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Current Trends in Mass Spectrometry Instrument

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Abstract: ***Starting from the mid-19th century many types of Mass Spectrometry Instruments been introduced to Analytical world from different Instrument Manufactures. Customers are now looking for new instruments and methods for their research work as they now have lot of options available from the market. In order to meet the growing demands of Customers, manufactures are now left with no choice than revolutionizing their instruments with respect to resolution, sensitivity and robustness.***

Keywords: MS – Mass Spectrometry, Instrument control Software (ICS)

1. Introduction

With the onset of modern Mass Spectrometry technologies, proteogenomics is experiencing revolution in terms of quantity and quality of data. The peptide fragmentation spectra help in precise identification of proteins, hence mass spectrometry-based proteomics can be applied to measure changes in protein abundance, post translational modifications and protein–protein interactions. Mass spectrometry-based proteomics is the only method currently available to comprehensively analyse changes in mutant proteomes [1]. Streamlining the workflows to make the research work robust. MS technology is now gone to level of quantify the amount of metal in an individual cell too.

Discovery to Verification and Validation in the shortest possible time is a major challenge faced by Academia (24%), Pharma (18%), Agriculture, Food and Beverages (18%), Biotechnology (12%), Hospital/Medical/Clinical lab (11%), Environmental Testing lab (4%), General Testing Lab (4%), CRO (3%), Government (3%), Chemicals (2%) and Other (5%) when using the Mass Spectrometry instruments[2].

Bridging the gap from discovery to verification and validation requires high-performance instruments and software, as well as high-level competence in MS based discovery and in method developments for verification. Research Laboratories should have the Analytical Mass Spectrometry instrument loaded with all the available technology to revolutionize their research work.

2. Background

There are lot many literatures available online in the form of articles and white paper [3] which informs us about the engineering evolution of MS instruments to accommodate different ionization source type, collision cell design, Mass Analyzer, Ion Detector optimization, MS Types (Table -2) - MS (single quadrupole), MS2 (dual quadrupole), MS3 (triple quadrupole) and MS4(tetra quadrupole) and different instrument types where MS acts a detector for LC and GC sample data input and mentioning the same here is beyond the scope of this article. Here we are limiting our discussion to the numbers of instruments currently released to the market by different vendors and their uniqueness which in turn speak about the trend.

3. Methods

Companies are coming out with cutting edge technology to meet customer needs and providing them a quality post service. AB SCIEX, ADVION, Agilent, Bruker, Perkin Elmer, Shimadzu, Thermo Fisher Scientific and Waters are the global leaders in Mass Spectrometry Business. Here (Table-1) are their releases to dominate for their existence.

Table – 01– Press release notes from the websites of AB SCIEX, ADVION, Agilent, Bruker, Perkin Elmer, Shimadzu, Thermo Fisher Scientific and Waters who are the global leaders in Mass Spectrometry Business were taken as reference, instrument that were released from June of last year (2018) to the current year (June 2019) were considered for this article. There were total of 19 newer version of instruments released to the market during the period. Which are documented in the table given below highlighting only their unique feature. Here are their releases to dominate for their existence.

Instrument	Unique Feature
June 3, 2018 **PerkinElmer** QSight™ Triple Quadrupole LC/MS/MS System QSight100, 200 and 400 Series[4]	Delivers **High Sensitivity** and **Enhanced Productivity** for Analytical Labs. System offers **patented flow-based** technology that enables up to 15% more productivity **StayClean™ Source**, self-cleaning design for maximum sensitivity and exceptional uptime. **Increased throughput** - Easy-to-use with ready to implement methods. **Laminar Flow Ion Guide™** - for highly efficient field-free transmission, providing virtually no maintenance requirements. **Dual Source technology**- gives you the capability to set ESI or APCI modes, with two independent probes for true multiplexing **Modular Simplicity™ 3Q software** to acquire, quantify, and report with flexible data viewing options and **powerful remote diagnostics**

