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Spring 2018 News

Scienta Omicron - Superior Technology

HAXPES Lab

brings hard X-ray photoelectron spectroscopy to end user's laboratories

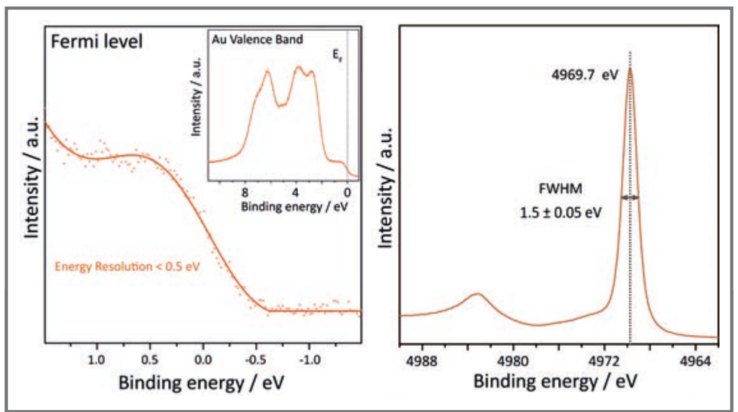

Figure 1: Left: Fermi level measurement on Au reveals fantastic instrumental energy resolution. Right: Ti 1s from a single crystal rutile TiO_2 measured with 9.25 keV Ga-source. Measurement time: 35 min.

Hard X-ray photoelectron spectroscopy (HAXPES) is now available outside of synchrotron endstations. The HAXPES Lab uses Liquid Ga metalJET technology and a state-of-the-art monochromater developed exclusively by Scienta Omicron to probe bulk sample properties and access deep core level electrons directly in a laboratory environment.

World class technology and expert engineering combine, making the HAXPES Lab the gold standard for laboratory based high energy photoelectron spectroscopy. Experience HAXPES capabilities first hand by bringing your own samples to be analyzed at our demo HAXPES Lab in Germany.

The HAXPES Lab is a complete analytical tool for cutting edge HAXPES. Soft X-ray sources and charge neutralization compliment the liquid Ga source and enable XPS analysis capability. The HAXPES Lab provides an unprecedented opportunity for high impact science with total instrument energy resolution <0.5 eV and measurement times comparable to those at synchrotron end stations. Previously unattainable sample penetration depth is achieved by high intensity Ga Kα X-rays produced by the Excillum Ga liquid jet source. These 9.25 keV photons provide the greatest depth sensitivity of any laboratory hard X-ray system. As shown in Figure 1, the metal silicon peak is still visible through 50 nm of SiO_2.
Chemical information can be probed from buried layers, or in the deep bulk of the sample. This is not possible using conventional Al or Cr based sources. The HAXPES Lab is capable of these measurements on practical and efficient time scales.
A compact design ensures that the HAXPES Lab is an efficient solution for laboratory based measurements. Scienta Omicron's worldwide service network provides ready support for our customers in all major markets.

www.scientaomicron.com/HAXPES

Interview with Anna Regoutz, Imperial College London, GB

What are you using HAXPES Lab for within your own research?
I mainly focus on technologically relevant metal oxide systems, in particular for application in electronic devices. I have applied HAXPES Lab to both bulk samples and heterostructures, and in both cases was able to obtain incredibly insightful data. The ability to collect complete bulk datasets including core levels, Auger lines, and valence bands is incredibly useful for the fundamental understanding of oxides. On the other hand, in real devices we often deal with buried layers and interfaces that are of great importance to the overall device behavior, which are not accessible through standard soft XPS. Using HAXPES Lab we can now investigate complex, buried structures and learn more about their chemistry and physics.

Having worked on the system, what do you think of it?
HAXPES Lab has really positively surprised me. Being used to working on a range of synchrotron HAXPES end stations, I wasn't sure what to expect from a laboratory system. I think that the overall performance is incredible, with both low energy resolution and good intensity. Working on it for a few months I was also impressed by the long term stability of the machine. We were measuring continuously for weeks, collecting data from a range of samples with the machine delivering stable conditions including excitation energy and intensity. The additional flexibility a laboratory system brings to users is also of great interest to me, for example when it comes to in-situ and in-operando experiments.

