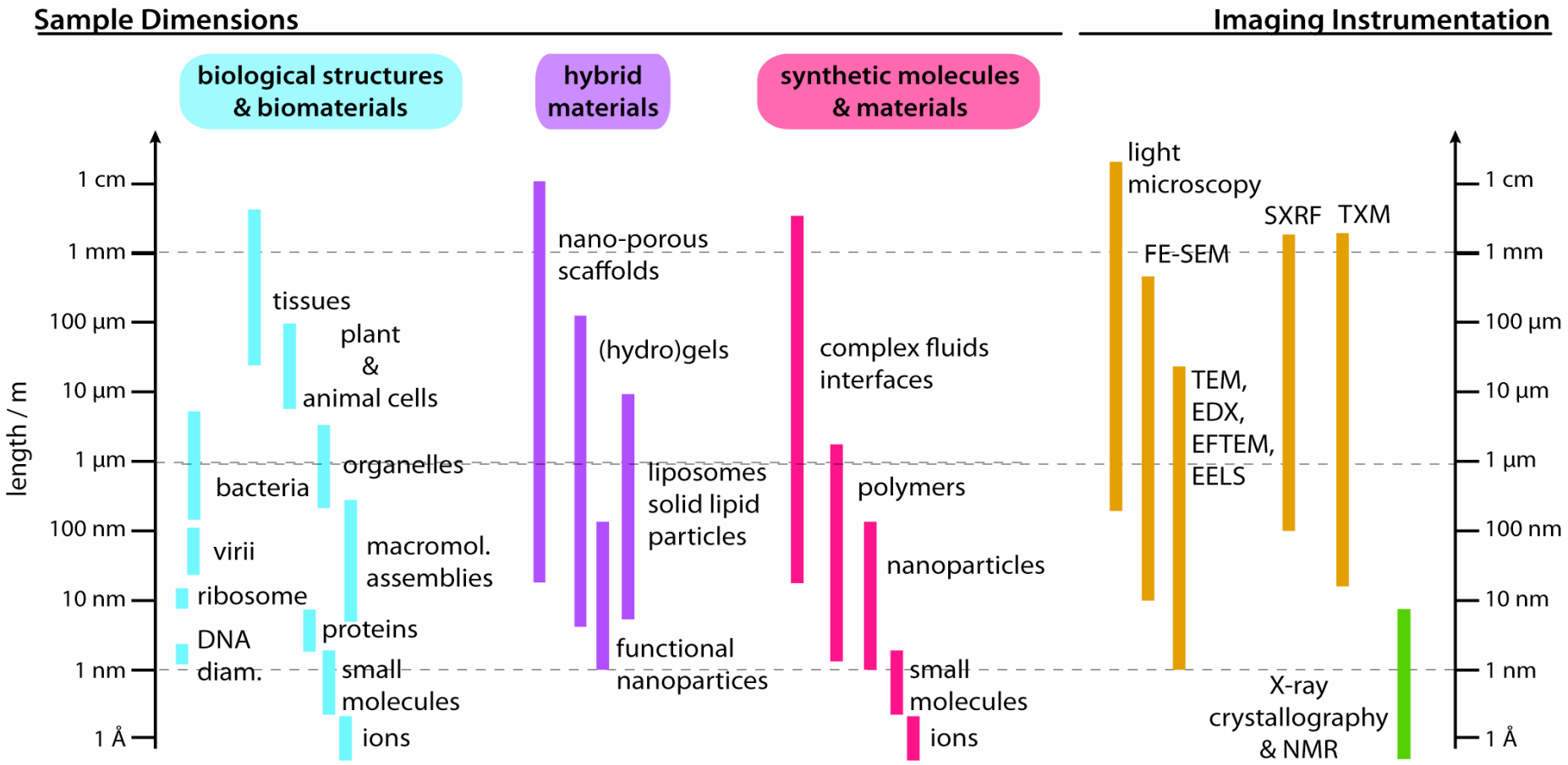
Soft Matter Team

- Ken Shull (Northwestern)
- Gila Stein (NIST, U. Houston)
- Mark Schlossman (UIC)
- Jin Wang (APS)
- Derk Joester (Northwestern)
- Brian Landes (Dow)
- Simon Mochrie (Yale)