	https://www.perkinelmer.co.uk/product/qsight-420-multi-opt-dual-source-system-bc003844
June 3, 2018 **PerkinElmer** NexION 2000 ICP-MS – Triple Quad B, C, P and S Model[5]	**SMARTintro™** sample-introduction module simplifies operator setup, streamlining your workflows. The industry's **fastest** data acquisition speed on the market (100, 000 points/sec) to handle any particle size A new solid-state RF generator with revolutionary **LumiCoil™** technology – first ICP-MS RF coil that requires **no maintenance** or cooling Triple Cone Interface with Quadrupole Ion Deflector, delivering **no maintenance** beyond the cones Built-in **Radian™ Remote Monitoring Service** with **Syngistix™** for ICP-MS software v 2.3 or higher – provides real-time monitoring of your NexION system's diagnostic parameters, enhancing laboratory productivity. Awarded this prize during analytica 2018 in Munich, Germany, in acknowledgment of a new technique enabling users to quantify the amount of **metal in an individual cell for the first time.** https://www.perkinelmer.co.uk/product/nexion-2000b-icp-ms-configuration-n8150044
June 3-7, 2018 **PerkinElmer** Torion® T-9 GC/MS[6]	The **Torion® T-9** GC/MS is the **world's smallest portable** GC/MS, and is fast, reliable, and easy to use. Mass range from 41 to 500 Daltons. Samples are injected using a novel **CUSTODION®** solid phase microextraction (SPME) fiber syringe or a needle trap (CUSTODION-NT). Weighs 32 pounds, and is rechargeable battery operated. It is easy to operate, with a color touch screen user interface or a simple three button navigation. The system's speed and **portability** makes it ideal for analysis outside your lab. https://www.perkinelmer.co.uk/product/torion-t-9-portable-gc-ms-instrument-ntsst090500
November 2, 2018 **Agilent Technologies Inc** ICP-MS Water Analyzer[7]	New **browser-based** ICP Go Software to set up and control ICP-MS methods. Preset method templates, consumables, and documented operating procedures. "It will allow customers to reduce ramp-to-revenue times and save costs associated with method implementation as well as staff training and re-training."The Agilent ICP-MS Water Analyzer enables environmental laboratories to set up and run regulated methods in a matter of days rather than weeks or even months. – MS uses and new instrument to Market https://www.agilent.com/about/newsroom/presrel/2018/02nov-ca18073.html
January 8, 2019 **Advion** SOLATION™ ICP-MS [8]	SOLATION™ Inductively Coupled Plasma Mass Spectrometer (ICP-MS)expands the current Advion mass spectrometer portfolio to include high performance, multi-element analysis for environmental, clinical, biomedical, food, agriculture and geological applications. https://www.advion.com/advion-introduces-the-solation-icp-ms-for-simple-high-performance-multi-element-analysis
Jan. 22, 2019 **Waters** BioAccord LC-MSTOF System[9]	BioAccord LC-MS System - ACQUITY UPLC I-Class PLUS with ACQUITY RDaTime of Flight Mass Detector – Reliably **reproducible** data with simple set-up, a **self-calibrating**, **self-optimizing**, self-sufficient tool that equips you with high quality data https://www.waters.com/waters/en_US/BioAccord-LC-MS-System-for-Biopharmaceuticals/nav.htm?locale=en_US&cid=135005818
June 1, 2018 **Shimadzu** LCMS Q-TOF-9030[10]	The **iRefTOF™** generates an ideal reflectron field, delivering the **highest resolution** for the flight path with highly stable mass accuracy. https://www.shimadzu.com/an/news-events/2018/lcms-9030.html
April 15, 2019 **Agilent** 6546 LC/Q-TOF[11]	Improved mass **resolution** over 60k (for high masses) and over 30k (for low masses) Maintenance made easy with **vent-free access** to ion source and inlet https://www.agilent.com/en/products/liquid-chromatography-mass-spectrometry-lc-ms/lc-ms-instruments/quadrupole-time-of-flight-lc-ms/6546-lc-q-tof
May 29, 2019 **Shimadzu** MALDImini-1 Digital Ion Trap Mass Spectrometer[12]	Shimadzu Scientific Instruments (SSI) announces the release of the MALDImini™-1, the first commercially available **compact MALDI** digital ion trap mass spectrometer. The MALDImini-1 fits in a space the **size of a piece of paper**, while allowing fast **high-sensitivity** measurements and detailed structural and qualitative analyses over a wide mass range, even with sub-microliter sample volumes. The small size and corresponding **lower power requirements** allow it to be plugged into a conventional AC power supply. **Switching** between MS, MS/MS and MS3 modes is quick and easy for seamless structural analysis. Its **signal-to-noise** ratio is greater than 3000:1. https://www.ssi.shimadzu.com/news/2019/new-shimadzu-MALDImini-1-digital-ion-trap-mass-spectrometer-provides-fast-high-sensitive-measurements-through-an-ultra-compact-design.html
05/30/19 **Waters** Cyclic IMS and New SYNAPT XS[13]	Ion mobility multiplies peak capacity and selectivity of analysis CCS measurements increase security of compound identification **StepWaveTM XS** - Redesigned segmented quadrupole transfer optics that provide enhanced sensitivity for challenging compounds while further improving the levels of analytical robustness. **SONAR** and **HDMSE** types of acquisition increase analytical peak capacity, providing 'clean and clear' fragmentation data, but based on different molecular properties. This provides a truly unique investigative toolbox for the in-depth interrogation of complex mixtures Ion Mobility and CCS measurement Conventional mass spectrometers separate components on the basis of m/z. The **SYNAPT XS** also allows separation of molecules according to their size, shape, and charge during ion mobility experiments as a function of their collisional cross section (CCS).