How do you think HAXPES Lab can contribute to the wider community?
I think it will have an immense impact on the current HAXPES community and beyond. The ability to perform high quality HAXPES measurements at a high X-ray energy in your home laboratory will provide direct results in a short timeframe, as well as supporting synchrotron applications through the ability to collect preliminary data. Furthermore, I believe that HAXPES Lab can provide access to this technique to a wider user community who may not be traditional users of this method.

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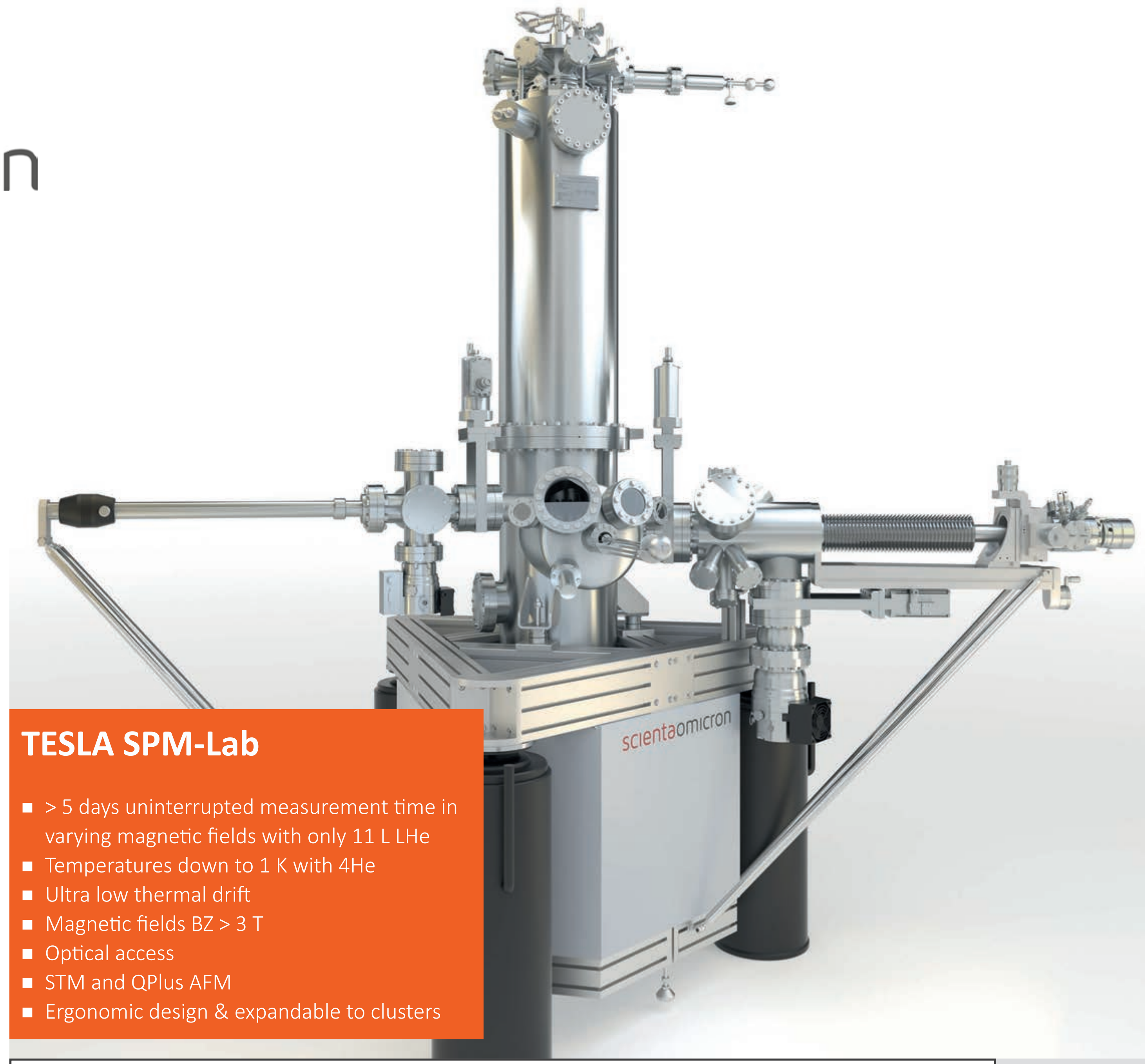


