Anton Paar

SAXSpace

The modular solution for nanostructure analysis

::: Innovation in Materials Science

New to SAXS?
Here are some essentials.

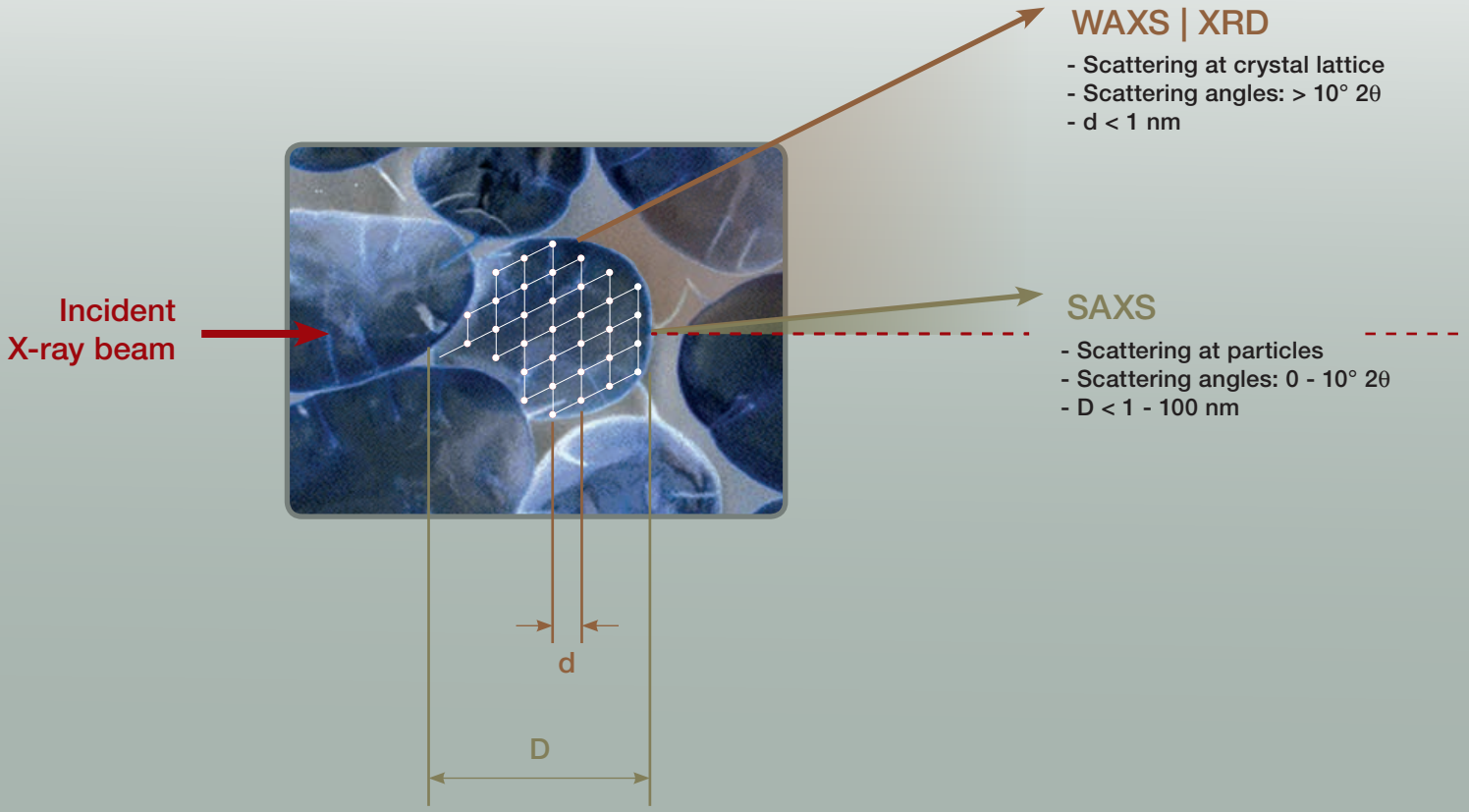
What SAXS is

SAXS, Small-Angle X-ray Scattering, is a non-destructive method for investigating nanostructures from 1 nm to 200 nm in size.

