure 50 and 59

Micromass argues for judgment as a matter of law or a new trial on three separate topics – the invalidity of the claims of the '736 patent, infringement, and damages.

Under Rule 50, the court should grant judgment as a matter of law where "there is no legally sufficient evidentiary basis for a reasonable jury to find for" the non-moving

party. Fed. R. Civ. P. 50(a). Thus, Micromass must show "that the jury's factual findings were not supported by substantial evidence or that the facts were not sufficient to support the conclusions necessarily drawn by the jury on the way to its verdict, or that the trial court applied the law erroneously." Applied Med. Res. Corp. v. United States Surgical Corp., 147 F.3d 1374, 1376 (Fed. Cir. 1998). In reviewing the jury's verdict, the court "must consider the evidence of record in the light most favorable to [AB/Sciex], drawing all reasonable inferences in its favor, without disturbing the jury's credibility determinations or substituting [the court's] resolutions of conflicting evidence for those of the jury." Id. at 1376-77.

Rule 59(a) provides that a "new trial may be granted . . . for any of the reasons for which new trials have heretofore been granted in actions at law in the courts of the United States." Fed. R. Civ. P. 59(a). New trials should be granted "when the record shows that the jury's verdict resulted in a miscarriage of justice or where the verdict, on the record, cries out to be overturned or shocks our conscience." Williamson v. Consol. Rail Corp., 926 F.2d 1344, 1353 (3d Cir. 1991).

B. Micromass's Contentions

Micromass contends that the claims of the '736 patent are invalid as a matter of law because they were anticipated by the French application. Micromass also contends that those claims are invalid as a matter of law because they would have been obvious to one of skill in the art. On the obviousness question, Micromass relies on: (1) the Hanley

and Anderson article on collisional cooling of metal ion clusters; (2) the 1977 March article on collisional cooling in ion traps; and (3) collision cell prior art such as the Caldecourt article, the TAGA 6000, and Dr. Enke's '791 patent.

To successfully challenge the validity of a patent, which is presumed to be valid under the Patent Act, see 35 U.S.C. § 282, Micromass must establish the invalidity of its claims by clear and convincing evidence. Superior Fireplace v. Majestic Products, Co., 270 F.3d 1358, 1367 (Fed. Cir. 2001).

C. Anticipation and the French Application

"[A] claim is anticipated if each and every limitation is found either expressly or inherently in a single prior art reference." Bristol-Myers Squibb Co. v. Ben Venue Labs. Inc., 246 F.3d 1368, 1374 (Fed. Cir. 2001). Micromass argues that French application contains each and every limitation of claims 1 and 14 of the '736 patent. As previously noted, the French application describes a tandem mass spectrometer, in which an AC-only collision cell operates between two AC-DC mass filters. The French application, like French's '420 patent, discloses the use of open structure rod extensions in the collision cell. By recreating the electrical field created by ordinary solid AC-only rods, the open structure rod sets permit gas to be removed more easily from the collision cell, thereby permitting the close arrangement ("close coupling") of the low-pressure mass filters to the collision cell. The last paragraph of the French application describes that "the invention" may also be used in a two-stage mass spectrometer, in which the AC-only

section is used to guide ions into a conventional AC-DC mass filter.

Neither party disputes that those claim elements of the ’736 patent that relate to the basic structure of a two-stage mass spectrometer would have been disclosed to one of skill in the art by the French application. Those structural claims include claims 1(a)-(i) and 14(a)-(e) and (g). The disputed claim elements include the P x L parameter (claims 1(j) and 14(f)), the means for maintaining the kinetic energies of ions at a relatively low level (claims 1(k) and 14(h)), and the improved transmission of ions through an interchamber orifice (claim 1(k) and the “whereby” clause of claim 14).

1. The P x L Product

With respect to the P x L product, the parties are in agreement that the French application discloses pressure and rod length parameters that meet the 2.25×10^{-2} torr cm requirement. The French application teaches using an AC-only rod set operating as a collision cell in a tandem mass spectrometer with pressures between 10^{-2} torr and 10^{-4} torr and rods of 4 inches. Both parties’ experts agreed that these parameters yield a P x L pressures as high as 10×10^{-2} torr cm, although Dr. Enke testified that one of skill in the art would understand the range to be a pressure gradient throughout the rod set, and not a single measure of pressure. He admitted, however, that the average gradient pressure would still exceed 2.25×10^{-2} torr cm. The dispute between the parties concerns whether the P x L product disclosed would have been understood by one of skill in the art to be applicable to the two-stage mass spectrometer referenced in the final paragraph of the

French application, or whether a reader would conclude those parameters are limited in application to the specific collision cell architecture in which they are described.

Micromass contends that it has proven that the French application's P x L product is applicable to the two-stage mass spectrometer. Micromass' expert, Dr. March, opined that the French application taught the necessary P x L product. In addition, Micromass elicited the following testimony during cross-examination of Dr. Enke.

> Q: Although the invention has been described for use with tree quadrupole sections in a series, it may also be used with only two such sections in a series, namely an AC-only section and an AC/DC section. Do you see that, Doctor?
> A: Yes, I do.
> Q: Now, that use with an AC-only section first and an AC/DC section next, would have an atmospheric pressure ionization source, would it not?
> A: Yes, it would.
> Q: And it would introduce the ions from the atmospheric pressure ionization source into the chamber containing the AC-only rod set; right?
> A: Yes, it would.
> Q: Do you understand this as a suggestion to use the *embodiment* of the French application in a two stage system that does not, is not intended to fragment ions?
> A: Yes, that's true.
> Q: So that *embodiment* would introduce the gas from the ion source directly into the AC-only section not for the purpose fo fragment ions; correct?
> A: That's right.

Trial Tr. at 1681-82 (emphasis added). Micromass relies on these final two questions to argue that Dr. Enke agreed that the French application taught using the embodiment of the collision cell, including its P x L parameter, in the ion guide section of a two-stage

mass spectrometer.

In response, AB/Sciex argues that Dr. Enke never admitted that the P x L product of the collision cell in the French application could be applied in an ion guide. During redirect examination, Dr. Enke testified about the last paragraph of the French application.

> Q: Now, this sentence refers to taking the invention of the French application and using it in this two-stage or two-series implementation, correct?
> A: Yes, that's right.
> Q: So what we need to do is look at what the invention of French is, don't we?
> A: Yes.
> . . . .
> Q: All right. Now, so is the invention the gas pressure in the collision cell of the tandem embodiment shown in French?
> A: No.
> Q: Is - -
> A: Not at all.
> Q: Is the invention the P x L product in the collision cell of the tandem embodiment shown in French?
> A: No. It definitely isn't.

Trial Tr. at 1712, 1714. AB/Sciex relies on this testimony to establish that the French application teaches nothing more than applying open structure rod sets and close coupling in a two-stage mass spectrometer, and not the particular pressure and length parameters explained for a collision cell.

AB/Sciex also cites the Declaration of Dr. French to show that the claimed P x L product is not taught by the French application.

> The French application does not suggest that the recited pressure range and rod length may be used in a quadrupole section which acts as an ion guide and which is not intended to fragment the ions. The pressure and rod length in the AC-only quadrupole described in the French application on page 7 was not intended to be used when that quadrupole was used only as an ion guide and not to fragment the ions.

French Decl. at ¶ 9. AB/Sciex argues that this Declaration and the testimony of Dr. Enke establish that a disputed issue of fact exists concerning whether the French application teaches applying the P x L product of the collision cell embodiment to the ion guide section of a two-stage mass spectrometer.

Micromass submits that by separately considering the two embodiments of the French application – the collision cell and the ion guide – AB/Sciex is subverting the requirement that courts examine the "the four corners of a single, prior art document" in considering anticipation. Advanced Display Sys., Inc. v. Kent State Univ., 212 F.3d 1272, 1282 (Fed. Cir. 2000). Micromass argues that if one considers the "four corners" of the French application, anticipation is established because elements described only in one embodiment can be added to elements described in another embodiment of the same reference to anticipate the claims of a patent. In particular, it cites this court's decision in IPPV Enterprises, LLC v. Echostar Communications Corp., 191 F. Supp. 2d 530, 560 (D. Del. 2002), to argue that different embodiments in one prior art reference must be combined in the anticipation inquiry.

Micromass reads too much into IPPV. In that case, the anticipating prior art expressly suggested the combination of two embodiments, "flat fee" and "pay-per-view,"

by noting that "any" of the embodiments could be used within the purview of the disclosed invention. Thus, the court concluded that the prior art anticipated a patent claim that taught using both methods in combination. IPPV, 191 F. Supp. 2d at 560-61. The question for decision in this case is whether the French application, like the prior art in IPPV, similarly discloses combining the P x L parameter of the collision cell embodiment with the ion guide embodiment referenced in its final paragraph. Only if the French application teaches or suggests the combining of different embodiments to one of skill in the art, should the fact finder do so for purposes of anticipation.

The testimony of Dr. Enke and the French Declaration establish that there is a disputed issue of fact about whether one would combine the pressure and rod length disclosed in the French application's collision cell to the two-stage mass spectrometer discussed in the final paragraph. As noted, that paragraph describes applying the "invention" of the French application – open structure AC-only rods and close coupling – to an ion guide. Given that the pressure and rod length parameters are expressly tied to the workings of a collision cell, a reasonable jury could conclude, based on this evidence, that the French application does not suggest using the same parameters in an ion guide. Therefore, Micromass is not entitled to judgment as a matter of law that the French application anticipates the P x L product claim limitation of the '736 patent.

2. "means for maintaining"

AB/Sciex also contends that the French application cannot anticipate the relevant

claims of the ’736 patent because it does not teach the means for maintaining the kinetic energies of ions at a relatively low level, as required by claim 1(k) and, in slightly different language, claim 14(h). In its claim construction opinion, the court construed the structure of this means plus function claim to be “the application of two variables: (1) a DC potential voltage between the inlet orifice and the first rod set, and (2) the pressure in the first vacuum chamber.” AB/Sciex contends that the DC potential voltage between the inlet orifice and the first rod set is nowhere disclosed in the French application.

To demonstrate that the French application teaches a DC potential voltage, Micromass relies on a passage of the French application explaining that “ions are drawn by appropriate electric potentials through a curtain gas chamber into the vacuum chamber 2.” However, this passage is another description of the tandem mass spectrometer. Thus, it describes using electric potentials to take ions from the source into a vacuum chamber containing a mass filter, and not an AC-only ion guide. Because this passage describes the tandem mass spectrometer, there was, as with the P x L claim limitation, ample evidence before the jury to conclude that one of skill in the art would not have applied the structure of the tandem mass spectrometer embodiment to the two-stage mass spectrometer.

Micromass also relies on passages of Dr. Enke’s testimony on cross-examination to establish that the French application’s recitation of “appropriate electric potentials” satisfies the “means for maintaining” claim element. Particularly, it relies on the

following testimony:

> Q: So [the two-stage] embodiment would introduce the gas from the ion source directly into the AC-only section not for the purpose of fragmenting ions; correct?
> A: That's right.
> Q: And in order not to fragment ions, one of the ways in which one would avoid fragmenting ions would be to lower the kinetic energy at which they are introduced; isn't that correct?
> A: Yes. You'd need to employ a means for controlling the kinetic energy of ions.

Trial Tr. at 1681-82. The second question asked of Dr. Enke, however, is not related to the French application or its teachings. Dr. Enke only speculated that one of the ways not to fragment ions would be to use lower kinetic energy; he made no statement explaining that this was taught by the French application. Dr. Enke's testimony, therefore, does not establish as a matter of law that the French application teaches the required means for maintaining the kinetic energy of ion at a relatively low level.

3. "improved transmission of ions"

Finally, Micromass contends that the "improved transmission of ions through said interchamber orifice" is taught by the French application. In particular, it relies on statements in the French application stating that the goal of the invention is "to reduce losses of ions between one quadrupole and the next in such a system, to improve sensitivity." It also argues that Dr. Enke's testimony established that such improved transmission is taught by the French application.

AB/Sciex argues that when the French application discusses improved sensitivity

and reductions in losses of ions, it is referring to the improved transmission of ions between adjoining rod sets. Yet the improved transmission of ions through rod sets is exactly what the '736 patent is referring to when it refers to the "interchamber orifice." Indeed, Dr. Enke said "yes" when asked about improved transmission, although he qualified his statement by explaining that this occurred from "better coupling of the AC sets" and occurs "with or without gas." Dr. Enke's distinctions between the improved sensitivity taught by the French application and that taught by the '736 patent are unconvincing. The French application is directed to improving ion transmission. Although it may do so in a different manner than the '736 patent, this claim element is taught and the jury could not reasonably have concluded otherwise.

However, due to its findings regarding the sufficiency of the evidence on the absence of the P x L product and means for maintaining limitations in the French application, the court finds that there is substantial evidence that supports the jury's ultimate conclusion that the French application does not expressly or inherently contain every claim limitation of claims 1 and 14 of the '736 patent and that there is sufficient evidence that supports the jury's verdict. Accordingly, it will deny Micromass's motion for relief from the verdict on this basis.

