FRONTIER MACROMOLECULAR CRYSTALLOGRAPHY (FMX)

SCIENTIFIC SCOPE

Frontier macromolecular crystallography (FMX) is an undulator beamline at sector 17-ID for structural biology investigations with micro-focusing macromolecular crystallography (MX), optimized for challenging bio-crystallographic problems. Its flux density will be unmatched by MX facilities world-wide. FMX construction is funded by the National Institutes of Health.

Micro crystal diffraction often required to yield structures:
Membrane protein (L), amyloid fibrils (R)
For larger crystals: Use micro beam to find best diffracting regions and mitigate impact of radiation damage.

BEAMLINE CHARACTERISTICS

FMX at NSLS-II:
- Elucidation of structure and function of macromolecular complexes from small, weekly diffracting heterogeneous or especially radiation-sensitive crystals.
- High flux, tunable energy, variable focal spot size and beam divergence.

TECHNIQUES:
- Single and multi-axis MX
- Serial crystallography
- Micro-Diffraction
- Cryo- and room temperature data collection

ENDSTATION DETAILS:
- 100 nm precision main goniometer
- Secondary goniometer
  - Plate screening
  - Acoustic Droplet Ejection
  - Dynamic beam shaping
- High resolution sample viewing microscope, fluorescence imaging
- Robotic sample mounting

Very high dose rates – Full Flux MX:
- Time resolved & rapid serial measurements
- Outrunning radiation damage?

New opportunities - Adaptation of Free Electron Laser (FEL)-driven Methods:
- Frozen suspension (L): Combine elements from serial fs crystallography with helical scan approach of micro-crystallography
- Room temperature (R): Flow through capillary

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Addressing the challenges of modern macromolecular crystallography

Structure of a β1-adrenergic G-protein coupled receptor

Structure of the cross-beta spine of amyloid-like fibrils

Serial crystallography on it in vivo grown microcrystals using synchrotron radiation
C. Gati, et al., IUCrJ (2014) 1, 97-94

Room-temperature macromolecular serial crystallography using synchrotron radiation
S. Stalke, et al., IUCrJ, (2014) 2, 204-212

Data compiled from literature courtesy J. Holton

Overview

PORT: 17-ID
SOURCE: Undulator (IVU21)
ENERGY RANGE: 5 – 30 keV
ENERGY RESOLUTION: $\Delta E/E = 1.6 \times 10^{-4}$
BEAM SIZE: 1 – 20 µm
FLUX: $10^{13}$ ph/s
CONSTRUCTION PROJECT: ABBIX
BEAMLINE STATUS: Construction
AVAILABLE TO USERS: Spring 2016

Beamline Team

STAFF
Dieter Schneider: lead beamline scientist
Martin Fuchs: beamline scientist
Jean Jakoncic: beamline scientist
Dileep Bhogadi: mechanical engineer
William Wilds: designer
Stu Myers: controls engineer
Tom Langdon: technician
John Lara: technician

ADVISORS
Steve Almo (Albert Einstein Col of Med)
Seth Darst (Rockefeller University)
Robert Fischetti (Argonne Natl Lab)
Miguel Garcia-Diaz (Stony Brook U)
George Phillips (Rice University)
Anna Marie Pyle (Yale University)
Christian Riekel (ESRF)
Thomas Schneider (EMBL Hamburg)
Stephen Wasserman (Eli Lilly Company)

Structures of interest:

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Microcrystals at beamline IVU21

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