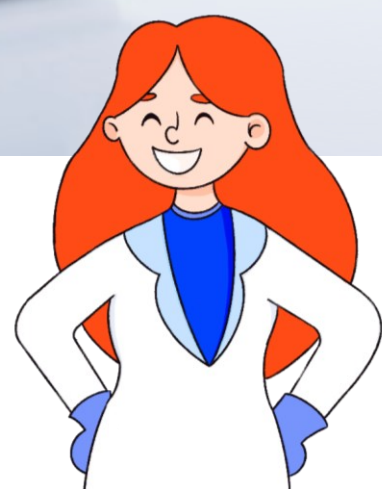


SSX

SUPER SESI - X



Secondary Electro-Spray Ionization
Biologically relevant metabolites in vapors and nano-aerosols



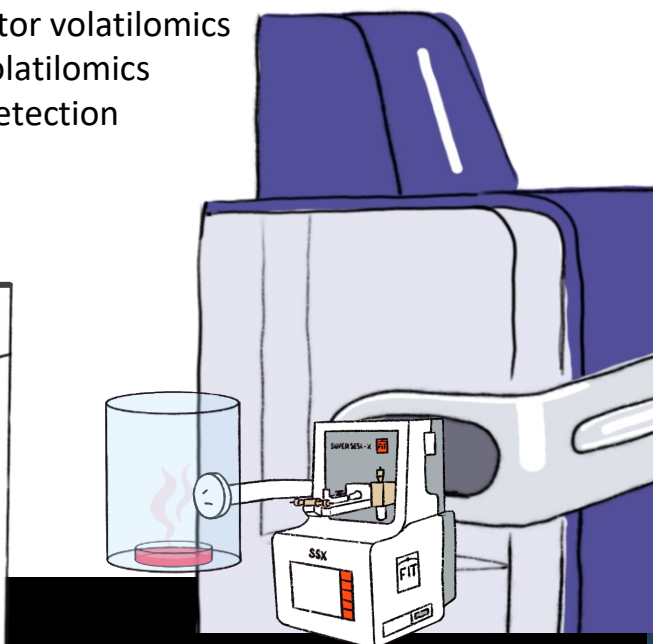
Biologically relevant vapor and nano-aerosol detection in real time

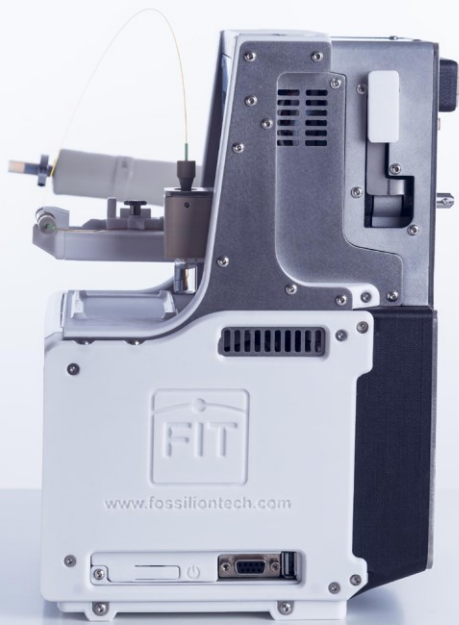
SSX ionizes vapors and nano-aerosols for MS analysis and **Biologically relevant metabolites** with very low vapor pressure

- High ionization efficiency
- Extremely soft ionization
- Atmospheric pressure operation
- Seamless sample flow introduction
- Compatible with **Thermo** Exploris™, Tribrid™ and TSQ™ MS series and **Bruker** timsTOF™ and QTOF instruments
- Real-time detection
- Molecular masses up to 600 Da

High Quality Data for:

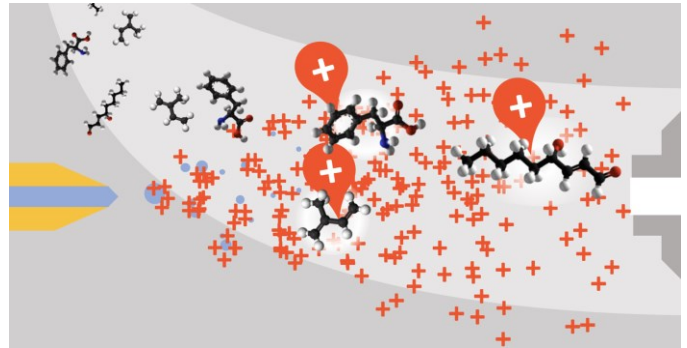
- Breath analysis
- Food and aroma
- Headspace analysis
- Cell culture volatilomics
- Environmental monitoring
- Bioreactor volatilomics
- Plant volatilomics
- Trace detection





Secondary ElectroSpray Ionization (SESI), first principles in simple terms

- A nano-electrospray produces charging agents at high concentration.
- Charge is transferred from protonated clusters to the vapors and nano-aerosols via Charge Transfer Reactions and Field Charging Effects.
- Charged vapors and nano-aerosols are desolvated, transferred into the vacuum side of the MS, and analyzed.