	CID and ETD Fragmentation Capabilities The dual collision cell arrangement of **TriWave** enhances MS/MS possibilities, by providing Collision Induced Dissociation (CID) and/or Electron Transfer Dissociation (ETD) fragmentation with high resolution and accurate mass measurements. The resolving quadrupole is available in 4KDa, 8KDa or 32KDa mass range options for MS/MS of small to macromolecular species TAP Fragmentation **Time aligned parallel (TAP)** fragmentation provides a distinct advantage for building a complete structure, through superior fragment ion coverage, sensitivity, and accuracy compared to traditional MSn or MS/MS techniques. https://www.waters.com/waters/en_US/SYNAPT-XS-High-Resolution-Mass-Spectrometer/nav.htm?cid=135020928&locale=en_US
June 3, 2018 **Waters** Xevo TQ-GC[14]	Minimal method development enabled by Quanpedia™ method database driven workflows High performance and reliable so you can easily surpass regulatory limits Rapid and mistake-proof source design to simplify maintenance tasks. Reduce training time and costs with a single software workflow for LC-MS/MS and GC-MS/MS analysis Maximized Uptime to Ensure your Success To ensure you don't spend precious time on lengthy instrument setup, intellistart health check informs you whether the system is ready to run injections and, if not, how the situation can be remedied. You need minimal tools for instrument maintenance and if any maintenance is needed it is not only quick, but mistake-proof. Targetlynx which is an Application Manager common across Waters LC and GC platforms. This means it not only gives full analyte quantification, simplified review of results, and customizable reporting, but also provides a common platform between instrument types simplifying data processing and reducing time to results. https://www.waters.com/waters/en_US/Xevo-TQ-GC-electron-ionization-triple-quadrupole-gas-chromatography/nav.htm?cid=134977323&locale=en_US
May 30, 2019 **Agilent** 6495C Triple Quadrupole LC/MS System[15]	The 6495C triple quadrupole LC/MS system is the highest performance LC/TQ available, ideally suited for peptide quant as well as applications that require ppt sensitivity. There is no other instrument like it – the combination of utmost sensitivity, extended mass range, ease of maintenance, and the power and flexibility of MassHunter makes this the system of choice for demanding applications. With Agilent's third generation iFunnel design and VacShield for easy maintenance, high performance has never been more aligned with high reliability. Vent-free ion source maintenance with VacShield technology https://www.agilent.com/en/products/liquid-chromatography-mass-spectrometry-lc-ms/lc-ms-instruments/triple-quadrupole-lc-ms/6495c-triple-quadrupole-lc-ms
June 3, 2019 **SCIEX** [16]	The TripleTOF® 6600+ LC-MS/MS System is the next chapter in the TripleTOF® portfolio, built for large-scale precise quantification and flexible use. The instrument incorporates simplified low-flow source technology to deliver accessible, sensitive and robust quantification; while multiple software-enabled improvements increase robustness and maximize system uptime. The key features of the TripleTOF® 6600+ LC-MS/MS System include: OptiFlow® Turbo V Source: A single source for all low-flow applications, with flow rates of 100 nL/min – 200 µL/min, the OptiFlow Turbo V Source enables long-term operations to study large sample cohorts Up to 100 Hz MS/MS Scan Speeds: Delivers unique qualitative and quantitative capabilities, from fast targeted quantification (MRMHR) to highly multiplexed data-dependent (DDA) and data-independent methods (SWATH) https://sciex.com/about-us/press-releases/sciex-introduces-the-tripletof%C2%AE-6600-lc-ms/ms-system-with-scanning-swath%C2%AE-acquisition-and-oneomics%E2%84%A2-in-sciex-cloud
June 3, 2019 **SCIEX** Triple Quad™ 5500+ System – QTRAP® Ready[17]	Triple Quad LC-MS/MS systems deliver superior quantitative results in a single injection workflow. SelexION® differential mobility separation which delivers exceptional selectivity of isobaric compounds. If your workflow demands low flow rates, the OptiFlow® Turbo V™ Ion Source is the ideal technology to achieve your goals. Optimized for microflow chromatography, the OptiFlow ion source can further increase sensitivity, improve selectivity and reduce the consumption of solvents and other consumables. OptiFlow Turbo V Ion Source- Upgrade to the OptiFlow source for low-flow analysis. It is robust and simple to operate, with a flow-rate range of 1 -200 µL/min. HED Detector and High Capacity CEM- Increased productivity with fast polarity switching of 5 msec enabling up to 6 orders of magnitude of linear dynamic range. Scheduled MRM™ Algorithm Pro- With Analyst® software, maximize the number of MRM transitions to analyze more compounds in a single run without sacrificing precision. https://sciex.com/products/mass-spectrometers/triple-quad-systems/triple-quad-5500-lc-ms-ms-system-%E2%80%93-qtrap-ready
June 3, 2019 **Bruker** timsTOFfleX™ with ESI and MALDI for SpatialOMx™[18]	Bruker introduces the novel timsTOFfleX™ mass spectrometer, which includes a software-switchable MALDI source adapted to the ESI timsTOF Pro™ platform. This new, combined ESI/MALDI capability enables spatially-resolved omics, SpatialOMx™, on a single instrument. The timsTOFfleX comes with Bruker's proprietary 10kHz SmartBeam™ 3D laser with true pixel fidelity for rapid, label-free MALDI imaging at high-spatial resolution, while fully preserving the unparalleled 4D proteomics and phenomics sensitivity of the timsTOF Pro in ESI mode. https://ir.bruker.com/press-releases/press-release-details/2019/Bruker-Launches-timsTOF-fleX--with-ESI-and-MALDI-for-SpatialOMx/default.aspx

