CHESS Operations Update

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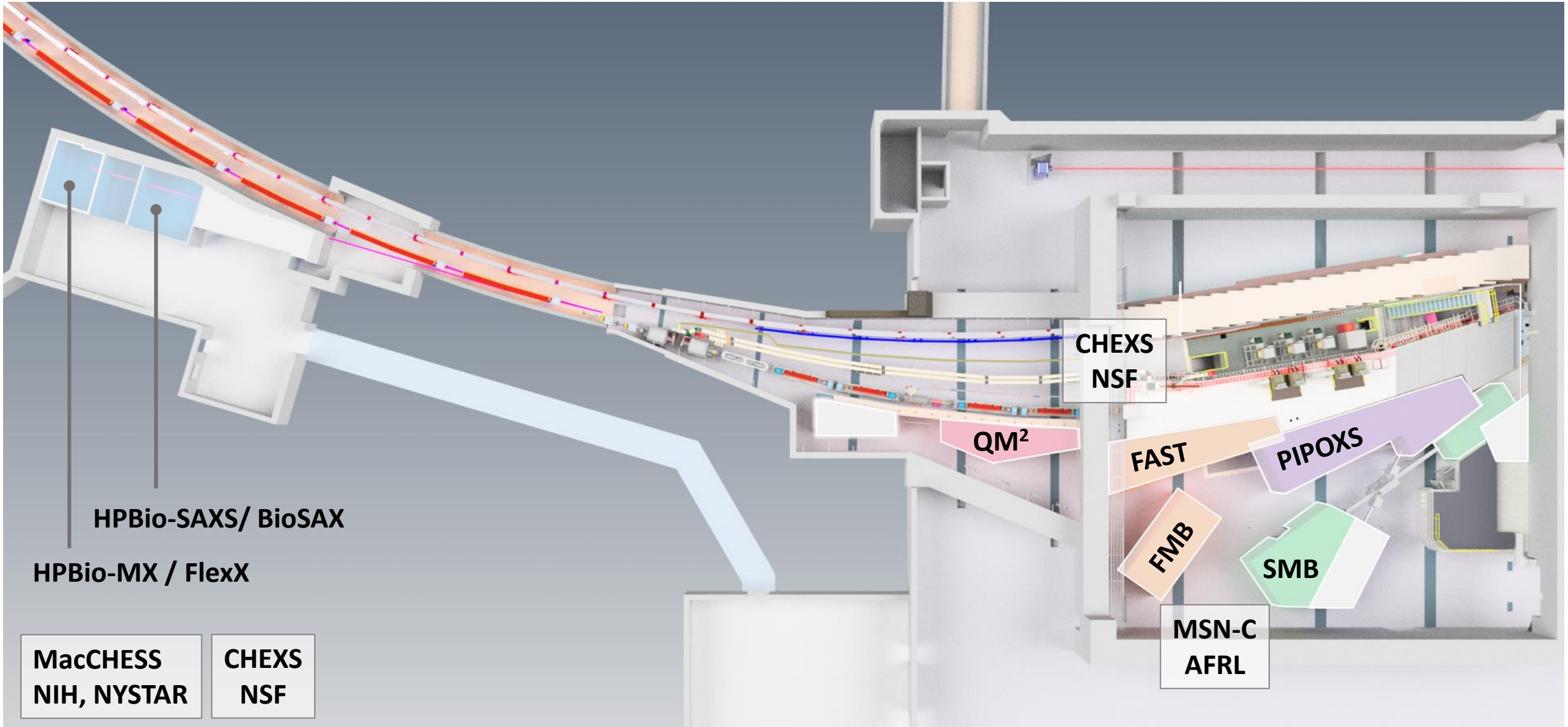
Associate Director, CHESS

CHESS Users Meeting, June 9, 2020

+ **CHESS Beamlines**
+ **CHESS Operations Schedule and Proposal Deadlines**
+ **Beamtime Allocations**

} **Impact of COVID-19**

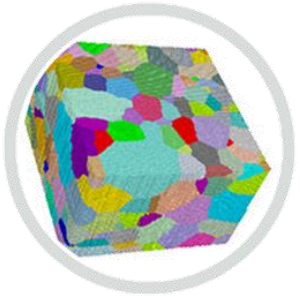
CHESS | Experimental Floor Layout



CHESS | Beamtime Allocation

CHEXS / MacCHESS

Beamtime allocations through peer-reviewed proposal process.

