scientaomicron

ARTOF-2 Electron Spectrometer
For Angle-Resolved Photoelectron Spectroscopy

The Scienta Omicron ARTOF 10k analyser marked a revolution in the field of angle-resolved photo-electron spectroscopy with its parallel full cone detection and unchallenged transmission. The Scienta Omicron ARTOF-2 is a further development of the ARTOF concept featuring several important improvements, especially for kinetic energies above 10 eV.


Figure 2. The new design features two pump ports for increased pumping capacity.

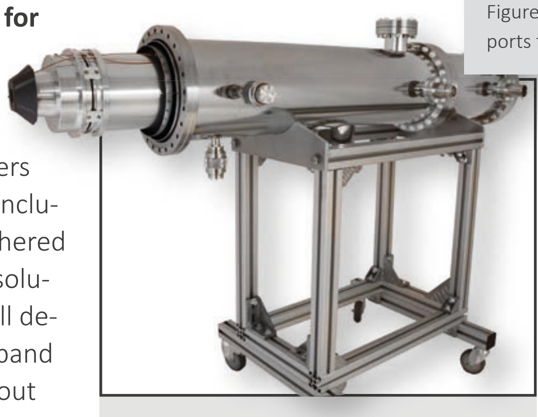


Figure 1. The new Scienta Omicron ARTOF-2 analyser, displaying the new lens front.

The Scienta Omicron ARTOF concept

In contrast to traditional electron spectrometers the Scienta Omicron ARTOF analysers do not include entrance slits. Therefore, electrons are gathered in a complete cone, with energy and angle resolution. The maximum acceptance angle, with full detection, is ±15°. In this way, two-dimensional band mapping experiments can be performed without sample rotation. Furthermore, the transmission is increased up to 250 times compared to traditional hemispherical electron analysers.

The latest member of the ARTOF family

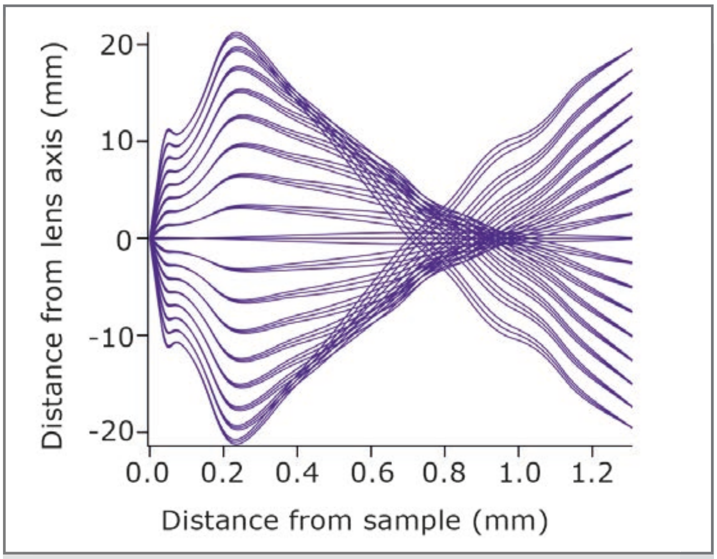
The Scienta Omicron ARTOF-2, shown in figure 1, is a development of the much acclaimed Scienta Omicron ARTOF 10k analyser, featuring several important improvements. Firstly, the analyser has a more advanced lens system optimized to reduce the number of electrons above the energy region of interest that reaches the detector, especially at higher kinetic energy (>10 eV). The ARTOF-2 lens design also enables larger energy windows with improved energy resolution. Secondly, the analyser is based on a new modular design that enables future upgrades of lens front and detector area. Thirdly, improved pumping capacity has been enables by the addition of two new pump ports (shown in figure 2) and an optional differential pumping modification.

