Advanced Photon Source Operation During the COVID-19 Pandemic[1]

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Workshop on Accelerator Operations

5th-8th October 2021 (Virtual event)

To be published at the Workshop on Accelerator Operations

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Remote operation, teleworking, and social distancing are just a few new concepts that have changed the way we are now operating. New policies and procedures upgrades are in place that have had an impact not only on operations, but also on how maintenance activities and user interactions take place. Detailed herein are experiences and adjustments at the Advanced Photon Source (APS) of Argonne National Laboratory in response to the COVID-19 pandemic.

Laboratory First Reaction

You can imagine how people around the world took the news that we are in a pandemic. In the United States, the Center for Disease Control (CDC) announced to the public that we were dealing with a virus called SARS-CoV-2, which caused the coronavirus disease 2019 or COVID-19. The virus is currently thought to spread between people who are in close contact with one another (within about 6 feet for at least 10 minutes) via respiratory droplets produced when an infected person coughs or sneezes. These droplets can land in the mouths or noses of people who are nearby or possibly be inhaled into the lungs. A person might also contract COVID-19 by touching a surface or object that hasthe virus on it and then touching their own mouth, nose, or eyes; however, this is not thought to be the main way that the virus spreads.

Upon digesting this information and its impact, Argonne, like businesses and organizations throughout the world, took immediate action. Argonne announced on its website that, “Access is suspended for all users, visitors, and guests starting Tuesday, March 17, 2020”, with some exceptions. “If you are not an Argonne employee, please cancel travel to Argonne during the 30-day period beginning March 17, 2020.”

Pandemic Response

All work and operating activities must now defer to new guidance, rules, and regulations enacted by the Department of Energy, Argonne National Laboratory, and the Advanced Photon Source regarding the standard for how operations are to be conducted during the SARS-CoV-2 (COVID-19) pandemic. All employees and contractors will practice social distancing, hand washing, equipment disinfection, and PPE (personal protective equipment) guidelines, as detailed by ANL/APS.

Work Standards

How to Plan and Execute Work (Work Planning and Control)

This is a resource to support work planning and control (WPC). Argonne plans, controls, and executes work according to the Integrated Safety Management (ISM) System core functions and guiding principles; applying guidance and best management practices.

New Hazard Assessment and Controls

The "Hazard Assessment and Controls to Reduce Potential Exposure to SARS-CoV-2 (COVID-19)" checklist was created to help workers (1) identify base-level work practices and controls to follow, (2) identify additional controls when social distancing cannot be maintained, and (3) document that a hazard assessment was performed. It can be used to brief workers on the additional COVID-19 controls required for the work task and, as applicable, be attached to a work control document or equivalent as supplemental requirements. The briefing must be recorded using this document or another method using the content of this document. All on-site work, other than office work, must be re-authorized.

Research Activities

Researchers from across the country use the Advanced Photon Source's ultra-bright, high-energy x-rays to determine the protein structures of many viruses. For example, research conducted at the APS has also directly led to two Nobel Prizes and contributed to a third. Most recently, the APS made significant contributions in the fight against COVID-19. Its beamlines are involved in research to both identify the protein structures of the virus and find potential pharmaceutical treatments and/or vaccines.Such work makes clear the ongoing importance of x-ray light sources, like the APS, in solving critical problems for our world.

COVID-19 Research

Argonne scientists and research facilities have helped track, treat, and stop the spread of the global pandemic. In 2020 the lab faced the COVID-19 pandemic by uniting, adapting, and leading at a time of greatuncertainty. Argonne scientists joined the fight against the coronavirus. The lab's research played acrucial role in helping better understand the underlying mechanisms of the SARS-CoV-2 virus, identifying potential drug targets, modeling the spread of COVID-19 and the effectiveness of preventative measures, and providing government leaders with the tools they needed to ensure that supply chains and infrastructure remained intact during a pandemic.

These accomplishments are now part of the lab's remarkable, distinguished history, and something we can celebrate — *together.*

(See Attached Poster)

APS Main Control Room Operation

The past year has been challenging for so many of us, and we've had so many ups and downs, but through it all we've adapted and grown stronger as a community. The Main Control Room (MCR) did change, but the operators adjusted their work habits and continued to operate the APS injectors. Pandemic or no pandemic, the light source had to be maintained for researchers working on the COVID-19 virus.