June 3, 2019 **Bruker** scimaX magnetic resonance MS (MRMS)[19]	Powered by MRMS Technology, scimaX provides superior eXtreme Resolution and mass accuracy enables routine Isotopic Fine Structure (IFS) analysis for a broad mass range results in unmatched confidence for compound identification scimaX is easy to site and maintain scimaX is an integrated and versatile instrument ESI and MALDI sources are included as well as several ion activation techniques (CID, (n) ETD, (n)ECD). The ESI source interface is compatible to various optional API sources (APPI, APCI, GC-APCI). https://www.bruker.com/products/mass-spectrometry-and-separations/mrms/scimax/overview.html
June 3, 2019 **Thermo Scientific** Orbitrap Exploris™ 480 mass spectrometer[20]	Maximize high-throughput performance in proteomics and biopharma applications with the Thermo Scientific™ Orbitrap Exploris™ 480 mass spectrometer. Maximum data certainty Market leading resolution & mass accuracy, selectivity & spectral quality to solve the most complex challenges. Robustness and reliability Makes large scale studies possible and reduces everyday hassle. It just works! Empowers more users Transition each experimental step to the next level with intelligence-driven performance. High resolution within a compact footprint Because space is always a premium regardless of lab. https://www.thermofisher.com/order/catalog/product/BRE725532
June 3, 2019 **The new Thermo Scientific** Orbitrap Eclipse™ Tribrid™ Mass Spectrometer[21]	Newest Tribrid platform includes Advanced Ion Management Technology (AIM+) with the new QR5 segmented quadrupole mass filter, Real-Time Search, Enhanced Vacuum Technology, optional Proton Transfer Charge Reduction (PTCR), and optional High Mass Range MSn (HMRn) mode. https://www.thermofisher.com/order/catalog/product/FSN04-10000
June 3, 2019 **Thermo Fisher Scientific** Orbitrap ID-X TribridMS[22]	Combining industry-leading mass analyzer technology dedicated for small molecule analysis with the Thermo Scientific™ AcquireX intelligent data acquisition strategy. A combination of the best of quadrupole, linear ion trap and Thermo Scientific™ Orbitrap™ mass analyzer technology for acquisition of the richest MSn data per sample. Method Editor templates with set-n-go experimental parameters to use as-is, or modify as needed. AquireX Deep Characterization scanning approach to easily and intelligently find more compounds with distinguishable fragmentations, enhancing your analysis. https://www.thermofisher.com/order/catalog/product/FSN03-10000