Angular and Alignment modes

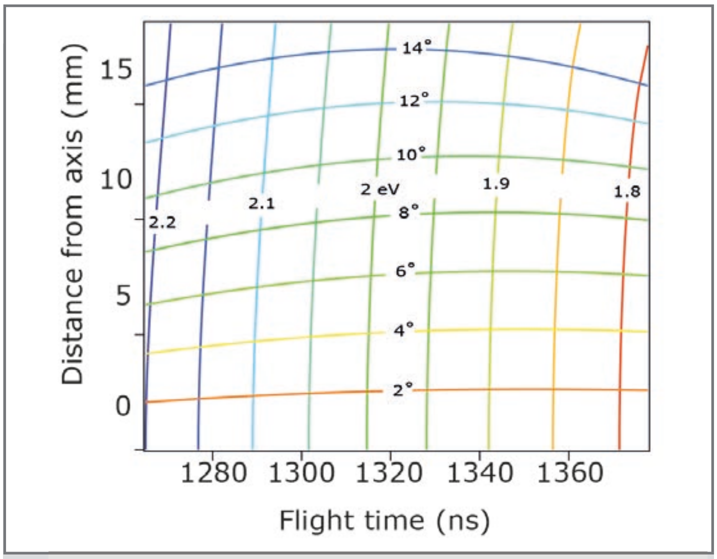
One important advantage of the Scienta Omicron ARTOF analysers is the alignment mode that enables real-time alignment using the electron optics and detector. Once alignment is achieved, the ARTOF-2 can be operated in either of two angular resolving modes, with ±7° or ±15° range, for high-resolution ARPES measurements.

ARTOF-2 features:

- New lens for improved detection efficiency
- New modular design
- Larger energy windows with improved resolution
- Prepared for future upgrades of lens front and detector
- Improved pumping possibilities
- Improved resolution



The graph shows calculated trajectories for 2 eV electrons with lens voltages optimized for a 0.4 eV energy window around 2 eV, and with angular window ±15°. The separation between trajectory pencils is 2° and the source diameter was 0.25 mm.



This plot shows how the measured time of flight and electron position on the detector is converted to energy and angular information for one particular lens setting. The energy contours are horizontal while the polar angle contours are vertical.

Suitable photon sources and triggers

The Scienta Omicron ARTOF-2 can handle all repetition rates between 0 and approximately 3.0 MHz. Even higher repetition rates can be used with special software treatment.

The pulse length will influence the energy resolution. Long pulses decrease the accuracy in determining the time of flight. On the other hand, very short pulses are less well defined in energy, due to the transform limitation. The optimum pulse length, depending on resolution requirements, ranges from tens of femtoseconds to hundreds of picoseconds. Smaller spot size increases the resolution in both energy and angle.

The Scienta Omicron ARTOF-2 is built to be triggered by the laser or beamline bunches that define time zero for the time of flight measurements. Any trigger source can be used as long as the Scienta Omicron ARTOF-2 and the excitation source are synchronized and that the trigger signals involved are well defined and have constant timing.

Detector

To obtain the outstanding energy and angle resolution described above the Scienta Omicron ARTOF-2 is equipped with a position and time resolving delayline detector from RoentDek, displayed in figure 3.

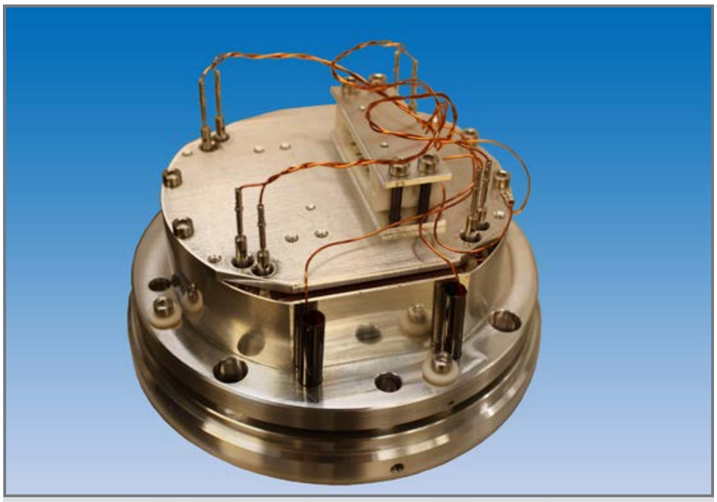


Figure 3. The delayline detector assembly used in Scienta Omicron ARTOF-2.