Materials and Length Scales



Techniques

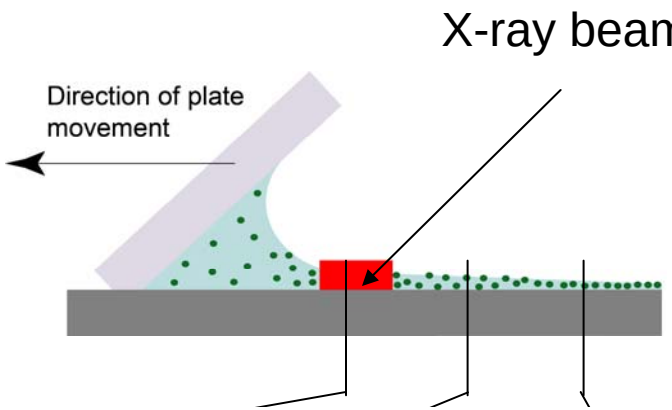
- Small angle x-ray scattering (SAXS):
- Grazing incidence x-ray scattering (GIXS
- x-ray standing waves (XSW)
- x-ray photon correlation spectroscopy (XPCS)
- Synchrotron x-ray fluorecence (SXRF) microscopy
- Transmission x-ray microscopy (TXM)

Science Drivers

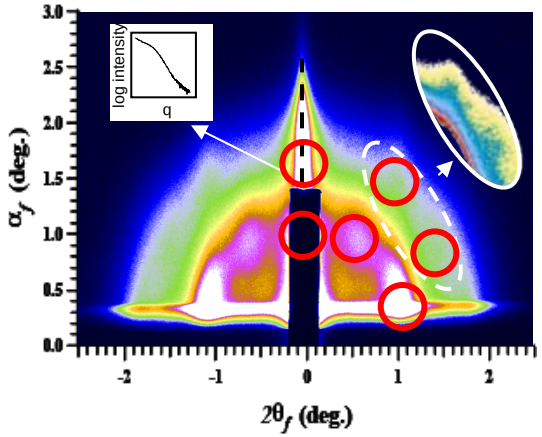
- Surface patterning
  - Block copolymer templating, organic thin films
- Liquid systems
  - Liquid/liquid interfaces, liquid jets, biological processes
- Materials Processing
  - Low-K nanoporous dielectric coatings
- Nanomaterials
  - Nanoparticle contrast agents for imaging

In-situ GISAXS studies of nanoparticle lattice formation

Goal: Use GISAXS to follow the dynamic pathway for rapid NP lattice formation during Evaporation-Induced Self-Assembly

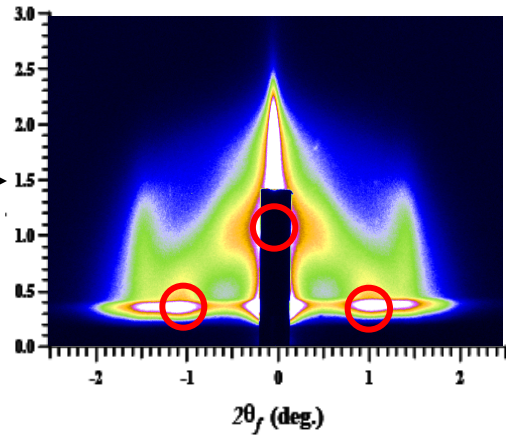


Time resolution = 7 seconds



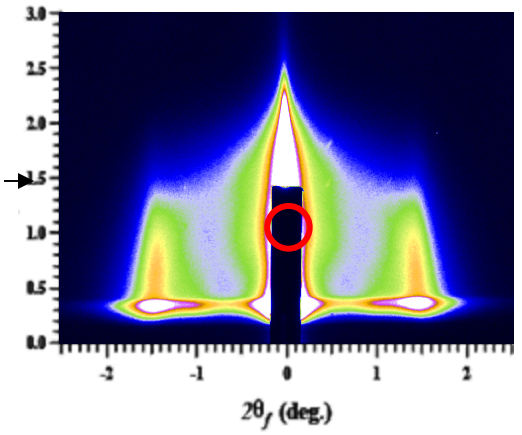
Initial non-close packed (bcc) phase

?



Simple cubic transition state

?



