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How can MetalJet enable the African Light Source?

African Light Source

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African Light Source

World-class science in Africa

Scientific Challenges

Questions

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Synchrotron

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Staff with great knowledge of X-rays, accelerator physics etc

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Researchers with awareness of X-ray Characterization

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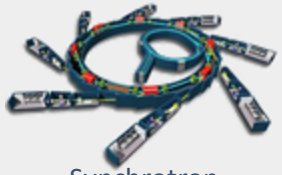

Synchrotron

Roadmap Summary for an African Light Source

In order to make its vision a reality and fulfil its mission, the AfLS Steering Committee decided upon the following short-, medium-, and long-term goals:

a. Short-term (0-3 years)

The short term goals focus on the following issues: building awareness of the benefits of light source based research; enhancing education; developing human capacity; developing international collaborations, linkages and partnerships related to light sources; promoting mobility and access to current light sources; developing local infrastructural capacity to support access to light sources; and building formal structures and procedures in support of the Roadmap.

i. Promote human capacity development in Africa by doing the following:
    1. Encouraging and training large numbers of scientists, engineers, technicians, students in fundamental, as well as applied, light source science.
    2. Developing and expanding the LS user community.
    3. Growing and enhnacing the relevant engineering technical expertise.
ii. Encourage and commit to light source radiation studies at existing international facilities.
iii. Form focused formal relationships/memberships with existing LSs.
iv. Promote the involvement of industry via the appointment of Liaison(s) between the AfLS Steering Committee and the business sector.
v. Establish a viable communication structure for the African light source science community.
vi. Promote outreach and communication around light source based science.
vii. Establish and enhance the current and needed critical feeder infrastructure that empowers light source science, which ultimately allows for the generation of successful proposals to LSs and the training of students.
viii. Study the feasibility of constructing African multinational beamlines at existing LSs, perhaps with partners from other regions of the world.
ix. Develop a Strategic Plan for submission to African Ministries.

Synchrotrons are nothing without the Staff and the USERS!

We need to build a base of high-end X-ray users and X-ray applications!

How do we do this?

Regional X-ray Characterization Centers!

Regional X-ray Characterization Center

- High class research facility
- Based around high-brightness X-ray source
  - MetalJet D2+

- Generate X-ray experience, Science output and User base
- Easily process 40 scientist/year/center

Regional X-ray Characterization Center

Investment and Running cost

What's needed?

- Lab space (approx. 40 m^2)
- 1 dedicated scientist/engineer to run the center
- High brightness X-ray system
- Budget for running cost (vendors' maintenance)

Approx. 1-1.5 M€ (full system, not only source)

Approx. 20-40 k€/year

Less than 0.5%* of cost of Synchrotron!

* Based on figures from Diamond Light Source (https://www.diamond.ac.uk/Home/About/FAQs/General.html)

It has been done before!

Multi Purpose facility

Immanuel Kant Baltic Federal University in Kaliningrad

SynchrotronLIKE®

International Synchrotron Training Center

Total Simulation of Synchrotron Reality

MetalJet Technology

About Excillum

- We make X-ray sources
  - MetalJet Technology
  - Advanced Electron Beam Technology
- Based in Stockholm, Sweden
- Founded in 2007
- Team of 42 people
- 85+ systems running globally

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Business model

Our main current business is to supply sources to analytical X-ray OEMs for integration in their state-of-the art systems, but we also sell to end-customers, mainly in academia, who build their own experimental systems

BRUKER

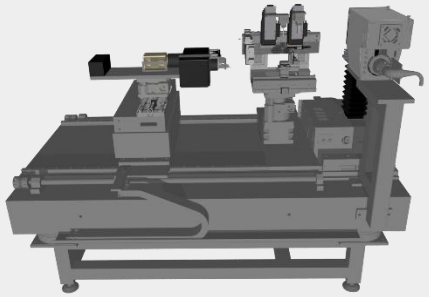
marXperts

STOE SINCE 1887

scientaomicron

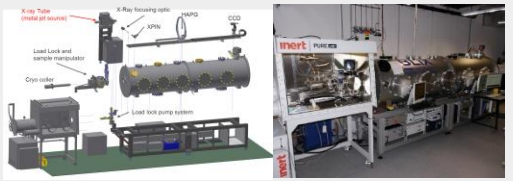
Anton Paar

xenocs Exploring the very small



Multi modal microscope at Würtzburg University / Fraunhofer, Germany

Home-built SAXS system at National Institute of Standards (NIST), USA.