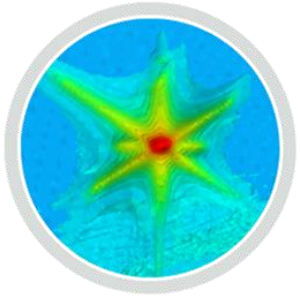


FAST Beamline

Time-resolved studies of manufacturing processes of structural metals.

PIPOXS Beamline

X-ray spectroscopic studies of geometric and valence electronic structure in catalytic systems and functional materials.

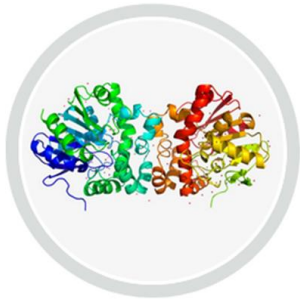


QM2 Beamline

High-throughput characterization of quantum materials.

BioSAXS/ HPBio-SAXS Beamline

Biomolecular structure from solution; High-pressure studies in biophysics; Deep Life; Food Science.

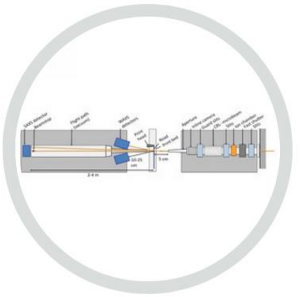


FlexX/ HPBio-MX Beamline

MX; Serial crystallography; High pressure MX.

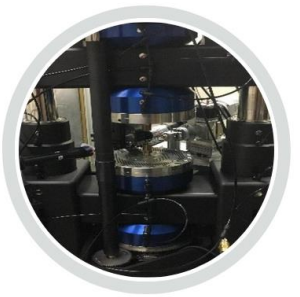
MSN-C:

Beamtime allocation through MSN-C Program managers



Functional Materials Beamline

Time-resolved in-situ characterization of soft materials during processing.

