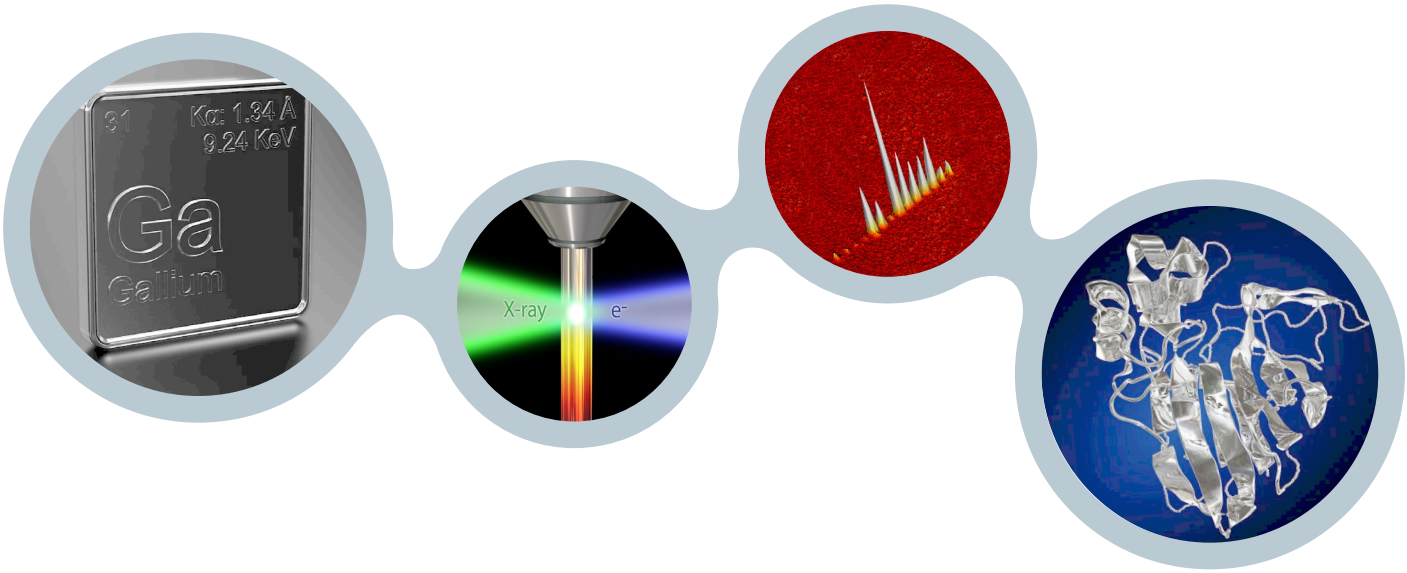



Product Sheet SC-XRD 49

# METALJET - Liquid Metal Jet X-ray source for Structural Biology

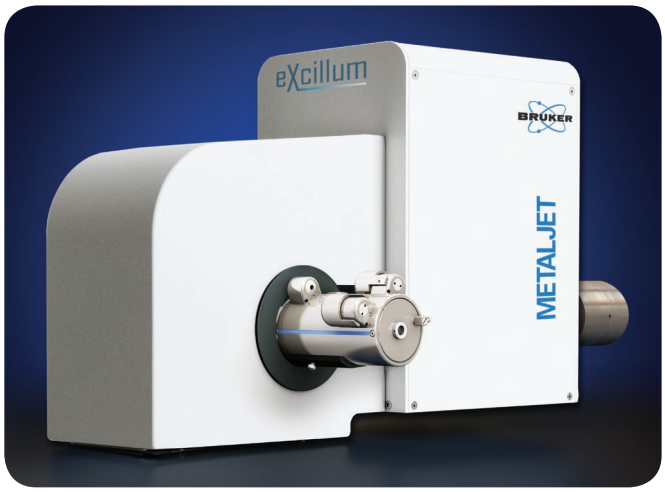
## An X-Ray Revolution Without Rotation

**Bruker's introduction of the revolutionary liquid metal jet X-ray source marks the first major advance in high performance home-lab X-ray source technology in more than a decade.**

The METALJET for X-ray diffraction was developed in collaboration with Excillum and delivers the smallest and most intense X-ray beam of any home lab X-ray source to meet the ever increasing demands of modern protein crystallography.

Like conventional rotating anode generators and microfocus sources, the METALJET uses the impact of electrons onto a metal target to generate X-rays. However, the solid anode of conventional generators is replaced by a high-speed jet of liquid metal that can accept a much higher power load. The result is an X-ray beam that is much brighter than what is currently achievable with a home source.

