

26 OCT 2022

# eBERlight – a virtual CAT for Biological and Environmental Research community - Update

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Structural Biologist

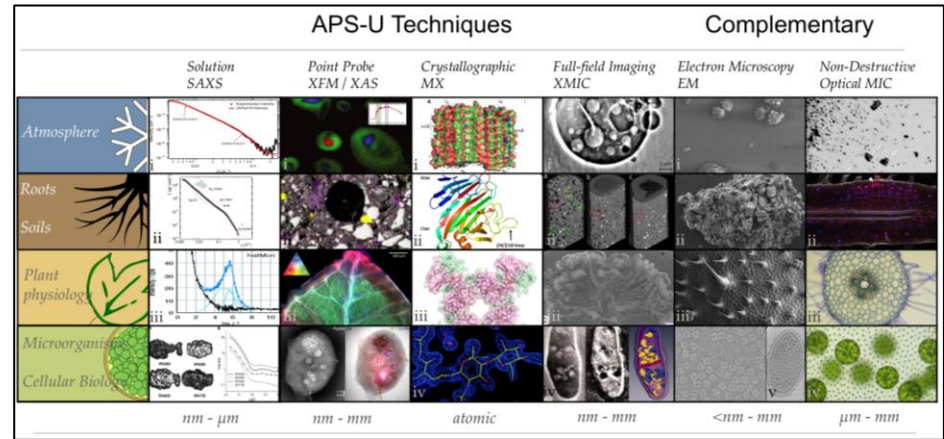
# eBERlight – an APS user program for BER community

## Starting FY24

eBERlight is a program utilizing multiple x-ray techniques to support research within the DOE/Biological Environmental Research mission.

eBERlight will:

- Serve as a liaison between BER researchers and the APS after the upgrade
- Offer dedicated beamtime at several beamlines
- Supported by experts and leverage additional Argonne resources to provide a comprehensive environment for the BER users





Atmosphere



Roots  
Soils



Microorganisms  
Cellular Biology



Plant  
Physiology  
(and  
decomposition)

# eBERlight integration with other DOE/BER programs

**Environmental Molecular Sciences Laboratory (EMSL)**  
Pacific Northwest National Laboratory  
• Cryo-EM  
Contact: James Evans

**Advanced Photon Source (APS)**  
Argonne National Laboratory  
• Structural Biology Center (SBC) – Macromolecular crystallography  
Contact: Andrzej Joachimiak

**National Synchrotron Light Source (NSLS-II)**  
Brookhaven National Laboratory  
• Center for BioMolecular Structure (CBMS) – Macromolecular crystallography, small-angle X-ray scattering/diffraction  
Contact: Sean McSweeney  
• Cryo-EM  
Contact: Ligu Wang

**Advanced Light Source (ALS)**  
Lawrence Berkeley National Laboratory  
• Berkeley Synchrotron Infrared Structural Biology (BSISB) – Fourier transform infrared (FTIR) spectromicroscopy  
Contact: Hai-Ying Holman  
• National Center for X-Ray Tomography (NCKT) – Soft X-ray tomography  
Contact: Carolyn Larabell  
• Structurally Integrated Biology for the Life Sciences (SIBLS) – Macromolecular crystallography, small-angle X-ray scattering  
Contact: Greg Hura

**Stanford Synchrotron Radiation Lightsource (SSRL)**  
SLAC National Accelerator Laboratory  
Stanford University  
• Structural Molecular Biology (SMB) – Macromolecular crystallography, X-ray spectroscopy, small-angle X-ray scattering, microXAS imaging  
Contact: Keith Hodgson  
• Cryo-EM and Tomography  
Contact: Wah Chiu

**Spallation Neutron Source (SNS) and High Flux Isotope Reactor (HFIR)**  
Oak Ridge National Laboratory  
• Center for Structural Molecular Biology (CSMB) – Small-angle neutron scattering, biodegradation  
Contact: Hugh O'Neill

★ DOE Office of Basic Energy Sciences light and neutron facilities  
● Cryogenic electron microscopy (Cryo-EM) facilities

