2	NAME	**Alexander A. Makarov**
	Nominating Society	**British Mass Spectrometry Society**

Supplementary Information and Description of Achievement

Alexander Alexeyevich Makarov is a Russian physicist who led the team that developed the Orbitrap mass spectrometer. For this key development, he received the 2008 ASMS Distinguished Contribution in Mass Spectrometry Award, the 2009 IMSF Curt Brunnee award and, in 2011, the first HUPO Science and Technology Award from the Human Proteome Organization (HUPO). Additionally, the Orbitrap instrument won the 2006 Pittcon Gold Editors' Award. Alexander Makarov's other honours include the Heinrich-Emanuel Merck Award, and the Gold medal of Russian Mass Spectrometry Society.

Dr. Makarov is currently Director of Global Research for Life Sciences Mass Spectrometry with ThermoFisher in Bremen (Germany) and San Jose (USA). He received his PhD from Moscow Physics Engineering Institute (MPEI), Russia in 1992. After undertaking post-doctoral research in the Laboratory for Laser Diagnostics in the General Physics Institute (GPI) of the Russian Academy of Sciences in Moscow (1992-1994) and at the University of Warwick, UK, Dr Makarov joined HD Technologies, Manchester, UK in 1996 as a research and development scientist. After the company was acquired by ThermoFinnigan in 2000 he became a Research Manager and a Senior Research Scientist with Thermo Electron, Bremen, Germany, before going on to his current post.

Dr. Makarov's research interests cover instrument and method development for mass spectrometry and his numerous major achievements have been (*inter alia*) in the development of ideal time-of-flight focusing, the invention of rotational TOF mirrors with axial reflection, the development of a benchtop TOF-MS for fast GC/MS with supersonic molecular beams, a compact LC-TOF for proteomics and high-throughput LC/MS, and, in 2000, an Orbitrap with a laser source with a simple injection technique for pulsed source. Makarov was responsible for developing the LTQ Orbitrap mass spectrometer which was launched by ThermoFinnigan in 2005. This instrument was the first commercial mass spectrometer to be based on this new type of mass analyzer; Orbitrap-based mass spectrometers offer performance that was previously only available from larger, more expensive, FT-ICR mass spectrometers, enabling more widespread use of ultra-high resolution and high mass accuracy instrumentation.

Dr. Makarov has published ca 40 research papers and 40 patents on mass spectrometry.

EMPLOYMENT HISTORY

06/07 – present. Director of Global Research, Life Sciences Mass Spectrometry.
Leader of research projects in Life Sciences, ThermoFisher in Bremen and San Jose.

07/06 – 06/07. Research Manager Life Sciences, Thermo Electron Bremen, Germany.
Leader of research projects in Life Sciences, Thermo Electron Bremen.

07/02-07/06. Senior Research Scientist FTMS, Thermo Electron, Bremen, Germany.

Scientific leader of the instrument R&D team (10 engineers and scientists) for the LTQ Orbitrap Mass Spectrometer launched by Thermo in 2005. This instrument has received **Gold Medal** at PittCon 2006, R&D 100 award for 2006, Frost & Sullivan Technical innovation reward for 2006.

Led the project from conceiving the idea of the new type of mass analyser type to proof-of-the-principle and then to launch into production in spring 2005. Solely responsible for development of all ion optics and all patenting, directly involved in development of ultra-accurate analyser manufacturing technology, electronics, data acquisition system, differentially-pumped vacuum system, ion source, ion source interface optics, mechanical design, software, applications, supporting instruments in the field, product definition and strategic

planning of the marketing program.

06/00-06/02. Research Manager, Thermo Finnigan (Masslab Ltd), Manchester, UK.

Head of research projects; research team: six scientists and engineers.

08/98-06/00. Research Manager, HD Technologies (acquired by ThermoFinnigan).

Responsible for all experimental research and verification of prototype instruments. The following projects has been carried out:

1. Prototype of high-resolution high-throughput auto-correlation MALDI-TOF for peptide fingerprinting for Genomic Solutions Inc. Invented the principle of auto-correlation TOFMS, developed all ion-optical design, participated in mechanical design, experimentally proved the concept. The project was discontinued upon the purchase of the company by Thermo Finnigan.
2. Prototype of bench-top TOFMS for fast GC/MS with electron impact (later marketed as **Tempus** by Thermo Finnigan) and metastable atom bombardment ion sources (later marketed as **MAB-TOF** by Dephy Technologies). Invented detector with high dynamic range, developed all ion-optical design (including gridless orthogonal accelerator), experimentally proved the analytical parameters on the prototypes and pre-production units, participated in product definition and marketing.
3. Compact LC-TOF set-up for proteomics and high-throughput LC/MS within the framework of feasibility studies for Thermo Finnigan Masslab. Developed all ion-optical design, experimentally proved the analytical parameters. This prototype became a pilot for LC-TOF project.
4. Orbitrap with laser source (has won SMART award). Invented simple injection technique for pulsed source, developed physical, electronic and ion-optical design, proved the concept.