SAXS results are representative of an entire sample, so SAXS ideally complements methods that only provide local information, such as electron microscopy.

SAXS also stands out for enabling studies on biological samples in their native state. This popular application is known as **Bio-SAXS**.

Different angles – different results



Different beam shapes – different benefits

Before scattering, the X-rays are transformed into a well-defined line-shaped or point-shaped beam. This process is called collimation.

While line collimation is ideally suited for measuring non-oriented (isotropic) systems, such as diluted dispersions and emulsions, point collimation is the right choice for analyzing oriented samples and solids with inhomogeneous structures.

You need both collimation modes to optimally cover the entire range of potential SAXS applications.

X-rays are sent through a sample and are scattered by its particles and domains, producing a scattering pattern characteristic of the sample's nanostructure. The scattered X-rays can be resolved at different angles.

In SAXS, you resolve small angles (< 10° 2θ) to measure molecular structure sizes up to 200 nanometers. To investigate smaller structures, such as crystal lattices on the atomic level, you can resolve the scattered X-ray beams at wider angles (> 10° 2θ). This method is called **WAXS** (Wide-Angle X-ray Scattering).

Alternatively, to investigate surface nanostructures, you can set your X-ray beam to graze a flat sample parallel to its surface. This technique is called **GI-SAXS (GI = Grazing Incidence)**.

SAXS Applications

- Surfactants

  Detergents, food additives, nutrients, pharmaceuticals, personal care products

- Colloidal Dispersions

  Pigments in paints, inks and sun screens, metal dispersions, blood cells

- Emulsions

  Food, drug carrier systems, micro-emulsions, personal care products

- Nano-composites

  Nano-filled polymer composites (clays, carbon nanotubes)

- Polymers & Fibers

  Semi-crystalline polymers, block copolymers, polymer blends, synthetic fibers

- Catalysts

  Petroleum refinement and processing, polymerization, gas purification, fuel cells

- Liquid Crystals

  Liquid crystal displays, lyotropic liquid crystals used as detergents, food and drug delivery systems, biological membranes

- Biological Materials

  Proteins, protein complexes, lipids, peptides

SAXSpace
Brilliance Your Way

SAXSpace is a modular nanostructure analyzer for **SAXS, WAXS, GI-SAXS, Bio-SAXS** and more. The system delivers high data quality at minimal measuring times – that's a given.

What's unique about SAXSpace is its readiness to meet your needs.