D. Obviousness

Section 103(a) of the Patent Act requires that for a patent to be valid, the invention disclosed within must be non-obviousness over the prior art. 35 U.S.C. § 103(a) states, in

relevant part that:

> A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains.

35 U.S.C. § 103(a). "The consistent criterion for determination of obviousness is whether the prior art would have suggested to one of ordinary skill in the art that this process should be carried out and would have a reasonable likelihood of success, viewed in the light of the prior art." In re Dow Chem. Co., 837 F.2d 469, 473 (Fed. Cir. 1988). In making this determination, fact finders should consider "(1) the scope and content of the prior art; (2) the level of ordinary skill in the prior art; (3) the differences between the claimed invention and the prior art; and (4) objective evidence of nonobviousness." Brown & Williamson Tobacco Corp. v. Philip Morris Inc., 229 F.3d 1120, 1124 (Fed. Cir. 2000) (citing Graham v. John Deere Co., 383 U.S. 1, 17-18 (1966)).

In considering the prior art, the fact finder must determine whether a particular prior art reference "is within the field of the inventor's endeavor," or, if not, whether it would have been pertinent to the problem the inventor was seeking to solve. Shatterproof Glass Corp. v. Libbey-Owens Ford Co., 758 F.2d 613, 620 (Fed. Cir. 1985). In considering whether the pertinent prior art references make the patent obvious, the accused infringer must make "a showing of a suggestion, teaching, or motivation to combine the prior art references." Brown & Williamson Tobacco Co., 229 F.3d at 1124

(describing this showing as the "essential evidentiary component of an obviousness holding" and citing C.R. Bard, Inc. v. M3 Sys. Inc., 157 F.3d 1340, 1352 (Fed. Cir. 1998)). Obviousness does not require that the accused infringer show such combination would have an "absolute predictability of success . . . . [A]ll that is required is a reasonable expectation of success." In re O'Farrell, 853 F.2d 894, 903-904 (Fed. Cir. 1988).

Frequently, the suggestion of combining prior art is provided by "the knowledge of one of ordinary skill in the art." Brown & Williamson Tobacco Co., 229 F.3d at 1125. One of skill in the art is presumed to be aware of all prior art in the field of invention. In re Dance, 160 F.3d 1339, 1343 (Fed. Cir. 1998).

In considering the prior art in the field of invention, the fact finder must also consider prior art which teaches away from the invention. Bausch & Lomb, Inc. v. Barnes-Hind/Hydrocurve, Inc, 796 F.2d 443, 448-49 (Fed. Cir. 1986). Moreover, other objective indicia of non-obviousness, such as commercial success of the patented product, a long-felt need for the invention, and the unexpectedness of the results, must also be considered in determining whether the prior art suggests the invention. Lindemann Maschinenfabrik Gmbh v. American Hoist and Derrick Co., 730 F.2d 1452, 1461 (Fed. Cir. 1984).

As with anticipation, the parties focus their discussion of obviousness on the final two elements of claims 1 and 14, the P x L product in the ion guide and the means for

maintaining the kinetic energy of ions at a relatively low level. The 1987 Smith article and other references disclose the basic structure of two-stage mass spectrometers, and it is uncontested that this structure would have been known to one of skill in the art. It is the P x L product and the means for maintaining claim elements that are in dispute on obviousness because, as Dr. Enke testified, it is those two claim elements that relate to the feature of collisional focusing. The parties also dispute whether particular references teach realizing improved transmission of ions, as required by the "whereby" clause of both claims.

1. The Hanley and Anderson article

Micromass contends that the asserted claims of the '736 patent are made obvious by combining the Hanley and Anderson article that it introduced at trial, with the 1987 Smith article. The Hanley and Anderson article discloses an instrument for studying large metal cluster ions. Hanley and Anderson had previously found it difficult to "unambiguously study reactions occurring simultaneously for a distribution of clusters of different sizes." Thus, they built a mass spectrometer to "pre-select particular size and composition clusters for study." The instrument is comprised of an ion source, AC-only octapole ion guides (also called "radio frequency ion guides"), and a quadrupole mass filter. Unlike the atmospheric pressure ionization chamber in the '736 patent, the Hanley and Anderson instrument creates metal cluster ions in a process called "sputtering," which uses a xenon atom beam, an argon ion beam, or a focused laser. The metal cluster

ions then proceed through two octopole ion guides located in a cooling cell before reaching a quadrupole mass filter. The cooling cell length is 20 cm and its pressure is 10^{-2} torr, resulting in a P x L product of 20 x 10^{-2} torr cm.

The Hanley and Anderson article explains that ions produced by "sputtering" have high energies, and the pressure of the cooling cell is used to reduce that energy.

> Cluster ions produced by sputtering are translationally and (presumably) internally excited. In the first ion guide the clusters are passed through a gas cell containing ca. 10^{-2} torr of helium, where they make 10-50 collisions and lose most of their translational energy.

The article goes on to describe the "cooling" process, which the article also calls thermalization, and explains that the metal clusters of light elements lose more translational energy than metal clusters of heavier elements. The cooling of the metal clusters enables the quadrupole mass filter to study further the composition of those clusters. Although the article admits that the instrument needs further refinement, it concludes by stating the "[c]ollisional cooling of the clusters is clearly an effective technique."

Micromass contends that the Hanley and Anderson article teaches several of the claim limitations of claims 1 and 14, and, in combination with the teachings of the 1987 Smith article concerning the remainder of the claim limitations, makes those claims obvious. Micromass argues the Hanley and Anderson article discloses the P x L parameters of the '736 patent and teaches means for creating relatively low ion kinetic energies by using pressure. With respect to the means plus function element, which

requires both a "DC potential voltage between the inlet orifice and the first rod set" and a "pressure in the first vacuum chamber" Micromass argues that the Hanley and Anderson article's cooling cell satisfies this claim element. While the article does not explain using a DC potential voltage, Micromass argues that one of skill in the art would conclude that using a zero DC potential voltage, together with the relatively high pressure of the cooling cell, would control the kinetic energies of ions.

AB/Sciex does not dispute that the Hanley and Anderson article meets the P x L parameter of claims 1 and 14, but argues that the "means for maintaining" is absent from its disclosure, including any mention of a DC potential voltage. Furthermore, AB/Sciex contends that the article is directed to a different problem than that addressed by the '736 patent inventors, and therefore one of skill in the art would not have thought it pertinent to the problem they sought to solve. In support of this conclusion, they note that the "improved transmission of ions" is nowhere described in the Hanley and Anderson article.

It is clear that the Hanley and Anderson article does teach the collisional cooling of ions by the use of high pressures in an AC-only rod set. It also teaches using pressures and rod lengths within the P x L parameter of the '736 patent. There are, however, significant differences. For example, because there is no space between the inlet orifice and the ion guides, there is no occasion to apply DC potential voltages to attract ions into the ion guide. Micromass argues that this distinction is irrelevant because a voltage

higher than zero would only increase the kinetic energy of ions, and therefore not keep the energy relatively low. While that is true, the relevant inquiry is whether the article would teach one of skill in the art to use the combination of a DC potential voltage and the pressure to "maintain" or "control" the kinetic energies of ions at a relatively low level. Because the Hanley and Anderson article does not suggest combining pressure and DC potential voltage to control the kinetic energies of ions, it does not teach the "means for maintaining" element of the '736 patent. Indeed, among the "experimental problems" of the instrument is that high collision energy results in ion cluster fragmentation. A high amount of fragmentation suggests that the kinetic energies of ions is not maintained at a relatively low level. Nor does Micromass submit that this element is taught by some other reference that could be combined with the Hanley and Anderson article's discussion of collisional cooling to render the '736 patent obvious. Thus, the jury had a reasonable basis from which to conclude that the Hanley and Anderson article, when combined with prior art references teaching the structure of a two-stage mass spectrometer, does not render the claims of the '736 patent obvious.

Furthermore, it is unclear whether the "improved transmission of ions" is taught by the Hanley and Anderson article. While the article does discuss collisional cooling, the cooling caused by colliding ions with gas molecules was well-known at the time of the '736 patent. The '736 patent, however, explains that such cooling can be used to improve the focusing of the ion beam in an ion guide. Micromass contends that using

collisional cooling to focus ions is disclosed by the Hanley and Anderson article. In particular, Micromass focuses on a passage of the article stating that "[a]fter cooling, the translational energy distribution is much narrower." It is unclear, however, whether this passage refers to the range of different kinetic energy levels among the ion clusters or whether it refers to the narrowing of the ion beam. Thus, the jury could have rationally concluded that the "improved transmission of ions" is not taught by Hanley and Anderson, even though collisional cooling is. Because the "improved transmission of ions" is the goal of the '736 patent's inventors, the lack of support for this claim element in the Hanley and Anderson article is also an indicator that it might not have been pertinent to the problem the inventors were seeking to solve.

2. Ion Trap References

Micromass argues that the asserted claims of the '736 patent are made obvious by the ion trap references it introduced at trial, and focuses particularly on Dr. March's 1977 article. An ion trap is a three-dimensional electrode that traps ions within its center. The 1977 March article discusses computer simulations using a buffer gas in an ion trap to increase the collisional cooling of ions trapped there. Micromass submits that because collisional cooling was well-known at the time of the '736 patent, it would have been obvious to one of skill in the art to use collisional cooling in an ion guide.

It is uncontested that the use of gas pressure to accomplish collisional cooling of ions was known at the time of the '736 patent. At least four ion trap references were

disclosed to the PTO upon reexamination of the '736 patent, including an article entitled Schaaf, et al., "Trapped Ion Density Distribution in the Presence of He-Buffer Gas," Applied Physics, Vol. 25, pp. 249-51 (1981). During the reexamination, AB/Sciex represented to the PTO that "[i]n general, the use of a buffer gas to cool ions in an ion trap was common knowledge in the art, as reflected by the article [by] Schaaf." AB/Sciex explained, however, that "[t]he use of a high pressure gas in the claimed mass spectrometer having an ion transmission rod set, on the other hand, would not have been obvious," because "the prior art would have suggested that the gas may cause scattering of the ions at the entrance of the rods and within the rod set, causing loss of ions to the rods." Additionally, "the prior art would have suggested that the ions not scattered to the rods would have a larger number of collisions and therefore may not have sufficient energy to exit at the far end of the transmission rod set." The PTO Examiner appears to have credited these distinctions, for he never raised any questions of patentability with respect to the ion trap references.

At trial, Dr. Enke agreed that collisional cooling had been known for several years prior to the '736 patent, but had never been applied to an ion guide. Trial Tr. at 1614. Given how long collisional cooling had been known, Dr. Enke believed that if it had been obvious to apply collisional cooling in an ion trap, it would have been done before the inventors of the '736 patent did so.

Based on the testimony of Dr. Enke and the evidence presented, the jury could

have rationally concluded that the application of collisional cooling in an ion guide was not obvious to one of skill in the art at the time of the ’736 patent.

3. Collision Cell References

Last, Micromass argues that in light of the various tandem mass spectrometers in use before the ’736 patent application, and articles relating to the use of a collision cell in such devices, the asserted claims of the’736 patent are obvious and should be rendered invalid. In particular, it relies on the Caldecourt article, AB/Sciex’s TAGA 6000, and Dr. Enke’s ’791 patent. Dr. Enke testified at trial that each of the references have pressures and rod lengths that exceed the 2.25×10^{-2} torr- cm P x L product claim element. Moreover, Micromass argues that the claims of the ’736 patent, as construed by the court, do not exclude collision cells because the fragmentation of ions is not precluded by the claims.

AB/Sciex responds by listing a number of claim elements that are not revealed in any of the collision cell references, including the “means for maintaining the kinetic energies of ions . . . at a relatively low level,” and the “improved transmission of ions.” In particular, AB/Sciex points out that collision cells do not keep the energies of ions at a relatively low level because they are intended to use high energy collisions to fragment ions. Because collision cells fragment ions, AB/Sciex also argues that they are not directed to improving ion transmission through the device.

AB/Sciex presented ample evidence at trial from which the jury could distinguish between collision cells and ion guides, although they may both meet the P x L parameter disclosed in the '736 patent. Among the evidence presented was the reexamination history, in which the PTO Examiner, after initially finding obviousness based in part on the collision cell in the French application, acknowledged the distinctions between collision cells and ion guides. Dr. Enke confirmed these distinctions in his testimony. This evidence was sufficient for the jury to find that it would not have been obvious to combine the P x L products of the collision cell references with the structure of an ion guide. The court will therefore deny Micromass's motion for judgment as a matter of law that the claims of the '736 patent are invalid as obvious to one of skill in the art.