X-ray emission spectroscopy system at Max Planck Institute, Germany

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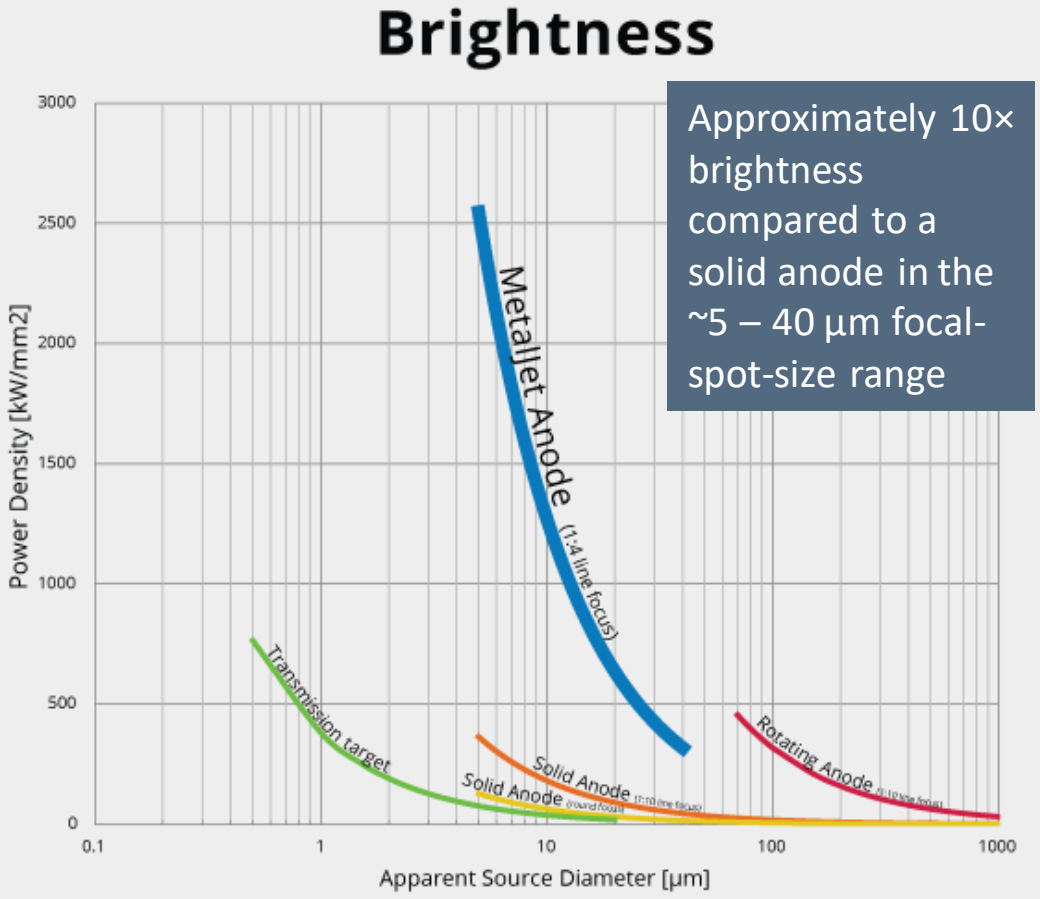
The Brightness Advantage



Approximately 10× brightness compared to a solid anode in the ~5 – 40 µm focal-spot-size range

Helping the scientists perform research previously not possible outside the synchrotron. In a wide range of application such as:

XRD – SM-SCD, MM-SCD, HRXRD, PXRD..
SAXS – BIO-SAXS, material science..
XRF - µXRF, TXRF
XPS - HAXPES
X-ray microscopy
Micro/Nano CT
…

Recently also first industrial applications are emerging where MetalJet can significantly improve the throughput, detection limit etc.