To deliver such a small X-ray beam required technical innovation in the design of the X-ray optics, since a smaller source requires greater precision in the d-spacing of the multilayers. The HELIOS MX optics for METALJET transmits the X-rays to the crystal in a uniformly small diameter, greatly exceeding the intensity of traditional X-ray sources.




Revolutionary METALJET X-Ray source

The METALJET enables you to collect data on smaller, more weakly diffracting crystals, improving productivity more than ever before in the home lab.

# X-Ray Revolution without Rotation

## Higher Power Load

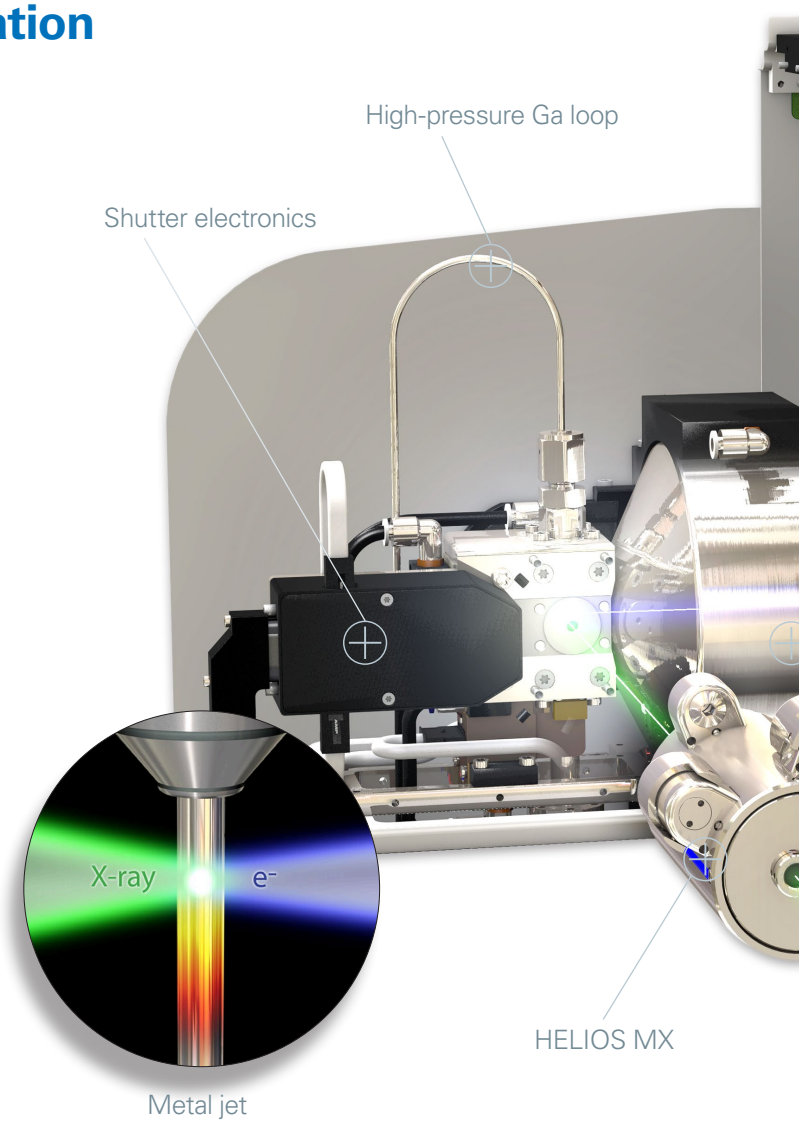
The brightness of traditional X-ray sources is limited by the anode's power loading capability. In conventional solid-anode technology, the power loading is limited by the need to maintain the target's surface temperature well below its melting point in order to avoid damaging the target. In the METALJET, this limitation is removed by using a target that is already molten. The target is regenerative by nature, with the metal jet supplying fresh target material at a speed exceeding 50 m/s.

## HELIOS MX for METALJET - A New Level of Precision and Quality

To generate the optimal beam for diffraction from the best in-house source, a specialized X-ray optic is required. Between Bruker and Incoatec, advancements in X-ray source and optic always go hand in hand. Transporting the extreme source brightness to the sample requires an optic of highest quality. More than a decade of experience in the field of synchrotron mirrors enabled us to develop a synchrotron-class optic for a home-lab instrument. State-of-the-art graded multilayer deposition techniques make the HELIOS MX for METALJET our best X-ray mirror ever. The HELIOS MX optic for gallium delivers the highest intensity of any source-optic combination to your sample.