IV. INEQUITABLE CONDUCT

Micromass asserts, both in defense to AB/Sciex's infringement allegation and in its counterclaim for a declaratory judgment of unenforceability, that the '736 patent is unenforceable due to AB/Sciex's breach of the duty of candor in prosecuting the patent before the PTO. It is well-established that "[p]atent applicants are required to prosecute patent applications with candor, good faith, and honesty." Semiconductor Energy Lab. Co. v. Samsung Elec. Co., 204 F.3d 1368, 1373 (Fed. Cir. 2000); see also 37 C.F.R. § 1.56(a). A breach of the duty of candor can take several forms, including "affirmative misrepresentation of a material fact, failure to disclose material information, or

submission of false material information." Molins PLC v. Textron, Inc., 48 F.3d 1172, 1178 (Fed. Cir. 1995). A breach of the duty of candor, when coupled with an intent to deceive or mislead the PTO, constitutes inequitable conduct, which, when proven, renders the patent unenforceable. Li Second Family Ltd. P'ship. v. Toshiba Corp., 231 F.3d 1373, 1381 (Fed. Cir. 2000).

A party attempting to establish the patentee's inequitable conduct must show "clear and convincing evidence of: (1) information that is material; (2) knowledge chargeable to the patent applicant of such information and its materiality; and (3) the applicant's failure to disclose or misrepresentation of such information as a result of an intent to mislead the PTO." FMC Corp. v. Manitowoc Co., 835 F.2d 1411, 1415 (Fed. Cir. 1987). Once the materiality of the information and the patentee's intent to mislead have been established, the court must "weigh them to determine whether the equities warrant a conclusion that inequitable conduct occurred." Molins PLC, 48 F.3d at 1178. If the court determines that the patentee's inequitable conduct is established, all the claims of the patent are unenforceable. Kingsdown Med. Consultants, Ltd. v. Hollister, Inc., 863 F.2d 867, 877 (Fed. Cir. 1988) (en banc).

To establish the materiality of the information, an accused infringer must show that there is a "substantial likelihood that a reasonable examiner would have considered the information important in deciding whether to allow the application to issue as a patent." Halliburton Co. v. Schlumberger Tech. Corp., 925 F.2d 1435, 1440 (Fed. Cir.

1991). For allegations of inequitable conduct occurring after 1992,[7] the PTO regulations further explain that information may be material if it either (1) "establishes, by itself or in combination with other information, a prima facie case of unpatentability of a claim," or (2) refutes, or is inconsistent with, a position the applicant took in either asserting an argument of patentability or opposing an argument of unpatentability relied on by the PTO. 37 C.F.R. § 1.56(b) (2001). Information that is cumulative of that already part of the record before the PTO is not material. Id. When considering whether a particular reference of prior art is material, "a trial court considers similarities and differences between prior art and the claims of the patent. In making this determination, the trial court must consider portions of prior art references which teach away from the claimed invention." Halliburton Co., 925 F.2d at 1441.

Micromass alleges that AB/Sciex breached its duty of candor to the PTO with the intent to mislead it both during the original patent prosecution and during reexamination. During the original prosecution, Micromass relies on AB/Sciex's failure to disclose French's European Patent Application and Douglas's low pressure experiments. With respect to reexamination, Micromass charges that AB/Sciex failed to disclose its allegation that the Micromass ICP mass spectrometer infringed the claims of the '736

[7]From 1977 to 1992, 37 C.F.R. § 1.56, also called Rule 56, defined materiality under the "substantial likelihood" standard. In 1992, the PTO expounded upon the materiality standard in the revised Rule 56 shown above. The revised Rule 56 is not retroactive and thus does not apply to allegations of inequitable conduct occurring before 1992. See Molins PLC v. Textron, Inc., 48 F.3d 1172, 1179 n.8 (Fed. Cir. 1995).

patent and that French's Declaration in support of patentability misrepresented the teachings of his European Patent Office Application.

A. The French European Patent Office Application

Micromass argues that AB/Sciex's failure to submit the French application to the PTO during the original prosecution of the '736 patent was inequitable conduct. It submits that the French application was material to the PTO Examiner because (i) the Examiner relied on it initially to reject the claims of the '736 patent during reexamination; (ii) the French application satisfies the P x L product of the '736 patent; (iii) the French application discloses an ion guide; and (iv) the French application teaches maintaining the kinetic energy of ions at a relatively low level by applying a zero DC potential voltage between the elements. Micromass further contends that AB/Sciex was aware of that materiality and acted with the intent to deceive the PTO. It argues that this intent is evidenced by Dr. French's inability to recall why the French application was not disclosed to the PTO, despite that it is allegedly more material than those references AB/Sciex did cite.

AB/Sciex argues that the Examiner's reliance on the French application to deny the claims in reexamination does not establish materiality, because that denial was unreasonable and was eventually withdrawn. AB/Sciex submits that the French application, like the '420 patent, is directed to using a collision cell in a tandem mass spectrometer. Therefore, it was not material to the ion guide disclosed in the '736 patent

application. Furthermore, AB/Sciex contends the French application was merely cumulative of the '420 patent, which was disclosed to the PTO, and therefore could not be material. Last, AB/Sciex argues that Micromass has not shown any evidence of an intent to deceive the PTO.

The PTO Examiner's initial rejection of the claims of the '736 patent in reexamination is strong evidence that the French application is material, but does not itself establish materiality as a matter of law. As the Federal Circuit has explained, "the result of a PTO proceeding that assesses patentability in light of information not originally disclosed is of strong probative value in determining whether the nondisclosed information would have been material." J.P. Stevens & Co. v. Lex Tex Ltd., Inc., 747 F.2d 1553, 1562 (Fed. Cir. 1984), overruled on other grounds by Kingsdown Med. Consultants, Ltd., 863 F.2d 867; recognized by Tol-O-Matic, Inc. v. Proma Produkt-Und Marketing Gesellschaft m.b.H., 945 F.2d 1546, 1554 (Fed. Cir. 1991). However, in situations in which that rejection was subsequently withdrawn, the court cannot merely rely on the Examiner's onetime assessment of the prior art to establish materiality as a matter of law. As one court has stated, "the fact that the claims of the [a] patent were initially rejected on the basis of [a prior art reference] during the reexamination of [that] patent does not establish the materiality of the reference given the fact that all the claims were eventually allowed over the reference." Eli Lilly & Co. v. Medtronic, Inc., 696 F. Supp. 1033, 1038 (E.D. Pa. 1988), rev'd on other grounds 872 F.2d 402 (Fed. Cir. 1989),

aff'd, 491 U.S. 661 (1990). To base a finding of materiality solely on the Examiner's initial assessment of the prior art, without considering the bases of the Examiner's action or the reasonableness of the rejection, would make material every prior art reference on which a rejection in reexamination is based. Micromass has not shown support for such a rule. Rather, the court finds that while the Examiner's initial rejection of the '736 patent in light of the French application is strongly probative evidence of its materiality, it does not establish materiality as a matter of law.

The gist of Micromass's argument on materiality is that the French application, unlike the '420 patent, discloses using a pressure and rod length within the 2.25×10^{-2} torr cm requirement of the '736 patent. This was the same argument that the PTO Examiner found persuasive in initially rejecting the claims of the '736 patent during reexamination. The Examiner cited the last paragraph of the French application, in which the usefulness of the invention in a two-stage mass spectrometer is discussed. He then went on to conclude that because the French application discloses a pressure and length exceeding 2.25×10^{-2} torr cm, it would have been obvious to combine those limitations with the suggestion in the Finnegan abstract and paper to control ion energy by means of a DC charge between 0 and 30 volts.

AB/Sciex argues that Micromass's argument on materiality makes the same errors the Examiner did. The bulk of the French application, including the pressure and length parameters, is directed to a tandem mass spectrometer. The final paragraph of the French

application, however, discusses using the invention in a two stage system in which the AC-only rod set guides ions "into a conventional AC-DC quadrupole mass spectrometer." AB/Sciex contends that this final paragraph did not incorporate every detail of the French application into the two-stage embodiment discussed only in its last paragraph. Rather, the pressure and length parameters were only relevant to the tandem mass spectrometer embodiment disclosed. Because of the significant differences between collision cells and ion guides, AB/Sciex submits that no reasonable reader of the French application would conclude that the pressure and length parameters for collision cells could be imparted to an ion guide. Instead, the French application merely suggests that close coupling and open structure rod sets might be used in a two-stage mass spectrometer.

The court agrees with AB/Sciex that the pressure and rod length parameters disclosed in the French application are expressly related to collision cells in tandem mass spectrometers, and not two-stage mass spectrometers. Collision cells are fundamentally different from ion guides because collision cells have a gas inserted between the AC-only rods to dissociate the ions, and that gas must be evacuated from the vacuum chamber to avoid increasing the gas pressure in either of the surrounding mass filters. Thus, the French application explains how open structure rod sets of a defined length near th mass filters can decrease the pressure in the collision cell more quickly. As the PTO Examiner recognized, the French application does not suggest utilizing the same pressure and

length parameters in a two-stage system, but only that open rod extensions and close coupling might improve ion transmission in an ion guide as well. The Examiner said, "the product of pressure and length of the AC only quadrupole described in the reference when that quadrupole was used as a collision cell between two mass analyzing quadrupoles to fragment ions was not intended to be used when that quadrupole was used only as an ion guide and not to fragment the ions."

Thus, the court credits AB/Sciex's argument that the French application was not material to the patentability of the '736 patent claims. That is, the French application, either by itself or in combination with other references, does not raise a prima facie case that the claims of the '736 patent are unpatentable as either anticipated or obvious.

In addition, Micromass has not shown that AB/Sciex intended to mislead the PTO. AB/Sciex has uniformly maintained that collision cell references are irrelevant to the patentability of the '736 patent, because the higher pressures used in a collision cell are intended to induce dissociation, whereas the pressure parameters of an ion guide are intended to focus ions into a narrow beam. It was for this reason that AB/Sciex focused on ion guide references during prosecution. Dr. Douglas confirmed at trial that the invention of the '736 patent is directed to improved transmission of ions through an ion guide, and it was for this reason that AB/Sciex did not disclose collision cell references such as the Caldecourt article or the TAGA 6000 device.

Of the prior art that was disclosed to the PTO, the two Smith articles both disclose

improved ion guide functioning at low pressures. Only the '420 patent shows a collision cell. But AB/Sciex's citation of the '420 patent is consistent with the distinction drawn between collision cells and ion guides. The '420 patent describes in claim 1 a two-stage ion guide with both close coupling and open structure AC-only rods. The open structure rods are directed to the same problem Drs. Douglas and French sought to solve, reducing the gas pressure in an AC-only rod set. AB/Sciex cited the '420 patent to establish the trend in the prior art to keep pressures low so as not to inhibit ion transmission.

Furthermore, because the '420 patent already taught using open rod extensions and close coupling in a two-stage mass spectrometer, citation of the French application would have been merely cumulative. As noted previously, Micromass emphasizes that the difference between the '420 patent and the French application is the P x L product. But because the P x L product is only directed to the functioning of a collision cell, citation of the French application to the PTO during the original prosecution would not have raised patentability questions regarding a two-stage mass spectrometer.

The court therefore concludes that even if the French application were material, AB/Sciex did not have knowledge of its materiality or an intent to mislead the PTO, given the reasonable distinction it drew between collision cells and ion guides. See FMC Corp., 835 F.2d at 1415 (inequitable conduct requires that knowledge chargeable to the patentee of the reference's materiality and intent to mislead the PTO).

B. Douglas's Low-Pressure Experiments

Micromass contends that AB/Sciex committed inequitable conduct before the PTO by failing to inform the Examiner of the "low pressure" experiments done by Dr. Douglas prior to the filing of the '736 patent. Micromass contends that these experiments demonstrate significant improvement in ion signal intensity at a P x L product less than the claimed 2.25×10^{-2} torr-cm parameter. Micromass submits that the results refute the allegations of the '736 patent specification and the arguments made in support of the novelty of the alleged invention. It therefore reasons that it was inequitable conduct for AB/Sciex not to include these results with its application.

AB/Sciex contends that there was nothing misleading about not mentioning the "low pressure" experiments because the PTO Examiner was presented with all of the relevant prior art, including the 1987 and 1988 Smith articles. Moreover, AB/Sciex argues that the "low pressure" experiments are not themselves prior art, because they were unknown at the time of the patent to anyone but the inventors.

The duty of candor owed to the PTO requires the patentee's submissions to be truthful. With respect to submissions of experimental results, one court has explained that

> there is a duty to disclose or to even go so far as to "red flag" contradictory information with regard to test results, where results appear to be in sharp contrast with what the applicant is telling the Patent Office, since the Patent Office is incapable of verifying comparative tests and has to rely upon the candor of the parties submitting those test results.

Golden Valley Microwave Foods, Inc. v. Weaver Popcorn Co. 837 F. Supp. 1444, 1475

(N.D. Ind. 1992) (citing Steierman v. Connelly, 192 U.S.P.Q. 433, 437 (Bd. of Pat. App. & Int. 1975)). Micromass relies on two statements made by AB/Sciex to show that AB/Sciex misled the PTO by failing to disclose the "low pressure" experiments. Those statements were both in the patent application and appear in its specification.

> For the apparatus used, with rods 32, 32' 15 cm long, it was found that pressures above 1.5 millitorr (PL product = 2.25×10^{-2} torr cm) produced signal enhancement.