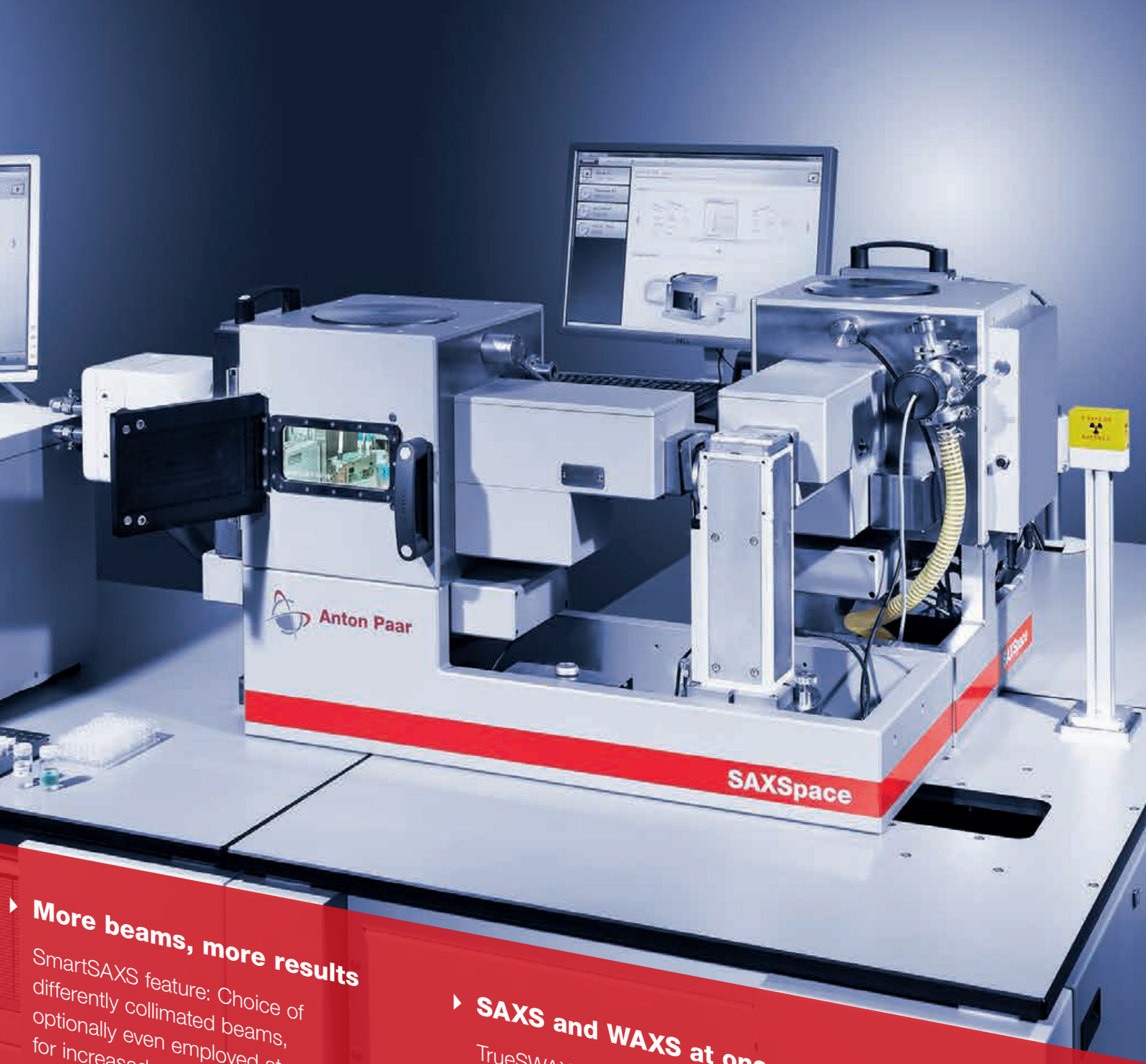
Some will breathe a sigh of relief at the system's user-friendliness, facilitating easy work at a fast pace. Other SAXS users want a sophisticated work space for full experimental flexibility. SAXSpace delivers on all counts.

Space to build on

Large all-in-one sample chamber with built-in alignment stage for full experimental flexibility

Wide range of measurement options

Sample holders and stages for virtually any kind of sample and measurement conditions



More beams, more results

SmartSAXS feature: Choice of differently collimated beams, optionally even employed at once, for increased productivity and a wider range of analyses

Time-saving alignment

TrueFocus feature: Fully automatic and intelligent self-alignment of components with X-ray beam for unprecedented ease-of-use

SAXS and WAXS at once

TrueSWAXS feature: Simultaneous and continuous SWAXS studies up to 74° 2θ, at uniform resolution

SAXSpace Only

The following features are only found in SAXSpace.

SmartSAXS

SAXSpace measures isotropic as well as oriented samples without requiring any setup change. Simply choose the collimation mode that best suits your needs.

