FRONTIER MICROFOCUSING MACROMOLECULAR CRYSTALLOGRAPHY BEAMLINE (FMX)

BROOKHAVEN NATIONAL LABORATORY

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NATIONAL SYNCHROTRON LIGHT SOURCE II ABBIX project • funded by NIH

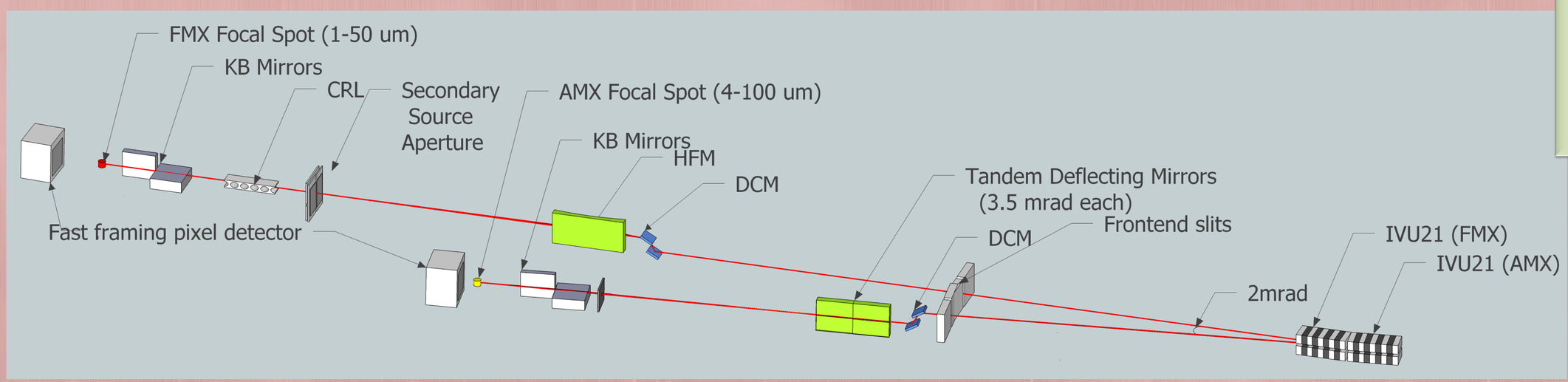
MISSION

NSLS-II Structural Biology beamline for micro-focusing macromolecular crystallography (MX)

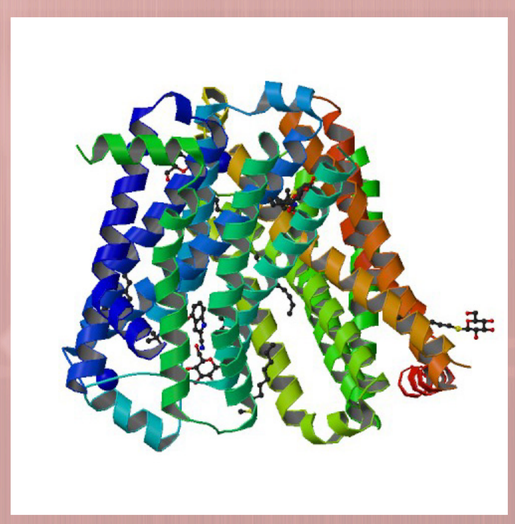
- Elucidation of structure and function of macromolecular complexes from small, weekly diffracting heterogeneous or especially radiation-sensitive crystals.
- High flux, tunable energy, variable focal spot size and beam divergence
- Optimized for challenging bio-crystallographic problems.
- An ABBIX project beamline funded by NIH

ABBIX:
Advanced Beamlines for Biological Investigations with X-rays

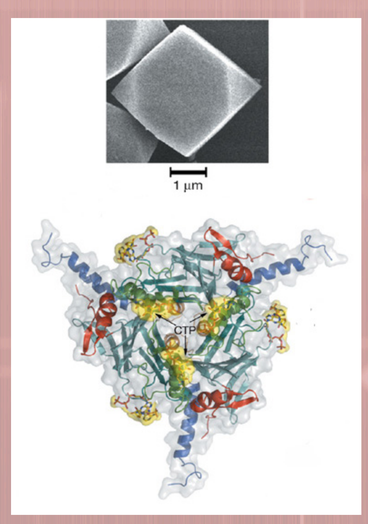
Complements **AMX**



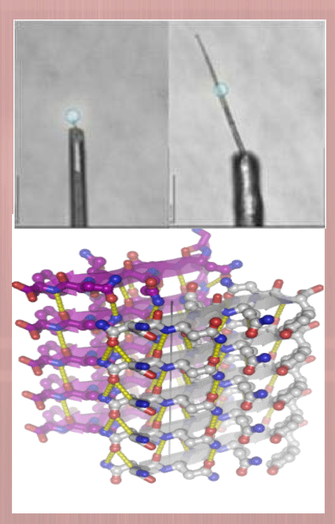
APPLICATIONS AND CAPABILITIES



From: T. Warne, M.J. Serrano-Vega, J.G. Baker, R. Moukhametzianov, P.C.Edwards, R. Henderson, A,G. Leslie, C.G. Tate, and G.F. Schertler. Structure of a ß1-adrenergic G-protein coupled receptor. Nature 454, 486-491 (2008).