Why SESI is ideal for large vapor molecules?

1- The advantages of ionizing at atmospheric pressure:

- **Turbulent losses** and **condensation losses** due to adiabatic cooling, which are typical of ionization systems operating at low pressure, **are eliminated** because the vapor inlet flow path is laminar, with very low pressure drop.
- The **velocity of the charge transfer reaction is much faster**. It scales with the concentration of the vapors and the charging ions, which go with the pressure in the ionizer. At room pressure (10³mBar), the velocity of the charge reaction is 10⁶ times higher than at 1 mBar.
- High performance Electrospray-MS systems are optimized to transfer and desolvate heavy ions from atmospheric pressure into their vacuum side. Super SESI X is designed to seamlessly substitute regular ESI ion sources and to **harness the power of advanced MS**.

2- Why using a nano-spray as a source of primary ions:

Nano-electrospray provides the best performance for ionization of biomolecules, but it comes with a price: stabilizing a water nano-electrospray can be tricky. So why bother?

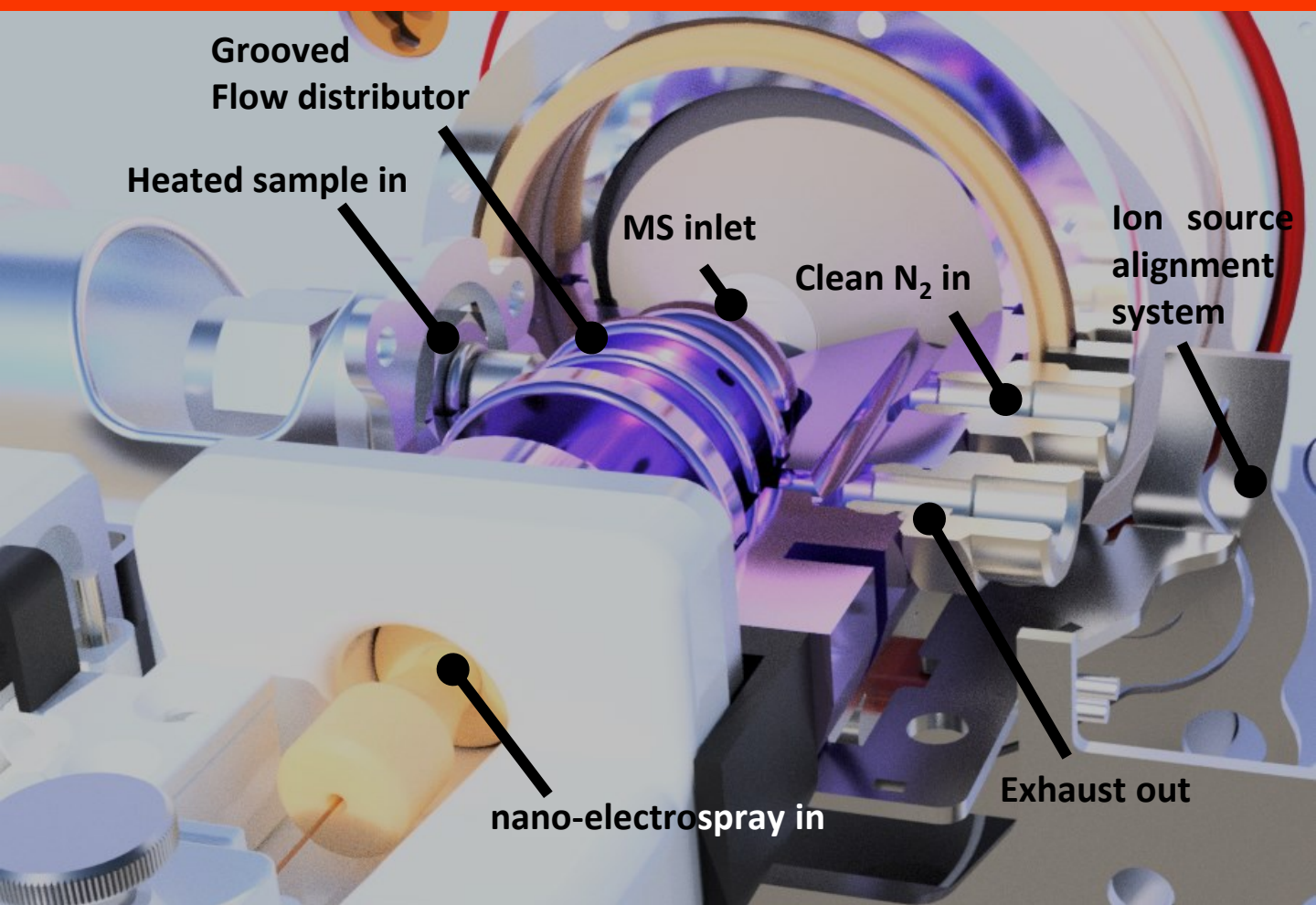
- **SESI produces very clean spectra** because, there are **no high-energy ions at any point** that could cause fragmentation. This is important for **biomarker discovery**.
- **The ionization efficiency is very high** because the concentration of charging agents near the nano-jet is extremely high. This means **better Limits of Detection**.