'736 Patent, Col. 13, ln. 32-35. Micromass submits this statement is misleading because Dr. Douglas actually achieved signal enhancement at pressures below 1.5 millitorr. Micromass also argues that AB/Sciex misled the PTO by stating:

> Typically the pressure in first chamber 30 [the ion guide] has been maintained at about 2.5×10^{-4} torr (0.25 millitorr) or less. Observations have indicated that if the pressure is increased from this level, then the ion signal transmission falls off substantially.

'736 Patent, Col. 4, ln.66 - Col. 5, ln.2. The latter statement is followed by discussion of the 1987 and 1988 Smith articles. Micromass contends this is statement is misleading because AB/Sciex observed ion signal increases at pressures above 2.5×10^{-4} torr.

Beginning with the first statement, the court finds nothing misleading about the inventor's statement that "pressures above 1.5 millitorr (PL product = 2.25×10^{-2} torr cm," produced signal enhancement. This is a true statement and Micromass has not challenged that it is false. Instead, Micromass contends that the statement implies that there was no signal enhancement below 1.5 millitorr. The court does not believe this to be a fair implication of the statement. Dr. Douglas testified at trial that the 2.25×10^{-2}

torr cm limitation was chosen because he observed "interesting increases in ion signal consistently above a pressure of about 1.5 millitorr." Furthermore, ion signal increases at lower pressures were "rather small." Given both the consistency and magnitude of the ion signal intensity above 2.25 x 10^{-2} torr cm, he chose to so limit the invention. The recitation of his findings does not suggest that there will be ion signal loss at all lower P x L products.

Taking the second statement, it is obvious from the context of that statement that the "observations" to which the patentees are referring are not their own, but are instead the "past observations" disclosed in the 1987 and 1988 Smith articles that are discussed in the next paragraph. As discussed in the '736 patent, the Smith articles confirmed what Drs. Douglas and French thought to be conventional wisdom before the '736 patent, that decreased pressure in an ion guide resulted in increased ion transmission; and conversely that increased pressure in an ion guide decreased ion transmission. Micromass has not submitted any evidence suggesting that the prior art suggested otherwise, thereby rendering the '736 patent not novel. Instead, Micromass relies on the "low pressure" experiments. But these experiments only confirm the novelty of the '736 patent; they do not refute it. Thus, the court finds that AB/Sciex's failure to include the "low pressure" experiments in its disclosures to the PTO did not make AB/Sciex's representations misleading.

Nor does the court find that the "low pressure" experiments would have been

material to the PTO. Micromass has not shown a "substantial likelihood that a reasonable examiner would have considered the [low pressure experiments] important in deciding whether to allow the application to issue as a patent." Halliburton Co., 925 F.2d at 1440. Its only argument on materiality is that the "low pressure" experiments show an increase in ion transmission at a P x L product (1.8×10^{-2} torr cm) similar to the P x L product that can be calculated from the parameters of the 1987 Smith article (1.76×10^{-2} torr cm). Micromass submits that had the PTO Examiner known of this similarity, he would have rejected the claims of the '736 patent as inherently shown by Smith.

This argument fails for several reasons. One, Dr. Douglas testified that the P x L products are not comparable, because the "rather small" increases in ion transmission he discovered at "low pressure" were the result of optimizing all the other operating parameters used in the device, including voltage. Thus, it cannot be said that the 1987 Smith article inherently showed the same increased ion transmission. Two, the 1987 Smith article is not directed to optimizing ion transmission. Rather, AB/Sciex cited the combination of the 1987 and 1988 Smith articles to establish the "classic theory" that ion signal increased with decreased pressure. The "low pressure" experiments actually refute this theory and thus confirm the novelty of the invention. Three, the inventors did not seek to patent P x L products below 2.25×10^{-2} torr cm. Therefore, even if the 1987 Smith article "inherently" showed increased ion transmission at 1.8×10^{-2} torr cm, as shown by the "low pressure" experiments, that reference would still have been

immaterial to the patentability of the higher P x L product.

Thus, the court concludes that the results of Dr. Douglas's "low pressure" experiments are not material to the patentability of the '736 patent application. AB/Sciex's failure to disclose those results to the PTO was therefore not inequitable conduct.

C. AB/Sciex's Allegation of Infringement of the Micromass ICP Mass Spectrometer

Micromass argues that AB/Sciex should have disclosed to the PTO Examiner during reexamination that it accused Micromass's ICP Mass Spectrometer of infringing the '736 patent. Micromass contends that the article "Interface Studies in the ICP-Mass Spectrometer," which AB/Sciex referred to in the infringement accusation of its January 10, 1997 letter, shows that the ICP device is a collision cell. Because AB/Sciex later contended in reexamination that collision cell references such as the Caldecourt article were not relevant to the ion guide claims of the '736 patent, Micromass contends that AB/Sciex had an affirmative duty to disclose its earlier, allegedly contrary, position that the ICP Mass Spectrometer infringed.

AB/Sciex argues that Micromass reads too much into AB/Sciex's letter of January 10, 1997. According to Dr. Davidson of AB/Sciex, the January 10, 1997 letter did allege that the ICP device infringed, but his concern of infringement did not relate to any collision cell properties of the ICP device. Instead, Dr. Davidson was concerned with what the article called the ICP device's "thermalising properties." Dr. Davidson

understood “thermalizing” to be the same phenomenon as collisional focusing, and thus had the letter sent by AB/Sciex’s attorney to solicit more information about the actual structure of the ICP device. Because Dr. Davidson was concerned with thermalizing, and not with the collision cell properties of the ICP device, AB/Sciex submits that the alleged infringement accusation is consistent with its allegation that the practicing of collisional focusing infringes the ’736 patent.

It is difficult to discern the structure of the ICP device from the “Interface Studies in the ICP-Mass Spectrometer” article. The article begins by stating that “[c]ollision cells in organic mass spectrometry have been shown to be an efficient means of fragmenting ions.” It then goes on to state that “[t]he use of the hexapole as an ion confining device . . . has been widely used as a collision cell and for focusing ion beams in electrospray sources.” In one of the few statements that actually discusses the Micromass device, the article states that “[t]he interface which has been constructed for the ICP ion source has been shown to have the thermalising properties which had been hoped for, and other properties which exceeded the expectations.” The article then depicts the following graphical representation of the ICP device, which appears to show a hexapole rod set contained within a cell and positioned at an angle. An inlet is shown at the top, but is not labeled.

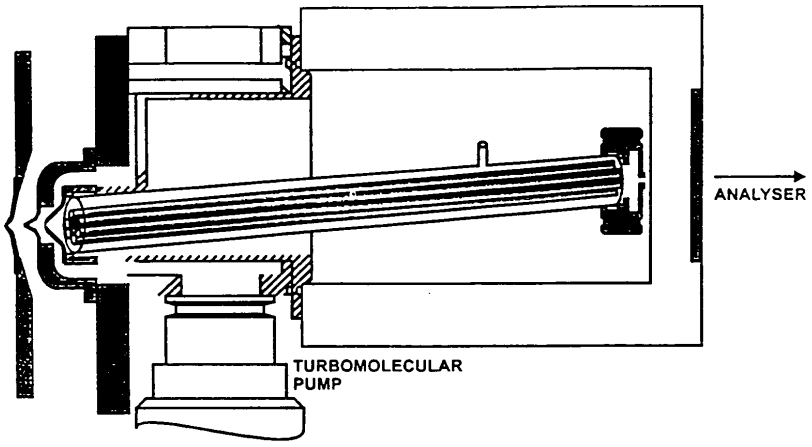


Figure 1: Diagram of the new ICP-MS Interface

Based solely on the explanations of the ICP device in the article, Micromass alleges that AB/Sciex must have known the device to be a collision cell. Although the inlet at the top of the device is not labeled, Micromass asserts that the inlet at the top is the gas inlet for a collision cell. It also notes that the article discusses "[c]ollisions in the hexapole interface." AB/Sciex contends that one reading the article would have concluded that the ICP device could be operated as a collision cell, but did not have to be. It notes that the article references using hexapole rod sets both "as a collision cell *and* for focusing ion beams in electrospray sources." (emphasis added).

The court agrees with AB/Sciex that it is unclear from the article whether the ICP device is always operated as a collision cell. While the article uses the word "collision

cell," it does not describe the dissociation of ions. What is clear from the article is that the ICP device benefits from "thermalising properties." While Dr. Davidson admitted that he could not be sure that the ICP device infringed without further information, such as the pressure, voltage, and rod set length, the article did indicate that the ICP device practiced collisional focusing, and thus he ordered the January 10, 1997 letter to be sent. AB/Sciex made no further allegations that the ICP device infringed.

Because Dr. Davidson's allegation of infringement is consistent with the distinction drawn by AB/Sciex between ion guides and collision cells, the allegation of infringement would therefore not have been material to a reasonable patent examiner. The court is not convinced that AB/Sciex, by sending the January 10 letter, intended to accuse a collision cell device of infringing the '736 patent.

Furthermore, even if the accusation of infringement in the January 10 letter would have been material as inconsistent with later comments made about collision cells, Micromass has not shown that AB/Sciex intended to deceive the PTO by withholding that letter. After learning that Micromass thought certain collision cell references anticipated or made obvious the claims of the '736 patent, AB/Sciex disclosed those references to the PTO in reexamination and detailed to the Examiner why Micromass might have thought those references to be important. AB/Sciex then distinguished the collision cell references. While it might have been inequitable conduct had AB/Sciex later accused a collision cell structure of infringing the patent, it never again accused a

collision cell structure of infringing the ’736 patent.

D. French’s Reexamination Declaration and AB/Sciex’s Amendment

Micromass argues that both the French Declaration and the concurrently filed Amendment by AB/Sciex contain false representations made with the intent to deceive the PTO.

With respect to the Declaration, Micromass focuses on paragraph 6, which explains that one of skill in the art would read the pressure description of the French application (10^{-4} to 10^{-2} torr) as a gradient of pressures over “the second quadrupole 6.” The second quadrupole 6 of the French application is the collision cell. Its rods are comprised of both solid center quadrupoles (14-1) and the open structure end extensions (14-2). Micromass asserts that the Declaration is false because the French application does not describe the gradient as occurring over the whole quadrupole 6. Rather, the French application describes the pressure gradient as occurring over just the solid portions of the quadrupoles (14-1).

Specifically, the French application states, “the gas density in the target region, i.e. in the space between rods 14-1, is in the range between 10^{-2} torr and 10^{-4} torr.” Whereas, the French Declaration states:

> The density distribution of the target gas varies across a length of the second quadrupole 6 with the pressure peaking near a center of the quadrupole section 6 and falling off at either end of the quadrupole section 6. Page 7 of the French application recites a pressure range of 10^{-2} torr to 10^{-4} torr, which means that the center of the quadrupole section 6 would be at about 10^{-2} torr and the ends of the quadrupole section 6 would be at or

below about 10^{-4} torr.

Parsing the French Declaration, its first sentence is accurate; the gas density in the quadrupole 6 would peak in the center and fall off at either end. It is the second sentence on which Micromass relies. That sentence is comprised of two parts. The first part restates the pressure range of the French application, without any context explaining to which structure it applies. The second part explains what the first part means – that the center of quadrupole section 6 is at about 10^{-2} torr, and that the ends of quadrupole section 6 would be "at *or below* about 10^{-4} torr." (emphasis added). This sentence is also accurate. The center of section 6, which is also the center of the solid rods (14-1), is indeed at 10^{-2} torr. Moreover, the ends must be "at or below" 10^{-4} torr because that is the disclosed pressure at the end of the solid rod segment (14-1). Thus, paragraph 6 of the French Declaration is technically accurate.

Micromass's best argument is that while the Declaration is accurate, it gives the mistaken impression that the pressure gradient of the French application applies throughout the whole collision cell and not just over the solid rod portion. The court doubts that a careful reader of both the Declaration and the French application, such as a PTO Examiner, would be left with this impression. Indeed, the Amendment submitted with the Declaration makes clear that the pressure gradient disclosed refers just to the solid rods, 14-1. But even if a reasonable PTO Examiner would have been misled, the discussion was not material. The PTO Examiner recognized that the P x L parameters of

the collision cell were not applicable to the two-stage mass spectrometer mentioned in the final paragraph of that reference.

Micromass also argues that AB/Sciex's Amendment is false; in particular, its recitation that "[t]he French application does not suggest the claimed product of pressure and length." This sentence is the heading of section IV.[8] The remainder of that section goes on to recite that one of skill in the art would read the French application's pressure limits as a pressure gradient, and not a single P x L product over the entire length. It cites Paragraph 6 of the French Declaration for support. It then argues that if one of skill in the art were selecting a pressure in that range, she would not have selected the highest pressure in that range, as the PTO Examiner did when he originally rejected the claims on reexamination. Rather, one of skill in the art would have selected from the lower portion of the range, consistent with the classical teaching that ion guides have improved transmission at lower pressures. Thus, AB/Sciex argued that the French application does not "suggest the claimed product of pressure and rod length" to one of skill in the art.