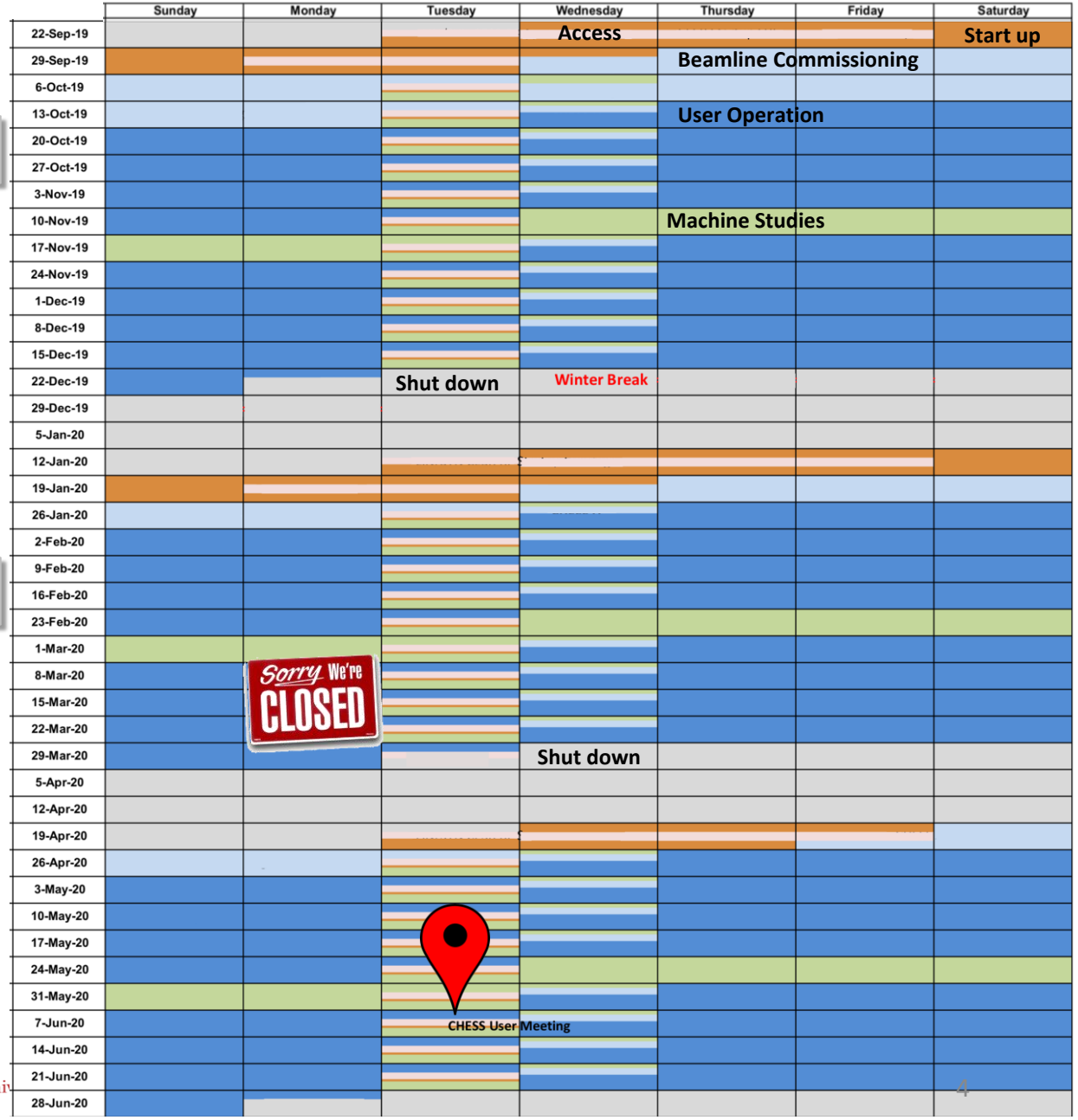


Structural Materials Beamline

High-energy monochromatic and white-beam characterization of materials' structure and evolution across length-scales.

CHEXS | NSF – 4 beamlines
AFRL | MSN-C – 2 beamlines
NIH/NYSTAR | MacCHESS – 1 beamline

CHESS Operations Schedule | 2019/2020



2019-3

2020-1

2020-2

125 days / year dedicated to user operation
3 calls for proposals per year

4-5 weeks of user operation
1 week machine studies
4-5 weeks of user operation
4 weeks of shut down for maintenance and upgrades

} For each of the 3 cycles

March 16, noon, CHESS suspended user operation and shut down the facility because of the COVID-19 crisis.

CHESS operations resumes this week for ~3 weeks for COVID-19 as well as defense related research and preparation for the fall 2020 experimental run.
The summer shut down is essential for maintenance, repairs and upgrades.

CHESS Operations | Proposal Deadlines

3 weeks [a] | 2 weeks [b] | 1 week [c] | 6 weeks

CHESS Run Cycle	Proposal Deadline	Peer Reviews due BTRs due	Beamtime allocation Safety reviews due (Proposals and BTRs)	Notifying users, beamlines scheduled by	Run Cycle Starts	Run Cycle Ends
2019-3	Jul. 8, 2019	Aug. 5th, 2019	Sept. 6th, 2019	Sept. 14th, 2019	Oct. 16th, 2019	Dec. 23, 2019
2020-1	Oct. 28, 2019	Nov. 25, 2019	Dec. 6, 2019	Dec. 13, 2019	Jan. 29, 2020	Mar. 30, 2020
2020-2	Feb. 3, 2020	March 2, 2020	March 13, 2020	March 20, 2020	April 29, 2020	June 29, 2020

~1.5 months

~3 months

(a) 3 weeks for scientific reviews, feasibility reviews and safety reviews of new proposals