TESLA JT SPM

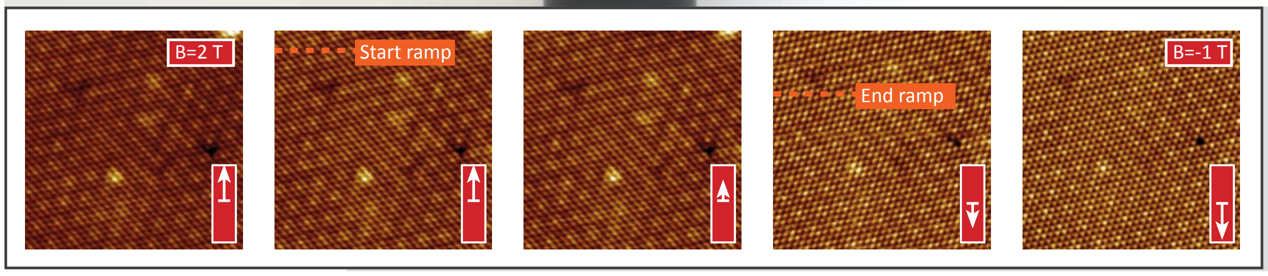
The Next Breakthrough

The TESLA JT SPM is the latest development in Scienta Omicron‘s long history of successful scanning probe microscopes. It is based on a strategic partnership with CryoVac GmbH, whose field proven, proprietary Joule-Thompson (JT) cooling and UHV magnet technology are united with our expertise in STM, advanced spectroscopy and QPlus AFM.

The TESLA JT SPM sets the standard in SPM performance in varying magnetic fields with picometer stability and thermal drift below 20 pm per hour. The system is based on a modern, ergonomic design that delivers dependable high performance SPM operation for successful scientific work. It fits perfectly into Scienta Omicron‘s comprehensive surface science technology portfolio and can be integrated into tailored UHV systems with thin film solutions (MBE) and electron spectroscopy, complimenting many techniques including ARPES, APPES, UPS and XPS.

TESLA SPM-Lab

- > 5 days uninterrupted measurement time in varying magnetic fields with only 11 L LHe
- Temperatures down to 1 K with 4He
- Ultra low thermal drift
- Magnetic fields BZ > 3 T
- Optical access
- STM and QPlus AFM
- Ergonomic design & expandable to clusters



Continuous & stable imaging of $NbSe_2$ at T=1 K while ramping the magnetic field from 2 T to -1 T.

2018 Australian of the Year

Scienta Omicron congratulates Scientia Professor Michelle Simmons

Scienta Omicron congratulates Scientia Professor Michelle Simmons, who was named 2018 Australian of the Year in recognition of her pioneering research and inspiring leadership in quantum computing.

Michelle Simmonsis a UNSW Professor of Physics and Director of the Australian Research Council Centre of Excellence for Quantum Computation and Communication Technology (CQC2T), based at UNSW, and leads a team of more than 200 researchers at eight Australian universities who are developing a suite of technologies for quantum computing, information storage and communications. Professor Simmons' research group is the only one in the world that can manipulate individual atoms to make atomically precise electronic devices. Her team at CQC2T is leading the world in the race to develop a quantum computer in silicon.
“Building a fully functioning prototype quantum computer in silicon is a massive task. But I have an excellent team with the dedication and determination to make it happen, and this award is also a wonderful recognition of their immense efforts.” stated Michelle Simmons.
Among their recent achievements, Simmons' research group created the world's first single-atom transistor, as well as the narrowest conducting wires ever made in silicon, just four atoms wide and one atom high. The UNSW approach has been to focus on making qubits out of single atoms of phosphorus or quantum dots in silicon.

Michelle Simmons,
2018 Australian of the Year,
in one of her labs.

Scienta Omicron's Scanning Probe Microscopes are the tools of choice the CQC2T group is using to perform atomically precise lithography, the key process to create single atom quantum bits or qubits. Currently, the team is running six VT SPM and one LT SPM to allow for the throughput needed to create and analyse various devices for future quantum computing.

Scienta Omicron is proud to announce that a partner organisation agreement has been signed between CQC2T and Scienta Omicron just recently to jointly develop future technologies for atomically precise manufacturing based on Scanning Probe Microscopy . Markus Maier, Head of SPM division at Scienta Omicron stated: “This partner agreement underlines the long and well-established relationship between our two organisations and we are looking to a fruitful partnership.”