Energy level ↑



Optimized flow path:

- Laminar flow avoids turbulent mixing and losses
- N₂ continuously flowing preserves ultra-clean internal environment
- Exhaust flow path designed to sweep vapors away from ionization region
- Sample flow path designed to minimize exposed areas
- Heated, continuous temperature control design with no bottlenecks
- Mirror grade-polished surgical 316L SS to eliminate micro-stagnated regions
- Analytical grade silikonert™ coated for best surface chemical inertness
- Embedded Active charcoal filter with noble materials produces ultra clean N₂
- High-precision, high-speed active Mass Flow Controller (Wisper Alicat™) controls the flow configuration in the ionization region
- Easy to access to Ionization region and flow distributor for deep cleaning



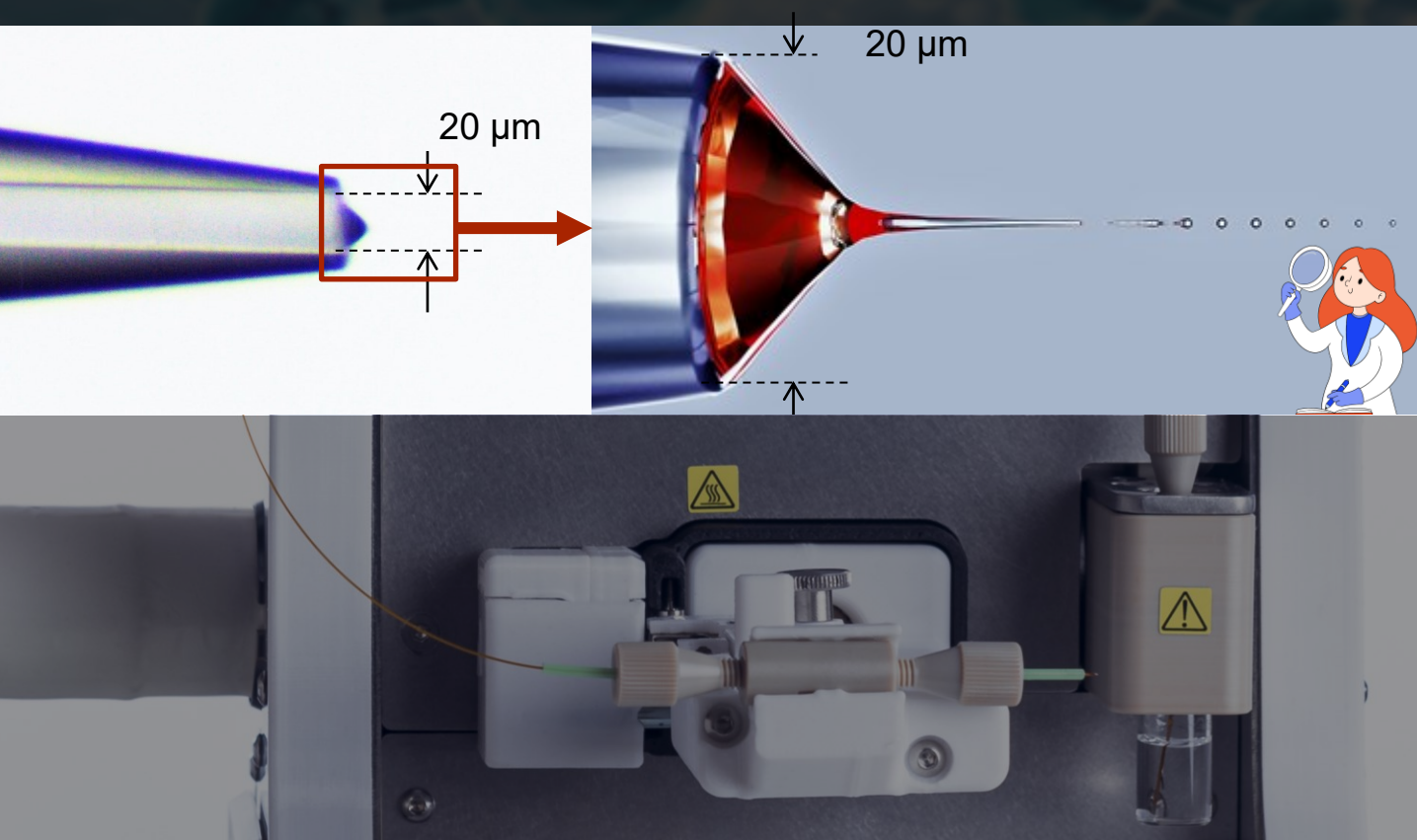
Low background and carryover effects

even for large and sticky molecules.

SSX uses a water/formic n-electrospray for its best ionization efficiency.

Reliable nano-electrospray:

- Discharges are eliminated with a voltage/current oscillation dampener.
- Stability is monitored by a digital nano-Amperemeter (precision of 0.3 nA).
- To minimize electrochemical effects, the liquid is electrified with tantalum.
- n-Electrospray position controlled by digital micro-servomotor
- Liquid feed controlled by digital pressure controller.
- SSX utilizes Sharp Singularity emitters*



n-ElectroSpray **POWER** with **CONTROL**.

- deep volatilome coverage
- high-quality data.

* The Sharp Singularity

SSX is AI-ready:

SSX is an electro spray robot. All the controls are electronic and connected to an embedded micro computer.

Why automate every control of an ion source?

- Nano-electrospray provides the best ionization performances known but obtaining a stable signal can be tricky.
- The new SUPER SESI-X is fully automatic and integrates the computational power to host smart control aids and intelligent control.





BREATH ANALYSIS

- Breath biomarker Discovery
- Real-time drug metabolism.
- Pharmaco-kinetics.
- Kinetics of inhaled drugs, exposure kinetics.

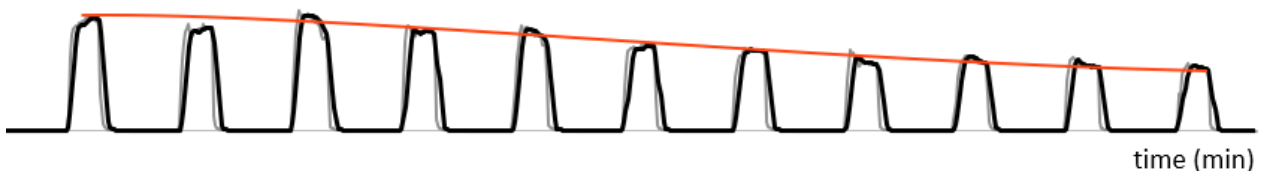
A non-invasive window into the human metabolism:

- **LUNG**^(TM of nature) is the most effective desorber available in the lab, by far!
- **EXHALION**TM guides the exhalation maneuver.
- **SESI-HRMS** receives, ionizes and analyzes breath directly.

Breath is analyzed as produced in the lungs.

By skipping the capture and Thermal desorption steps, SSX gives you:

- the **time evolution** of your study, as you go.



- the **sensitivity advantage** of direct breath analysis:

- The lung is **extremely efficient at gas exchange**, with up to 100m².
- The **lung produces nano-aerosol** of via two mechanisms:
 - 1- Bursting of the alveolar fluid (a foam made of water-surfactants)
 - 2- Epithelium cilia strokes sometimes spray tiny nanodroplets

“The lung is the most efficient desorption system available in the lab, by far. It dwarfs human technology. It can even put viruses to fly! What human-made Thermo Desorber (TD) can do that?”