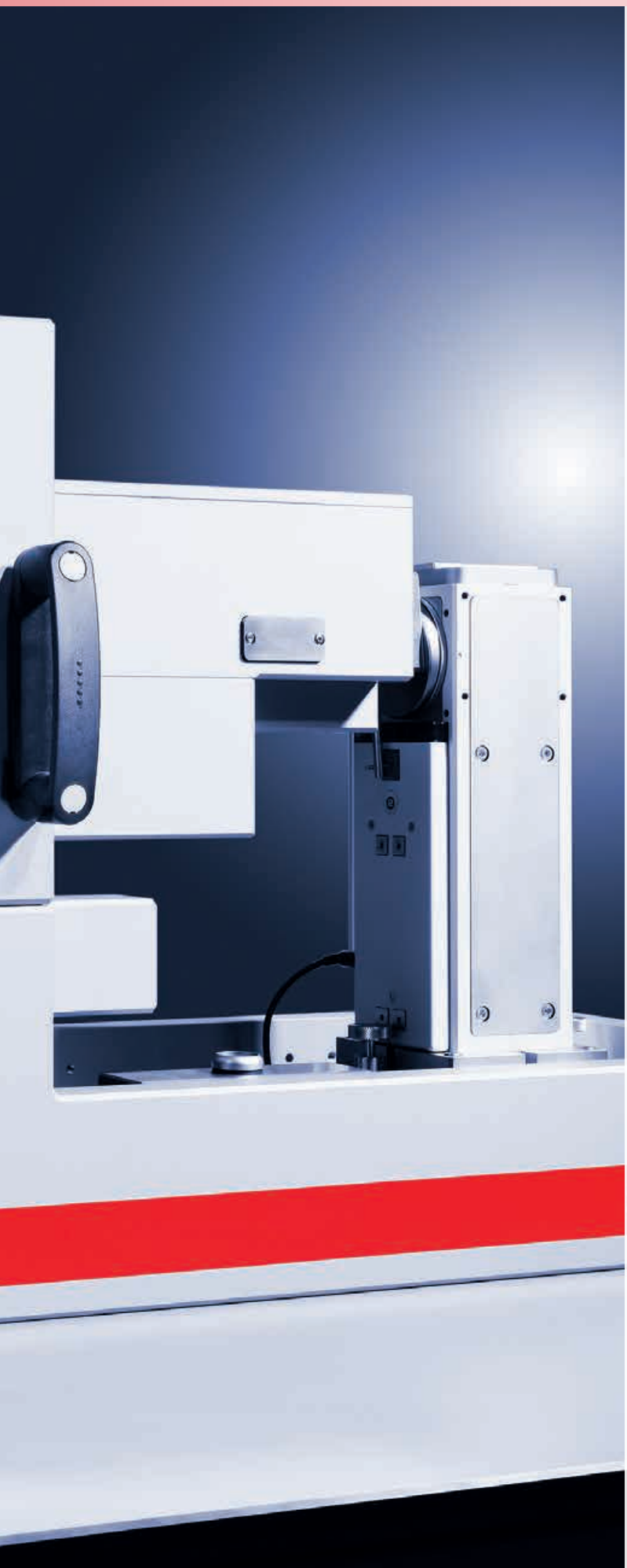
The instrument's SmartSAXS multiple beam concept even enables you to employ line and point collimation at once, with several beam lines connected to a single X-ray source.

Measurement times are reduced to a minimum and your throughput is considerably increased.

TrueFocus

In former SAXS systems, the alignment of X-ray optics and collimating components with the X-ray beam has never been known as a simple procedure. SAXSpace stands out for quick and easy alignment at the push of a button.

Based on its TrueFocus feature, SAXSpace aligns all X-ray components automatically. Even experienced SAXS operators will tell you how much easier life in the lab becomes without the need for complex, time-consuming manual alignment.



A source of quality

Apart from component quality, SAXS and WAXS data quality largely depends on smart **scatterless beam collimation** and the quality of the X-ray beam itself. SAXSpace employs an intense monochromatic beam with very low background radiation, providing reliable data even on very low-contrast samples.

This beam quality is achieved with a Kratky-based block collimator, the outstanding result of over 50 years of continuous refinement. The basic system was initially developed by SAXS “founding father” Otto Kratky together with Anton Paar in the 1950s.

TrueSWAXS

Analyze your samples’ overall nanostructure (< 200 nm) as well as their crystal structures at the atomic level (< 1 nm) – by performing continuous SAXS and WAXS measurements at wide angles up to 74° 2θ. You can also run these measurements simultaneously.