(b) 2 weeks for safety review of BTRs; Beamtime allocation meetings

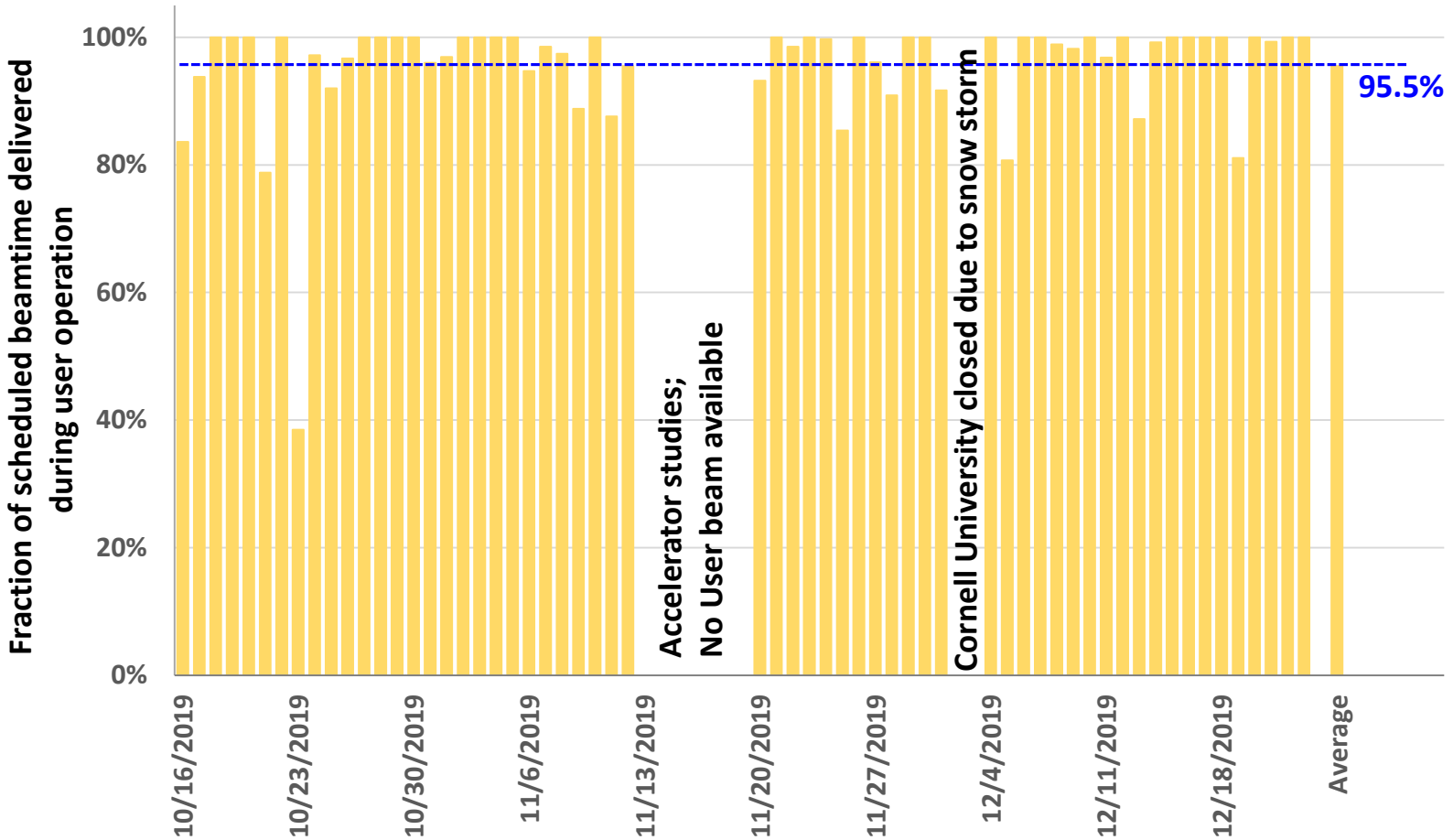
(c) Developing beamline schedules

2019-3 CHESS Experimental Run | Demand for CHESS beamlines

Beamline	Beamline Acronym	Requests # of Proposals	Allocation # of Proposals	Over subscription Requests/ Allocation	Allocation /Requests	Requests # of shifts	Allocation # of shifts	Over subscription Requests/ Allocation	Allocation /Requests
1A3	SMB	*	8				144		
2A	PIPOXS	24	8	3	33%	369	138	2.67	37%
3A	FAST	24	15	1.6	62%	332	129	2.57	39%
3B	FMB	*	6				141		
4B	QM2	18	9	2.00	50%	351	108	3.25	31%
7A1	HPBioSAXS /BioSAXS	29	23	1.26	79%	265	144	1.84	54%
7B2	HPBioMX/ FlexX	26	19	1.37	73%	267	141	1.89	53%
All		121	88	Average: 1.64	Average: 59%	1584	945	Average: 2.4	Average: 43%

*Beamtime allocations at the SMB and FMB beamlines is not based on a peer review of proposals.

2019-3 CHESS Experimental Run | Delivered Beamtime



During the 2019-3 experimental run, CHESS was scheduled for 159 8h-shifts of user operation distributed over 62 calendar days.

For 45 out of 62 calendar days of user operation, CHESS delivered more than 95% of the scheduled beamtime for that day.