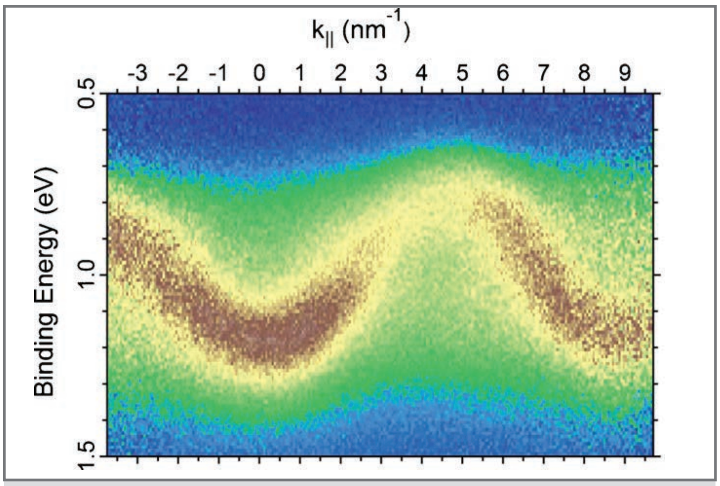
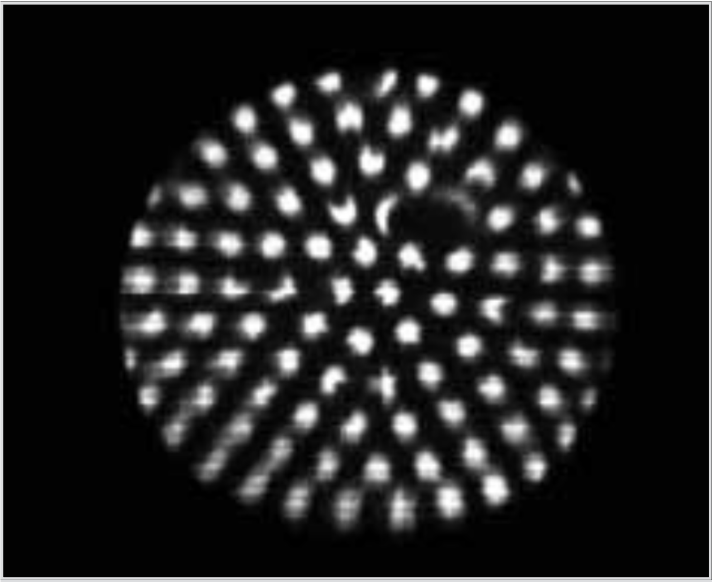
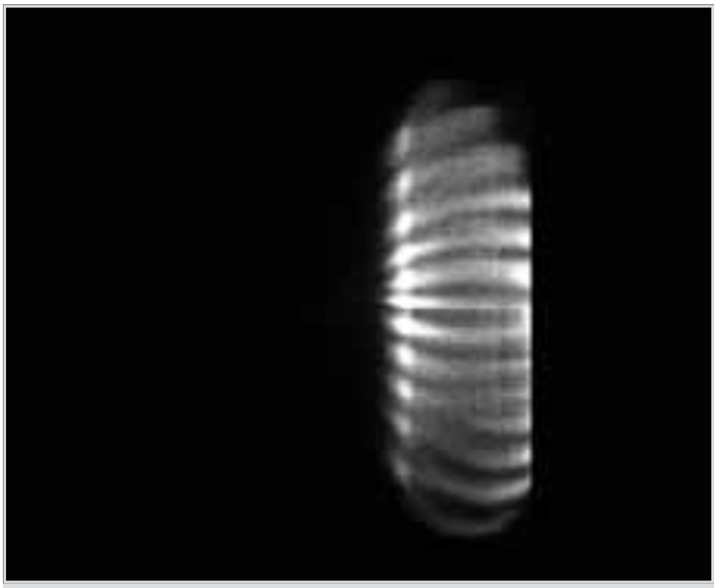