08/96-07/98. Research and Development Scientist, HD Technologies, Manchester, UK.

Responsible for all experimental research and physical basics of instruments. The following projects has been carried out:

1. Bench-top TOFMS for fast GC/MS with supersonic molecular beams (has won SMART and SPUR awards, was marketed as **HyperJet** by HD Technologies Ltd). Developed all physical and ion-optical design (including supersonic beam interface, differential pumping, switchable source with electron impact and hyperthemal surface ionisation), carried out experimental research. The instrument was discontinued upon the purchase of the company by Thermo Finnigan.
2. Bench-top ICP-TOF MS **Optimass 8000** (has won R&D100 award, now marketed by GBC Pty Ltd). Invented gridless orthogonal accelerator, developed all physical and ion-optical design (including plasma sampling, differential pumping, lenses, analyser and SmartGate), directly participated in mechanical design, carried out all experimental research and analytical tests, installed prototype in GBC.

08/94-07/96. Research Fellow, University of Warwick, Coventry, UK.

Participated in the following instrument development grants:

1. In-series magnetic-sector/ parabolic mirror TOFMS with MALDI ion source for high-energy MS/MS.
2. Tandem TOF/TOF MS with MALDI ion source for high-energy MS/MS
3. Electrospray source for MMM magnetic sector instrument

In all of them, was responsible for physical and ion-optical design, in the first project- also for experimental proof-of-the-principle. Developed theory of parabolic-field mirror design.

06/92-08/94. Scientific Researcher, Laboratory for Laser Diagnostics, General Physics Institute (GPI) of Russian Academy of Sciences, Moscow, Russia.

Consultant for Kratos Analytical Ltd, participated in design of Magnetic sector/TOF instrument for Univ. of Warwick, experiments on orthogonal TOF and improvements to Kompact MALDI 3 instrument.

In GPI, was responsible for ion-optical design of Laser ablation/resonance photo-ionisation TOFMS for ultra-trace organic analysis. Also, on initiative basis investigated application of nuclear-track membranes in mass spectrometry and scanning tunnelling microscopy.

Created theory explaining anomalously high resolving power of ion traps with resonant excitation.

03/89-03/92. Graduate Research Assistant, Moscow Physics Engineering Inst.(MPEI).

In PhD thesis, developed theory of ideal time-of-flight focusing, and practical realisation of such fields, invented rotational TOF mirrors with axial reflection. Responsible for design of TOFMS with large-area dust-impact ion source for analysis of interplanetary micrometeorites in space.

03/88-03/89. Undergraduate Research Assistant, MPEI.

Invented, designed and provided proof-of-the principle for multi-electrode TOF analyser with hyper-logarithmic field for spark ion source.

EDUCATION

9/93-10/93	Course in Business, Diplomatic School, Moscow, Specialist in International Buisiness
5/89-3/92	POSTGRADUATE: Dept. of Molecular Physics, Moscow Physics-Engineering Institute, Russia: PhD in Physics and Mathematics. Title of the dissertation: "Quasi-isochronous motion of charged particles in static electromagnetic fields" (scientific advisor: Prof. A.A.Sysoev)
9/83-3/89	UNDERGRADUATE: Dept. of Molecular Physics, Moscow Physics-Engineering Institute, Russia, Master of Science with Honors, Molecular Physics, Engineer-Physicist

AWARDS

2008	Award of American Society for Mass Spectrometry for a Distinguished Contribution to Mass Spectrometry
2007	Heinrich-Emmanuel Merck Award
2007	Gold medal of Russian Mass Spectrometry Society
2005	Gold Editors Award for LTQ Orbitrap, Pittcon 2006 (Orlando)
2005	R&D 100 Award for LTQ Orbitrap
1998	R&D 100 Award for Optimass 8000

PUBLICATION LIST

1. “Equilibrium ion distribution modeling in RF ion traps and guides with regard to Coulomb effects” Grinfeld D. E.; Kopaev I. A.; Makarov A. A.; NUCLEAR INSTRUMENTS & METHODS IN PHYSICS RESEARCH SECTION A-ACCELERATORS SPECTROMETERS DETECTORS AND ASSOCIATED EQUIPMENT, 645, 141-145.

2. “Mass Measurement and Top-Down HPLC/MS Analysis of Intact Monoclonal Antibodies on a Hybrid Linear Quadrupole Ion Trap-Orbitrap Mass Spectrometer” P. V. Bondarenko P.Tonya, V. Zubrouska, A. A. Makarov. JASMS, 20, 1415-1425

3. “The orbitrap mass analyser”, *Encyclopedia of Genomics, Proteomics and Bioinformatics*, Eds. M.Dunn, L. Jorde, P. Little, S. Subramaniam, J.Wiley, 2006.

4. “Higher-energy C-trap dissociation for peptide modification analysis”, *Nature Methods*, v.4 (9), p. 709-712 (2007), with J. Olsen, B. Macek, O. Lange, S. Horning, and M. Mann.

5. “Orbitrap Mass Analyzer- Overview and Applications in Proteomics”, *Practical Proteomics*, 1, 16-21 (2006), with M. Scigelova.