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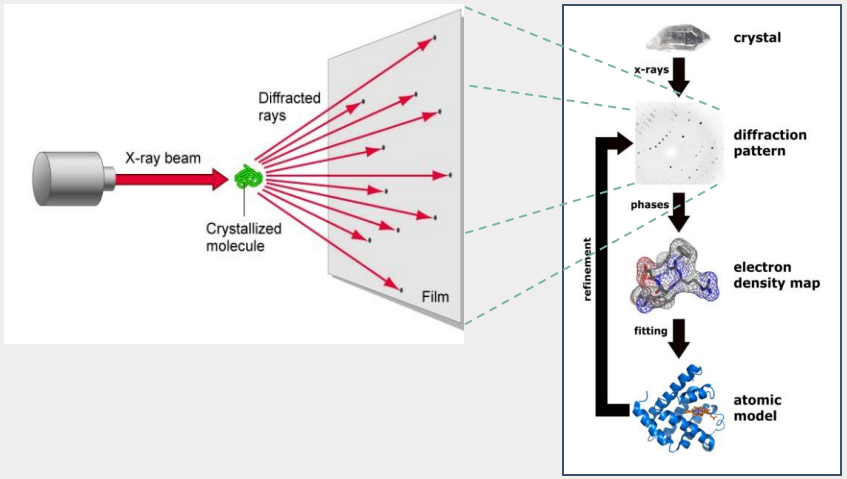
First MetalJet customer installation in 2009
>85 MetalJet sources sold to date

MetalJet Applications

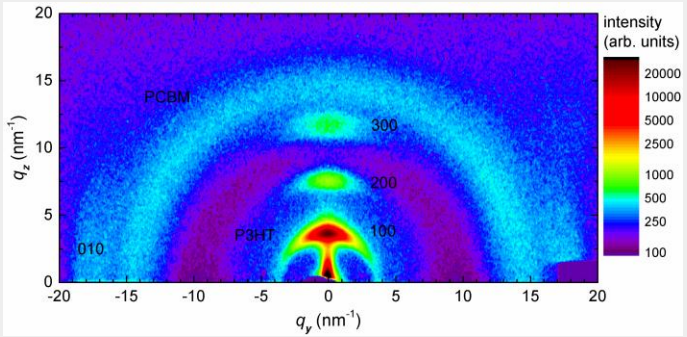
MetalJet Applications

X-ray Spectroscopy

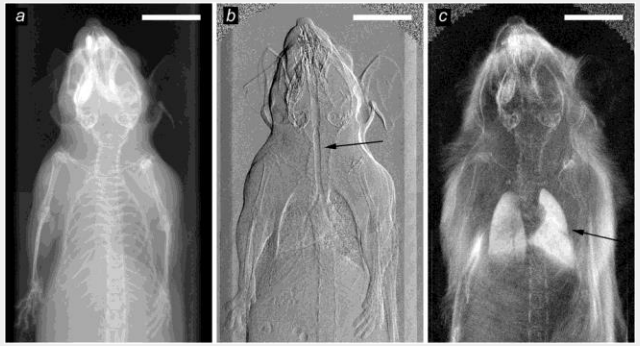
X-ray Crystallography



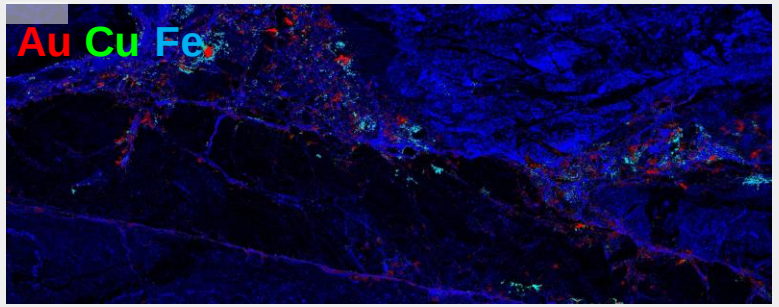
X-ray Scattering



X-ray Imaging



X-ray Fluorescence



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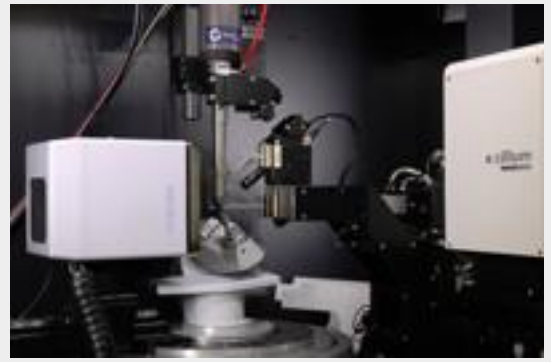
Small Crystals

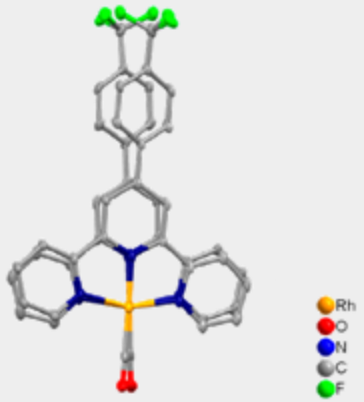
Researchers at the University of Hong Kong determined the crystal structure of a tiny crystal of $C_{23}H_{14}F_3N_3ORh \cdot CF_3O_3S$ using a Bruker Diffractometer with Equipped with Metaljet, using Ga Kα, radiation (λ = 1.34Å).