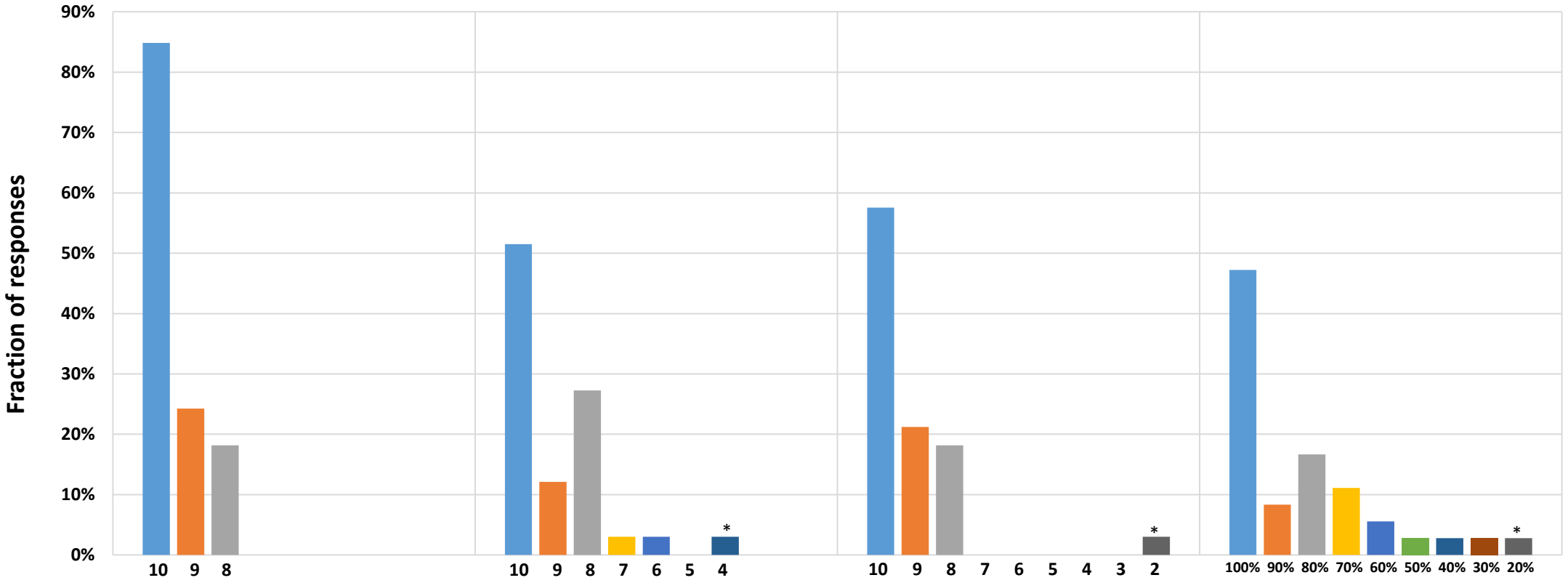
For 58 out of 62 days of user operation, CHESS delivered more than 80% of the scheduled beamtime for that day.

CHESS had to suspend user operation for 2 calendar days (Dec. 2nd/3rd, 2019) mandated by Cornell University due to a snow storm.

For the 2019-3 experimental run, 95.5% of the scheduled beam time was delivered.