Final close-packed film after drying

Better time resolution is needed to understand the relationship between these lattice structures

Liquid Surface Scattering

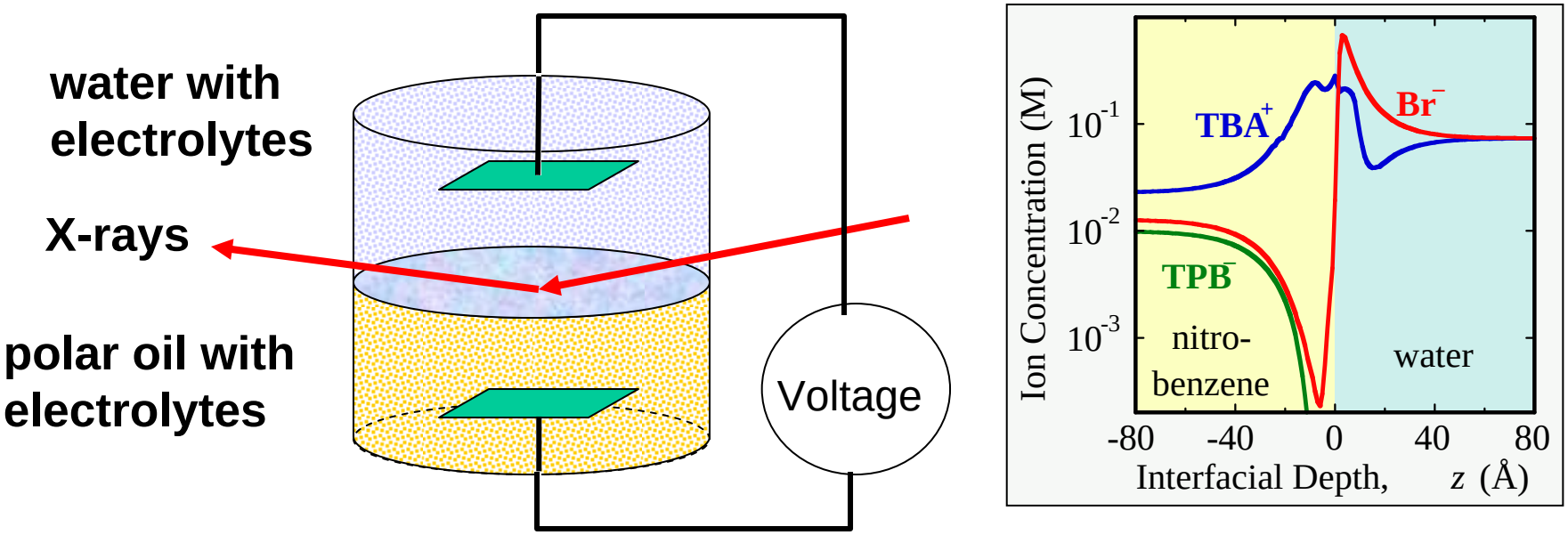
Scientific and industrial relevance in many areas:

<u>Wetting/de-wetting</u>
liquids-on-liquids, liquids-on-solids (coatings, paints), biological cells on wet surfaces
<u>Communities</u>
Chemical engineers, industrial chemists and materials scientists, environmental scientists.

<u>Complex fluids</u>
Surfactant assemblies at interfaces, many domestic products (soaps, detergents, emulsions), oil industry
<u>Communities</u>
Chemical engineers, industrial chemists, materials scientists, and soft matter physicists.

The liquid surface community is poised for growth into new areas

Ion distributions at water-oil interfaces



High energy capabilities of the APS are important for such studies.

Applications

Separation membranes

Extraction processes

Phase transfer catalysis

Sensor design (microfluidics)

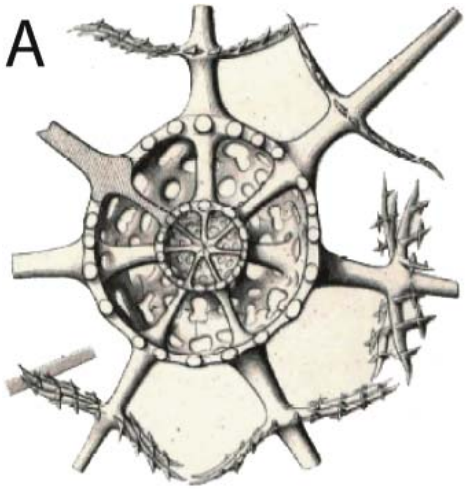
Model for biomembrane processes such as:

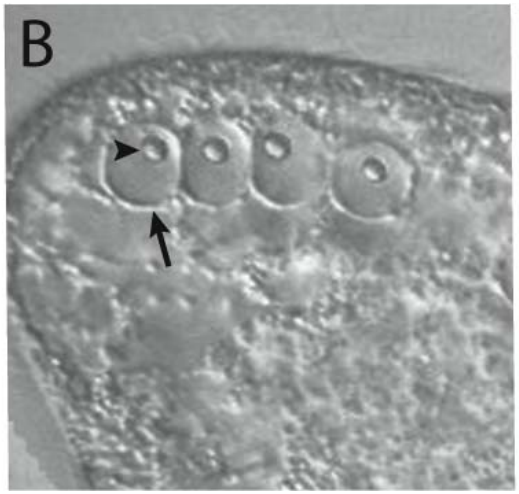
drug transport

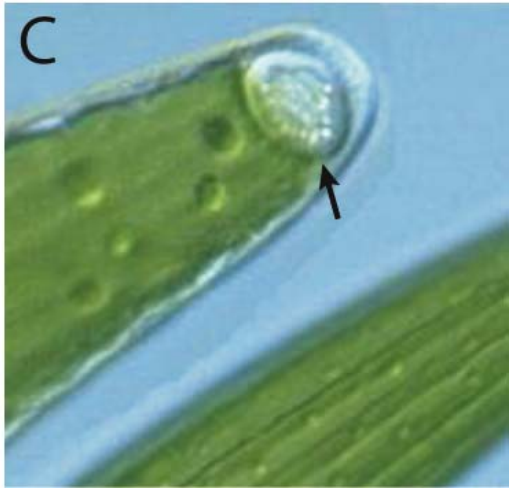
protein-lipid interactions

Bioremediation

^{90}Sr - contaminated
Waste/Water





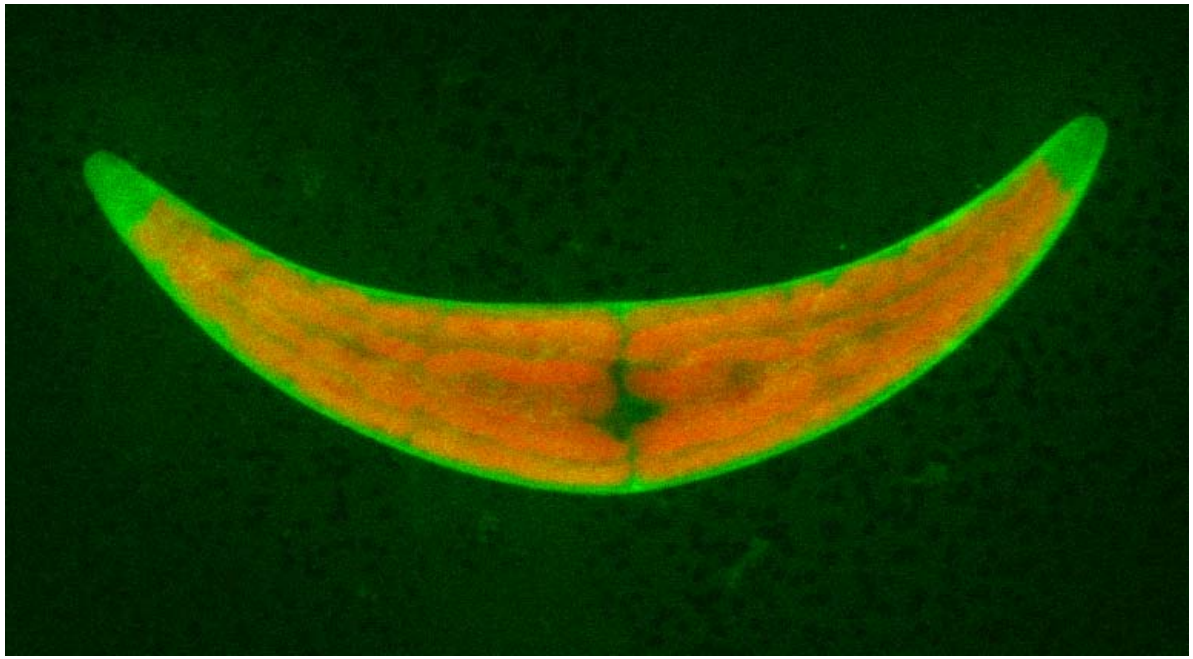


^{90}Sr

Uncontaminated water

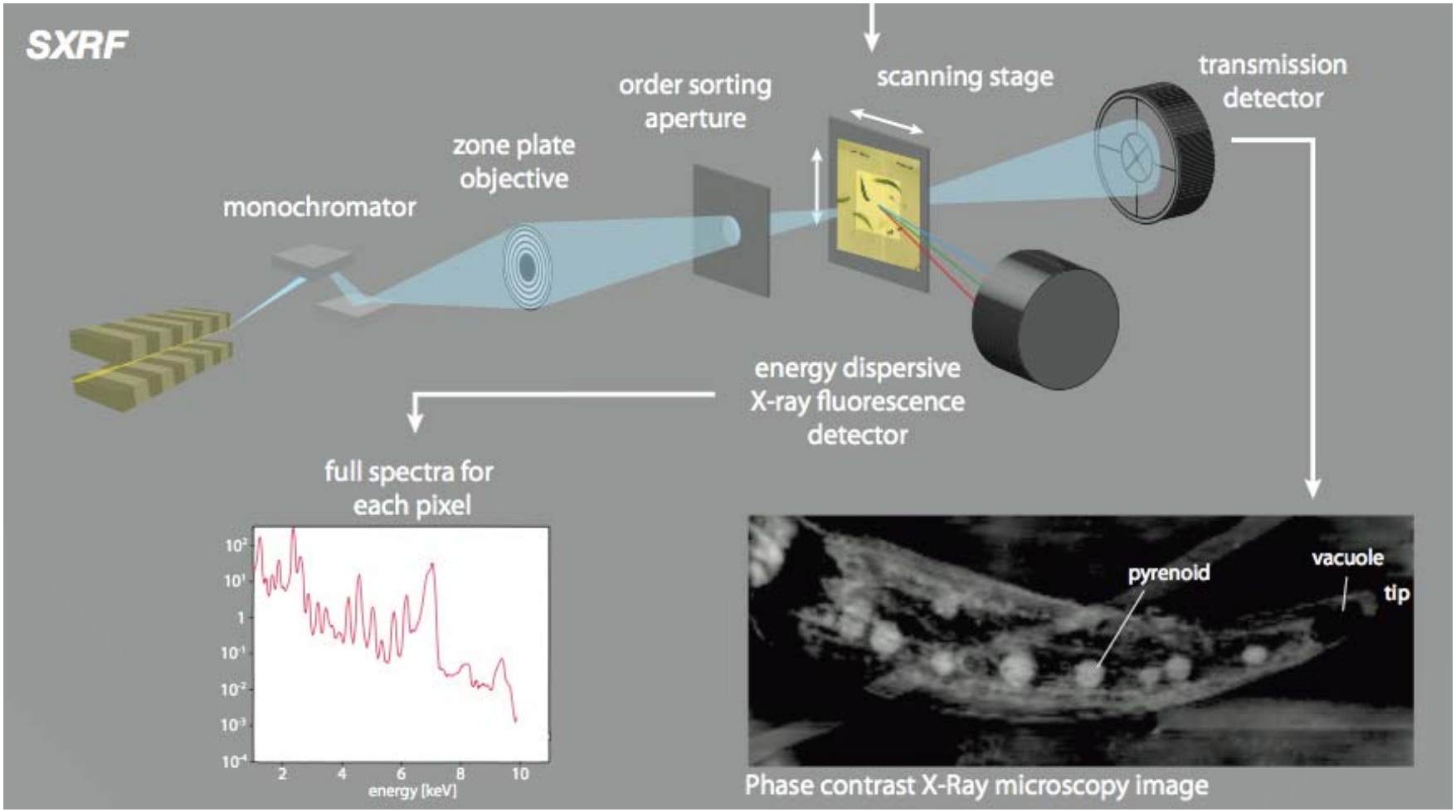
Live Desmids of the Genus *Closterium:*

- green algae that may help remove ^{90}Sr from the environment and radioactive waste.
- transport processes are fast and occur only in the living, hydrated cell.
- No selective fluorescent dyes for Sr or Ba => SXRF critical



Synchrotron x-ray fluorescence microscopy

- Map and quantify elemental distributions
  - Identify cellular trafficking pattern & kinetics for Ca/Sr/Ba-transport