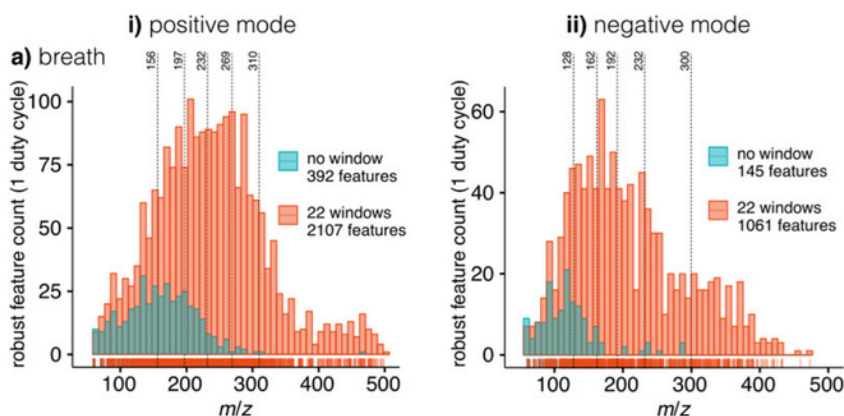
BREATH ANALYSIS

That works



- No. of **robust features*** detected in one exhalation: >2000
- Resolving power: >120.000 (for a SS coupled with a QE-Plus)
- Response time: less than 2 seconds

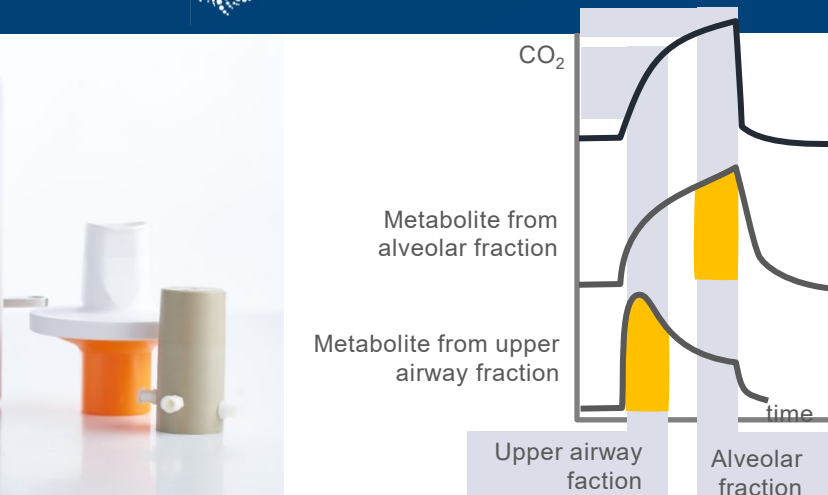
* “feature was considered “robust” only if it matched the following criteria: (i) observed in $\geq 80\%$ of the biological samples; (ii) the median intensity of the biological samples is above 1000 units; (iii) signal-to-noise ratio above 4; (iv) for breath samples, a relative standard deviation (RSD) across the biological sample injection lower than 30%”



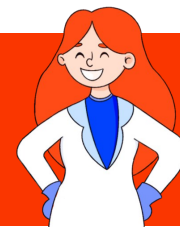
J.Lan, J. Kaeslin, G. Greter, & R. Zenobi; Minimizing ion competition boosts volatile metabolome coverage by secondary electrospray ionization orbitrap mass spectrometry. *Analytica Chimica Acta*; doi.org/10.1016/j.aca.2021.338209.

Robust Breath Analysis Research Workflow:

- Breath analysis instrumentation: SSX – Orbitrap™
- **Standardized Breath Sampling Operational Procedures:** EXHALION, Standardization procedures for real-time breath analysis by secondary electrospray ionization high-resolution mass spectrometry; K. D. Singh, et. *AI Analytical and Bioanalytical Chemistry*, July 2019, Volume 411, Issue 19, pp 4883–4898
- **Quantification:** FIT recommends the methods developed by Prof. R. Zenobi (ETH Zurich).
- **Data analysis:** FIT recommends the SW tools and services for breath analysis and clinical research data developed by our Swiss partners Deep breath Intelligence www.dbi.ch



Customer Success



Patrik Spanel is investigating analytical techniques to monitor and quantify volatile compounds present in air. He is a specialist in the topic of ion molecule reactions in the gas phase and low temperature plasmas, in mass spectrometry and trace gas analysis. He was involved in the discovery of the selected ion flow tube mass spectrometry, SIFT-MS.