This unique TrueSWAXS functionality is based on an ingenious, space-saving set of component movements. With TrueSWAXS, there is no need to re-align your system. You can be sure of uniform resolution and reliable results.

Full Experimental Flexibility

Innovative SWAXS-based research requires a smart and versatile framework. SAXSpace's all-in-one sample chamber is open to countless analysis options, providing you with full experimental flexibility.

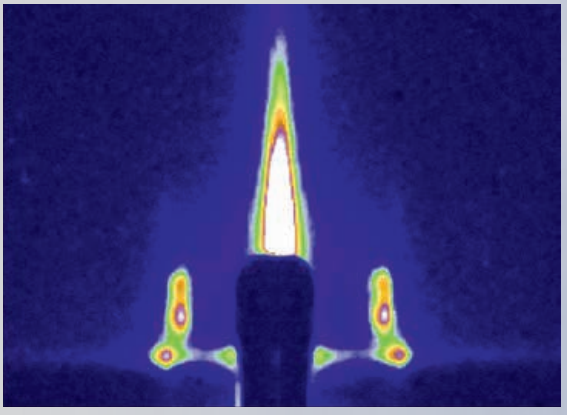
Choose from a wide variety of sample stages and holders easily incorporated in unprecedented Plug and Play fashion. The system's Stagemaster feature automatically recognizes new stages and configures the instrument for you.

SAXSpace's large sample chamber gives you sufficient space for your own experimental setups, for which Anton Paar provides you with comprehensive support tailored to your needs.

In any case, you are covered by precise temperature control, optionally ranging from -150 °C up to 300 °C.

Application example: GI-SAXS analysis

Using SAXSpace with the GI-SAXS stage, high-quality SAXS data at grazing incidence is obtained. Here's an example: The image on the right shows a GI-SAXS pattern of a mesoporous organosilica thin film in an orthorhombically distorted cubic phase.



Sample kindly provided by Prof. Bein group, LMU Munich

Wide range of sample holders:

- **µ-Cell** – for lowest sample volumes (>8 µL)
- **FlowCell** – for automated sampling
- **PasteCell** – for viscous and powder samples
- **RotorCell** – for averaging microcrystalline domains
- **TubeCell** – for online experiments (disposable fluid pathway)
- **TCS Capillary Holder** – for disposable capillaries

Wide range of sample stages:

- **TCstages** – for SWAXS studies from -150 °C to 300 °C
- **Humidity Cell** – for SWAXS studies under relative humidity
- **Tensile Stage** – for SWAXS studies under mechanical load
- **GI-SAXS Stage** – for analysis of nano-structured surfaces
- **VarioStage** - for multi-purpose SWAXS studies

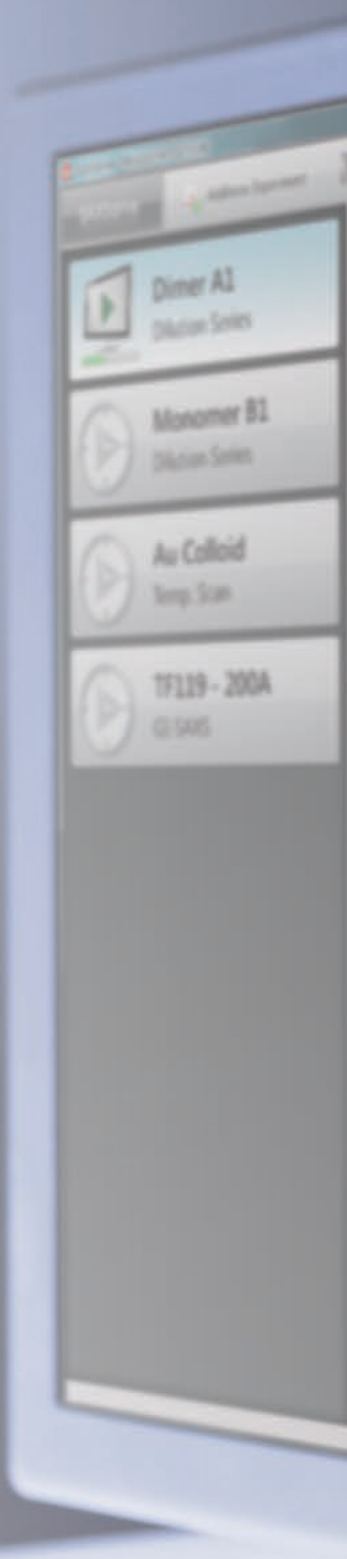
Autosamplers for liquids and solids:

- **ASX autosamplers** – for high-throughput screening of up to 192 liquid samples, with cooling option for protecting sensitive samples such as biomaterials

- Autosampler for multiple solid samples

SAXSpace Software
The Essence of SAXS Intelligence

Dedicated software is one of the most important components of a modern SAXS system. SAXSpace comprises three different programs for automated system control and data acquisition as well as fast and easy template-based processing and analysis of 2D and 1D SWAXS data.



SAXSdrive™
Measurement and control software

The new powerful SAXSdrive™ software automatically detects and controls SAXSpace's system components, including X-ray sources, sample stages and detectors. SAXSpace is aligned automatically; several alignment modes are stored and easily re-called.

SAXSdrive™ enables you to perform automated SAXS and WAXS experiments, including temperature-dependent and time-resolved studies as well as high-throughput screening experiments.

SAXSquant™
2D and 1D SWAXS data treatment, processing and analysis

SAXSquant™ simplifies the treatment of 2D and 1D SWAXS data which are processed using fully customizable templates. Large data sets for multiple samples are handled at the push of a button.

SAXSquant™ features all essential evaluation routines and calculates important parameters like the radius of gyration R_G, particle size, specific volume and more. The generated data files (ASCII text format) can be opened and processed in any SAXS data evaluation software, such as ATSAS, SANSView, SASfit.

Advanced data interpretation software
Particle structure and interaction

The PCG software retrieves structural information from experimental SAXS data using mathematical methods which allow you to determine your samples' particle shape, size and size distribution.