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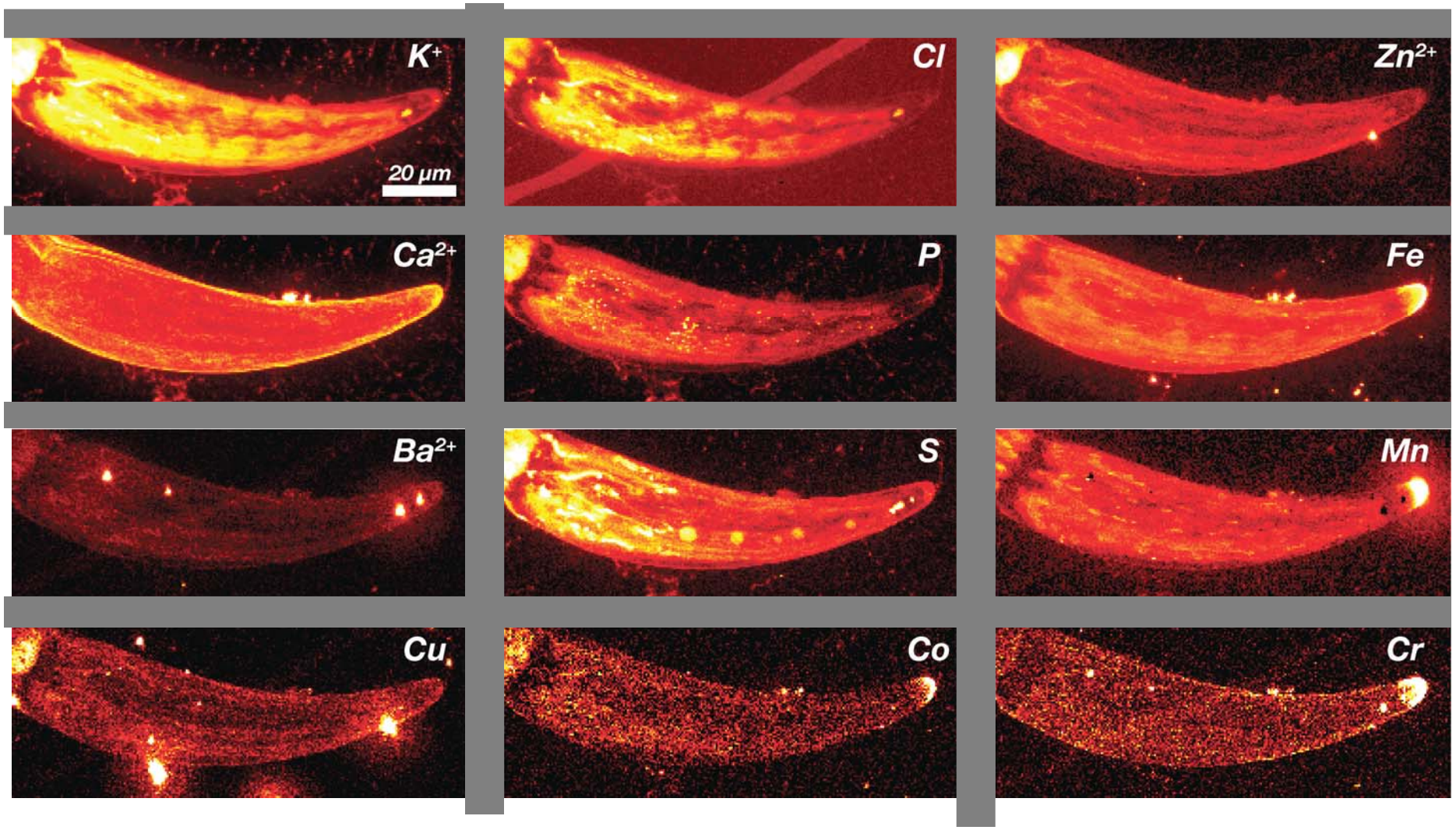
Synchrotron X-ray fluorescence microscopy

*here: cryo-fixed & freeze dried cells - distinct need for **cryo-imaging** and **tomography** capabilities to help identify transport steps*



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Communities

- Environmental Science
- Energy
- Biomaterials
- Materials Science
- Chemistry and Chemical Engineering

Upgrades

- Extended energy range
- Beam focusing
- Cryogenic capabilities
- Time resolution
- Detector resolution

Break-Out Session

- 2:00-2:15 Intro: **Ken Shull**
- 2:15-2:45 Scattering techniques (SAXS, GISAXS, etc.): **Gila Stein**
- 2:45-3:00 APS scattering capabilities: present and future: **Byeongdu Lee**
- 3:00-3:30 Scientific Opportunities in Liquid Surfaces and Interfaces: **Mark Schlossman**
- 3:30-4:00 Imaging (Synchrotron x-ray fluorecence (SXRF) microscopy and transmission x-ray microscopy) **Jin Wang**
- 4:00-4:15 APS imaging capabilities: **Wah-Keat Lee**
- 4:15-5:00 Connection to life science issues, general discussion.