This is a colorable argument of non-obviousness. The title for the argument, "[t]he French application does not suggest the claimed product of pressure and rod length" is an accurate, if oversimplified, description of its conclusion. Thus, while the French application does indeed disclose pressures and rod lengths in excess of 2.25×10^{-2} torr cm, the Amendment's argument heading is nonetheless accurate when understood in

[8]There are actually two sections labeled "IV" in the Amendment. The court refers to the first of these, on page 8.

context. Thus, the court finds that the Amendment was not misleading or false. Moreover, given the colorable argument in support of that conclusion, the court finds that AB/Sciex did not intend to mislead the PTO.

Therefore, Micromass has not shown, by clear and convincing evidence, that AB/Sciex committed inequitable conduct before the PTO.

V. EQUITABLE ESTOPPEL

"Equitable estoppel is cognizable under 35 U.S.C. § 282 as an equitable defense to a claim for patent infringement." A.C. Aukerman Co. v. R.L. Chaides Constr. Co., 960 F.2d 1020, 1028 (Fed. Cir. 1992). To successfully invoke this defense, an alleged infringer must establish, by a preponderance of the evidence, three elements. Id. at 1046. One, that "[t]he patentee, through misleading conduct, leads the alleged infringer to reasonably infer that the patentee does not intend to enforce its patent against the alleged infringer." Id. at 1028. Misleading conduct can "include specific statements, action, inaction, or silence where there was an obligation to speak." Id. Two, that "[t]he alleged infringer relies on that conduct." Three, that due to the reliance of the alleged infringer, it "will be materially prejudiced if the patentee is allowed to proceed with its claim." Id. If an alleged infringer establishes these three elements by a preponderance of the evidence, the patentee's claim is entirely barred as unenforceable. Id.

Micromass seeks to estop AB/Sciex from asserting the '736 patent on the basis

that AB/Sciex's conduct in 1997, including its silence after being confronted with the collision cell references in Dr. Yorke's April 16, 1997 letter, misled Micromass to conclude that the AB/Sciex would not assert the '736 patent because it was invalid. Micromass states that the result of this misleading conduct was its development the Quattro Ultima.

AB/Sciex contends that its actions form no basis for the application of equitable estoppel. It submits the January 10, 1997 letter shows that AB/Sciex believed the ICP device might infringe, but the letter was not a threat of immediate suit. Without the threat of immediate suit, AB/Sciex contends its silence cannot be construed as a representation to Micromass of any kind. AB/Sciex also argues that Micromass did not rely on AB/Sciex's silence in proceeding with development of the Quattro Ultima, but instead relied on its own incorrect judgment that the '736 patent was invalid.

It is undisputed that AB/Sciex made no affirmative representations in response to Dr. Yorke's April 16, 1997 letter. Instead, Micromass's position is that AB/Sciex's silence, when combined with its request for copies of the references, constituted conduct giving rise to the conclusion that it would not assert its '736 patent because it was invalid. "Misleading action by the patentee may be silence, if such silence is accompanied by some other factor indicating that the silence was sufficiently misleading to amount to bad faith." ABB Robotics, Inc v. GMFanuc Robotics Corp., 52 F.3d 1062, 1064 (Fed. Cir. 1995). Usually, that "some other factor" is an "immediate threat of enforcement" of the

patent, followed by a prolonged silence. But the immediate threat of enforcement is not the only factor that can be combined with silence to constitute misleading conduct. Id. The parties' course of dealing, such as subsequent license negotiations on related patents, can also give rise to the fair inference that the patentee will not enforce a particular patent. Id.

The court finds that there are not sufficient other factors to transform AB/Sciex's silence into a representation that it would not enforce the '736 patent. First, the court does not consider the January 10, 1997 letter a threat of imminent enforcement of the '736 patent. Wafer Shave, Inc. v. Gillette Co., No. Civ. A. 89-0720-WF, 1993 WL 427407, *5 (D. Mass. Oct. 12, 1993) (stating that "[c]ourts have generally held that in order for a patentee's silence to be considered misleading, the patentee must first 'threaten[ ] prompt and vigorous enforcement of the patent.'" (citation omitted)). The letter acknowledges that the device was not yet sold, and therefore an imminent enforcement action would have been premature. Furthermore, the letter stated that it appeared to AB/Sciex that the device infringed, but it did not threaten suit or order Micromass to cease manufacturing the product. Instead, the letter solicited Micromass's comments. The court finds this fact pattern analogous to Meyers v. Brooks Shoe, Inc., 912 F.2d 1459 (Fed. Cir. 1992), overruled on other grounds, A.C. Aukerman Co., 960 F.2d at 1038, in which the patentee contacted the alleged infringer and notified it potential infringement, and then was silent for several years. The Federal Circuit found

these actions did not support equitable estoppel because "there was no threat of immediate suit." Id. at 1464. The court explained that it did "not believe that a suggestion of infringement coupled with an offer to license followed by silence would suffice to establish equitable estoppel." It further explained that one could not fairly infer from those facts that the patentee was abandoning the patent. Id. Like Meyers, AB/Sciex did not threaten litigation and abandon that course, it only asserted possible infringement and requested Micromass's comment. Cf. Schoelle Corp. v. Blackhawk Molding Co., 133 F.3d 1469, 1472-73 (Fed. Cir. 1998) (patentee committed equitable estoppel by alleging infringement, ordering the accused infringer to desist, actually pursuing litigation against a competitor, and appearing to accept the accused infringer's revised product as a non-infringing alternative).

Furthermore, AB/Sciex's silence has to be viewed in context of the representations made by Dr. Yorke. Dr. Yorke's April 16, 1997 letter, and his explanatory testimony, establish that he made two representations to AB/Sciex in his letter. He both asserted that the ICP device did not infringe the '736 patent, and that the claims of the '736 patent were invalid. His statement, "[t]he instrument . . . does not infringe any valid claim of these patents," does not specify which claims were not infringed, invalid, or both, but communicates both non-infringement and invalidity generally. Thus, AB/Sciex's silence following this statement can be reasonably construed to mean, if anything, that AB/Sciex accepted either of these propositions – that the ICP device does not infringe or that claims

are invalid. It would have therefore been unreasonable for Dr. Yorke to assume that AB/Sciex adopted the latter position, when it could have just as reasonably accepted the former. Indeed, the reasonableness of construing AB/Sciex's silence as possibly relating to infringement was confirmed by AB/Sciex's failure to accuse the ICP of infringing when Micromass finally produced it.

Recognizing that Dr. Yorke's letter makes both of these assertions, Micromass focuses on the fact that AB/Sciex's attorney, in subsequent correspondence, requested copies of the cited references and not specifications of the ICP device. Micromass's imparts too much significance to this request. Dr. Yorke could not reasonably have concluded from this request for the references that AB/Sciex thought the references were relevant or invalidating. Instead, the only representation made by AB/Sciex's attorney was that he did not have copies of those references, and the only inference that can be drawn therefrom is that he and AB/Sciex were unprepared to make an informed judgment of their significance.

Therefore, the court concludes that, on these facts, AB/Sciex's silence did not reasonably suggest that it thought the '736 patent to be invalid and therefore did not intend to enforce it. Thus, Micromass has not shown, by a preponderance of the evidence, that AB/Sciex should be equitably estopped from asserting the '736 patent. For the sake of completeness, however, the court will make findings on the remaining elements.

With respect to the remaining considerations, the court finds that Dr. Yorke did indeed rely on AB/Sciex's conduct. Dr. Yorke testified at trial that it was his conclusion, based on the references cited in his letter, that the '736 patent was invalid. Thus, Dr. Yorke's approval of the Quattro Ultima development program can be said to have resulted from his own reasoned conclusions concerning the patent's validity. Had AB/Sciex claimed otherwise in subsequent correspondence with Micromass, Dr. Yorke explained that he would have encouraged designing around the '736 patent. The court concludes, therefore, that AB/Sciex's silence confirmed Dr. Yorke's independent judgment that the claims were invalid, and thus Dr. Yorke can be said to have relied on that silence. Wafer Shave, Inc., 1993 WL 427407 at *9 (even if a defendant relied on independent judgment that it did not infringe, it can also have relied on the patentee's apparent abandonment of the patent). Of course, given the court's conclusion that AB/Sciex's conduct did not imply that it was abandoning the '736 patent, that reliance was unreasonable.

Finally, Micromass has shown that it was prejudiced by its reliance on AB/Sciex's silence. Both the $1.5 million spent in development of the Quattro Ultima and the liability Micromass faces in this action are sufficient to establish its prejudice.

VI. MICROMASS'S MOTION FOR JUDGMENT AS A MATTER OF LAW OR A NEW TRIAL ON INFRINGEMENT

Micromass presents two arguments that AB/Sciex failed to prove that both the

Hexapole Quattro Ultima and the Ion Tunnel Quattro Ultima infringe the claims of the '736 patent as a matter of law. First, Micromass argues that AB/Sciex presented no competent evidence showing the "improved transmission of ions through said interchamber orifice" in either device, as required by claims 1(k) and 14. Second, Micromass argues that AB/Sciex failed to show that either device operates "below that pressure at which an electrical breakdown will occur between the rod means of said first rod set," as required by claims 1(j) and 14(f).

With respect to the jury's verdict that the Ion Tunnel Quattro Ultima infringes the '736 patent under the doctrine of equivalents, Micromass argues it is entitled to judgment as a matter of law overturning that verdict for two reasons. First, prosecution history estoppel should bar AB/Sciex from claiming that the rings of the Ion Tunnel Quattro Ultima are the equivalent of the rod sets in the '736 patent. Second, AB/Sciex failed to prove that the Ion Tunnel is substantially the same as the first rod set.

A. Has AB/Sciex shown "improved transmission of ions" in the Quattro Ultima?

AB/Sciex relies on two types of evidence to establish that the Quattro Ultima practices the "improved transmission of ions," as required by the whereas clauses of both claims 1 and 14. Dr. Enke testified that he performed computer simulations that show improved transmission of ions in the Quattro Ultima. Dr. Enke also testified that Micromass documents explaining the focusing of ions in the Quattro Ultima demonstrate that it practices collisional focusing.

Micromass's primary argument is that Dr. Enke's computer simulations did not simulate the parameters of the Quattro Ultima, and thus should have been excluded as unreliable to support an opinion of infringement under Daubert v. Merrell Dow Pharmaceuticals, Inc., 509 U.S. 579, 589 (1993). Dr. Enke's computer simulation used the same pressures, rod diameter, rod spacing, and voltages found in the Quattro Ultima. However, the simulation used 100 cm rods, whereas the rods of the Quattro Ultima are only 12.3 cm. With 100 cm rods, the P x L product is 15,000 x 10^{-2} torr cm. Furthermore, Dr. Enke "selected to start them [the ions] in the middle of a long set of rods," rather than at their beginning. Finally, Dr. Enke's simulation did not include an interchamber orifice at its conclusion, and thus did not measure whether the ions would pass through that orifice. Micromass's expert, Dr. March, testified that he duplicated Dr. Enke's simulation, and the simulated ions never exited the simulated rod set. Therefore, Micromass argues that Dr. Enke's testimony should have been excluded.

At trial, Dr. Enke explained that his simulation studied the effect of the parameters on the radial energies of ions over time, and not as they traverse a rod set. According to Dr. Enke, his simulation could not measure the forward movement of ions along a rod set because the damping property of gas in that direction was not well-understood, and thus had not been mathematically modeled. His simulations instead focused on modeling ion movement within the rods over time. He assumed 100 cm rod sets and started the ions in their middle so that the ions would not be lost to ends of the rods during the simulation.

His simulations lasted 0.5 milliseconds, approximately one-tenth of the time it would take an ion to traverse the rods of the Quattro Ultima. Those simulations showed collisional focusing occurred in that time, and as a result, collisional focusing in the Quattro Ultima "happened very, very quickly." Enke opined that the ions would have remained focused "for the remainder of the rod set."

With those admitted caveats, Dr. Enke's testimony was properly considered by the jury. Federal Rule of Evidence 702 and Daubert require only "that the court assure that the scientific or technologic evidence be relevant and of appropriate scientific validity, according to the standards of the discipline." Biotec Biologische Naturverpackungen GmbH & Co. KG, v. Biocorp, Inc., 249 F.3d 1341, 1349 (Fed. Cir. 2001). Micromass does not argue that the Dr. Enke's simulations lacked appropriate scientific validity according to the standards of the discipline. Instead, it argues that simulations were not relevant to the issue of whether the Quattro Ultima practices the invention because they only modeled some of its parameters. Dr. Enke explained the limitations of simulations, however, and explained how they were comparable, although not identical, to the Quattro Ultima. Therefore, his simulations were relevant to the issue of infringement. Dr. March introduced conflicting evidence and the jury was free to accept or reject the evidence presented.

Moreover, Dr. Enke's simulations were not the only evidence submitted by AB/Sciex on the issue of infringement of the "improved transmission of ions" element.

AB/Sciex also relied on Micromass documents that showed the results of decreasing the size of the interchamber orifice in the Quattro Ultima from 2.5 mm to 1.2 mm, a reduction of 77%. Because ion transmission was reduced by only 20% when this reduction occurred, Dr. Bateman of Micromass testified that a disproportionately high number of ions were centered in a 1.2 mm stream. Dr. Enke testified that this was the result of collisional focusing and evidenced improved transmission of ions through the interchamber orifice.