Table 2: Different Instrument types currently available in the market [23]

S No	Instrument Type	Full Form
1	EI-B	Electronic Ionization -ion Beam
2	EI-EBEB	Electronic Ionization- Electric (E) and Magnetic (B) sectors
3	GC-EI-Q	Gas Chromatography – Electronic Ionization - Quadrapole
4	GC-EI-QQ	Gas Chromatography – Electronic Ionization – Quadrapole - Quadrapole
5	GC-EI-TOF	Gas Chromatography – Electronic Ionization – Time Of Flight
6	CE-ESI-TOF	Capillary Electrophoresis-Electrospray Ionization- Time Of Flight
7	ESI-ITFT	Electrospray Ionization-Ion Trap Fourier transformation
8	ESI-ITTOF	Electrospray Ionization- Ion Trap Time Of Flight
9	ESI-QTOF	Electrospray Ionization-Quadrapole-Time Of Flight
10	ESI-TOF	Electrospray Ionization-Time Of Flight
11	LC-ESI-IT	Liquid Chromatography-Electrospray Ionization- Ion Trap
12	LC-ESI-ITFT	Liquid Chromatography-Electrospray Ionization- Ion Trap Fourier Transformation
13	LC-ESI-ITTOF	Liquid Chromatography - Electrospray Ionization- Ion Trap Time Of Flight
14	LC-ESI-Q	Liquid Chromatography - Electrospray Ionization-Quadrapole
15	LC-ESI-QFT	Liquid Chromatography - Electrospray Ionization-Quadrapole Fourier Transformation
16	LC-ESI-QIT	Liquid Chromatography-Electrospray Ionization-QuadrapoleIon Trap
17	LC-ESI-QQ	Liquid Chromatography-Electrospray Ionization-Quadrapole Quadrapole
18	LC-ESI-QQQ	Liquid Chromatography-Electrospray Ionization-Quadrapole Quadrapole Quadrapole
19	LC-ESI-QTOF	Liquid Chromatography-Electrospray Ionization-Quadrapole Time of Flight
20	LC-ESI-TOF	Liquid Chromatography-Electrospray Ionization- Time of Flight
21	APCI-ITFT	Atmospheric Pressure Chemical Ionization - Ion Trap Fourier transformation
22	APCI-ITTOF	Atmospheric Pressure Chemical Ionization - Ion Trap Time Of Flight
23	APCI-Q	Atmospheric Pressure Chemical Ionization-Quadrapole
24	CI-B	Chemical Ionization – ion Beam
25	CI-Q	Chemical Ionization – Quadrapole
26	FAB-B	Fast Atom Bombardment-ion Beam
27	FAB-BE	Fast Atom Bombardment Electric (E) and Magnetic (B) sectors
28	FAB-EB	Fast Atom Bombardment Electric (E) and Magnetic (B) sectors
29	FAB-EBEB	Fast Atom Bombardment Electric (E) and Magnetic (B) sectors
30	FD-B	Field Desorption-ion Beam

31	FI-B	Field Ionization-ion Beam
32	GC-FI-TOF	Gas Chromatography- Field Ionization-Time of Flight
33	LC-APCI-ITFT	Liquid Chromatography- Atmospheric Pressure Chemical Ionization- Ion Trap Fourier Transformation
34	LC-APCI-Q	Liquid Chromatography- Atmospheric Pressure Chemical Ionization-Quadrapole
35	LC-APCI-QTOF	Liquid Chromatography- Atmospheric Pressure Chemical Ionization-Quadrapole Time of Flight
36	LC-APPI-QQ	Liquid Chromatography-Atmospheric Pressure Photoionization- Quadrapole Quadrapole
37	MALDI-QIT	Matrix Assisted Laser Desorption/Ionization-Quadrapole Ion Trap
38	MALDI-TOF	Matrix Assisted Laser Desorption/Ionization- Time of Flight
39	MALDI-TOFTOF	Matrix Assisted Laser Desorption/Ionization- Time of Flight Time of Flight

4. Conclusion

Better resolution and sensitivity are the motto of all instrument vendors. The trend is going towards Auto-calibrating, miniatures and less weight designed instrument for on field portability. Future analytical instruments will have to compete with already existing benchmark features set by the available instrument to exist in the business.

