FRONTIER MACROMOLECULAR CRYSTALLOGRAPHY (FMX)

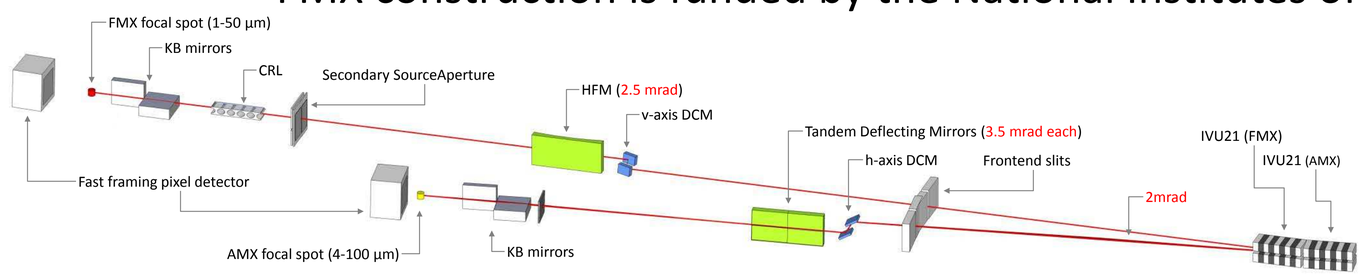
BROOKHAVEN NATIONAL LABORATORY

NATIONAL SYNCHROTRON LIGHT SOURCE II

SCIENTIFIC SCOPE

Frontier macromolecular crystallography (FMX) is an undulator beamline at sector 17-ID for structural biology investigations with micro-focusing macro-molecular 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.



Beamline layout: FMX and AMX share a straight section. FMX's vertical monochromator axis increases vibrational stability.

BEAMLINE CHARACTERISTICS

FMX at NSLS-II:

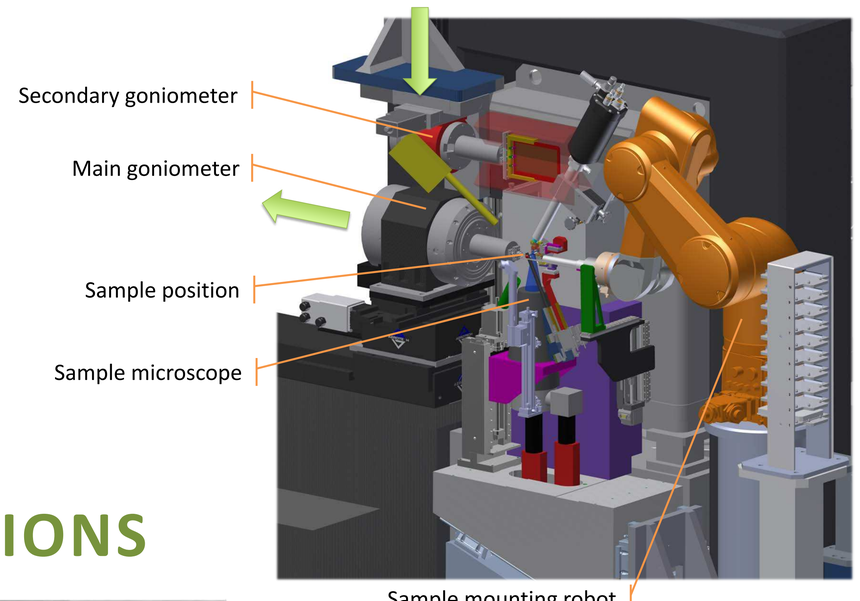
- Elucidation of structure and function of macromolecular complexes from small, weekly diffracting heterogeneous or especially radiation-sensitive crystals.
- High flux, tunable energy, variable focal spot size and beam divergence.