CHEXS at CHESS | User Surveys | Oct. – Dec. 2019

2019_3_Cycle



Assistance provided by technical staff

Average = 9.8

Scale 10-1, 10 is best

Performance of facilities, equipment

Average = 9

Scale 10-1, 10 is best

Success of the visit

Average = 9.3

Scale 10-1, 10 is best

Fraction of planned research accomplished

Average = 83%

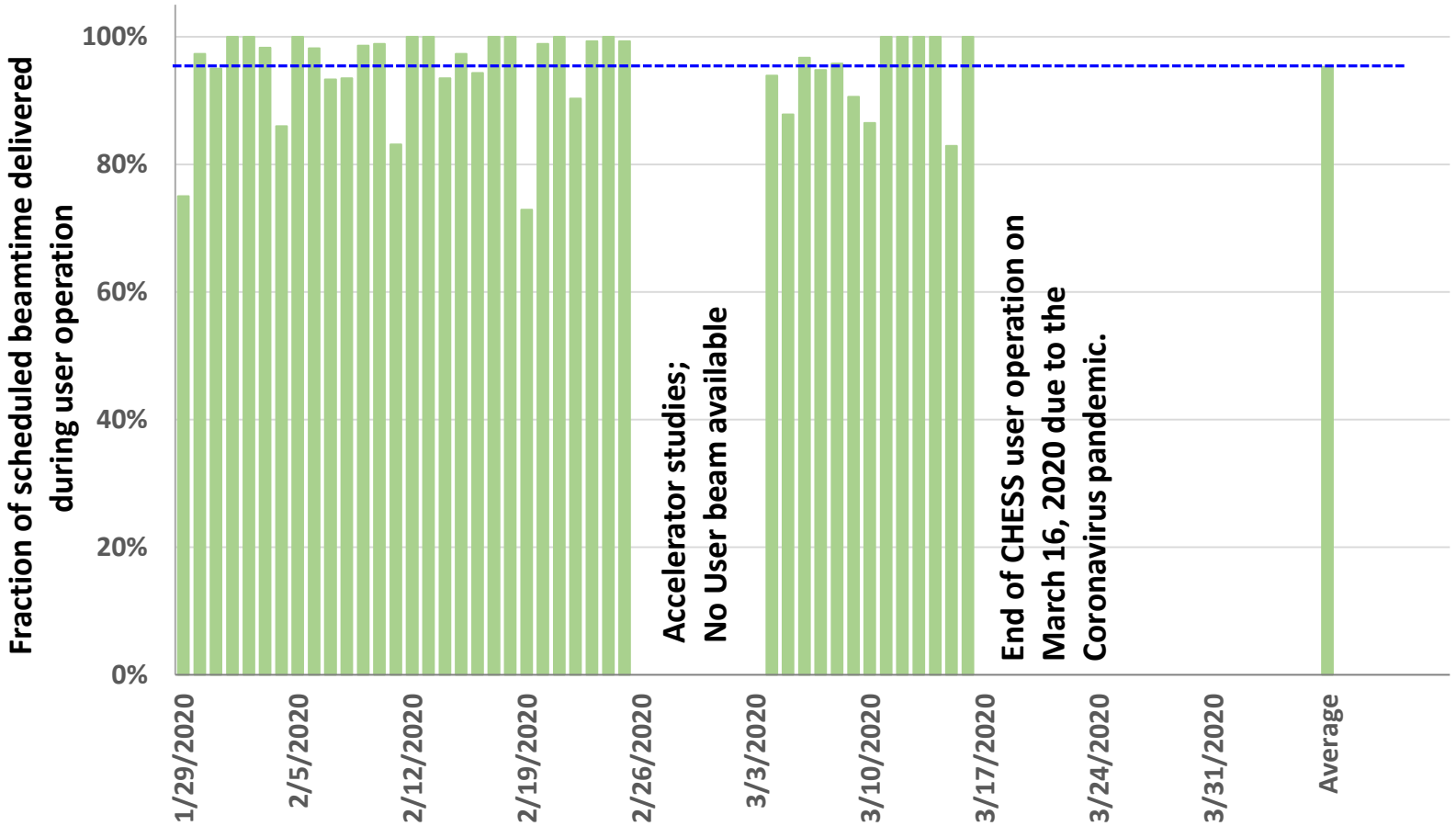
* Beamtime abbreviated when Cornell/CHESS shut down during a snow storm.

2020-1 CHESS Experimental Run | Demand for each beamline

Beamline	Beamline Acronym	Requests # of Proposals	Allocation # of Proposals	Over subscription Requests/ Allocation	Allocation /Requests	Requests # of shifts	Allocation # of shifts	Over subscription Requests/ Allocation	Allocation /Requests
1A3	SMB	*	1				135		
2A	PIPOXS	14	9	1.56	64%	195	126	1.55	65%
3A	FAST	21	11	1.91	52%	280	138	2.03	49%
3B	FMB	*	9				126		
4B	QM2	11	7	1.57	64%	210	117	1.79	56%
7A1	HPBioSAXS /BioSAXS	27	20	1.35	74%	182	117	1.56	64%
7B2	HPBioMX/ FlexX	26	17	1.53	65%	161	129	1.25	80%
All			74	Average: 1.58	Average: 64%	1028	888	Average: 1.64	Average: 63%

*Beamtime allocations at the SMB and FMB beamlines are not based on a peer review of proposals.

2020-1 CHESS Experimental Run | Delivered Beamtime



During the 2020-1 experimental run, CHESS was scheduled for 144 8h-shifts of user operation distributed over 56 calendar days.

Due to the Coronvirus pandemic, the 2020-1 experimental run ended on March 16, i.e. 15 days before the scheduled end of the run.

For 26 out of 41 calendar days of user operation, CHESS delivered more than 95% of the scheduled beamtime for that day.

For 39 out of 41 days of user operation, CHESS delivered more than 80% of the scheduled beamtime for that day.

For the 2020-1 experimental run, 94.9% of the scheduled beam time was delivered prior to the facility suspending operations due to the Coronavirus.