Patrik is Head of the Department of Ion and Cluster Chemistry, Chairman of the Board and Vice-director for Science of the J Heyrovsky Institute of Physical Chemistry, Czech Academy of Sciences.; and Part-time Professor at Imperial College London

“The SSX ion source is surely a masterpiece of state of the art engineering. Full understanding of the ion chemistry occurring between the ESI generated ions and VOC molecules inside will be an interesting challenge to tackle”



Malcolm Kohler is Chair of Respiratory Medicine and Clinical Director of the Dep. of Pulmonology of the Uni. Hospital of Zurich, Switzerland. His research focuses on the pathophysiology and treatment of obstructive sleep apnea, chronic obstructive pulmonary disease and other respiratory disorders. He founded the Zurich Exhalomics flagship project, a research consortium which explores the metabolome of breath with diverse real-time technologies. Kohler has contributed more than 300 scientific articles in respiratory medicine. His work has been acknowledged with national and international awards

“We observed significant changes in glyoxylate and dicarboxylate, tricarboxylic acid cycle (TCA), and tryptophan metabolic pathways. Our findings suggest that continuous monitoring of metabolite shifts from exhaled air should focus on monitoring platforms dedicated to volatile and slightly volatile metabolites”



Pablo Sinues pioneered SESI-MS with a focus in breath analysis. He was acquainted with the technique at the former laboratory of Prof. John B. Fenn (Nobel Prize in Chemistry 2002) under the supervision of Prof. Juan Fernandez de la Mora at Yale University. He was awarded a prestigious Eccellenza grant from the Swiss National Science Foundation and was recipient of the 2020 Swiss Group for Mass Spectrometry award for his outstanding research in mass spectrometry. Sinues is Vice-president of the Swiss Metabolomics Society (SMS) and Professor at U. Children’s Hospital & University of Basel, Switzerland

“We use SESI-HRMS to sense exhaled molecules at minute concentrations. Since the analysis requires no sample-preparation or manipulation, the diagnostic result can be obtained nearly in real-time. This technology is especially well suited for children due to its non-invasive nature”



Renato Zenobi is Professor of Analytical Chemistry at the Organic Chemistry Lab at ETH Zurich. Zenobi’s research areas include electrospray and laser-assisted MS, ambient mass spectrometry among others. He has contributed to the understanding of the ion formation in MALDI-MS, and ambient ionization methods. He is known for the development of analytical tools for the nanoscale, in particular TERS (tip-enhanced Raman spectroscopy). Renato Zenobi has received many awards for his scientific work, the most recent being he Thomson Medal (International Mass Spectrometry Foundation, 2014), the RUSNANO prize (2014), and the Fresenius Prize (German Chemical Society, 2015).

“When SESI is combined with state-of-the-art mass spectrometers, low limits of detection (pptv) are achievable without any sample pre-concentration. We exploit this feature in our lab in a number of projects which require fast mass spectrometric analysis of vapors at trace concentrations.”

Customer Success



Chris Jiangjiang Zhu is assistant professor of Human Nutrition in the Department of Human Sciences and the Comprehensive Cancer Center. He is also a faculty member in the Discovery Theme Food For Health Initiative. His research investigates the development and application of mass spectrometry-based metabolomics; human microbial metabolic analysis for the understanding of human-microbe interaction; nutritional metabolomics studies; cancer metabolism studies.

“Our results suggested that the SESI-HRMS method can be suitable for the analysis of VFAs from gut microbes in a rapid, sensitive, and non-invasive manner”



Xue Li serves at the Institute of Mass Spectrometer and Atmospheric Environment, Jinan University (Guangzhou, China). Xue does research in Analytical Chemistry and Real-time Breath Analysis by Using Secondary Nano-Electrospray Ionization Coupled to High Resolution Mass Spectrometry. Applying this technique to mice breath analysis, Xue Li was able to characterize metabolic changes induced by viral infection: ‘In vivo monitoring of volatile metabolic trajectories enables rapid diagnosis of influenza A infection’

“IAV infection induces a cascade of metabolite alterations, some of which are excreted via the skin and breath to the ambient air. Such IAV-induced odor traits could be captured by SESI-HRMS by simply dragging the air surrounding the infected mice into the analyzer. The process is non-invasive and rapid, as it requires no sample manipulation.”



Christian Zwicky is the CEO of Deep Breath Intelligence (www.dbi.ch). Prior to joining DBI, he has been working for over 25 years in the field of Life Science, MedTech, Clinical Diagnostics and Digital Pathology. Thanks to his international experience in different Executive Management functions, Christian has accumulated deep knowledge and understanding in Leadership, Sales & Marketing, Innovation, and Project Management. Christian achieved a Master’s degree in Chemistry and Industrial Management. He provides managerial expertise as well as financial and digitalization know-how to DBI.