Micromass contends that this evidence is inadequate because it compares two allegedly infringing Quattro Ultima devices, instead of comparing a non-infringing device to the Quattro Ultima to determine whether "improved transmission" is actually realized by the device. While Micromass is correct that this evidence alone does not show "improved transmission," it could establish for the jury that the Quattro Ultima had a narrow ion beam. Dr. Enke testified that one of skill in the art would expect an ordinary distribution of ions in the space between the rods without collisional focusing, and thus the narrow distribution of the Quattro Ultima illustrated that it resulted in improved transmission of ions through the interchamber orifice. Based on this evidence and the simulations of Dr. Enke, the jury could reasonably conclude that the Quattro Ultima realizes improved transmission of ions through the ion guide.

B. Has AB/Sciex shown the Quattro Ultima operates at a pressure below that at which electrical breakdown will occur?

Micromass contends that AB/Sciex has not shown evidence that the Quattro

Ultima operates at a pressure "below that pressure at which an electrical breakdown will occur between the rod means of the said first rod set," as required by claims 1(j) and 14(f). Its argument is premised on evidence presented at trial by Dr. Enke, including an article in the field explaining that "the electrical breakdown problem is most significant at pressures of about 1 torr." Micromass argues that because its Quattro Ultima operates at 1.5 to 2 torr, it operates above the pressure at which electrical breakdown will occur and therefore cannot infringe the "electrical breakdown" claim limitation.

In the court's claim construction opinion, it considered, but did not construe, the electrical breakdown claim element. See Applera Corp. v. Micromass UK Ltd., 186 F. Supp. 2d 487, 522-23 (D. Del. 2002). The court rejected Micromass's proposed construction that 30 millitorr was an electrical breakdown pressure because, while that pressure was referenced in the patent specification, it had no support in the claim language itself. The court did not construe the element further, but offered to do so should it become relevant to infringement. Neither party accepted the court's offer. Micromass's argument of non-infringement is premised on the existence of a particular pressure at which electrical breakdown occurs. The court rejected this construction of the claim term previously and continues to stand by this determination. It is thus irrelevant that the Quattro Ultima operates above 1 torr.

Micromass also argues that to prove infringement, AB/Sciex must show that there is a pressure at which the Quattro Ultima will experience electrical breakdown. Dr.

Bateman of Micromass testified that he has operated the Quattro Ultima at pressures of up to 10 torr without electrical breakdown, and Micromass argues there was no evidence to the contrary, thereby establishing as a matter of law that the Quattro Ultima does not have an upper pressure limit.

Micromass's argument is unpersuasive for two reasons. One, it assumes that electrical breakdown is only a function of pressure. AB/Sciex showed at trial that electrical breakdown is not merely a function of pressure, but also of the voltage used. It explained that the Quattro Ultima can use a higher than expected pressure because it uses smaller voltages. Two, the "electrical breakdown" limitation only requires AB/Sciex to prove a negative – that no electrical breakdown occurs. It does not require AB/Sciex to take an affirmative step of showing some upper limit of pressure and voltage at which electrical breakdown will occur in the Quattro Ultima, just to prove that the device operates beneath that level.

AB/Sciex showed that the Quattro Ultima operates without electrical breakdown, and thus has presented evidence sufficient for the jury to conclude that it infringes the "electrical breakdown" claim limitation.

C. Has AB/Sciex shown that the Ion Tunnel Quattro Ultima infringes under the doctrine of equivalents?

Micromass presents two arguments challenging the jury's verdict that the Ion Tunnel Quattro Ultima infringes the '736 patent under the doctrine of equivalents. First, it argues that AB/Sciex should be estopped from claiming that the Ion Tunnel is an

equivalent to a rod set because, during reexamination, it limited itself to electrodes shaped as rods. Second, even if the court does not apply prosecution history estoppel to limit AB/Sciex to rods, Micromass submits that AB/Sciex's evidence of equivalence is inadequate to support the jury's verdict.

1. Should AB/Sciex be estopped from claiming that the Ion Tunnel is equivalent to rod sets?

"Prosecution history estoppel precludes a patentee from obtaining under the doctrine of equivalents coverage of subject matter that has been relinquished during the prosecution of its patent application." Pharmacia & Upjohn Co. v. Mylan Pharms., Inc., 170 F.3d 1373, 1376-77 (Fed. Cir. 1999). "Estoppel may arise by amendments made to overcome prior art rejections, or by argument made to secure allowance of a claim." Lockheed Martin Corp. v. Space Systems/Loral, Inc., 249 F.3d 1314, 1323 (Fed. Cir. 2001). Arguments made to obtain the reallowance of the claims during reexamination may also give rise to prosecution history estoppel. See Cole v. Kimberly-Clark Corp., 102 F.3d 524, 532 (Fed. Cir. 1996) (affirming the finding estoppel on the basis of comments by the patentee during reexamination).

Prosecution history estoppel is a matter that is to be decided by the court. Festo Corp. v. Shoketsu Kinzoku Kogyo Kabushiki Co., 234 F.3d 558, 585 (Fed. Cir. 2000) (noting that the court should evaluate prosecution history estoppel either during dispositive pretrial motions or post-trial motions for judgment as a matter of law), cert. granted, 533 U.S. 915 (2001). To evaluate whether the patentee should be estopped from

claiming infringement on the basis of the prosecution history, "[t]he relevant inquiry is whether a competitor would reasonably believe that the applicant had surrendered the relevant subject matter." Cybor Corp. v. Fas Techs. Inc., 138 F.3d 1448, 1457 (Fed. Cir. 1998). Because the competitor's belief must be reasonable, assertions on which estoppel is based must "evince a clear and unmistakable surrender of subject matter." Litton Sys., Inc. v. Honeywell, Inc., 140 F.3d 1449, 1458 (Fed. Cir. 1998).

Micromass makes two arguments on prosecution history estoppel. First, it argues that AB/Sciex, in distinguishing the ion trap references during reexamination, disclaimed coverage of any electrodes that are not rods. Second, it takes the more narrow position that AB/Sciex disclaimed coverage of ion traps, and that because the Ion Tunnel is a series of ion traps, the Ion Tunnel cannot infringe under the doctrine of equivalents.

For purposes of its motion, Micromass primarily relies on statements AB/Sciex made to distinguish the Schaaf article during reexamination, although AB/Sciex made similar comments to distinguish the ion trap references. AB/Sciex stated that "[t]he claimed mass spectrometer has a first rod set in a first vacuum chamber and a second rod set in a second vacuum chamber. The first rod set receives essentially only an AC voltage so that ions are guided through the first vacuum chamber without being trapped there, ..." To distinguish this structure, AB/Sciex stated that Schaaf "does not disclose or suggest the first and second vacuum chambers, the first and second rod sets, the inlet orifice, the interchamber orifice, the application of an AC-only voltage to the first rod set

. . . . In addition to being directed to an ion trap rather than the claimed mass spectrometer system, Schaaf . . . ." AB/Sciex went on to distinguish the Schaaf article on other grounds, including the lack of the required P x L product.

The passage relied on by Micromass establishes that AB/Sciex should be estopped from claiming that the claims of the '736 patent cover ion traps under the doctrine of equivalents. The structural arguments made by AB/Sciex were for the purpose of patentablility and a competitor would reasonably conclude that ion traps would not infringe the claimed mass spectrometer system. Lockheed Martin Corp., 249 F.3d at 1323. However, Micromass has not shown a basis for extending that estoppel beyond the ion trap to include any non-rod set structure. Nowhere in the reexamination history did AB/Sciex state that the claimed invention applied only to rods and not other structures; it merely distinguished the structure of the prior art presented, including ion traps. Therefore, a reasonable competitor would conclude that ion traps were not covered by the claims of the '736 patent, but there is no clear statement establishing that the estoppel should go beyond ion traps. Litton Sys., Inc., 140 F.3d at 1458.

Thus, the remaining question is whether AB/Sciex, by disclaiming coverage of ion traps, should be estopped from asserting that the Ion Tunnel Quattro Ultima infringes under the doctrine of equivalents. Put simply, is the Ion Tunnel a series of ion traps? At trial Micromass's technical director, Dr. Bateman, and its expert, Dr. March, testified that the series of 84 concentric rings that comprise the Ion Tunnel create 82 separate ion traps

between them. They explained that the ion rings create electric fields in three dimensions, including 2 radial dimensions (an x and y direction towards and away from the rods) and an axial dimension (a z direction described as the ion path from the inlet to the interchamber orifice). The elongated rod sets, in contrast, only create electric fields in the two radial dimensions because the electrode itself extends in the axial direction. Micromass also relies on an article discussing ion tunnels, entitled "Stacked Ring Electrostatic Ion Guide," by S. Guan and A. Marshall, 7 J. Am. Soc. Mass. Spectrom. 101-06 (1996). That article warns that because the ion tunnel creates an axial electric field (that is, in the direction of the interchamber orifice), "[i]t is important to accelerate ions to a high axial velocity to avoid trapping ions in the shallow pseudopotential well between adjacent ring electrodes." Dr. Bateman testified this "well" was the space exactly between two electrode rings where the opposite axial electric fields cancel one another out, resulting in a "ground plane" of zero AC voltage. On the basis of this evidence, Micromass submits that the Ion Tunnel is a series of ion traps.

AB/Sciex admits that the electrode rings of the ion tunnel, unlike rod sets, create electrical fields in an axial dimension, but argues that distinction does not make the Ion Tunnel into an ion trap unless ions are actually trapped by that electric field. AB/Sciex argues that because the very purpose of the Ion Tunnel is to guide ions in the axial direction and not to trap them, it is self-evident that the rings do not function to trap ions. AB/Sciex relies on the testimony of Dr. Bateman of Micromass to establish that the axial

electric fields of the Ion Tunnel do not trap ions because the alternating current of each successive ring largely eliminates any "well" in the axial field that might trap an ion and prevent it from reaching the interchamber orifice.

> Q: So if an ion is coming through this and it hits one of these [axial] fields created by these rings, what is the effect of the field on the ion?
>
> A: Well, the field is in the direction of the axis of the ion guides. That's the prime field. So the major effect of that field would be to accelerate the ions forward or decelerate them or accelerate them backwards, so that's the prime effect of the field, but the overall effect of that over many cycles, over many plates[,] is to cancel itself out and not really have any effect at all. . . .
>
> Q: Tell me what the trajectories are before the gas is introduced or without the gas.
>
> A: If there was no gas present, then ion would tend to travel in roughly straight lines until they approach within close proximity of the edges of the electrodes. There, they would experience this oscillating field which would have a short-term effect of accelerating or decelerating the ions in the direction of the ion guide. But, as I mentioned before, that cancelling out over several oscillations and several plates but without a residual effect which repels the ions away from the edges of the electrodes.

Trial Tr. at 1003-04. AB/Sciex also notes that the Guan and Marshall article discusses at length the guiding function of the Ion Tunnel, and only mentions the trapping of ions to warn that ions with low axial kinetic can become trapped "near the negatively biased ring electrodes."

It is evident that Micromass's Ion Tunnel, while it may trap some ions with small axial kinetic energies, does not function as an ion trap. The ion trap references

distinguished by AB/Sciex are designed to trap ions in a confined space and then eject them from that space based on mass-charge ratio in response to the application of a particular electric charge. The Ion Tunnel functions to guide ions from the ion source to an interchamber orifice, in the same manner that a quadrupole ion guide does. Indeed, the Guan and Marshall article recognizes the Ion Tunnel and quadrupole (or hexapole and octupole) ion guides are "[c]losely related" ion guide structures. Thus, while AB/Sciex may have disclaimed ion traps, Micromass has not shown that its Ion Tunnel is an ion trap.

Micromass also presses a related position that the court erred in failing to decide the scope of prosecution history estoppel before the jury's verdict. Micromass argues that the scope of estoppel must be explained to the jury, so that it might resolve the subsidiary factual question of whether the ion tunnel is a series of ion traps. AB/Sciex contends that the court did not err by reserving prosecution history estoppel for after trial. It also argues that the jury's verdict that the ion tunnel is the equivalent of the first rod set implicitly includes the conclusion that the ion tunnel is not an ion trap, given the differences between ion traps and ion tunnels.

It is well-established that prosecution history estoppel is an equitable doctrine that presents a matter to be decided by the court. Festo Corp., 234 F.3d at 585. Indeed, the Federal Circuit in Festo noted that the court should address prosecution history estoppel either on dispositive pretrial motions or post-trial motions for judgment as a matter of

law. Id. It did not suggest, as Micromass does, that prosecution history estoppel is a claim construction issue that must be decided by the court and then presented to the jury to inform its judgment of infringement by equivalents. Indeed, the authority is to the contrary. See Yeu v. Kim, 904 F.2d 44 (table), 1999 WL 56140, *1 (Fed. Cir. 1999) (while holding that the defense of prosecution history estoppel can be waived, noting that "prosecution history estoppel is not applied as a mandatory rule of construction"). Thus, the court believes it has the authority to resolve questions of fact relating to application of prosecution history estoppel and that it has done so in a manner consistent with the jury's verdict.