## Smaller Samples Require More Stable Systems

The D8 VENTURE perfectly matches the demands of the small beam generated by the METALJET; the smaller the beam, the more stable and accurate your entire experimental setup needs to be. The D8 VENTURE comes with all of the




## Gallium: 'The Better Copper'

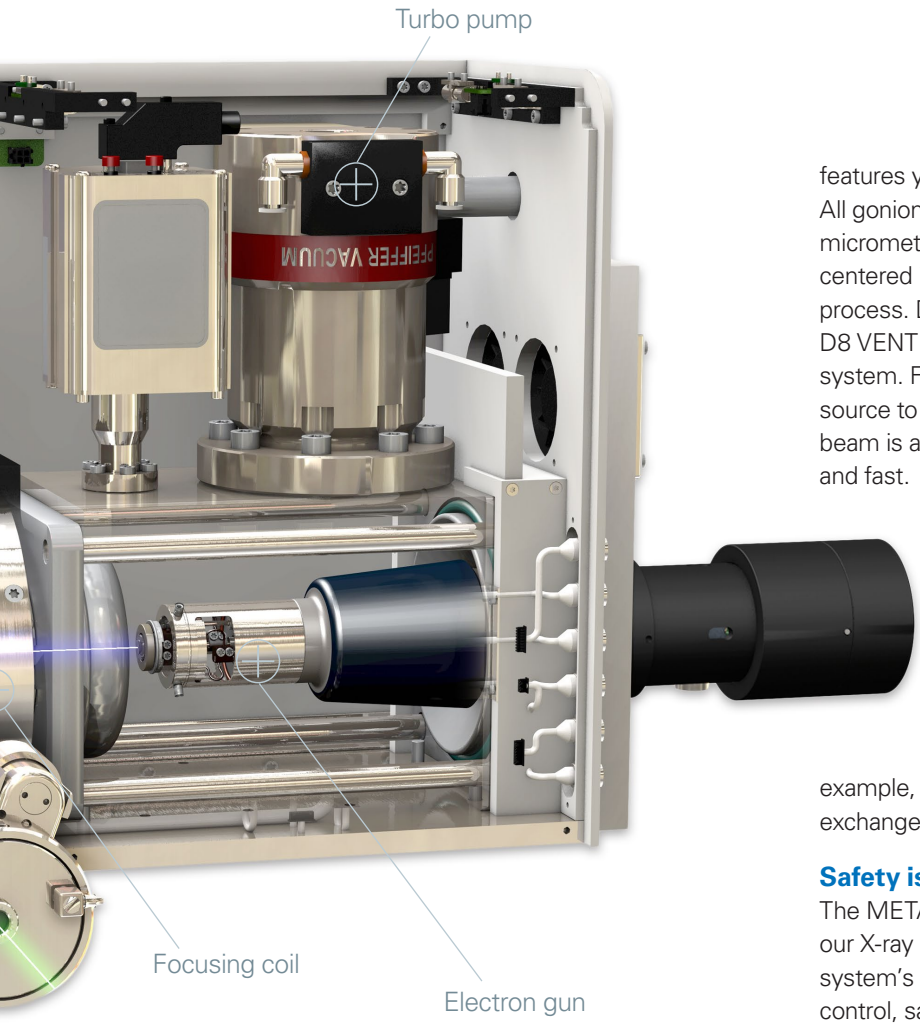
The METALJET target is a gallium-rich (Kα = 1.34 Å) alloy with the Kα emission line close to that of copper (Kα = 1.54 Å). Gallium provides the necessary diffraction spot spacing for accurate and reliable data reduction, yet the shorter-wavelength causes less radiation damage to the crystal, enabling high-multiplicity data sets to be collected.

The very small beam and gallium's shorter wavelength greatly improve the signal-to-noise ratio with increased detector sensitivity, reduction of X-ray absorption by the sample, scattering by air and mother liquor.


## Extreme Brightness

The power-loading capability of microfocus X-ray targets roughly scales with the diameter of the electron beam's focus (not its area). Therefore, the brightness is inversely proportional to the source diameter.

By combining extreme power-loading capability with a small electron focus, a liquid-jet source can achieve unprecedented brightness at micrometer spot sizes.