6. “Performance Evaluation of a Novel Hybrid Linear Ion Trap/Orbitrap Mass Spectrometer”, *Anal. Chem.*, 78, 2113-2120 (2006), with E. Denisov, A. Kholomeev, W. Balschun, O. Lange, K. Strupat, S. Horning.

7. “Dynamic Range of Mass Accuracy in LTQ Orbitrap Hybrid Mass Spectrometer“, *J. Am. Soc. Mass Spectrom.*, 17, 977-982 (2006), with E. Denisov, O. Lange, S. Horning.
8. “Resonant AC Dipolar Excitation for Ion Motion Control in the Orbitrap Mass Analyzer”, *J. Phys. Chem. A*, 110, 2682-2689 (2006), with Q. Hu, R. G. Cooks, R.J. Noll.
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10. “Parts per Million Mass Accuracy on an Orbitrap Mass Spectrometer via Lock Mass Injection into a C-trap”, *Mol. Cell. Prot.*, 4, 2010-2021 (2005), with J.V. Olsen,, L.M. F. de Godoy, G. Li, B. Macek, P. Mortensen, R. Pesch, O. Lange, S. Horning and M. Mann.
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13. “The Orbitrap: a new mass spectrometer”, *J. Mass Spectrom.*, 40, 430-443 (2005), with Q. Hu, R. Noll, H. Li, M. Hardman, R.G. Cooks.
14. “Interfacing orbitrap mass analyser to an electrospray ion source”, *Anal. Chem.*, 75, 1699-1705 (2003), with M. Hardman.
15. “Tandem time-of-flight mass spectrometer (TOF-TOF) with a quadratic-field ion mirror”, *Rev. Sci. Instrum.*, 73, 2115-2123 (2002), with A. E. Giannakopulos, B.Thomas, A. W. Colburn, D. J. Reynolds, E. N. Raptakis, P. J. Derrick.
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22.“Pitfalls on the road to the ideal mirror. Time-of-flight with ideal time-focusing in the second stage of tandem mass-spectrometers”, *Int. J. Mass Spectrom. Ion Proc.*, v.146/147, p.165-182 (1995), with P.J. Derrick and E.N. Raptakis.
23.“The application of nuclear track membranes for ion sampling to mass spectrometer”, *Radiation Measurements*, 25, 741-742 (1995), with V.V. Mlynsky and V.A.Oleinikov.
24.“Application of secondary structures prepared on the base of track membrane technique for scanning tunnelling microscopy”, *Rad. Measurements*, 25, 699-702 (1995), with V.A.Oleinikov.
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PATENTS AND PATENT APPLICATIONS

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2. “Multi-channel detection”, WO2008046594
3. “Multi-electrode ion trap” WO2007000587.
4. “Ion spread reduction for MS”, with Monastyrskiy M. & Grinfeld D. WO2007122383.
5. “Mass spectrometer with ion storage device”, WO2007122381.
6. “Method of ion abundance augmentation in a mass spectrometer”, WO2007122379.
7. “Mass spectrometer arrangement with fragmentation cell and ion selection device”, WO2007122378.
8. “Multiple ion injection in mass spectrometry”, WO2006129083, with O.Lange and S.Horning.
9. “Tandem mass spectrometer”, UK Pat. Appl. 0511083.8, with co-authors.
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11. “Improvements in an electrostatic trap”, WO2006129109, with E.Denisov, G. Jung, W. Balschun, S. Horning
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16. “RF power supply for a mass spectrometer”, WO05124821, with E. Denisov, A. Kholomeev.
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18. “High throughput ion source for MALDI MS”, US6903334, with A. Verentchikov.
19. “High dynamic range mass spectrometer”, US6969847, with S.C. Davis and J.D. Hughes.
20. “All-mass MS/MS method and apparatus”, WO04107388.
21. “Obtaining tandem MS data for multiple parent ions in an ion population”, US2004222369, WO04083805, with J. Syka.
22. “Ionisation apparatus and method for mass spectrometer system”, WO03081205, US20030178563, with P. Bondarenko.
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24. “Ion storage and injection into electrostatic traps”, US6998609, US6995364, WO02078046, with M. Hardman, J. Schwartz, M.Senko.
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31. “A time-of-flight analysis device”, WO9840907, with S.C. Davis, D.R. Bandura, A.H. Hoffman.
32. “Time-of-flight mass spectrometer”, WO9748120, with S.C. Davis.
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36. “Method of pumping of gases and vacuum pump”, Russian Patent 2079000, with Luskinovich P.N. and Ryzhikov I.A.
37. “Time-of-flight mass-spectrometer”, UK Patent GB2274197, with S.C.Davis.
38. "Time-of-flight mass-spectrometer", Russian Patent 1716922, with S.Alimpiev, S. Nikiforov, V. Mlinsky, B. Sartakov.
39. "Time-of-flight mass-spectrometer", USSR Positive Decision No. 4434884/21, with A. Pecaln and V. Ivanov.