User Access Modes | Until March 2020

Beamline	Abbreviation	User Operation (≤ 3/2020)
Forming and Shaping Technology Beamline	FAST	In person
Photon-In, Photon-Out X-ray Spectroscopy Beamline	PIPOXS	
Q-Mapping for Quantum Materials Beamline	QM2	
Biological Small Angle X-ray Solution Scattering/ High-Pressure Biology Small Angle X-ray Scattering	BioSAXS/ HPBio-SAXS	In person Mail-in
Flexible Protein Crystallography/ High-Pressure Biology Beamline	FlexX/ HPBio-MX	In person Remote
Functional Materials Beamline	FMB	In person, Mail in
Structural Materials Beamline	SMB	In person, Mail in

In person operation: User visit CHESS to measure at a beamline

Mail-in operation mode: Samples shipped to CHESS and CHESS staff conducts experiments

Remote experiments: Users operate beamlines and stations remotely from their home institutions.

User Access Modes | Since March 2020

Beamline	Abbreviation	User Operation
Forming and Shaping Technology Beamline	FAST	~~In person~~
Photon-In, Photon-Out X-ray Spectroscopy Beamline	PIPOXS	
Q-Mapping for Quantum Materials Beamline	QM2	
Biological Small Angle X-ray Solution Scattering/ High-Pressure Biology Small Angle X-ray Scattering	BioSAXS/ HPBio-SAXS	~~In person~~ Mail-in
Flexible Protein Crystallography/ High-Pressure Biology Beamline	FlexX/ HPBio-MX	~~In person~~ Remote
Functional Materials Beamline	FMB	~~In person~~, Mail in
Structural Materials Beamline	SMB	~~In person~~, Mail in

In person operation: User visit CHESS to measure at a beamline **Suspended due to COVID-19 pandemic**

Mail-in operation mode: Samples shipped to CHESS and CHESS staff conducts experiments

Remote experiments: Users operate beamlines and stations remotely from their home institutions.

Plan and Prepare to Resume Operation | March 23, 2020

For each Beamline

+ **Identify measurement/experiment to be possible *remotely* for off-site users after restart of CHESS operations**
+ **Identify needs for implementation of remote measurements/experiments**
+ **Identify operations support needs**

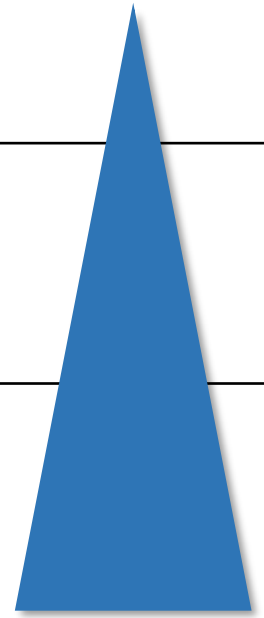
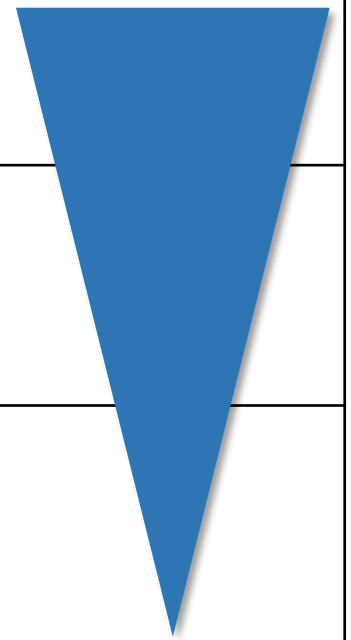
Criteria for choosing first remote measurements/experiments

+ **Possibility/difficulty of implementation**
+ **User demand and interest**

CHESS staff last week and this week:

+ **Start up beamlines with reduced on site staff**
+ **Align beamlines remotely**
+ **Conduct first experiments remotely**

User Access Modes | September 2020 and later

Access Mode	Beamline Abbreviation	Support Needs during Beamtime	Fraction of Beamtime
Remote experiments	Samples shipped to CHESS Users operate beamlines and stations remotely from their home institutions		
Mail-in operation mode	Samples are shipped to CHESS CHESS staff conduct experiments in close collaboration with users who stay at their home institutions		
Joint Ventures	Samples are shipped to CHESS, CHESS scientific and technical staff dedicates significant time and effort to experiment and analysis		

Beamline talks today will provide detailed information about access modes and experimental capabilities.
Information posted soon on the CHESS web site: CHESS → Users → Beamline Directory