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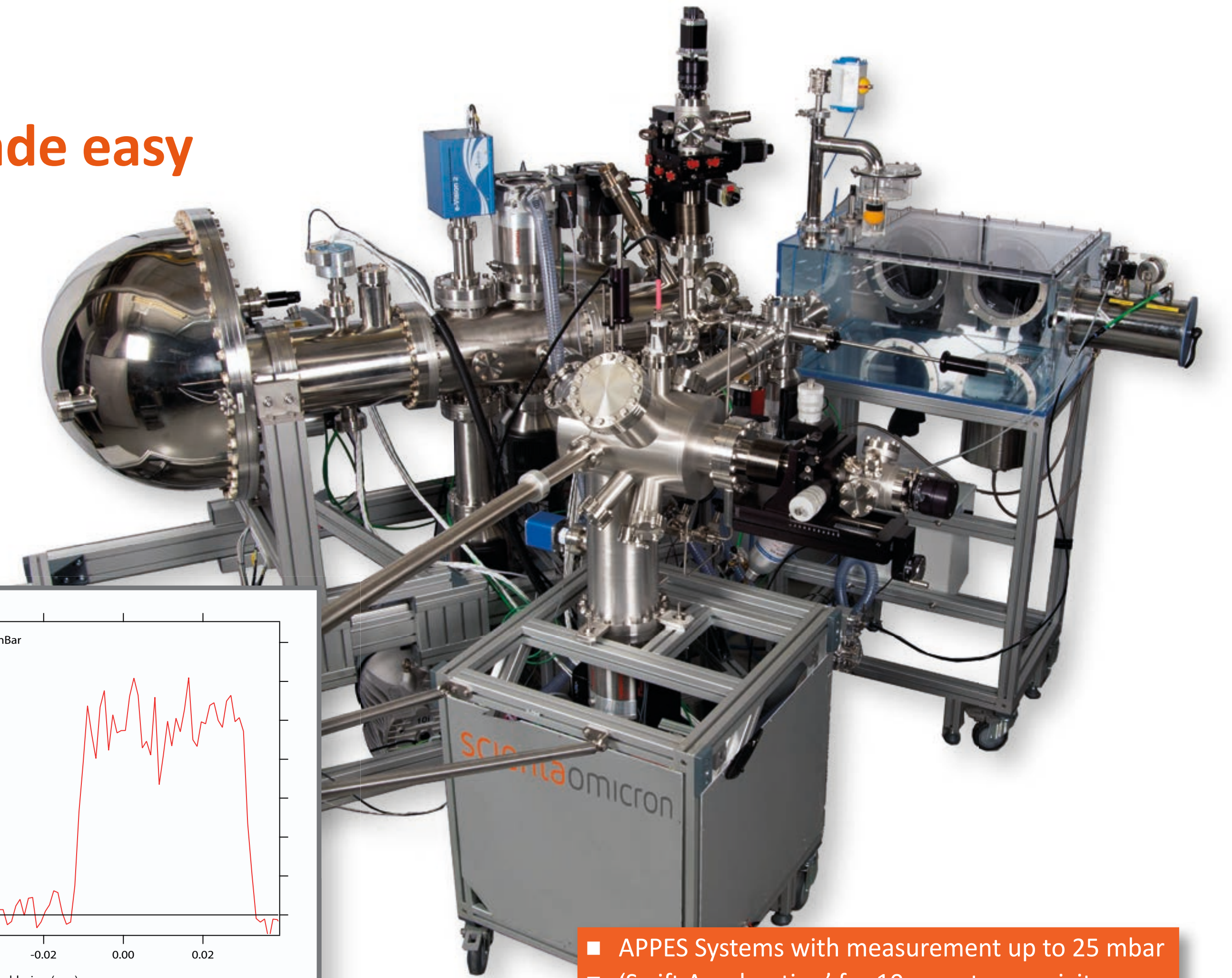
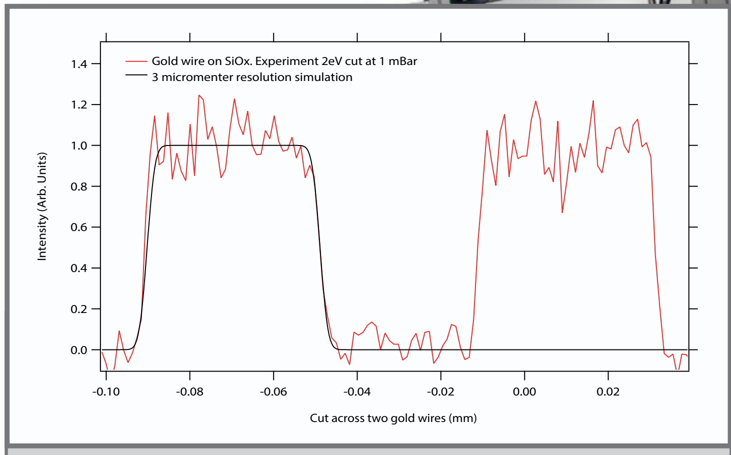
HiPP Lab