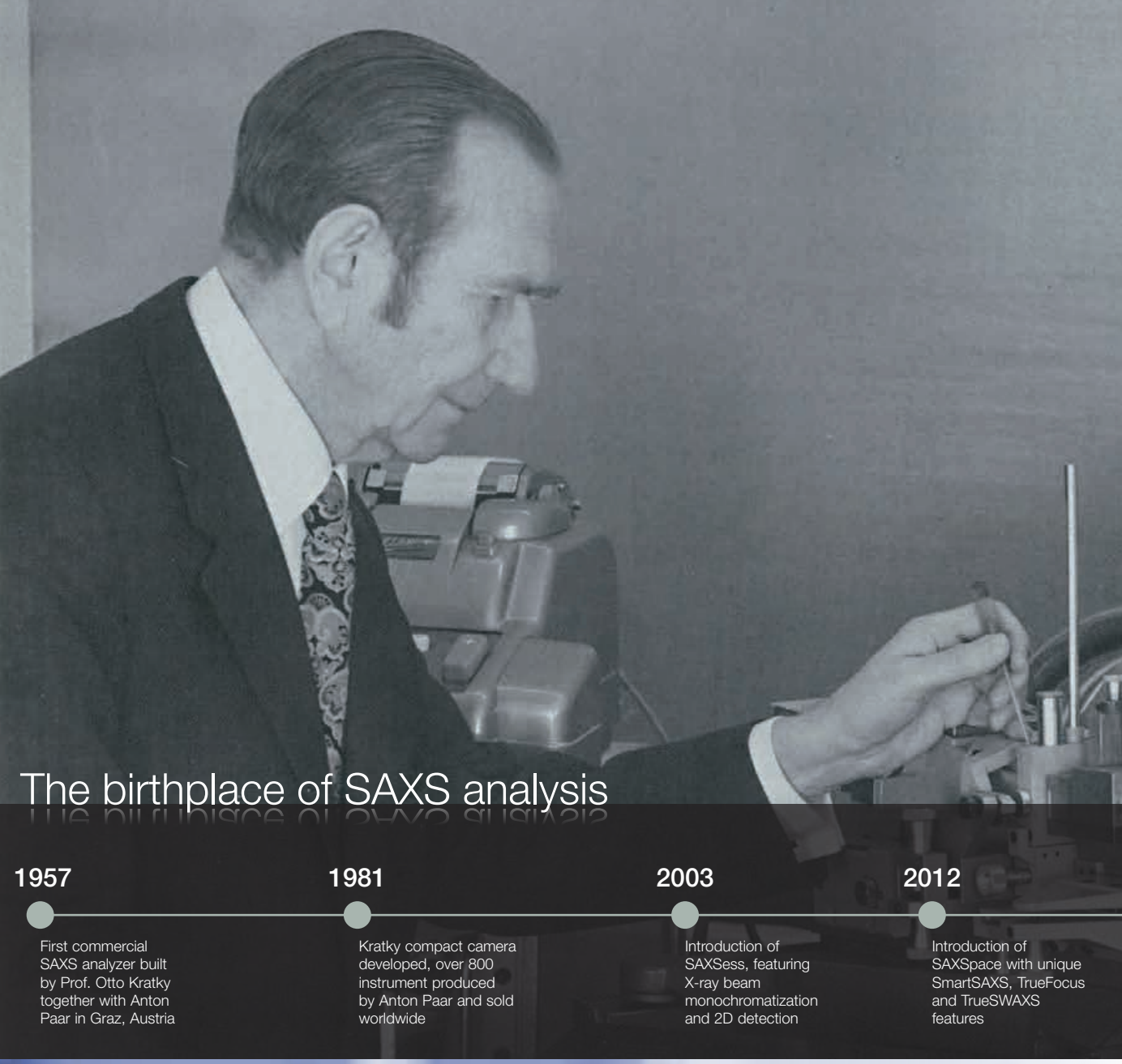
The software offers you a unique advantage: You can interpret data of interacting (i.e. concentrated or charged) particle systems based on a single experiment only. This considerably speeds up your work, since you no longer need to run measurement series at different concentrations.


Dimer A1-100 - measuring -
CCD - Detector
Intensity
Acquisition time: 60 s
Temperature Control
Device Type: TCS150
Temperature: 10 °C
Cell Type: Capillary 1mm
Autosampler: ASX-c
TCS150
X: 80.050 mm
Y: 45.610 mm
Z: SAXS
Ready
X-ray Generator
Device Type:
Voltage:
Current:
Wavelength:
Shutter No.:
Status:
SAXSpace Device Setup
Show Log

Specifications

System resolution	q_{min}: 0.03 nm^{-1} (0.003 $Å^{-1}$)
Accessible q range	0.03 nm^{-1} to 49.0 nm^{-1} (0.003 $Å^{-1}$ to 4.90 $Å^{-1}$) 200 nm to 0.13 nm
Measuring time	<1 minute to 30 minutes (typical)
Special features	SmartSAXS: multiple beam line option TrueFocus: self-alignment with X-ray beam TrueSWAXS: continuous and simultaneous SWAXS studies up to 74° 2θ Stagemaster: YZ stage with auto-recognition of sample stages
Sample environment: **- Temp. range** **- Atmosphere**	-150 °C to 300 °C Vacuum, air, inert gas, humidity, (reactive gases on request)

X-ray source	Sealed tube (line and/or point collimation), Microsource
X-ray optics	Multilayer optics Advanced Kratky-based line and point collimator
Sample stages / Autosamplers	TCStages Humidity Cell Tensile Stage GI-SAXS Stage ASX autosamplers Customized stages on request
Sample holders	Quartz capillaries for liquids Sample holder for solids µ-Cell FlowCell PasteCell RotorCell TubeCell TCS Capillary Holder
Detectors	Imaging plate detector (2D data acquisition) CCD detector (2D data acquisition) Diode array detectors (1D and 2D data acquisition)
Software	SAXSdrive™ control and data acquisition software SAXSquant™ data analysis software Advanced data interpretation software (PCG)
Dimensions (footprint)	1.8 m x 0.9 m (L x D)