Every hour of every day that the APS is generating x-rays, the MCR operators monitor electrons that reach roughly 99.99999973% of the speed of light as they race through the incredibly complextechnology of the APS particle accelerators on their way to producing high-brightness x-ray beams.

The MCR operators don't just stare at screens all day (or night). They maintain beam stability and stored-beam injected current while they manage all of the accelerator systems (linac, particle accumulator ring, booster, and main storage ring). The tasks performed by the MCR operators include:

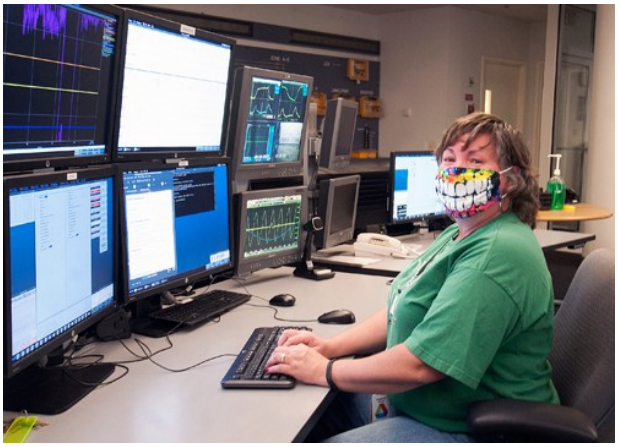
- Perform electron beam steering and optimization
- Monitor group Lockout-Tagout (LOTO) and operation of the Access Control Interlock System to prevent personnel exposure to ionizing radiation
- Approve and coordinate work performed on the accelerators
- Write and review dozens of procedures for operation of the various technical systems
- Implement policies and operating standards as set forth by the machine managers
- Coordinate tasks among various technical groups
- Respond to various user requests, particularly in the cases of technical glitches in the machine

Technical glitches in the APS accelerators are far from an everyday occurrence, and when they happen they are dealt with as expeditiously as possible. From 1997 to today, the APS has delivered x- rays to its users 97.3% of the scheduled 5,000 hours per year. MCR operators are there for every minute of those hours.

These talented, dedicated people are the critical interface between users and the machines that are the heart of the APS. They have the awesome responsibility of keeping users supplied with a steady stream of x-rays so that the APS record of scientific and technical excellence can continue.

Meet (most of) the Main Control Room (MCR) operators who are part of the Accelerator Systems Division of the Advanced Photon Source (APS).

Left photo: **Megan Kimbro** and **Steve Labuda**. *Right photo*: **Ted Grodecki** (left, MCR crew chief): "There have been some inconveniences [during the pandemic], but nothing that I'd say are challenges. Things like disinfecting your work area at shift change [note the cleaning supplies on the table, background], distancing, and remembering to put a mask on when assisting the other operator with an issue that's come up or during their training sessions have become a habit/routine over the last few months. We're just doing our jobs." **Kyle Berg** (right): "As an operator, we have to be highly adaptive in order to deal with the myriad duties and issues that come with the job. We have adapted to COVID in a variety of ways: Cleaning regularly and thoroughly, using new lines of communication, having increased awareness about distance between people and contact with surfaces, and more. These changes were to be expected given what we know of the virus, so I could not call them unusual, and the steps we have taken to adapt have not been particularly challenging as we have support from a variety of teams, resources, and good communication from management. As the situation continues to develop, we will continue to keep adapting. I am confident we will keep the lights on."



Left photo: **Dmitriy Ronzhin** (MCR crew chief): “I miss live interaction with the various technical groups. I am hoping that the pandemic will be over soon and the APS activities return to normal.” *Right photo:* **DeeAnna Weyer**: “Smiling for science. It is very rewarding to have a small part in support of the research which may lead to a cure for COVID-19.”

Eric Smith

Sean Orne

Not pictured: **Lisa Berkland**

A panoramic (and distorted) view into the Main Control Room from the hallway. The monitors in the window at left show (top) the electron current in the storage ring (solid blue indicates a steady maximum "fill" of electrons) and (bottom) the beamline shutters that are currently open to allow x-rays into experiment stations. A mural depicting the APS storage ring is visible at left.