2. Has AB/Sciex shown sufficient evidence to prove infringement under the doctrine of equivalents?

Micromass also contends that AB/Sciex has not brought forward sufficient evidence to prove infringement under the doctrine of equivalents. Therefore, Micromass contends that it is entitled to judgment as a matter of law on this point.

Infringement under the doctrine of equivalents may be shown in different ways. It can be shown by proving that the difference between the structure asserted to be equivalent and the structure of the claims is "insubstantial." Overhead Door Corp. v. Chamberlain Group, Inc., 194 F.3d 1261, 1269 (Fed. Cir. 1999). It can also be shown by proving that the disputed claim element "performs substantially the same function in substantially the same way to obtain substantially the same result as the claim limitation." Schoell v. Regal Marine Indus., Inc., 247 F.3d 1202, 1209 (Fed. Cir. 2001). Micromass

argues that AB/Sciex has failed to show competent evidence that the ion tunnel is the equivalent of the first rod set under this "function-way-result" test.

Micromass does not dispute that the two devices perform the same function. At trial, AB/Sciex introduced evidence from Dr. Enke and others on this subject. In particular, the deposition testimony of Dr. Giles, a research scientist with Micromass, established sufficient evidence that a jury could find that the ion tunnel performs the same function as the first rod set of the '736 patent. When asked the purpose of the ion tunnel, he stated "[t]he purposed is to collimate or guide ions from one region to another region." Micromass's argument is premised on both the way and result of the ion tunnel. With respect to whether the stacked rings of the ion tunnel work in the same way as the first rod set, Micromass contends that AB/Sciex failed to address that the rings generate a third dimension of electric field in the axial direction. According to Micromass, this axial electric field exists between successive rings of alternating current, creating a "ground plane" of zero AC voltage at the middle which traps ions and causes them to oscillate in an axial direction as the voltage is alternated. The result is an ion beam with "pulsing" in the axial direction. This contrasts with rod sets, which have no axial electric field and move ions continuously along their length.

In further support of its argument, Micromass cites the deposition testimony of Dr. Scott Tanner, AB/Sciex's principal research scientist.

> Q: Is there any difference between the three-dimensional field collisional cooling and what you understand is the invention of the

’736 patent?

A: Certainly, there’s a difference. . . . The two-dimensional device and the three-dimensional device are different beings and they have different characteristics of ion motion.

Q: Are those differences substantial?

A: Absolutely.

Trial Tr. at 1173-74. While Micromass depicts this passage as an admission that the ion tunnel guides ions in a different way than the rod sets, Dr. Tanner does not admit nearly that much. He simply acknowledged that the characteristics of ion motion when acted on by a three-dimensional electrical field are substantially different than that of a two-dimensional electrical field. He did not relate those comments to whether the axial field created in the ion tunnel operates in a substantially different way than the rod set.

Indeed, the earlier cited testimony of Dr. Bateman suggests that the axial electrical field of the stacked rings do not have a substantial effect on the motion of ions in an ion tunnel. He stated that although the effect of the axial electrical field was to accelerate and decelerate them in an axial direction, “the overall effect of that over many cycles, over many plates is to cancel itself out and not really have any effect at all.” He also described this axial oscillation as “short term” and “without a residual effect.” Trial Tr. at 1003-04. This testimony was supported by that of Dr. Enke, who explained that the axial field alternates “a million times a second” and averages “out to zero.” He also explained that the ions do not receive any appreciable net axial energy by the axial

electric field.

Dr. Enke also testified regarding how the stacked ring sets work. Like quadrupole rod sets, the stacked rings alternate between attracting and repulsing the ions, forcing them to oscillate in a radial direction (i.e., towards and away from the ring edges) as they travel down the path of the rings. He also explained that this process creates "collisional focusing" and results in confinement of the ions to the central space. Thus, a reasonable jury could conclude that the stacked ring set of the Ion Tunnel Quattro Ultima works to confine ions in a central stream and guide them towards an interchamber orifice in the same way as the first rod set of the '736 patent.

With respect to differing results, Micromass relies on the testimony of Dr. Bateman that the ion tunnel provides a one-hundred percent increase in ion transmission over the previously used hexapole ion guide. Micromass argues that an increase this large cannot be "insubstantial" as a matter of law, and thus the ion tunnel does not have the same result as the '736 patent. However, Micromass's comparison lacks force. Micromass compares a product found to infringe literally with a product found to infringe under the doctrine of equivalents. The relevant comparison is whether result of the ion tunnel is substantially identical to the claim limitation as explained in the patent. Claims 1(k) and 14 of the '736 patent require only "improved transmission of ions through said interchamber orifice." The claims do not require a particular magnitude of improvement as their result. Thus, any improvement in ion transmission over non-

infringing devices will satisfy the claim limitation. Moreover, showing an improvement over the claimed device does not avoid infringement under the doctrine of equivalents. Ryco, Inc. v. Ag-Bag Corp., 857 F.2d 1418, 1426-27 (Fed. Cir. 1988) ("That the accused device is an improvement on the claimed subject matter does not avoid infringement even under the doctrine of equivalents.").

Because AB/Sciex has shown sufficient evidence establishing genuine issues of fact regarding whether both the "way" and "result" of the ion tunnel is equivalent to the claimed first rod set, the court finds that the jury could have reasonably found that the Ion Tunnel Quattro Ultima infringes under the doctrine of equivalents.

VII. MICROMASS'S MOTION FOR JUDGMENT AS A MATTER OF LAW AS TO THE JURY'S DAMAGES AWARD

Micromass argues that the jury erred in awarding AB/Sciex lost profit damages as a matter of law because AB/Sciex has not presented competent evidence on two of the four requirements discussed in Panduit Corp. v. Stahlin Bros. Fibre Works, Inc., 575 F.2d 1152, 1156 (6th Cir. 1978), including evidence of demand for the patented product and the absence of non-infringing alternatives. Micromass also alleges that the court erred by refusing to give the jury an instruction explaining how it should consider the evidence of demand for the patented product under Panduit. Finally, Micromass argues that the "reasonable royalty" calculation made by AB/Sciex's damages expert is contrary to the evidence and unsupportable as a matter of law.

A. Lost Profits Damages

The jury awarded $47.5 million in damages to AB/Sciex, $41.3 million of which was attributable to the Hexapole Quattro Ultima. It can be assumed that this award was based on the lost profits of AB/Sciex, for both figures exceeded the highest amount of damages suggested by AB/Sciex's expert, Dr. Stewart, as a reasonable royalty.[9] Micromass now contends that AB/Sciex is not entitled to lost profits damages as a matter of law.

The Federal Circuit has held "that the general rule for determining actual damages to a patentee that is itself producing the patented item is to determine the sales and profits lost to the patentee because of the infringement." Rite-Hite Corp. v. Kelley Co., 56 F.3d 1538, 1545 (Fed. Cir. 1995). "To recover lost profits, the patent owner must show 'causation in fact,' establishing that 'but for' the infringement, he would have made additional profits. Id. (citing King Instrument Corp. v. Otari Corp., 767 F.2d 853, 863 (Fed. Cir. 1985)). The Federal Circuit has generally endorsed the factors detailed in Panduit as a "useful, but non-exclusive, way for a patentee to prove entitlement to lost profits damages." Id. There are four factors that must be shown under Panduit to show an entitlement to lost profits damages. These include: "(1) demand for the patented

[9]AB/Sciex's expert, Dr. Stewart, opined that total reasonable royalty damages would be between $45.5 million (assuming Dr. Stewart's estimate of Micromass's incremental profit) and $34.1 million (assuming Mr. Sim's estimate of Micromass's incremental profit). Dr. Stewart also opined that the highest reasonable royalty damages for just the Hexapole Quattro Ultima was $38.9 million.

product, (2) absence of acceptable noninfringing substitutes, (3) [the patentee's] manufacturing and marketing capability to exploit the demand, and (4) the amount of the profit [the patentee] would have made." Panduit Corp., 575 F.2d at 1156. The patentee "need not negate every possibility that the purchaser might not have purchased a product other than its own, absent the infringement," but only has to show a reasonable probability that it would have made the sales but for the infringement. Rite-Hite Corp. 56 F.3d at 1545. If the patentee makes a satisfactory showing on each of these factors, the patentee "has sustained the burden of proving entitlement to lost profits due to the infringing sales." Id.

Micromass argues that AB/Sciex has not shown that there was a demand for the patented product, the first of the Panduit factors. The parties do not appear to dispute the nature of AB/Sciex's evidence on this factor, but instead disagree as to its significance. AB/Sciex showed that there was demand for the API 3000 and 4000, AB/Sciex's high sensitivity mass spectrometers that practiced the '736 patent. These products were demanded as a result of their increased sensitivity. Moreover, the API 4000 sells for almost $100,000 more than the API 3000 because of its enhanced sensitivity. AB/Sciex also produced several Micromass internal documents acknowledging the importance of sensitivity. It is uncontested that AB/Sciex did not attempt to show demand for "collisional focusing" per se, but instead put forth evidence of significant demand for the sensitivity that results from such focusing.

Micromass notes that "[c]ausation is more difficult to establish where the patent covers only an improvement on or a small part of the product sold by the infringer." 7 Chisum on Patents, § 20.03[1] (2001). It argues that causation (that is, that the patentee would have made the sales of the accused infringer) cannot be proven in these circumstances because AB/Sciex has not shown that demand for sensitivity is the same as demand for collisional focusing. It further contends that because sensitivity can be improved in several different ways, mere demand for sensitivity does not translate into demand for the patented product. See Grain Processing Corp. v. American Maize-Prods. Co., 185 F.3d 1341,1354 (Fed. Cir. 1999) (denying lost profits to a patentee when the demand shown was for "low-dextrose maltodextrins," and not the particular type of low-dextrose maltodextrins that the plaintiff had patented, and because other maltodextrins were suitable alternatives). Thus, because there are non-infringing ways to improve sensitivity, evidence of demand for sensitivity does not prove demand for the patented invention. On this basis, Micromass argues that AB/Sciex has failed to prove "demand for the patented product" – the collisional focusing of the '736 patent – and that it therefore cannot receive lost profits.

Micromass's position conflates two inquiries – demand for the patented product and the absence of non-infringing alternatives. In this circumstance, it is correct to do so. Because AB/Sciex has only shown demand for sensitivity and instruments with increased sensitivity, and because there are allegedly non-infringing mechanisms of obtaining

sensitivity, AB/Sciex cannot show demand for collisional focusing, the teaching of the ’736 patent, without showing that the non-infringing alternatives for obtaining the demanded sensitivity are inadequate. This is analogous to the “entire market value rule” for measuring profits in improvement patents. That rule “permits recovery of damages based on the value of a patentee's entire apparatus containing several features when the patent-related feature is the ‘basis for customer demand.’” Rite-Hite Corp., 56 F.3d at 1549. To the extent that AB/Sciex can show that the basis of consumer demand for the API 3000 and other high sensitivity instruments is the collisional focusing of the ’736 patent because there are no adequate alternatives, it is entitled to rely on demand for sensitivity to establish demand for the patented product. Thus, the court’s inquiry turns on the presence or absence of non-infringing alternatives to obtaining sensitivity improvements with collisional focusing.

For purposes of showing a non-infringing alternative, Micromass relies on a hypothetical mass spectrometer it asserts that it could have constructed at the time it developed the Hexapole Quattro Ultima. Such a hypothetical alternative can be considered for purposes of lost profits damages. Grain Processing Corp., 185 F.3d at 1351 (“only by comparing the patented invention to its next-best available alternative(s) - regardless of whether the alternative(s) were actually produced and sold during the infringement - can the court discern the market value of the patent owner's exclusive right”). However, “[t]o prevent the hypothetical from lapsing into pure speculation, this

court requires sound economic proof of the nature of the market and likely outcomes with infringement factored out of the economic picture." Id. at 1350. Dr. Bateman testified that when he developing the Quattro Ultima, he made a number of changes to the original Quattro LC to improve sensitivity, including changes to the Z-spray ionization source, the addition of small rods, called "stubbies," before the mass filters, and improvements in the detector. The testimony showed that without those changes, the Quattro LC was from six to two times less sensitive than the API 3000, but that each of those changes improved sensitivity by a "factor of two" or a factor of "two and a half and three." On this basis, Micromass contends that it could have created a non-infringing Quattro Ultima with five times the sensitivity of the Quattro LC, and that this product would have been a suitable non-infringing alternative to the API 3000. Because it can show that such a hypothetical product was a possible alternative, Micromass submits it has established the presence of non-infringing alternatives to the API 3000. It also argues that these changes demonstrate that the demand for sensitivity can be met by other improvements, and thus there was no demand for "collisional focusing."