[berstructuralbioportal.org](http://berstructuralbioportal.org)

February 2020

**Joint BioEnergy Institute**  
Lawrence Berkeley National Laboratory (Berkeley, California)

**Great Lakes Bioenergy Research Center**  
University of Wisconsin (Madison)  
Michigan State University (East Lansing)  
Michigan Technological University (Houghton)  
Texas A&M University (College Station)  
University of British Columbia (Vancouver, Canada)

**Center for Bioenergy Innovation**  
Oak Ridge National Laboratory (Oak Ridge, Tennessee)  
Colorado State University (Fort Collins)  
Dartmouth College (Hanover, New Hampshire)  
GreenWood Resources, Inc. (Portland, Oregon)  
Massachusetts Institute of Technology (Cambridge)  
National Renewable Energy Laboratory (Golden, Colorado)  
Nidhe Research Institute (Ardmore, Oklahoma)

**The Pennsylvania State University**  
State College  
University of California (Riverside)  
University of Colorado (Boulder)  
University of Georgia (Athens)  
University of North Texas (Denton)  
University of Tennessee (Knoxville)  
University of Wisconsin (Madison)  
West Virginia University (Morgantown)

**Center for Advanced Bioenergy and Bioproducts Innovation**  
University of Illinois (Urbana-Champaign)  
Auburn Biological Station (Venus, Florida)  
Boston University (Massachusetts)  
Brookhaven National Laboratory (Upton, New York)  
Colorado State University (Fort Collins)  
HudsonAlpha Institute for Biotechnology (Plantville, Alabama)  
Institute for Systems Biology (Seattle, Washington)  
Iowa State University (Ames)  
Lawrence Berkeley National Laboratory (Berkeley, California)  
Mississippi State University (Starkville)  
Princeton University (New Jersey)  
Texas A&M University (College Station)  
University of Florida (Gainesville)  
University of Idaho (Moscow)  
University of Nebraska (Lincoln)  
University of Wisconsin (Madison)  
U.S. Department of Agriculture Agricultural Research Service (Painesville, Louisiana; Peoria and Urbana, Illinois)  
West Virginia University (Morgantown)

● Joint BioEnergy Institute led by Lawrence Berkeley Laboratory (Berkeley, California)  
● Great Lakes Bioenergy Research Center led by the University of Wisconsin—Madison  
● Center for Bioenergy Innovation led by Oak Ridge National Laboratory (Oak Ridge, Tennessee)  
● Center for Advanced Bioenergy and Bioproducts Innovation led by the University of Illinois at Urbana-Champaign

Bioenergy research centers



# eBERlight – update since April 2022

- eBERlight was presented to several DOE/BER managers (July 21) and received positive response
- Reports to BES received similar feedback
- Signed Memorandum of Understanding between APS/eBERlight and LS-CAT
- Received an official eBERlight proposal invite from BER
  - due Jan 13, 2023, on-site review March 23, 2023
- Ongoing outreach effort
  - Advanced Photon Source capabilities for bioenergy research, GLBRC Annual Meeting, May 17-19, 2022 (KM, ZF)
  - SBC presentation at the APS Upgrade Structural Biology Virtual Town Hall Meeting, Jun 21, 2022 (KM)
  - Advanced Photon Source capabilities for biological and environmental science, Plant Biology, Portland July 9-13, 2022 (ZF)
  - Advanced Photon Source capabilities for biological and environmental science, EMSL, PNNL, Aug 3, 2022 (KM)
  - Dynamic and Serial Crystallography: Time-Resolved  $\beta$ -lactam Cleavage by L1 Metallo- $\beta$ -Lactamase EMSL, PNNL, Aug 3, 2022 (AJ)
  - American Crystallographic Association annual meeting, Portland, Jul 29 - Aug 3, 2022 (RF, KM)
  - eBERlight - a virtual facility for biological and environmental science, Pittsburg Diffraction Conference, Oct 2-4, 2022 (KM)
  - Advanced Photon Source capabilities for biological and environmental science, EMSL Integration meeting, Oct 4-6, 2022 (ZF)
  - Direct communication with individual researchers
- Discussion with the User Office how to incorporate eBERlight into the UPS
- IT infrastructure
- Ongoing pilot projects (individual researchers or via collaboration with BER facilities)