Advanced measurements made easy

The HiPP-Lab is a state of art ambient pressure photoelectron spectroscopy (APPES) system optimized for speed to result by its stability, simplicity and user friendly design. The system is based on the most modern concepts of APPES, including features like exchangeable chamber and high throughput analyser swift acceleration mode.

Central in the idea of HiPP-Lab is the ability to be able to optimize the setup for different measurements, taking advantage of the ease to exchange chambers while maintaining the core components of the system, the swift acceleration and image resolving APPES analyser and Al Kα monochromized X-ray source. The base module can easily be interfaced with other system modules like preparation chambers or be a part of a cluster type system.





Au 4d5/2 spatially resolved gold stripes at 1 mbar. 3.5 micrometer spatial resolution.

- APPES Systems with measurement up to 25 mbar
- 'Swift Acceleration' for 10x greater sensivity
- Advanced imaging & angular modes
- Innovative modular design for ease of use

NanoESCA with Laser

Installed at Graz University of Technology

The NanoESCA's unique ability among all photoemission spectrometers to provide 2D live view images of the real and momentum space of a sample (such as one-shot Fermi level mapping for all k|| within a Brillouin zone) with an excellent 2D imaging energy resolution makes it increasingly attractive as end-station for Laser light source laboratories.

Such a new NanoESCA lab is located at the Institute of Experimental Physics of Graz University of Technology (TU Graz) and will serve as core facility for the Physics Research Groups of the two Graz Universities: TU Graz and Karl-Franzens University.

The state-of-the-art lab will be combined with a femtosecond laser facility in order to push forward a number of research projects initiated by physics groups in Graz:
The NanoESCA will allow studies of new nanomaterials such as deposited clusters and nanowires prepared in helium droplets, lithographically prepared nanostructures, nanoscale metallic materials with tailored properties, materials synthesized by chemical vapor deposition, or topological insulators. Combining the instrument with various laser light sources will allow the study of electronic structure and dynamics, of charge transfer processes, and of electron phonon coupling in different materials.

Focus of the joint research investigations will be the development of new efficient catalysts, plasmonic sensors, and tailored materials for quantum information technology.

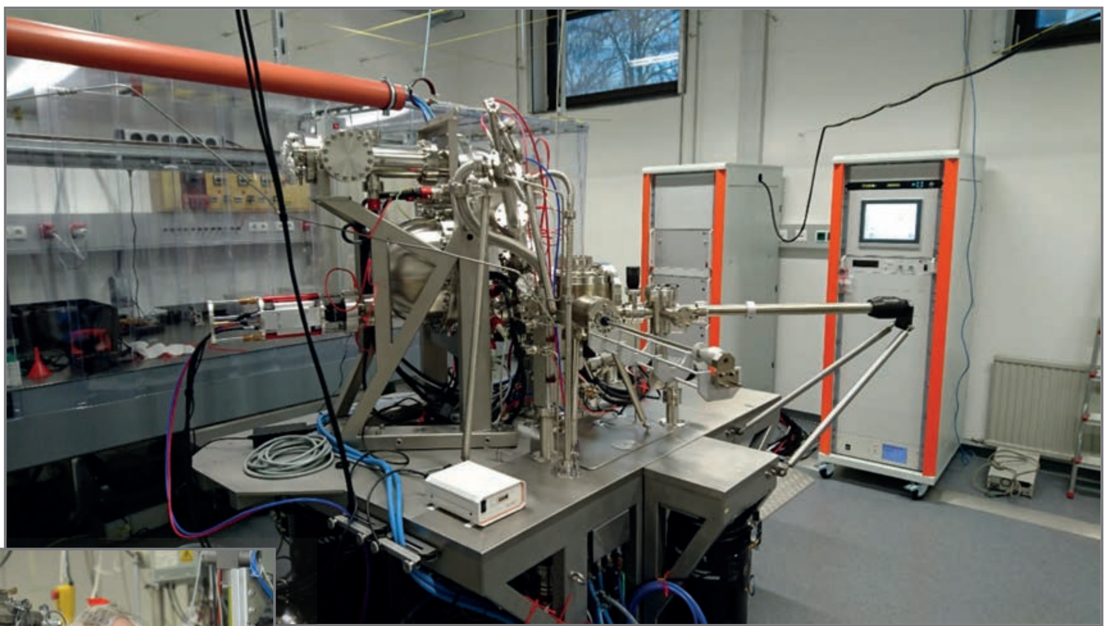


Figure 2: NanoESCA installed at Graz University
Photo by Kira Jochmann, Scienta Omicron