Acknowledgments

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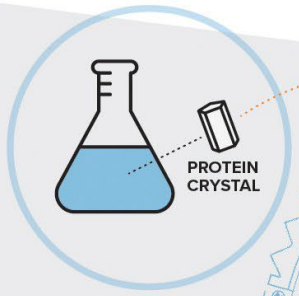
CRACKING THE **COVID-19 CODE**

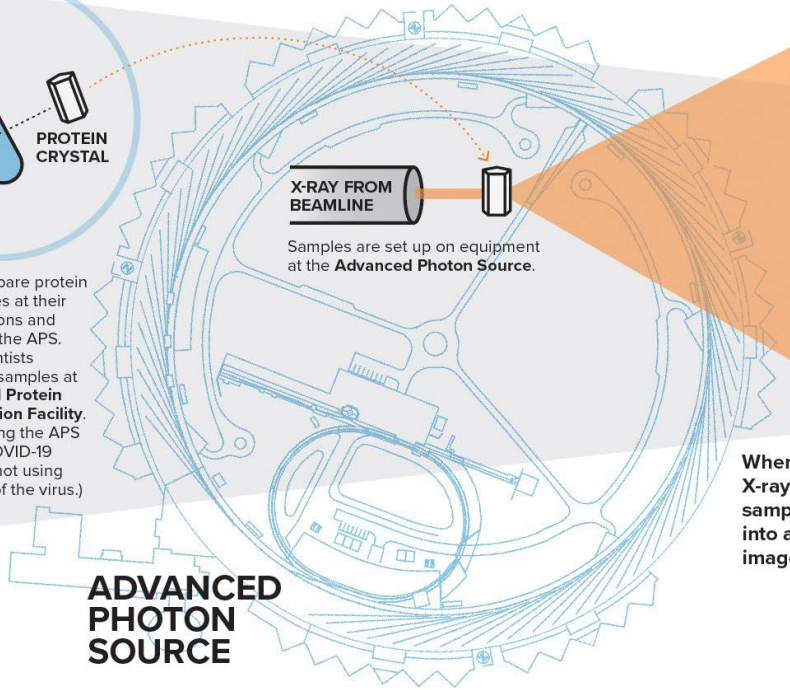
Argonne NATIONAL LABORATORY

Finding treatments or vaccines starts with understanding the protein structure of a virus.
Here's how it happens at the Advanced Photon Source (APS) at Argonne National Laboratory.

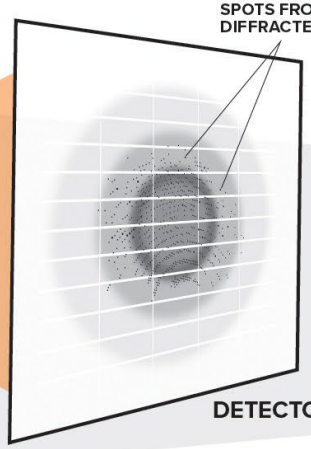
PREPARE SAMPLE → **CONDUCT** EXPERIMENT → **ANALYZE** RESULTS



Scientists prepare protein crystal samples at their home institutions and send them to the APS. Argonne scientists prepare their samples at the **Advanced Protein Characterization Facility**. (Scientists using the APS to conduct COVID-19 research are not using live samples of the virus.)

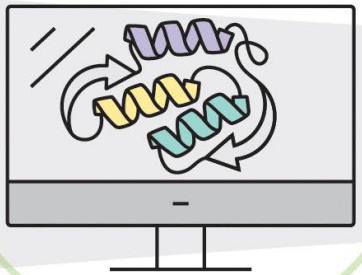


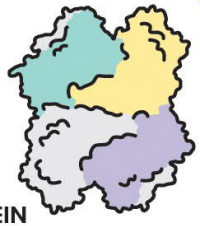
Samples are set up on equipment at the **Advanced Photon Source**.



When the extremely bright X-ray light hits the crystal sample, it diffracts the light into a detector, which creates images of spots patterns.

Computers measure the position and intensity of the the imaged "spots" to create a 3-D structure of the sample from the diffracted light.





Models of the virus's protein structures reveal docking sites in the structures.

Drugs or antibodies can be identified or developed to mate to the docking sites, therefore interfering or impeding the virus's ability to further infect people. Vaccine development depends on identifying these interactions as well.

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