# eBERlight supported science

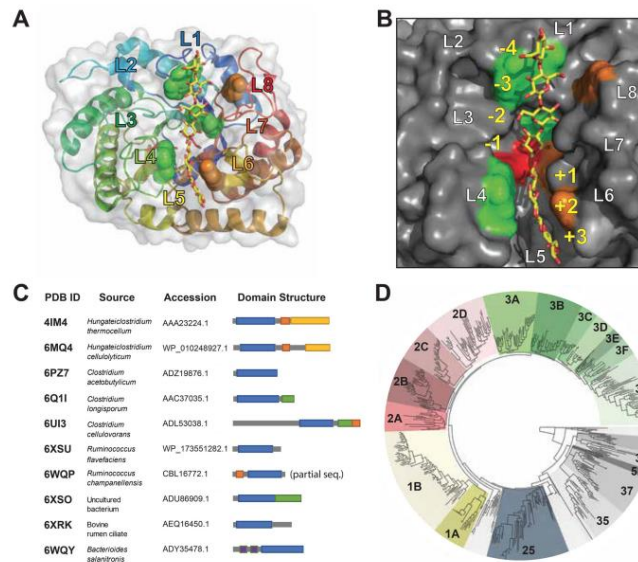
Plant  
Physiology  
(and decomposition)



PI: Brian Fox (UW)

## Serial and dynamic crystallography of endoglucanases

- Biotechnological degradation and conversion of biomass into commodities relies on enzyme-catalyzed processing
- Enzymes have not been optimized for industrial applications
- Utilize dynamic MX for catalysts engineering



Glasgow et al, 2020

# eBERlight supported science

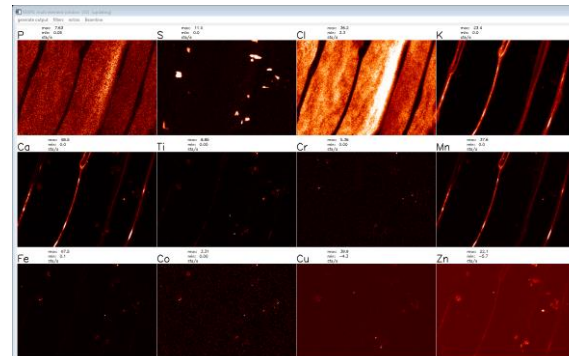
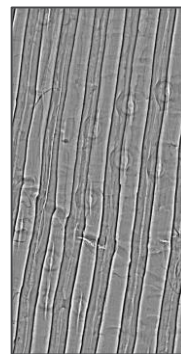
*Plant  
Physiology  
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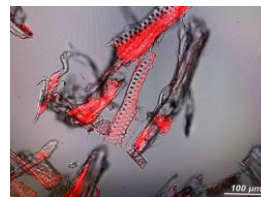
**PI: Emma Master (UToronto)**

## Functional and structural analysis of microbial expansin - related proteins that transform lignocellulosic biomass

- Expansins are small proteins that loosen plant cell walls
- Potential application in industrial biomass processing
- Understand expansins role in wood degradation utilizing quantum dots (with CNM), XRF and ptychography