Figure 4. Zoom-in of the HOMO-band region of rubrene in Γ–Y direction.



The graph shows calculated trajectories for 2 eV electrons with lens voltages optimized for a 0.4 eV energy window around 2 eV, and with angular window ±15°. The separation between trajectory pencils is 2° and the source diameter was 0.25 mm.



This plot shows how the measured time of flight and electron position on the detector is converted to energy and angular information for one particular lens setting. The energy contours are horizontal while the polar angle contours are vertical.

Data from Helmholtz-Zentrum Berlin

As part of the development process, an ARTOF-2 prototype has been built and delivered to Helmholtz-Zentrum Berlin (HZB).

This prototype shares the improvements of the ARTOF-2 described above, although its design is different. One example of a measurement performed with the ARTOF-2 prototype is the data shown in figure 4. This spectrum reveals the band dispersion of rubrene single crystals. As many organic molecules, rubrene is very sensitive to radiation damage. For that reason, measurements can only be performed with very limited photon flux. With the unchallenged transmission of the Scienta Omicron ARTOF-2 spectra of unprecedented quality could be recorded in only 10 hours.

Data courtesy:
R Ovsyannikov and A. Vollmer, Helmholtz-Zentrum Berlin / Germany.
For more info please see: A. Vollmer et al., J. Elec. Spectr. Rel. Phenom., 185 (2012) 55.

How to contact us:

America | Europe & Africa | Asia & Australia

We have agents and sales representatives around the world - and right next door. Please check our website for your local contact and partner. Many thanks.
www.scientaomicron.com

Technical Data

Property	Specification
Max.Theoretical Energy Resolving Power	13000
Energy Resolution	< 0.36 meV FWHM at 2 eV kinetic energy[A]
	< 1.6 meV FWHM at 10 eV kinetic energy[A]
	< 265 meV FWHM at 300 eV kinetic energy[A]
Kinetic Energy Range	0.2 - 1000 eV
Angular Modes	±7°, ±15°
Alignment Mode	Yes
Angular Resolution	<0.06°
Working Distance	34 mm
Pass Energy	Not applicable[B]
Slits	No
Energy Window	CRR: 2%, 5%, 10%, 15%, 20%, 50%, 100%[C]
Vacuum Tank	Electro-polished stainless steel
Mounting	NW200CF
Magnetic Shielding	Double mu-metal liner
Analyser Pump Port	Two
Port Length	300 mm
Lens Clearance	< 40°
Detector Type	Delay-line detector
Detector Interface	Ø 40 mm MCP
Count Rate Tolerance	> 1 MHz[D]
Maximum Repetition Rate	Approximately 3.0 MHz

High Voltage Electronics

Property	Specification
Temperature stability	< 2 ppm/°C (R-version)
Noise (AV at analyser)	< 1 ppm + < 500 µV
Drift	< 20 ppm/year
Electric isolation	6 kV
Min. step size HV100	1.6 mV
Min. step size DAC	200 µV
DAC bits	16
Modular	Yes
Communication	USB

[A] Calculated for 2 % energy window, ±15° angular mode, and 50 µm sample radius.
[B] Set instead by a time window in the spectrometer and optimized lens tables for each kinetic energy window.
[C] Available in a limited kinetic energy range
[D] Property of the RoentDek DLD40 detector.

How to contact us:

www.ScientaOmicron.com
info@ScientaOmicron.com