“DBI uses Super-SESI for the ionization of breath samples. The unique combination of the FIT Ion-Source and Thermo-Fisher High-Resolution Mass Spectrometer allows real-time result with highest selectivity and highest sensitivity”

FIT’s quality commitment and customer service

Four (4) steps to ensure your success:

- **Installation:** FIT’s service engineer installs the SSX at your facilities.
- **On-site training.** FIT’s engineer will spend three days in total at your facilities..
- **Full technical support** for two years. If you have any issue, just let us know and we will assist you.
- **Warranty,** during the warranty period (2 years in the EU) reparation service and spare parts will be provided

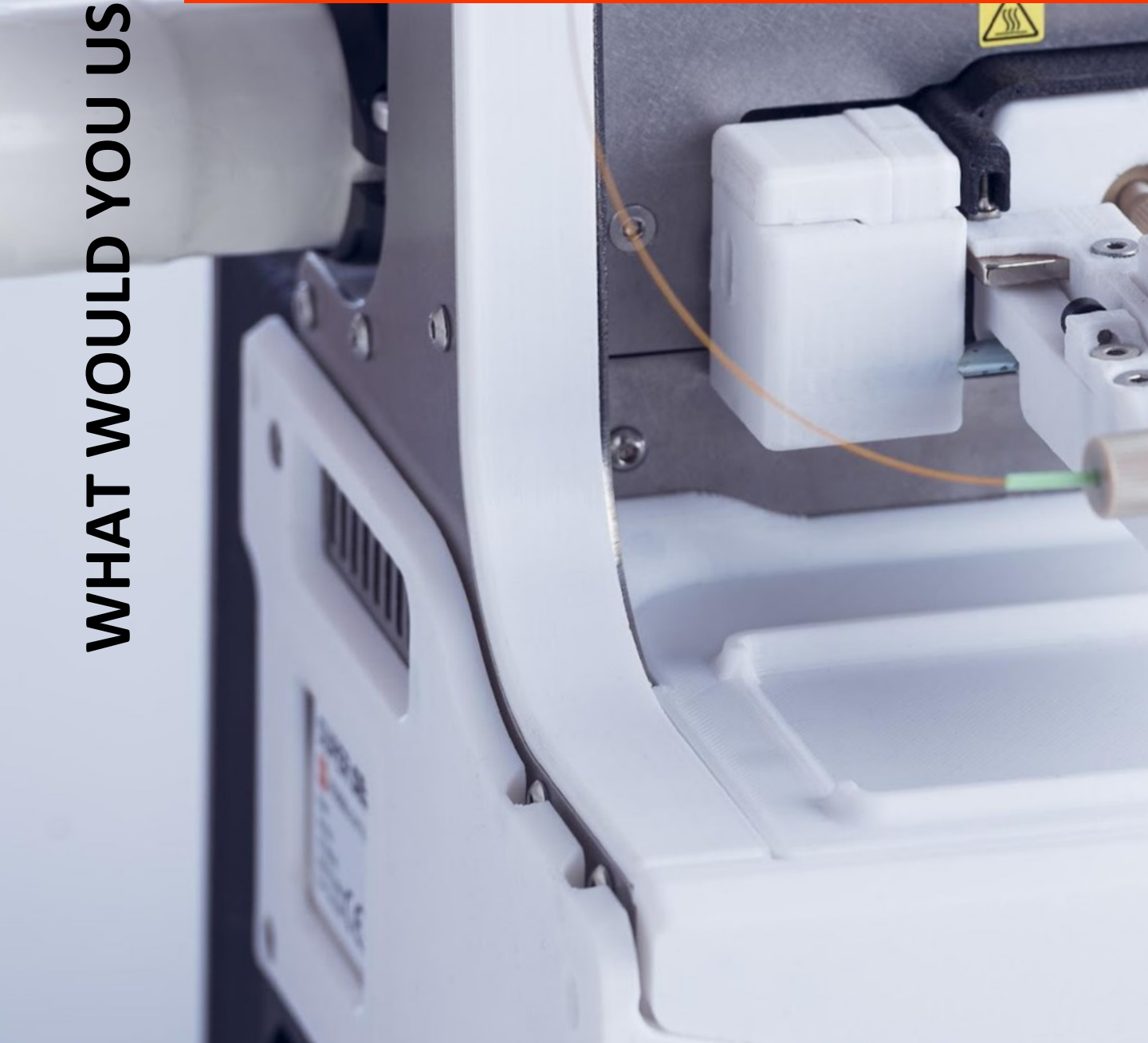
Servicing science since 2016!