Fly13, 35x30 um, 0.1 um step, 100 ms dwell



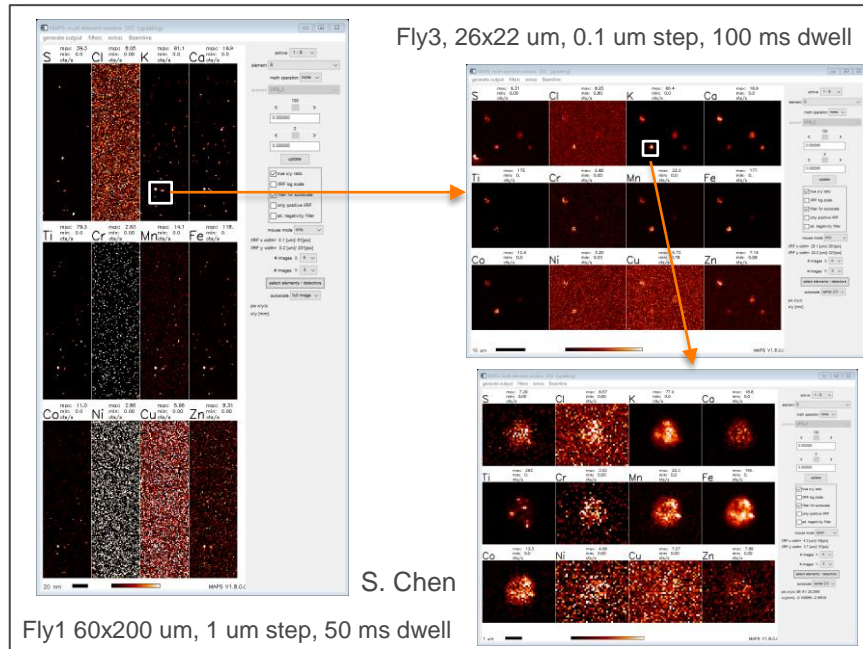
Q. Jin, G. Babnigg, S.Chen, J. Deng



PI: Swarup China (PNNL)

### Multiscale insights into the vertical distribution of biological particles and their potential for ice cloud formation at the Southern Great Plains

- Ice clouds play a role in climate system
- Their formation via heterogenous ice nucleation in poorly understood
- Investigate complexity of ice nucleating particles via SAXS and XRF





# eBERlight supported science

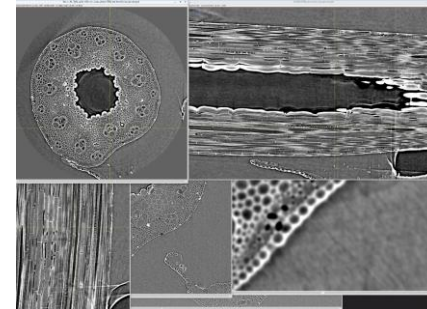
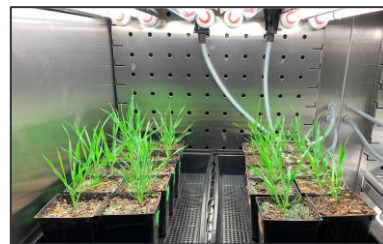
Plant  
Physiology  
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PI: Andrei Smertenko (WSU)

Comparative systems analysis of bioenergy grass internode development for biofuel production in marginal environments

- Grass internodes are the main source of lignocellulosic biomass
- Poorly understood molecular functions linked to specific phenotypes
- Investigate molecular basis of the internode development and growth and relationship between cellular architecture and drought tolerance
- Image internodes under drought and normal conditions by CT and XRF



T. Varga, G. Babnigg, V. Nikitin, P. Shevchenko C. Chang, Z. Finfrock

# eBERlight supported science

Roots

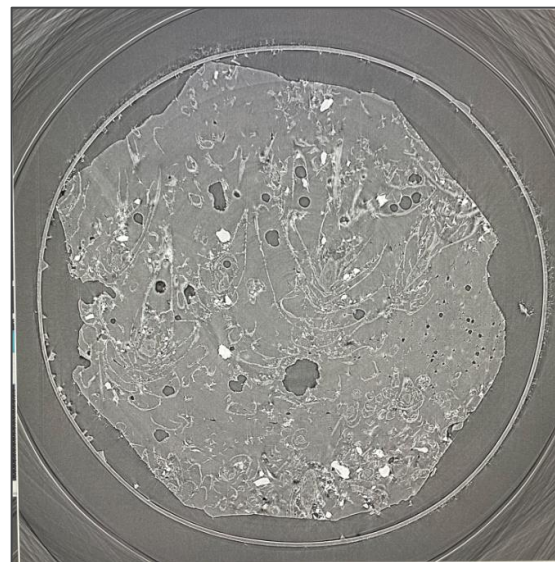
Soils



PI: Karen Lloyd (UTennessee)

