CORNELL HIGH ENERGY SYNCHROTRON SOURCE (CHESS) **$7,000,000**
-$15,000,000 / -68.2%

Cornell High Energy Synchrotron Source Funding

(Dollars in Millions)

FY 2018 Actual[1]	FY 2019 (TBD)	FY 2020 Request[2]	Change over FY 2018 Actual Amount	Percent
$22.00	-	$7.00	-$15.00	-68.2%

[1] FY 2018 Actual includes $10.0 million to fund part of FY 2019 costs.

[2] The FY 2020 Request reflects the transition of CHESS from an NSF stewardship to a partnership model in the FY 2018-FY 2019

CHESS is a high-intensity, high-energy X-ray facility located on the campus of Cornell University in Ithaca, New York. It uses synchrotron light given off by charged particles, both electrons and positrons, as they circulate in a ring at nearly the speed of light. This multi-user facility provides X-ray beams for research in physics, chemistry, biology, materials, engineering, and environmental sciences. Emphasis areas include soft matter and thin film studies, solution scattering, nanomaterials, high-pressure science, structural biology, time-resolved studies of materials, and X-ray studies of structural materials. Oversight of the facility is provided through the MPS Division of Materials Research (DMR).

As a national user facility, CHESS provides access to beamtime through a competitive proposal review process. The primary function of the staff is to maintain and operate the facility and to assist users from across the United States and overseas. Approximately 1,200 users annually perform a broad array of research including computationally-enabled scattering studies of complex materials, along with analyses of the structure of designer solids and the impact of processing. Scientists use time-resolved synchrotron radiation to enable research in engineering of materials, X-ray imaging and spectroscopy, structural materials under operating conditions, and, in collaboration with the National Institutes of Health (NIH), the analysis of macromolecules and biochemistry. An annual meeting of users and several workshops help disseminate results from the facility.

CHESS supports users from academia, industry, and national laboratories. The facility has developed a dynamic testing station for structural materials through collaboration with the U.S. Air Force Research Laboratory and the Office of Naval Research. Key collaborations include work with Department of Energy (DOE)-supported synchrotron facilities, such as the Advanced Photon Source (APS), the National Synchrotron Light Source, and the Linac Coherent Light Source (LCLS) at Stanford. X-ray detectors developed at CHESS are now in use at third and fourth generation X-ray sources around the world, including LCLS, the world's first hard X-ray laser. Cornell University has just completed an upgrade to CHESS's light source, the Cornell Electron Storage Ring (CESR). CESR is now a third-generation light source of the same class as the APS. The upgrade, funded by the State of New York, incorporated cost-effective undulators developed at CHESS. These undulators will increase X-ray flux by orders of magnitude and enable scientists to pursue time-resolved and high-resolution experiments and imaging not previously possible. The CHESS-developed undulators, and other innovations such as high-flux X-ray optics, are impacting synchrotron science worldwide.

Researchers at CHESS also developed a new Kolsky bar apparatus to study the impact of high strain rates on structure using *in situ* diffraction from metals undergoing shock-wave induced strain. This unique capability uses the high flux in combination with a new high-speed pixel array detector. Understanding high-impact deformation is particularly important to the automotive and aerospace industries.

CHESS supports and enhances Ph.D.-level graduate education, postdoctoral research, and research experiences for undergraduates, K-12 students and science teachers. The education and outreach program annually impacts over 6,000 people of all ages, including over 1,300 visitors touring the Cornell facilities. Each year, about 60 Ph.D. degrees are granted to students who have used the facility for their research. CHESS is a key training ground for X-ray and accelerator scientists, with CHESS graduates being hired by other X-ray facilities in the United States and around the world.

With the recent upgrade to CESR, CHESS is now equipped with a high-energy hard X-ray synchrotron source. In FY 2017, NSF conducted a review of the science case for this upgraded X-ray facility, named CHESS-U, and determined that this upgrade would provide new capability in a niche area at CHESS, but the unique aspects lacked sufficient breadth to justify continued stewardship of the source by NSF. This led to NSF's decision to continue funding CHESS operations only through March 2019 and to accept a transition proposal in FY 2018. CHESS has proposed to establish a new partnership model, whereby NSF would consider targeted support for the most promising science and unique experimental components but no longer support full operation of the source. The initial expiration date of the cooperative agreement was March 2019. NSF has extended the award to August 2019 to allow NSF to complete the transition process. FY 2019 funding for CHESS during this transition includes $15.0 million through August 2019, $10.0 million of which was funded in FY 2018.

Total Obligations for CHESS

(Dollars in Millions)

	FY 2018	FY 2019	FY 2020	ESTIMATES[2]				
	Actual	(TBD)	Request	FY 2021	FY 2022	FY 2023	FY 2024	FY 2025
Operations & Maintenance (MPS)[1]	$14.00	-	$5.00	$5.00	$5.00	$5.00	$5.00	$5.00
Operations & Maintenance (BIO)	4.00	-	1.00	-	-	-	-	-
Operations & Maintenance (ENG)	4.00	-	1.00	-	-	-	-	-
Total	**$22.00**	-	**$7.00**	**$5.00**	**$5.00**	**$5.00**	**$5.00**	**$5.00**

[1] The FY 2018 MPS Actual includes $10.0 million to fund part of FY 2019 costs.

[2] Outyear funding estimates are for planning purposes only. The current cooperative agreement ends in August 2019. The process for transition of CHESS from an NSF stewardship to a partnership model began in FY 2018 and should be completed in FY 2019. Future funding is dependent on proposal review.

Management and Oversight

- NSF Structure: CHESS is supported by MPS through a cooperative agreement with Cornell University. A MPS/DMR program director is the primary contact with the facility. NIH provides additional support for CHESS operations through the Macromolecular Diffraction at the Cornell High Energy Synchrotron Source (MacCHESS) award. A Joint Oversight Group (JOG) was established to better coordinate the CHESS and MacCHESS awards. The JOG serves as a vehicle to keep interested parties informed and includes MPS, ENG, BIO, and NIH program directors. The NSF Division of Acquisition and Cooperative Support (DACS) and the Large Facilities Office (LFO) in BFA provide oversight of financial and administrative aspects of the award. The MPS Facilities team, together with the Chief Officer for Research Facilities (CORF), also provide high-level guidance, support, and oversight.
- External structure: The Cornell Laboratory of Accelerator-baSed Sciences and Education (CLASSE), which falls under Cornell's Vice Provost for Research, administers CHESS. The principal investigator serves as the CHESS director and reports to the director of CLASSE. The CHESS director receives guidance primarily from an internal executive committee and diversity committee as well as from external groups including the External Advisory Committee and the Users' Executive Committee.

Reviews

NSF provides oversight by monitoring annual plans and reports including user metrics, as well as by conducting monthly phone conferences with the director. NSF uses annual site visit reviews to assess the user program, in-house research, long-term plans to contribute significant research developments both nationally and internationally, as well as the operations, maintenance, and development of the facility. Annual reviews also assess the status of education, training and outreach; operations and management efficiency; and diversity plans. The reviews are conducted by a panel of experts from the research community. Representatives from NIH attend the reviews as observers. In addition to these annual scientific reviews, business reviews are conducted regularly by LFO and DACS.

Renewal/Recompetition/Termination

With the awarded five-month extension, the new expiration date of the current cooperative agreement is August 2019. Pending the outcome of the proposal to transition to a partnership role, a new award is expected to be in place no later than September 2019. This partnership, which NSF will monitor closely, will be for a period of five years. Support thereafter will depend on successful operation in the partnership mode and meritorious review of a renewal proposal.