

CORNELL HIGH ENERGY SYNCHROTRON SOURCE**\$16,000,000**
- \$4,030,000 / -20.1%**Cornell High Energy Synchrotron Source**

(Dollars in Millions)

FY 2016 Actual	FY 2017 (TBD)	FY 2018 Request	Change over FY 2016 Actual	
			Amount	Percent
\$20.03	-	\$16.00	-4.03	-20.1%

The Cornell High Energy Synchrotron Source (CHESS) is a high-intensity, high-energy X-ray user facility in Ithaca, NY. 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. CHESS provides capabilities for X-ray 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. Stewardship and oversight of CHESS is provided through the NSF Division of Materials Research within the Directorate for Mathematical and Physical Sciences (MPS/DMR), as well as the Directorates for Biological Sciences (BIO) and Engineering (ENG).

With support from the state of New York, CHESS is currently upgrading the source ring to a high energy hard X-ray synchrotron source. In FY 2017, NSF conducted a review of the science case for the proposed new X-ray source, named CHESS-U, and determined that this upgrade would not provide a sufficiently unique facility to justify continued stewardship of the source by NSF. This led to the decision to continue funding CHESS operations until March 31, 2019 with a plan to accept a transition proposal in FY 2019. This proposal would establish a partnership model whereby NSF would consider investing in the most unique experimental components but no longer support full operation of the source. Within this FY 2018 allocation, the transition will begin one year early.

Total Obligations for CHESS

(Dollars in Millions)

	FY 2016 Actual	FY 2017 (TBD)	FY 2018 Request	ESTIMATES ¹				
				FY 2019	FY 2020	FY 2021	FY 2022	FY 2023
Operations & Maintenance (MPS)	\$10.03	-	\$8.00	\$8.00	\$5.00	\$5.00	\$5.00	\$5.00
Operations & Maintenance (BIO)	5.00	-	4.00	-	-	-	-	-
Operations & Maintenance (ENG)	5.00	-	4.00	-	-	-	-	-
Total, CHESS	\$20.03	-	\$16.00	\$8.00	\$5.00	\$5.00	\$5.00	\$5.00

¹ Outyear funding estimates are for planning purposes only. The current cooperative agreement ends in March 2019. NSF will begin transition of CHESS from NSF stewardship to a partnership model in FY 2018, with future obligations dependent on review of a transition proposal.

CHESS is a national user facility accessed through a competitive proposal review process. The primary function of CHESS staff is to maintain and operate the facility and to assist users. Users number about 850 annually and perform a broad array of research including: computationally-enabled scattering studies of complex materials; an analysis of the structure of designer solids including the impact of processing; enabling the engineering of materials through time-resolved synchrotron radiation studies, x-ray imaging, and spectroscopic studies; studying structural materials under operating conditions; and the analyses of macromolecules and biochemistry. The latter topic is done in collaboration with NIH. An annual users meeting and several workshops help disseminate results from the facility.

CHESS supports users from academia, industry, and national laboratories. CHESS 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. CHESS collaborates with Department of Energy (DOE) - supported synchrotron facilities such as the Advanced Photon Source and the National Synchrotron Light Source. X-ray detectors developed at CHESS are now in use at 3rd and 4th generation X-ray sources around the world, including the world's first hard X-ray laser, DOE's Linear Coherent Light Source. CHESS-developed undulators, that cost an order of magnitude less than current technology, are being installed at CHESS. The undulators will increase X-ray flux by an order of magnitude and enable CHESS to pursue time-resolved and high resolution imaging experiments not previously possible. The Cornell undulators, and other innovations such as high flux X-ray optics, are impacting synchrotron science worldwide.

CHESS researchers also developed a new Kolsky bar apparatus to study the impact on structure of high strain rates using in-situ diffraction from metals undergoing shock-wave induced strain. This unique capability uses the high flux of CHESS 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 and for K-12 students and science teachers. The CHESS 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 as a result of CHESS research. CHESS is a key training ground for X-ray and accelerator scientists, with CHESS graduates being hired to staff other X-ray facilities in the U.S. and around the world.

Management and Oversight

- NSF Structure: CHESS is supported by MPS, BIO, and ENG through a cooperative agreement with Cornell University. A MPS/DMR program director is the primary contact with the facility and leads an internal NSF team of program directors. 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 program directors in MPS, BIO, and ENG at NSF, as well as NIH program directors.
- 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 the CHESS executive committee, from an external policy and advisory board, the CHESS diversity 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 facility development. Annual reviews also assess the status of education, training and outreach; operations and management efficiency, and diversity plans. In addition to a panel of experts composed of members from the research community, representatives from NIH attend these site visits. Recent and upcoming reviews include:
 - Review of science case for state funded upgrade of CHESS (CHESS-U), October 26-28, 2016.
 - Program Director site visit, October 2017.
 - Review of Transition Proposal, March 2018.

Renewal/Recompetition/Termination

The end date of the current CHESS award is March 2019. In FY 2017, NSF conducted a review focused on the science case for the state-supported on-going upgrade of CHESS. The outcome led to NSF's decision to transition from a stewardship role of CHESS to one focused on partnership to enable the best science. Initial plans were to accept a transition proposal in FY 2019. The current plan is for the transition to begin in FY 2018, or one year early. At the FY 2018 Request level, support will total \$16.0 million with DMR providing \$8.0 million and BIO and ENG providing \$4.0 million each.