

X-ray Crystallography and Automated Biological Calorimetry Facilities Newsletter - Spring 2022

1. SEC-MALS and BioSAXS installations is complete. Training available: Feb. 4th, 18th & 25th, 3-4 pm.
2. Highlights from recent applications using SEC-MALS in-line with BioSAXS
3. Free training session for CD and ITC March 1st, 1-3pm.
4. Good score received on NIH grant application for Beckman Optima Multiwavelength Analytical Ultracentrifuge. Installation and training in 2022!
5. Installation of new NIH funded X-ray instrumentation for crystallography and biological small angle X-ray scattering is complete.
6. Recent publications

1. SEC-MALS-DLS & SAXS at-a-glimpse

What: Free introduction sessions
Where: 8 Althouse Lab
When: Feb 4, 3-4pm SEC-MALS
Feb 18, 3-4pm NanoStar DLS
Feb 25, 3-4pm BioSAXS

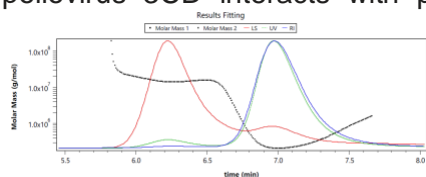


Contact Julia Fecko jaf48@psu.edu

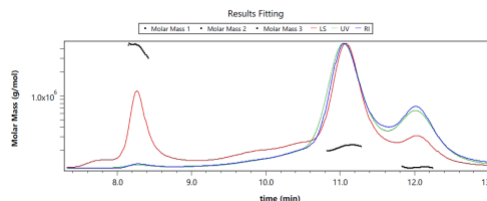
Our latest NIH funded grant has enabled purchase of a Wyatt Technology DLS multi angle light scattering (MALS) equipment in-line with size exclusion chromatography (SEC). Allows for valuable information about accurate size, molecular weight, and stoichiometry data on a host of disease related biomolecules, viral and bacterial proteins, motor, nucleosome and intrinsically disordered proteins, nucleic acids, liposomes and their complexes. Schedule your experiment today.

2. Studying fractions from SEC-MALS-DLS-RI with bioSAXS

Dennis Winston (Boehr Lab)- The goal of my project is to determine how the 3C protease domain of poliovirus 3CD interacts with phosphoinositide-enriched membranes, which may be important for understanding regulation of protein function throughout the viral life cycle. To study these interactions, I am using lipid nanodiscs as a model system for NMR. I am also using SEC-MALS followed by SAXS to characterize the size and shape of nanodiscs with different lipid compositions.



Maddy Helm (Weinert Lab) - My research focuses on characterizing a class of heme proteins called globin-coupled sensors (GCS). GCS proteins are widely distributed in bacteria and contain a heme-sensor domain that is linked to an output domain that can regulate diverse functions, such as biofilm formation and degradation. GCS proteins' heme-sensor domain can sense gaseous ligands (oxygen, nitric oxide, and carbon monoxide) to turn on or turn off the output domains' function. I use biochemical, spectroscopic, and structural techniques to understand how the GCS protein from *Klebsiella variicola* catalyzes the formation of the bacterial second messenger cyclic-di-GMP and impacts pathogenesis. We use the SEC-MALS to obtain the molecular weight and oligomerization states of GCS proteins. The fraction collector was used to obtain sample for further exploration using bioSAXS.



3. Free training session on the CD and ITC

What: CD and ITC training session

Where: 8 Althouse Lab

When: March 1st 1-3pm

Contact Julia Fecko jaf48@psu.edu to reserve your spot

Jasco J-1500 Circular Dichroism Spectrometer Chiroptical spectroscopy is one of most important techniques for the characterization, determination of absolute configuration and stereochemical analysis of biomolecules. CD measurements in the far UV can give quantitative estimates of secondary structure.



TA instruments Affinity auto ITC



If you would like to learn more about how the automated calorimetry equipment works, we welcome you to attend a free training session. You will be instructed on proper sample preparation techniques, how to use the “Design of Experiments” feature of origin software in order to get optimal starting concentrations. This is a great opportunity for beginners interested in obtaining the thermodynamic profile of the binding partners of interest including small molecules and macro molecules.

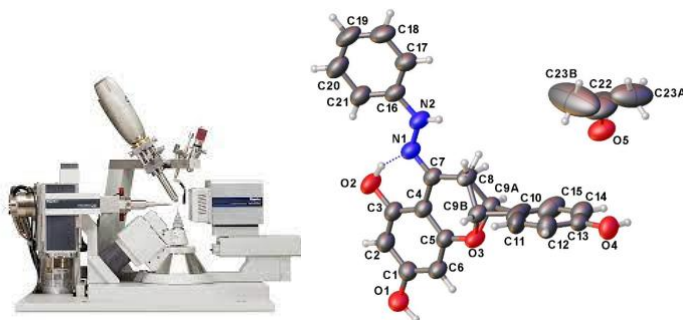
4. Beckman Optima Analytical Ultracentrifuge coming in 2022

Our latest NIH grant for procuring the multiwavelength Beckman Optima analytical ultracentrifugation scored high. This will enable characterization of samples in their native state under biologically relevant solution conditions. AUC is the most versatile, rigorous and accurate technology available for determining the hydrodynamic shape, size, molar mass, and binding thermodynamics of any macromolecule and its complexes. We will have more details coming soon.



5. Crystal structures being solved with the NIH funded Rigaku HyPix-Arc 150° detector suitable for both small and macromolecular X-ray crystallography - contact Dr. Hemant Yennawar hpy1@psu.edu

The crystal structure of 5,7,4'-trihydroxyflavanone-N-phenyl hydrazone, a hydrazone naringenin derivative (crystals submitted by Dr. Anna Sigmon, Penn State Brandywine) which has been reported to induce apoptosis in human cervical cancer cells. Naringenin is a naturally occurring flavanone compound found in citrus fruits, bergamot and tomatoes, reported to have a wide range of biological activities, including anti-viral, anti-inflammatory and anti-aging properties.