TECHNIQUES:

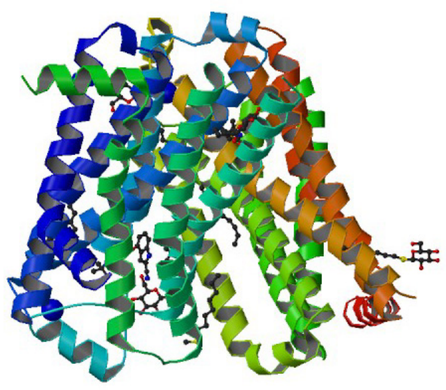
- Single and multi-axis MX
- Serial crystallography
- Micro-Diffraction
- Cryo- and room temperature data collection

ENDSTATION DETAILS:

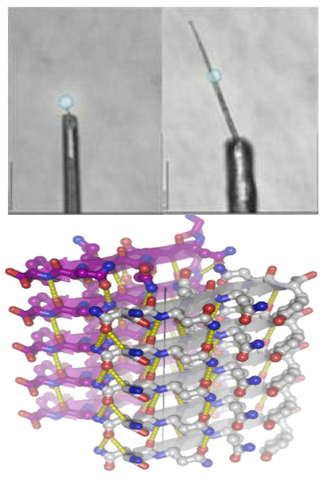
- 100 nm precision main goniometer
- Secondary goniometer
  - Plate screening
  - Acoustic Droplet Ejection
- Dynamic beam shaping
- High resolution sample viewing microscope, fluorescence imaging
- Robotic sample mounting



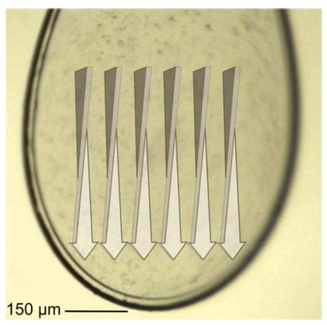
SCIENTIFIC APPLICATIONS



Structure of a ß1-adrenergic G-protein coupled receptor
T. Warne, G.F. Schertler, et al., *Nature* (2008) **454**, 486-491

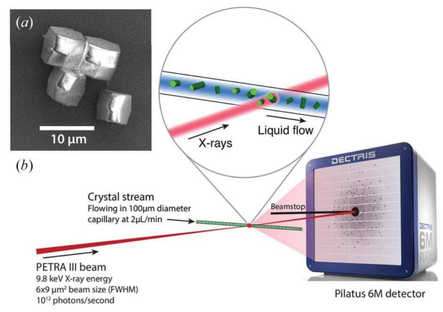


Structure of the cross-beta spine of amyloid-like fibrils
R. Nelson, D. Eisenberg, et al., *Nature* (2005) **435**, 773-8



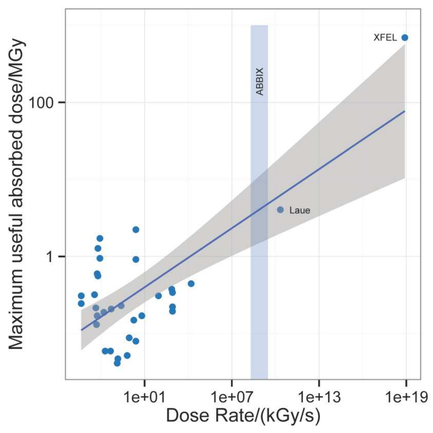
Serial crystallography on it in vivo grown microcrystals using synchrotron radiation
C. Gati, et al., *IUCrJ,* (2014) **1** 87-94

- Frozen crystal suspension at PETRA3 P14



Room-temperature macromolecular serial crystallography using synchrotron radiation
F. Stellato, et al., *IUCrJ,* (2014) **1** 204-212

Room temperature crystal suspension at PETRA3 P11



Data compiled from literature courtesy J. Holton

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.

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

Very high dose rates – Full Flux MX:

- Time resolved & rapid serial measurements
- Outrunning radiation damage?

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

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