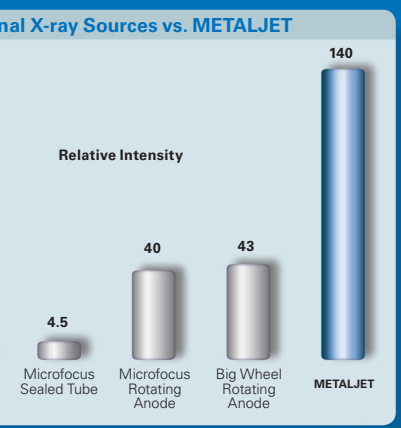

features you need to make your experiment a success. All goniometer axes intersect within a sphere of just seven micrometers. This ensures that the crystal remains perfectly centered in the X-ray beam during the entire data collection process. Downstream alignment, established in all D8 VENTURE systems, allows easy alignment of the entire system. First the HELIOS MX optic is aligned with the source to ensure maximum intensity, and then the optimized beam is aligned with the goniometer center. Easy, stable, and fast.

### Low maintenance for extended up-time

Maintenance of the METALJET is straightforward and comparable to that of modern microfocus X-ray sources. Long intervals between servicing the instrument result in extended instrument up-time. The METALJET is designed for low maintenance and easy servicing to give peace of mind. For example, the non-toxic liquid gallium target can be easily exchanged using a syringe.

### Safety is Paramount

The METALJET is available for the D8 VENTURE. Like all of our X-ray sources, the METALJET is fully integrated with the system's safety circuits. Advanced hardware and software control, safety switches at all crucial positions, X-ray labyrinths, and component recognition ensure that the instrument's state is always safe.

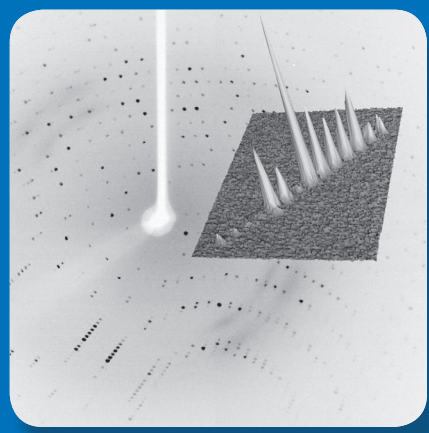



### Gallium SAD Phasing

The crystal structure of Thaumatin from *Thaumatococcus danielii* was determined by sulfur-SAD phasing methods using data collected on a D8 VENTURE diffraction system with the METALJET X-ray source.

Using one 70-micrometer crystal, a complete data set was collected to 1.65 Å in less than 3 hours. The experimental phases derived from the anomalous signal of the sulfur atoms allowed 95% of the protein backbone to be traced.

The successful phasing from a relatively low multiplicity data set highlights the very high quality of the Ga data and shows that



S-SAD data can be collected in the home lab.

## THE METALJET Wrap-Up

**Highest X-ray intensity** due to exclusive patented liquid-metal-jet technology. The liquid target is able to accept a power-load an order of magnitude greater than conventional rotating anode X-ray sources.

**Unprecedented brightness** resulting from the extremely high power loading and smallest electron focus.

**Perfect spot quality** is achieved through the high-brightness $LaB_6$ cathode and smooth, self-regenerating, liquid metal target which provides exceptional spatial and emission stability.

**Lower noise** as the shorter-wavelength gallium Kα X-rays result in reduced background scatter.

**Lower running costs** are ensured by the low power consumption, minimal cooling requirements, and the self-regenerating target.

**Lower maintenance** is achieved through the advanced design for serviceability and the use of best components with highest reliability.

| Technical Specifications | |
|---|---|
| **Cathode** | High-brightness $LaB_6$ |
| **Target material** [1)] | Gallium alloy |
| **Target type** | Liquid jet |
| **Energy, wavelength** | Kα = 9.243 KeV, 1.3414 Å |
| **Voltage** | 70 kV |
| **Power** | 200 W |
| **Max current** | 4.3 mA |
| **Apparent focal spot size** | Less than 70 µm |
| **Beam size at sample** | Less than 100 µm FWHM |
| **Flux density for samples smaller than 50 µm** | Greater than $3.5 \times 10^{11}$ X-rays/mm$^2$ -sec |
| **Mains, integrated with a D8 VENTURE** | 200-240 VAC (+6%, -10%), 1-phase, 50/60 Hz, 3x 32 A<br>208 VAC (±10%), 1-phase, 50/60 Hx, 2 x 40 A |
| **Cooling** | No external cooling required |
| **Ambient temperature and humidity** | 20 - 25° C, 20%-80% relative humidity (condensation not allowed) |
| **Target lifetime** | Greater than 8000 h |

[1)] Room temperature liquid gallium alloy consisting mainly of more than 90% gallium, indium, and tin.

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