Foundations of Structural Biology I: GMS BY 762
Structure Determination by Crystallography and Electron Microscopy

Course Director: Dr. David Atkinson, W302, 8-4015, atkinson@bu.edu

Fall Semester, 2013: Thursday 1:00 – 2:50 pm

Location: R115, except 10/3, 10/10, 11/7 & 11/14 L209

5 September Dr. Atkinson

Introduction, Perspectives and background of structural biology. Symmetry in structural biology

12 September Dr. Atkinson

Fourier Theory in Structural Biology
Waves, Fourier series. Fourier and inverse Fourier Transforms.

19 September Dr. Atkinson

X-ray Crystallography I
Geometrical Diffraction: Lattices, Unit Cells, Crystal Systems, Bragg’s Law, Reciprocal Lattice, Space Groups, von Laue Conditions, Ewald sphere,

26 September Dr. Atkinson

X-ray Crystallography II
Fourier Theory in Diffraction: Importance in Structural methods, Convolution, Correlation

3 October (L209) Dr. Atkinson

X-ray Crystallography III
Fourier Analysis of Scattering and Diffraction: Atomic scattering, form factors, assemblies of atoms, lattices, electron density, Structure factor, Patterson function, resolution, phases and phase problem, symmetry and systematic absences.

10 October (L209) Dr. Rynkiewicz

X-ray Crystallography IV
Protein Crystallization: Preparing proteins; purification, concentrating, storage. Crystal growth: principles and methods, solubility, saturation, nucleation, batch, vapor diffusion and dialysis methods, micro and macro seeding, crystal storage and handling. Crystal soaking: cryo-protectant, heavy atoms, substrates, ligands or inhibitors.

17 October Dr. Rynkiewicz

X-ray Crystallography V

24 October Dr. Rynkiewicz

X-ray Crystallography VI
The Phase Problem: Phase determination: Multiple isomorphous replacement, multiple anomalous dispersion, molecular replacement, direct methods. Phase improvement: Solvent flattening, histogram matching, non-crystallographic averaging.

31 October Dr. Rynkiewicz

X-ray Crystallography VII
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<tr>
<th>Date</th>
<th>Instructor</th>
<th>Topic</th>
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<tr>
<td>14 November (L209)</td>
<td>Dr. Akey</td>
<td><strong>Structural Electron Microscopy II</strong>&lt;br&gt;Radiation Damage, Specimen Preparation and the Projection Theorem: Specimen preparation: thin sections, negative staining and plunge freezing to achieve rapid vitrification. The Projection Theorem and its application to 3D structural analysis of electron micrographs.</td>
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<td>21 November</td>
<td>Dr. Akey</td>
<td><strong>Structural Electron Microscopy Illa</strong>&lt;br&gt;Analysis of Single Particles: The roles of particle symmetry, cross correlation and classification methods in creating 2D averages and class averages.</td>
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<td>5 December</td>
<td>Dr. Akey</td>
<td><strong>Structural Electron Microscopy Illb</strong>&lt;br&gt;3D Analysis of Single Particles: Random conical tilt 3-D reconstruction, Projection matching and 3D reconstruction of particles with low and high symmetry, including viruses.</td>
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<td>12 December</td>
<td>Dr. Akey</td>
<td><strong>Structural Electron Microscopy IV</strong>&lt;br&gt;Analysis of Thin 2-Dimensional Crystals In 2-D and 3-D: 2-dimensional plane groups and electron diffraction. Cross correlation and Fourier methods of averaging crystals. Merging diffraction data to form a 3-D reconstruction. Interpretation and modeling of 3D maps with a short overview of tomography with sub-volume averaging and phase plate imaging.</td>
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