**Using culture-independent methods to link active compound-specific carbon degradation to greenhouse gas production and recycling in natural populations of permafrost microbes**

- Permafrost is one Earth's largest reservoirs of soil organic carbon
- Environmental impact of its thawing depends on microbial metabolic processes
- Assess microbial and biogeochemical dynamics and its nutrient dependence by CT and XRF



Z. Finrock, A. Lavens, V. Nikitin, P. Shevchenko

# Dark period activities

## TRANSITION PERIOD (APR 2023 – APR 2024)

- Close down of SBC operation (Apr 2023 – Sep 2023)
  - Moveout of SBC 19ID
  - Equipment transfer (surplus or re-purpose)
  - Completion of the SBC collaborative projects
  - Summer students to engage with eBERlight IT activities
- Starting up eBERlight operation (Oct 2023 – Apr 2024)
  - IT developments
  - User program
  - Beamline R & D activities
  - Outreach

# Dark period activities

## STARTING UP EBERLIGHT OPERATION (OCT 2023 - APR 2024)

- Software
  - LIMS system development
  - eBERlight portal/website development
  - Integration of eBERlight database/system with other BER facilities (JGI, EMSL...)
- User program
  - Install data analysis software, training staff for data analysis (could extend to users)
  - Scientific Advisory Committee (SAC)
- Outreach & training
  - Attending conferences, increasing eBERlight publicity
  - Developing BER supported user community
  - Training session on sample preparation and data analysis for pilot BER users
- Beamline R & D
  - Integration of SBC equipment with other beamlines infrastructure
  - Enhancement of current sample environments and sample handling capabilities to better accommodate BER type experiments
- Staff recruitment and training

## EBERLIGHT ACTIVITIES (MAY 2024 - JUL 2024)

- Commissioning of MX equipment at LS-CAT
- Reinitiating of eBERlight pilot projects

# eBERlight calls for proposals

Discussions with the User Office on how eBERlight can be incorporated into the Universal Proposal System

Current ideas (subject to change):

- eBERlight calls will be concurrent with the APS calls
- Proposals will follow the GUP guidelines for submission
- eBERlight staff will do the technical review of submitted proposals
- GUP review and scoring, eBERlight proposals captured by the team and allocated beamtime within the eBERlight-allocated CAT time

# Facilities Integrating Collaborations for User Science (FICUS)



## FICUS Program Information

The Facilities Integrating Collaborations for User Science (FICUS) program was created in 2014 to accelerate ambitious user research projects. The program, spearheaded by EMSL and the [Joint Genome Institute \(JGI\)](#), provides researchers with access to the world-class resources of multiple user facilities through a single proposal. The program has expanded to include several other user facilities.

Through [FICUS proposal call for Fiscal Year 2023 with EMSL and JGI](#), users had access to EMSL, JGI, the [National Ecological Observatory Network \(NEON\)](#) and the [Bio-SANS beamline at the High Flux Isotope Reactor \(HFIR\)](#) through the [Center for Structural Molecular Biology \(CSMB\)](#). A [separate FICUS call](#) provides access to EMSL and the [Atmospheric Radiation Measurement \(ARM\)](#) user facility.

## Submitting a FICUS Proposal

FICUS proposal calls are usually announced in January of each year. Visit the [Proposal Calls](#) page to see open calls. You can also view recent FICUS Proposal Calls:

- [Call for FICUS Research Proposals with ARM and EMSL, FY2023](#)
- [Call for FICUS Research Proposals with EMSL and JGI, FY2023](#)
- [Call for FICUS Research Proposals with JGI and EMSL, FY2022](#)
- [Call for FICUS Research Proposals with ARM and EMSL, FY2022](#)
- [Call for FY2021 Letters of Intent for FICUS Research](#)

In preparation for FY24 call,  
to be announced in January

eBERlight will offer MX,  
imaging and microscopy  
with beamtime allocations  
for FY25

# Acknowledgements

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Shelly Kelly  
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