AB/Sciex argues that Micromass's hypothetical product is unproven and is not a true "alternative" to a product with collisional focusing. First, it notes that Micromass's change to the Z-spray ionizing chamber was an increase in the orifice size, which permits both more ions and more gas into the subsequent chambers. AB/Sciex notes that this increase occurred only because Micromass could keep the pressure higher in those

chambers by using collisional focusing. Without collisional focusing, Micromass would have had to employ large, costly, and unreliable cryopumps to decrease the pressure in those chambers. Thus, the change in the Z-spray ionization chamber was related to collisional focusing. AB/Sciex also notes that the addition of stubbies and improvements to the detectors were all already part of the Quattro Ultima itself. If those changes alone were capable of yielding sensitivities as high as that achieved by practicing the invention, Micromass would not have practiced the invention in the first place. Also, while each of these improvements may produce increases in ion signal in the Quattro LC by a factor of two or three when practiced alone, no witness testified that the combination of these improvements will arithmetically increase sensitivity by a factor of five to six. Finally, it bears noting that when Micromass changed its product from the Hexapole Quattro Ultima to the Ion Tunnel Quattro Ultima, it continued to utilize the equivalent of the claimed invention. AB/Sciex contends that if Micromass could have produced equivalent sensitivity without the invention, it would have simply relied on the stubbies and improved detector for sensitivity, and not replaced the hexapole ion guides with an ion tunnel.

AB/Sciex has shown a disputed issue of material fact concerning whether Micromass could have produced a hypothetical product that would have had the same sensitivity as the API 3000, but that did not infringe. The jury, by awarding lost profits damages, resolved this issue in favor of AB/Sciex. The court concludes that the jury had

sufficient evidence before it to find both that the demand for sensitivity translated into demand for "collisional focusing," and that there were no non-infringing alternatives for increasing sensitivity.

Additionally, Micromass argues that the court erred in not delivering to the jury its requested instruction on the Panduit factors. The court delivered the following instruction.

> In deciding whether or not AB/Sciex lost sales, you should consider whether or not AB/Sciex has proven by a preponderance of the evidence that there existed a demand for the patented product.
>
> . . . .
>
> In determining whether AB/Sciex lost sales due to infringement, you must consider whether or not, if Micromass's infringing hexapole and/or ion tunnel Quattro Ultima were not available, some or all of the people who bought the hexapole and/or ion tunnel Quattro Ultima from Micromass would have bought a different, noninfringing product from Micromass or from somebody else, rather than buy from AB/Sciex.
>
> In deciding whether or not people who bought from Micromass would have bought a noninfringing product, you should consider whether or not there was such a demand for the patented aspects of the infringing product that purchasers would not have bought a noninfringing product.

Trial Tr. at 1789. The court also detailed the other Panduit factors not relevant to this motion. The second and third paragraphs of the court's instruction are taken from the Federal Circuit Bar Association (FCBA) Draft Model Instructions. The first paragraph, which does not appear in those instructions, is instead modeled on American Intellectual Property Law Association (AIPLA) Guide to Model Patent Jury Instructions. It reflects the first Panduit factor and was added by agreement of the parties.

Micromass argues it was entitled to the following instruction.

> In deciding whether AB/Sciex lost sales, you should consider whether or not AB/Sciex has proven by a preponderance of the evidence that there existed a demand for the patented product as evidenced by significant sales of AB/Sciex's mass spectrometers that incorporated the patented technology and/or significant sales of Micromass's infringing product. Demand for the patented product only exists if the sales of AB/Sciex's mass spectrometers that incorporate the patented technology and the sales of Micromass's infringing product were due to the inclusion in those products of the patented technology and not due to factors unrelated to the patented technology, such as superior customer service and customer preference for a manufacturer's particular suppliers.

Micromass's version is premised on its construction of Grain Processing Corp, 185 F.3d at 1354. It adds the "demand for the patented technology" language within the discussion of demand for the product, and further explains other bases of product demand.

The court concludes that the instruction it delivered was correct and that Micromass has failed to show that the further explication it desired was required to clarify the Panduit factors. As noted above, the demand for the patented aspect of the API 3000 turns on whether the same desired sensitivity could be achieved in other ways. Thus, the instruction delivered by the court on non-infringing substitutes, especially the third paragraph recited above, addresses Micromass's concern that the jury was not informed that the demand must relate to the patented aspects of the invention. Therefore there was no error.

B. Reasonable Royalty Damages

At trial, AB/Sciex's damages expert, Dr. Stewart, opined that a reasonably royalty

for use of the ’736 patent would be $225,000 per Quattro Ultima, an amount in excess of 67% of its selling price. Micromass’s damages expert, Mr. Sims, testified that this was far in excess of the highest royalty payment, $3,333 per device, of which he was aware. Micromass seeks to exclude the reasonable royalty calculations under Daubert v. Merrell Dow Pharmaceuticals, Inc., 509 U.S. 579 (1993).

The jury’s damages award was in excess of the highest total offered by either expert for a reasonable royalty. It is thus evident that the jury awarded damages based on AB/Sciex’s lost profits. Because the court has found the lost profits damages to be reasonable, it will not address Micromass’s allegations of error as to AB/Sciex’s reasonable royalty calculation.

VIII. AB/SCIEX’S MOTION FOR SUMMARY JUDGMENT ON MICROMASS’S ANTITRUST CLAIMS

Micromass presented counterclaims in this suit that AB/Sciex violated § 2 of the Sherman Act, 15 U.S.C. § 2, by enforcing a fraudulently procured patent and by filing a “sham” lawsuit. These counterclaims are premised on two theories. First, Micromass alleges that AB/Sciex procured the ’736 patent by a fraud on the PTO, which is known as a “Walker Process” claim. See Walker Process Equip, Inc. v. Food Mach & Chem. Corp., 382 U.S. 172 (1965). Second, Micromass alleges that this lawsuit is “objectively baseless” and was brought by AB/Sciex in an improper attempt to maintain its monopoly power, which is known as a “Handgards” claim. See Handgards, Inc. v. Ethicon, Inc.,

743 F.2d 1282 (9th Cir. 1984). The court deferred trial on Micromass's antitrust counterclaims until the issues of validity, infringement, willful infringement, and damages were tried to a jury. Following the verdicts in favor of AB/Sciex on validity, infringement, and damages, AB/Sciex moved for summary judgment on Micromass's antitrust counterclaim, arguing that the claim is inconsistent with the jury's verdicts.

With respect to the Walker Process claim, Micromass must prove, inter alia, that but for the alleged fraud on the PTO, the '736 patent would not have issued. See Nobelpharma AB v. Implant Innovations, Inc., 141 F.3d 1059, 1070 (Fed. Cir. 1998) (noting that the applicant's fraud must "cause the PTO to grant an invalid patent" to establish Walker Process liability). The jury has found that the '736 patent is not invalid and the court has upheld the reasonableness of that determination in this opinion. Moreover, the court has also determined that the inventors of the '736 patent did not engage in any inequitable conduct before the PTO. These determinations are fatal to Micromass's Walker Process claim. Id. at 1070-71 ("A finding of Walker Process fraud requires higher threshold showings of both intent and materiality than does a finding of inequitable conduct").

On the subject of the Handgards claim that AB/Sciex has brought this "sham" lawsuit in order to perpetuate its monopoly power, Micromass offers no response. The jury verdict in its favor proves that AB/Sciex's litigation has merit. Moreover, it is beyond question that AB/Sciex did not bring the suit with knowledge that it lacked merit.

Handgards, Inc., 743 F.2d at 1289. The court will therefore grant AB/Sciex's motion for summary judgment.

IX. AB/SCIEX'S MOTION TO ALTER OR AMEND THE JUDGMENT

AB/Sciex moves to alter or amend the judgment entered by the court to include prejudgment interest and to enjoin Micromass's further infringement of the '736 patent.

A. Prejudgment Interest

AB/Sciex argues that it is entitled to prejudgment interest on its damages under 35 U.S.C. § 284. That statute, in relevant part, states that "[u]pon finding for the claimant the court shall award the claimant damages adequate to compensate for the infringement, but in no event less than a reasonable royalty for the use made of the invention by the infringer, together with interest and costs as fixed by the court." The Supreme Court has explained that this provision gives courts the discretion to award prejudgment interest, but does not mandate prejudgment interest in every case. See General Motors Corp. v. Devex Corp., 461 U.S. 648, 656-57 (1983). The Court explained that "prejudgment interest should be awarded under § 284 absent some justification for withholding such an award." Id. at 657. AB/Sciex submitted a declaration from its damages expert, Dr. Stewart, in which he calculates the quarterly prejudgment interest to be, in total, $5,148,470.

Micromass argues that three circumstances justify withholding an award of

prejudgment interest in this case. First, Micromass argues that the jury's damage award of $47.5 million is already excessive, and thus the court should not compound the error by awarding prejudgment interest. The appropriateness of the jury's award, however, is of no consequence to AB/Sciex's prejudgment interest motion. The court must presume that the jury's award is the full value necessary to make AB/Sciex whole, and determine prejudgment interest on that basis. In any event, the court has rejected Micromass's argument that the jury's damages verdict was improper as a matter of law.

Second, Micromass argues that the court cannot be sure whether the jury's award is based on lost profits or on reasonable royalties. For that reason, Micromass's damages expert, Sims, has submitted an declaration that appears to adopt the same methodology as Dr. Stewart for calculating quarterly royalties, but assumes that royalties in any given quarter only become payable in the subsequent quarter. Sims testified that most royalty agreements would include such a quarterly lag in payment. On this basis, he submits that the prejudgment interest can be no greater than $3,955,335. However, the jury's damages award was greater than that proposed by either expert for a cumulative reasonable royalty, and thus the court concludes that the jury's award reflected AB/Sciex's lost profits. Micromass has not explained in its briefing why this conclusion is unfounded, and thus the court will award prejudgment interest on the premise that the jury found AB/Sciex was entitled to lost profits.

Finally, Micromass argues that AB/Sciex should not be entitled to prejudgment

interest because it unreasonably delayed bringing this infringement suit. The Hexapole Quattro Ultima was first offered for sale in February 1999. Thus, Micromass submits that the one year delay in bringing suit until February 2000 was improper and should bar the award of prejudgment interest. AB/Sciex's delay was not one year, however, because the '736 patent remained in reexamination until May 1999 and Micromass did not ship the first Quattro Ultima until June 1999. Micromass was unable to perform tests on the Quattro Ultima until November 1999, when one of its research scientists was permitted to visit a Nebraska company that possessed one. Suit was filed just three months later in February 2000. Given the reasonable difficulty in procuring a competitor's product and the investigation necessary to ensure that the suit was brought in good faith, AB/Sciex's delay was reasonable. The court will not deny AB/Sciex prejudgment interest on this basis.

After reviewing the declaration of Dr. Stewart, the court concludes that his estimate of prejudgment interest, based on the prime rate and calculated quarterly, is reasonable. The court will therefore amend the judgment to award AB/Sciex an additional $5,148,470 in prejudgment interest.

B. Injunctive Relief

Micromass does not dispute that AB/Sciex is entitled to an injunction following the jury's verdict of infringement pursuant to 35 U.S.C. § 283. Instead, Micromass argues that AB/Sciex's proposed injunction is too broad because it would encompass

more than simply the Hexapole and Ion Tunnel Quattro Ultimas.

AB/Sciex's proposes, in relevant part, that the court's injunction enjoin Micromass from:

> infringing the '736 patent by making, using, offering for sale, selling or importing into the United States any Quattro Ultima mass spectrometers or any other mass spectrometer that includes an ion guide that acts as an intermediate pressure stage between an ion source and a vacuum chamber containing a rod set used as a mass filter, the ion guide comprising a vacuum chamber that contains a rod set or a ring set and in which the pressure in the chamber times the length of the rod set or the ring set is greater than 2.25×10^{-2} torr cm.

Micromass disagrees with this formulation, arguing that it extends beyond simply the Hexapole and Ion Tunnel Quattro Ultima to any hypothetical product that might meet the description of the injunction, even if it does not literally infringe the '736 patent. Micromass argues instead that the injunction should simply bar it from making, using, offering for sale, selling, or importing the two Quattro Ultimas at issue in this litigation.

The court agrees that the scope of AB/Sciex's proposed injunction sweeps too broadly. By attempting to summarize the salient features of the '736 patent, the proposed injunction raises the possibility that Micromass could be subject to contempt sanctions for producing a mass spectrometer meeting the description of the order, but not possessing all the claim limitations of the '736 patent. Because such a process would subvert the infringement inquiry on any new Micromass products, the court will limit its injunction to the two products accused in this litigation.

X. CONCLUSION

For the foregoing reasons, the court will deny Micromass's motions for reconsideration of claim construction and for judgment as a matter of law on validity, infringement, and damages. The court further finds that Micromass has not shown inequitable conduct in AB/Sciex's prosecution of the '736 patent. Nor has Micromass shown that AB/Sciex should be equitably estopped from asserting the '736 patent based on the 1997 correspondence between the two companies.

The court will grant AB/Sciex's motion for summary judgment on Micromass's antitrust counterclaims. Furthermore, the court will amend the judgment to account for prejudgment interest and to enjoin permanently the infringement of the '736 patent by Micromass's Quattro Ultima devices.

The court will issue an order consistent with this opinion.