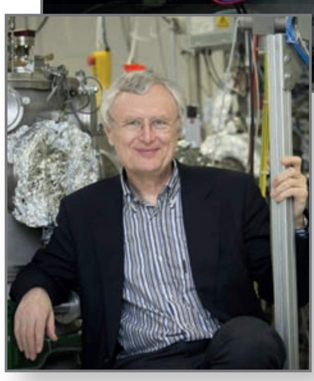


Figure 1: Prof. Wolfgang E. Ernst in his laboratory at TU Graz
Photo by Helmut Lunghammer,
https://www.tugraz.at/institute/iep/institut/homepage-mitarbeiter/prof-ernst/

Related websites: At TU Graz (Prof. Wolfgang E. Ernst): https://www.tugraz.at/en/institutes/iep/home/ incl. movie: https://www.tugraz.at/fileadmin/user_upload/Institute/IEP/Bilder/Video/Graz_130215_converted.mp4
At Karl-Franzens University (Profs. Martin Sterrer and Mike Ramsey): https://physik.uni-graz.at/en/experimentalphysics/

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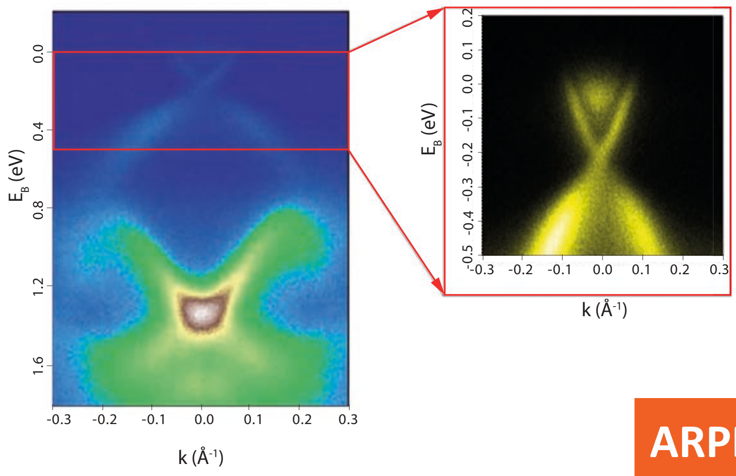
Speed to Result: ARPES Lab

Scienta Omicron, recognized as provider of the world's leading electron spectrometers offers complete turn-key ARPES measurement systems with guaranteed performance. Scientific success in publishing and securing new funding is connected to speed to result. As demonstrated below, the Scienta Omicron ARPES Lab is a proven, reliable path to quickly produce publication quality data.

Dr. Lian Li, Dept of Physics and Astronomy, West Virginia University, had his ARPES Lab installed in 2018. His current research includes MBE growth of Dirac materials. Fe-based superconductors, and 2D transition metal dichalcogenides, and using ARPES to gain new insights into these quantum phases of matter. The figure shows Dirac surface states on Bi_2Se_3 at RT and are some of the first results from Lian Li's ARPES Lab, showing a productive system within weeks of installation.

Related website:
https://physics.wvu.edu/faculty-and-staff/faculty/lian-li

Bi_2Se_3/epitaxial graphene/SiC(0001)



Data courtesy: Dr. Lian Li, West Virginia University.

