Unravelling The Dynamics of Biomolecules by Serial Crystallography At X-Ray Free Electron Lasers

Petra Fromme[1]
[1]*Arizona State University*
pfromme@asu.edu

New avenues for structural discovery of the function and dynamics of biomolecules have been opened by X-ray Free Electron Lasers (XFELs) by Serial Femtosecond Crystallography (SFX). SFX provides a novel concept for structure determination, where X-ray diffraction "snapshots" are collected from a fully hydrated stream of nanocrystals, using femtosecond pulses from high energy X-ray free-electron lasers (XFELs) [1-4]. The XFEL pulses are so strong that they destroy any solid material, but a femtosecond is so short (1 fs =10 -15s) that X-ray damage is diminished and diffraction from the crystals is observed before destruction takes effect [3]. Structural Biology with X-ray Free electron lasers allows for data collection at near physiological conditions at room temperature [5-13] thereby opening new avenues for the study of light-driven systems in pump probe experiments [7-12] as well as the study of medical important proteins that could enhance structure-based drug design with SFX studies [5,13]. The talk will give an overview of XFEL studies on medical important proteins, including the XFEL studies on the SARS-CoV2 protein NendoU that hides the virus from the immune system [14] (Figure 1). The talk will also report on our most recent time- resolved studies on light-driven systems including Photosystem I and II and give an overview of the development of compact X-ray Free electron Lasers and their future impact for Structural Biology.

References
{1} Chapman,HN et al 2011, Nature, 470, 73-77 ;
{2} Fromme P and Spence JC, 2011 Curr Opin Struct Biol 2011, 21: 509-516;
{3} Barty A et al. 2012, Nature Photonics 6, 35–40
{4} Boutet S et al. 2012, Science, 337: 362-364
{5} Liu W et al. 2013, Science 342: 1521-1524
{6} Aquila,A et al. 2012, Optics Express, 20 (3), 2706-16
{7} Kupitz C et al. 2014, Nature 513, 261-5
{8} Suga M et al. 2017, Nature 543, 131-135
{9} Ibrahim M et al. 2020, PNAS 117 (23), 12624-12635
{10} Li H et al. (2021), IUCrJ 8 (3) 431-443
{11} Gisriel C et al. 2019, Nature Communications 10(1), 5021
{12} Pandey S et al. (2020), Nature Methods, 17(1), pp.73-78
{13} Pandey S et al. (2021), IUCrJ 8(Pt 6): 878-895
{14} Jernigan R et al (2023) Structure, 31, Issue 2: pp 138-151.e5

This work is supported by the National Science Foundation BIOXFEL STC (NSF-1231306) and NSF RAPID IIBR 2031343 grant, the National Institute of General Medical Sciences grant R01 GM095583 and the Biodesign Institute at Arizona State University

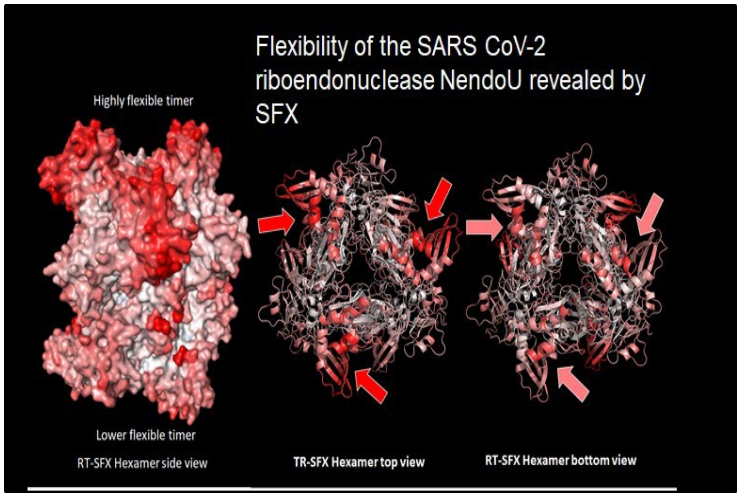

Figure 1