6. Recent co-authored publications

1. Esakova, OA, Grove, TL, Yennawar NH, Arcinas AJ, Almo SC and Squire J. Booker (2021), **Structural basis for tRNA methylation by the radical S-adenosylmethionine enzyme MiaB**, *Nature*, Sep;597(7877):566-570.
2. Yennawar HP, Medica JJ, Silverberg LJ. (2021) **Synthesis and Crystal structure of racemic (R*,R*)-2,2'-(1,4-phenyl-ene)bis-(3-phenyl-2,3,5,6-tetra-hydro-4H-1,3-thia-zin-4-one)**. *Acta Cryst. E Crystal. Commun.* Nov 9;77(Pt 12):1263-1266
3. Silverberg LJ, Mal TK, Pacheco CN, Povelones ML, Malfara MF, Lagalante AF, Olsen MA, Yennawar HP, Sobhi HF, Baney KR, Bozeman RL, Eroh CS, Fleming MJ, Garcia TL, Gregory CL, Hahn JE, Hatter AM, Johns LL, Klinger TL, Li JJ, Menig AJ, Muench GC, Ramirez ME, Reilly J, Sacco N, Sheidy AM, Stoner MM, Thompson EN, Yazdani SF(2021), **T3P-Promoted Synthesis of a Series of 2-Aryl-3-phenyl-2,3-dihydro-4H-pyrido[3,2-e][1,3]thiazin-4-ones and Their Activity against the Kinetoplastid Parasite *Trypanosoma brucei***, *Molecules*, Oct 9;26(20):6099
4. Chatterjee D, Wittmeyer K, Lee TF, Cui J, Yennawar NH, Yennawar HP, Meyers BC, Chopra S. (2021) **Maize unstable factor for orange1 is essential for endosperm development and carbohydrate accumulation**. *Plant Physiol.* Aug 3;186(4):1932-1950.
5. Bansia H, Mahanta P, Yennawar NH, Ramakumar S. (2021) **Small glycols discover cryptic pockets on proteins for fragment-based approaches**. *J Chem Inf Model.*, Mar 22;61(3):1322-1333.
6. Dayna C. Patterson, Myrhh Perez Ruiz, Hyerin Yoon, Johnnie A. Walker, Jean-Paul Armache, Neela H. Yennawar* and Emily E. Weinert (2021), **Differential ligand-selective control of opposing enzymatic activities within a bifunctional c-di-GMP metabolic protein**, *Proc. Natl. Acad. Sci.*, Sep7;118(36):e2100657118.
7. Yifan Xu, Rui Zu, Neela H. Yennawar, Venkatraman Gopalan, Robert J. Hickey (2021), **Cocrystalline Polymer Films Exhibiting Second-Order Nonlinear Optical Properties**, *ACS Macro Lett*, 10, 1216-1222. DOI: 10.1021/acsmacrolett.1c00345
8. Dayna C. Patterson, Yilin Liu, Sayan Das, Neela H. Yennawar, Jean-Paul Armache, James R. Kincaid, and Emily E. Weinert, (2021), **Heme-Edge Residues Modulate Signal Transduction within a Bifunctional Homo-Dimeric Sensor Protein**. *Biochemistry*. 2021 Dec 14;60(49):3801-3812. doi: 10.1021/acs.biochem.1c00581. Epub 2021 Nov 29. PMID: 34843212.
9. Jungjin Yoon, Yuchen Hou, Abbey Marie Knoepfel, Dong Yang, Tao Ye, Luyao Zheng, Neela Yennawar, Mohan Sanghadasa, Shashank Priya, Kai Wang (2021), **Bio-inspired strategies for next-generation solar mobile power sources**, *Chem Soc Rev*. Nov 29;50(23):12915-12984.
10. Barber GD, George C, Hogg K, Johnstone ST, Pacheco CN, Yennawar HP, Van Der Sluys WG. (2020) **Hydrothermal Synthesis and Structure of a Dinuclear Molybdenum(III) Hydroxy Squarate with a Mo-Mo Bond**. *ACS Omega*. Feb 28;5(9):4668-4672.
11. Hoelzel CA, Hu H, Wolstenholme CH, Karim BA, Munson KT, Jung KH, Zhang H, Liu Y, Yennawar HP, Asbury JB, Li X, Zhang X. (2020) **A General Strategy to Enhance Donor-Acceptor Molecules Using Solvent-Excluding Substituents**. *Angew Chem Int Ed Engl*. Mar 16;59(12):4785-4792.
12. Kim SA, Zhu J, Yennawar N, Eek P, Tan S, (2020) **Crystal structure of the LSD1/CoREST histone demethylase bound to its nucleosome substrate**. *Mol Cell*. Jun 4;78(5):903-914.

Recent Facility Acknowledgements

1. **Long Tracts of Guanines Drive Aggregation of RNA G-Quadruplexes in the Presence of Spermine** Allison M Williams, Raghav R Poudyal, Philip Bevilacqua. (2021) *Biochemistry*. Sep 14;60(36):2715-2726.
2. **Energy and Enzyme Activity Landscapes of Yeast Chorismate Mutase at Cellular Concentrations of Allosteric Effectors**. Gorman SD, Boehr DD. (2019) *Biochemistry*. Oct 1;58(39):4058-4069.

Contact us

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Automated Biological Calorimetry: <http://www.huck.psu.edu/facilities/calorimetry-up>

X-ray Crystallography: <https://www.huck.psu.edu/core-facilities/x-ray-crystallography-facility>