ARPES Lab at a glance

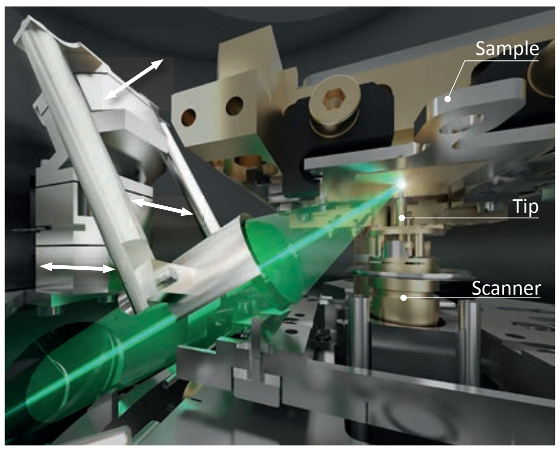
- Comprehensive ARPES solution by market leader
- Expert integration of the best technologies
- Smart system and measurement automation
- Expert support for configuration and design
- Rapid service from our world-wide support teams

LT STM III: On Stage Optics for TERS

Optical spectroscopy techniques like near-infrared, Tip Enhanced Raman Spectroscopy (TERS) or low-temperature fluorescence provide detailed information about the chemical and environmental structure on organic systems.

Here, we introduce our new concept for advanced optical experiments at helium temperature in ultra-high vacuum environment.

To guarantee best optical conditions, the optical integration is optimised on the following key factors:



The preparation for low temperature Tip Enhanced Raman Spectroscopy option (TERS) consists of a three dimensions movable lens (3x3x3mm). The high numerical aperture of NA=0.39 and the 30° angle of incidence provides a high detection efficiency.

- Highest detection efficiency is provided by the numerical aperture (NA) of NA = 0.39 which results in a theoretical focus diameter of 835 nm at 532 nm excitation wavelength.
- The angle of incidence in this setup is optimised to 30°. Three piezo-motors allow the adjustment of the lens in the full temperature range from 4.5K to 300 K.
- The x/y piezo motor is moving within the sample coordinate system, while the z-piezo motor is oriented along the optical axis of the lens. This ensures convenient operation of the optical setup.

In combination with the proven performance of the LT STM, this modification allows a broad range of new and exciting experiments.

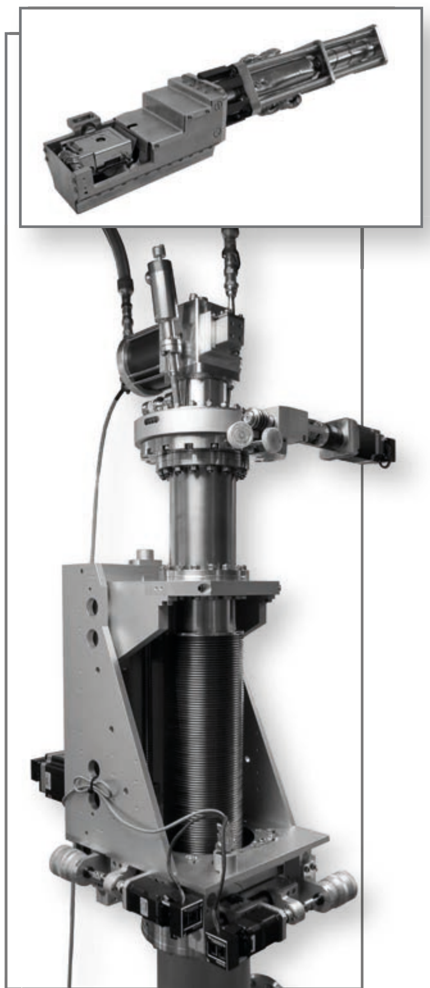
Complete Range of Closed Cycle Cryo Manipulators

A complete range of cryo manipulators for ARPES is now offered by Scienta Omicron in collaboration with Fermion Instruments and Omnivac. This strategic partnership provides cryo manipulator options for 4-, 5- and 6-axes available in both open and closed cycle versions, with lowest possible sample temperatures, proven ARPES performance and attractive pricing.

The *Extreme 5-axis Closed Cycle Cryo Manipulator* achieves guaranteed temperatures lower than 5K, including counter-heating capability. This base temperature yields minimal broadening of 1.5 meV, complementing the high energy resolution of the DA30-L analyser series.
In combination with the ultra-narrow bandwidths of the VUV 5k and VUV Laser sources offered by Scienta Omicron, new levels of energy resolution are now accessible to ARPES Lab users.

All axes are motorized and software integrated, providing precise sample scans and accurate movement between measurement positions (ARPES, VLEED, etc.). All Scienta Omicron ARPES Lab systems include security interlocks that prevent clashes, ensuring a user friendly environment.

These cryo manipulators are also available as components through your local Scienta Omicron sales representative.



Scienta Omicron 4, 5, and 6-axes closed cycle cryo manipulators.