Available Mass Spectrometry Instruments in the market focus on,

Quality data –There is a constant evolution in technology happening every day from all MS instrument vendors for market leading sensitivity and resolution of the analytical data by improvising the existing algorithm or innovating new algorithm / workflows and by new hardware designs. All these new innovations help users to get reliably reproducible, clean and clear fragmentation data with increased Signal-to-noise ratio.

Fast Switching–Researches are now focused on MS, MS/MS MS3 and MS4 multidimensional modes for structural predications. Switching between MSn modes is quick and made easy for seamless multi dimentional structural analysis. Novel electronics and a modified ion transfer capillary enable extremely fast Polarity switching. High-speed ion polarity switching can be specially useful when it cannot be judged whether samples will be detected as positive or negative ions. Current MS Instruments have ability to measure spectra using more than one ionization modes in the same instrument. Instruments are now providing flexibility in switching between ESI and APCI by Dual Source technology, which is capable to set ESI or APCI modes, with two independent probes for true multiplexing. Rapidly switchable matrix-assisted laser desorption/ionization and electrospray quadrupole-time-of-flight mass spectrometry have capacity to obtain side-by-side high quality ESI and MALDI mass spectra from a single proteolytic mixture, which greatly facilitates the identification of proteins and elucidation of their primary structures.

High through Put - Due to the increasing amount of research work in biological field, analytical instrument laboratories are under constant pressure to increase productivity and again, productivity should not be compensated for accurate quality of analytical data. Highly automated optimized analytical workflow are pushing MS Instrument towards high-throughput. ICS provides built-in methods for commonly found analytes, processing methods, library searching capabilities, data review and reporting with built-in templates which results in Qualitative and Quantitative high throughput screening.

Easy to use–All Instrument control Software (ICS) now comes along less user dependent, easy to use with ready to implement build-in preset method, data processing and report templates - It will allow customers to reduce ramp-to-revenue times.

Maintenance cost– For annual maintenance of MS instrument user must spend 5 to 10% of the initial cost of the instrument. So, vendors are now bringing Minimal cost or No Maintenance requirement instruments to the market. Some of the cost-effective analytical engineering work includes vent free access to Ion Source and Inlet, simplified low-flow source technology (1 nL- 0.001 µL) which reduce the consumption of solvents and other consumables. Lower Power requirements some are battery operated. Planned maintenance activity. Easy to use with ready to implement preset method templates - It will allow customers to reduce ramp-to-revenue times and allow customers to save costs associated with method implementation as well as staff training and re-training. Reduce training time and costs with a single software workflow. Some instruments come in are economical; they are priced cheaper compared to their fully-fledged Instrument System Stack.

Acquisition Rate - Fast scanning speed for MS instrument helps in getting enough data points across very narrow LC/GC-MS chromatographic peaks which gives better resolution power for peptide analysis. There are MS instruments which have fastest data acquisition speed on the market

Software–Current Trend is to control instrument through "Browser based software"–which helps user to remote real-time monitoring from anywhere outreach from the instrument which will enhance lab productivity. Researchers and service engineer can remote access through web browser for diagnostics purpose and for troubleshooting Instrument errors. Apart from browser-based software traditional instrument control software too have improvised in their mass spectral prediction tools, accelerating results to let you go beyond faster through automated workflow, Common platforms for the Instrument types LC/GC-MS

Portability–Users now look for Smallest Portable, Less weight LC/GC-MS instruments for On Spot sample acquisition and Data Analysis for environmental monitoring, homeland security and for human health study. Users can now setup Instruments outside lab and run regulated methods provided with the instrument. Instrument compact to size of the paper with weight of 32 pounds allowing analysts to take portable MS systems into the field. This

effectively brings the chemistry lab to the sample and eliminates sample shipment/transport.

Increased Mass Range– with resolving 32KDa mass range.

Maximized Uptime - Maximized Uptime to Ensure your Success-To ensure we don't spend precious time on lengthy instrument setup, we now have instruments that have Self-cleaning source, Self-Calibrating - stretch calibration across several days with appropriate validation measures and Self-optimizing which keeps everything functioning to its optimum over the long haul and continuously monitors the status of the peripheral equipment to ensure that operational parameters are within an acceptable range.

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