F. Coulibaly, E. Chiu, K. Ikeda, S. Gutmann, P.W. Haebel, C. Schulze-Briese. The molecular organization of cypovirus polyhedra. Nature 446, 97-101 (2007).



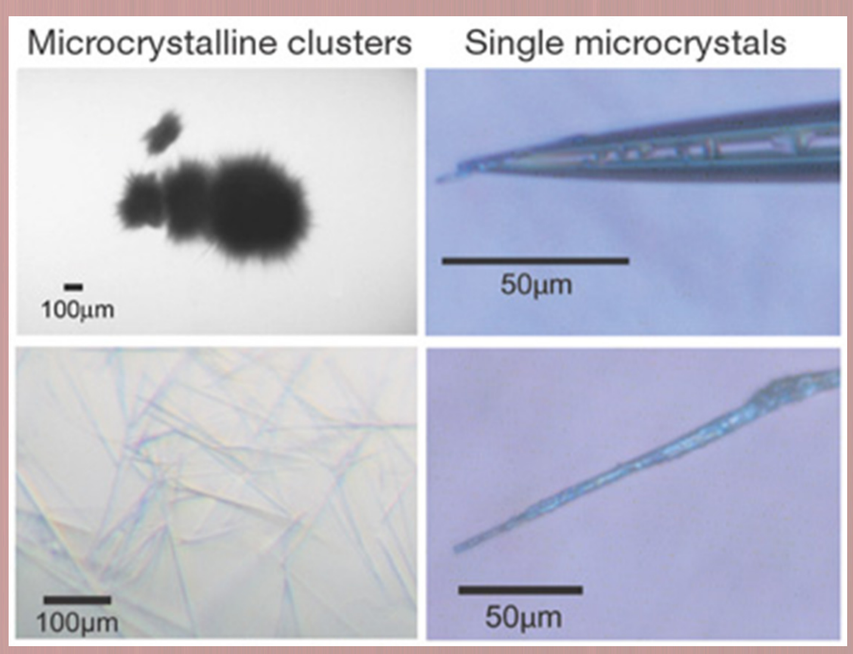
R. Nelson, M.R. Sawaya, M. Balbirnie, A.O. Madsen, C. Riekel, R. Grothe, D. Eisenberg. Structure of the cross-beta spine of amyloid-like fibrils. Nature 435, 773-8 (2005).

Micro crystal diffraction often required to yield structures: Membrane protein (l), virus polyhedra (center) amyloid fibrils (r)
For larger crystals: Use micro beam to find best diffracting regions and mitigate impact of radiation damage.
Serial crystallography: Multi crystal data set acquisition and merging.

Source	Canted IVU21 undulator
Optics	Double crystal monochromator
	Horizontal focusing mirror
	Secondary source aperture
	CRL lenses
	K-B focusing mirrors

Energy range	5 – 30 keV
Wavelength range	0.4 – 2.5 Å
Flux at focus	~10^{13} ph/s
Focal spot min	1 x 0.5 μm^2
Focal spot range	1 – 50 µm

ADDITIONAL INFORMATION



From: M.R. Sawaya, S. Sambashivan, R. Nelson, M.I. Ivanova, S.A. Sievers, M.I. Apostol, M.J. Thompson, M. Balbirnie, J.J. Wiltzius, H.T. McFarlane, A.O. Madsen, C. Riekel, and D. Eisenberg. Atomic Structures of Amyloid Cross-ß Spines Reveal Varied Steric Zippers. Nature 447, 453-7 (2007).

Micro-focusing at FMX will yield a beam of 1 µm diameter with an intensity exceeding by an order of magnitude that of comparable instruments elsewhere.

To fully exploit this unique capability and to expand it into the regime of the mini-beam MX beamline, FMX will feature:

- Dedicated mirror and compound refractive lens optics to expand beam up to 50 µm
- Fast framing pixel array detector
- Sub-micrometer precision goniometer
- Six-axis sample-changing robotic system
- Temperature stabilization of optics and equipment to ±0.1 K