- Small beam reduce background scatter and makes sure no photons are wasted.

- High flux density enables enough scattering also from very small and weekly scattering crystals.

Crystal size: 0.04 × 0.01 × 0.01 mm^3
Data collection time: 2 hours
R1 = 4.9 %
Completeness: 98.3%





crystal system	Monoclinic
space group	C2/c
a, Å	17.5481 (8)
b, Å	20.1172 (10)
c, Å	13.4385 (6)
α, deg	90
β, deg	101.468 (2)
γ, deg	90
volume, Å^3	4649.3 (4)

J. Am. Chem. Soc. 140, 26, 8321-8329

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So, what do We propose?

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MetalJet Centers in Africa

Our Proposal

- 4 state-of-the-art X-ray Labs distributed in Africa
  - Different main application for each center
- Easily 40 users/center/year
  - 150+ users/year ready to go to AfLS!
- After AfLS?
  - Screening
  - Continued building of user-base
  - Complementary data collection

Thank you

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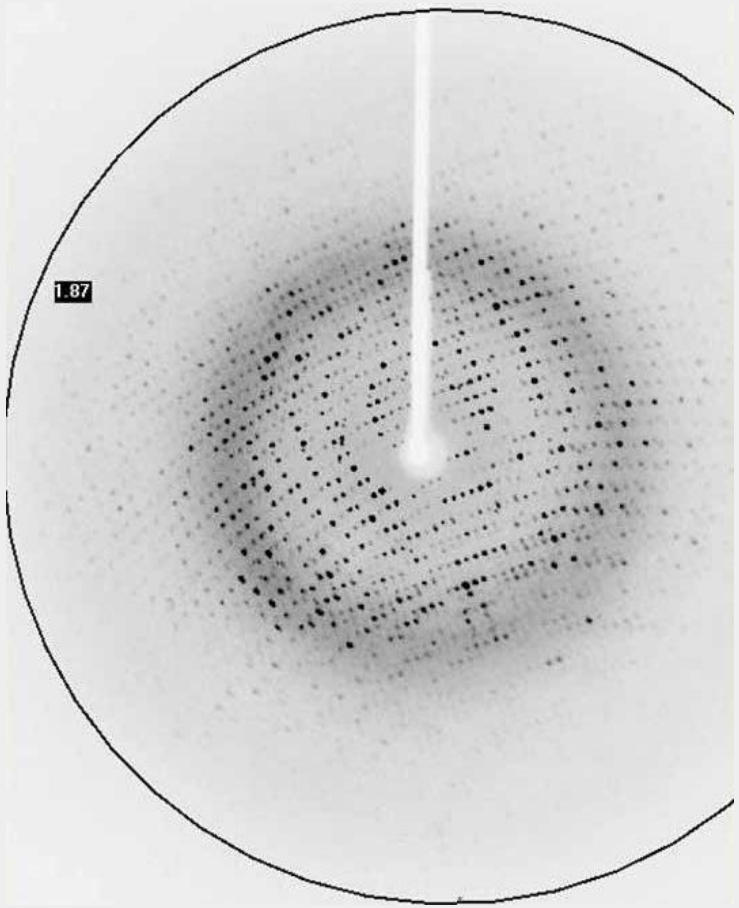
SCD - Protein crystallography, Fast data collection



As an example of a fast data collection, applications scientists at Bruker AXS recorded data on a crystal of a cyclin-dependent kinase (CDK) using a MetalJet X-ray source on a D8 Venture system.

The complete experiment lasted 200 seconds and consisted of 100° of data with the resulting 1.95 Å data allowing for a structure solution by molecular replacement.

- Exposure time: 1 second
- Crystal size: 0.1 × 0.08 × 0.05 mm^3
- Completeness: 97.5%
- Multiplicity: 3.68
- R_{merge}: 6.58%
- R_{pim}: 3.58%