The birthplace of SAXS analysis

1957
First commercial SAXS analyzer built by Prof. Otto Kratky together with Anton Paar in Graz, Austria

1981
Kratky compact camera developed, over 800 instrument produced by Anton Paar and sold worldwide

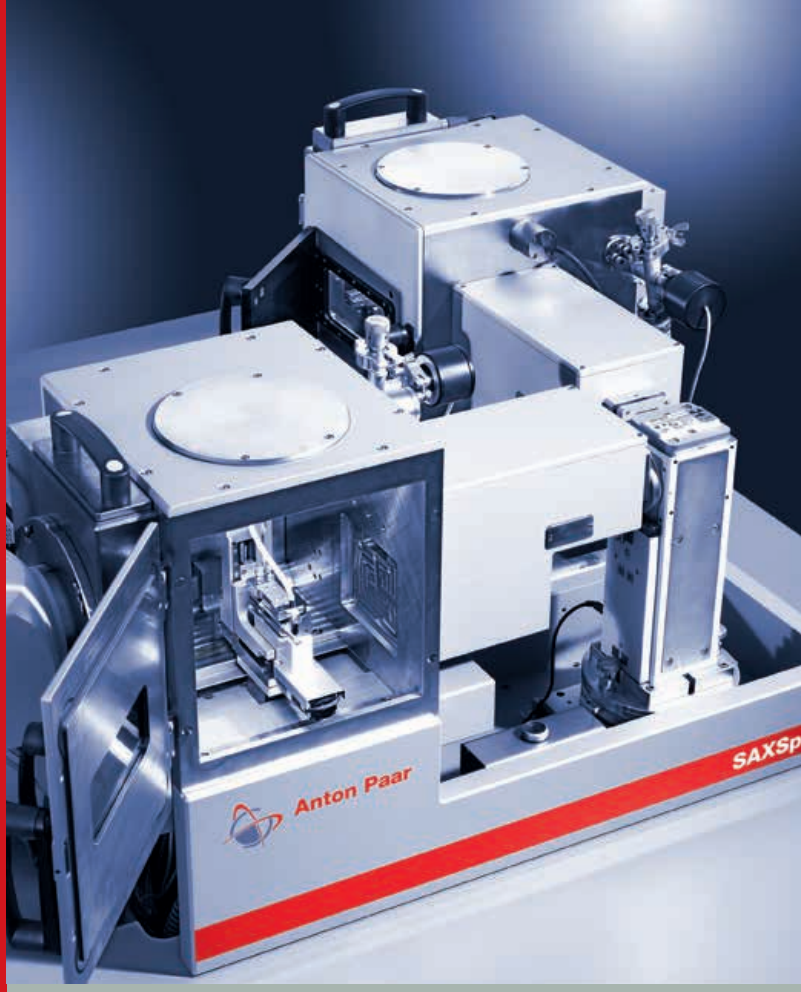
2003
Introduction of SAXSess, featuring X-ray beam monochromatization and 2D detection

2012
Introduction of SAXSpace with unique SmartSAXS, TrueFocus and TrueSWAXS features

High uptime – profound knowledge

Rely on Anton Paar's worldwide network of experienced service engineers to provide swift support, ensuring smooth SAXSpace operation and maximizing your instrument's uptime.

In thorough user trainings during and after installation and by profound SWAXS application knowledge made available by our dedicated application specialists, we aim to help you make the most of your SAXSpace system.



Photos: Croce & Wir

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Instruments for:
Density and concentration measurement

Rheometry

Viscometry

Sample preparation

Microwave synthesis

Colloid science

X-ray structure analysis

Refractometry

Polarimetry

Petroleum testing

High-precision temperature measurement

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