WHAT WOULD YOU USE **SSX FOR?**

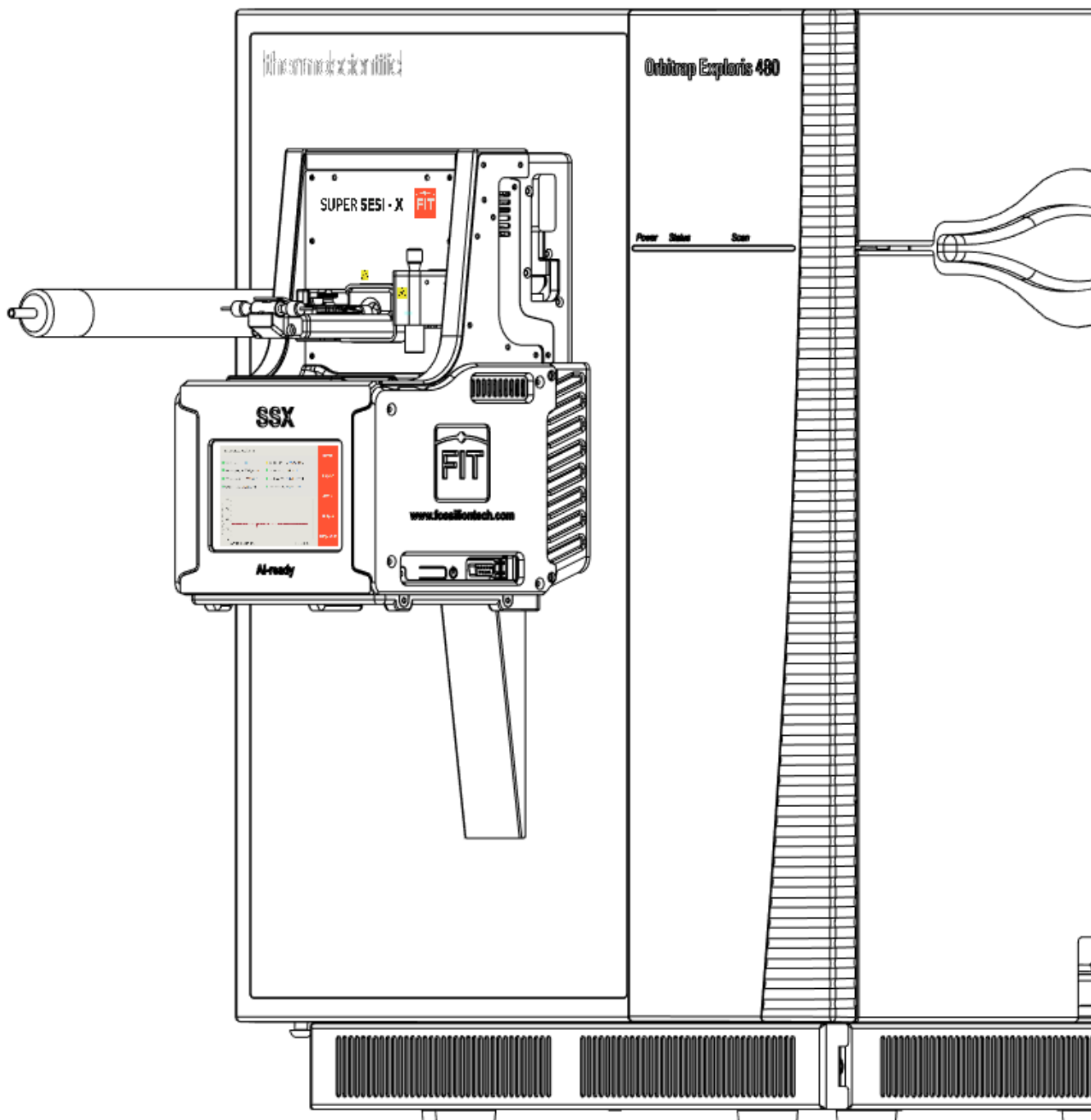
Ionization for high-quality data :

- low fragmentation
- low background levels
- low carryover effects.
- precise control
- high ionization efficiency



SSX technical specifications:

- Power: 220 VAC, 500W
- Weight: 7.5 Kg
- Dimensions of the main body: 291x213x179 (h·w·l) mm
- Max temperatures: 180°C (line), 130°C (ionization core)
- nAmp: from -200 to 200 nA, (precision: 0.3nA)
- HV isolation: 8kV
- Computational power: Quad core, 64-bit@1.5 GHz, 8GB SDRAM
- Connectivity: 2xSerial (and 1xUSB reserved for remote tech support)





**WE WILL ACCOMPANY YOU
ALONG THE WAY**

CONTACT US

info@fossiliontech.com

EU (Spain) +34 676 061 326

USA +1 408 600 2713

Find out more at:

www.fossiliontech.com