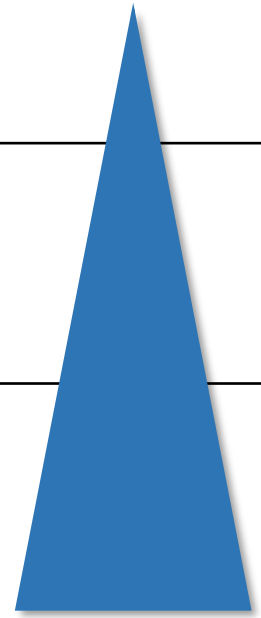
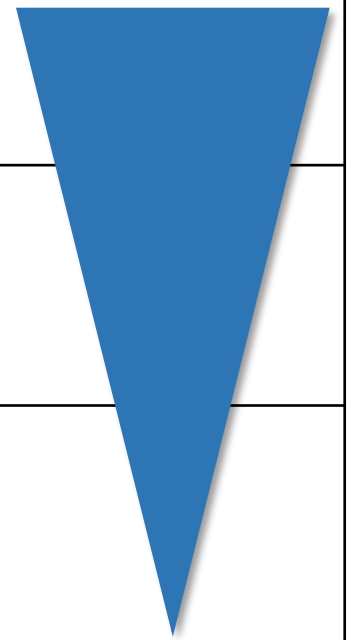
CHESS Beamlines Staffing Levels | Fall 2020

Beamline	Beamline Abbreviation	Center/Funding Agency	Beamline Scientific Staff	Beamline Technical Staff
Forming and Shaping Technology Beamline	FAST	CHEXS (NSF)	1 FTE	
Photon-In, Photon-Out X-ray Spectroscopy Beamline	PIPOXS	CHEXS (NSF)	1 FTE	
Q-Mapping for Quantum Materials Beamline	QM2	CHEXS (NSF)	1 FTE	
Biological Small Angle X-ray Solution Scattering	HPBio-SAXS/ BioSAXS	CHEXS (NSF), MacCHESS (NIH, NYSTAR)	2.5 FTE	1.5 FTE
Flexible Protein Crystallography/ High-Pressure Biology Beamline	HPBio-MX/ FlexX	CHEXS (NSF), MacCHESS (NIH, NYSTAR)	2.5 FTE	1.5 FTE
Functional Materials Beamline	FMB	MSN-C (AFRL)	2.5 FTE	1 FTE
Structural Materials Beamline	SMB	MSN-C (AFRL)	2.5 FTE	1 FTE

Additional support: CHESS operators, CHESS technical and engineering support.

Beamline staffing levels influence amount of beamtime available in different access modes

User Access Modes | September 2020 and later

Access Mode	Beamline Abbreviation	Support Needs during Beamtime	Fraction of Beamtime
Remote experiments	Samples shipped to CHESS Users operate beamlines and stations remotely from their home institutions		
Mail-in operation mode	Samples are shipped to CHESS CHESS staff conduct experiments in close collaboration with users who stay at their home institutions		
Joint Ventures	Samples are shipped to CHESS, CHESS scientific and technical staff dedicates significant time and effort to experiment and analysis		
In person operation	User visit CHESS to measure at a beamline Training of users at beamlines by CHESS scientists Ongoing interaction about experiments, analysis, interpretation during beamtime Experiments are continuously monitored (24h operation by user team)	Weeks? Months? A year? 	Increasing onsite staff + CHESS staff + "Local" users + National users + International users

CHESS Operation Schedule | Fall 2020 - Planned

Week	Start	Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
1	30-Aug-20							
2	6-Sep-20		Labor Day			Access		Start up
3	13-Sep-20					Beamline Commissioning		
4	20-Sep-20					User Operation		
5	27-Sep-20							
6	4-Oct-20							
7	11-Oct-20							
8	18-Oct-20				Machine Studies			
9	25-Oct-20							
10	1-Nov-20							
11	8-Nov-20							
12	15-Nov-20							
13	22-Nov-20			Winter Down starts		Thanksgiving - - - - - Holiday		

CHESS Run Cycle	Proposal Deadline	Notifying users	Run Cycle Starts	Run Cycle Ends
2020-3	July 1, 2020	Aug. 12, 2020	Sep. 23, 2020	Nov. 24, 2020

Proposal Submission Deadlines: CHESS Web site → Users → Proposal Deadlines
Proposal Submission: → CHESS Web site → Users → User Portal

Beamtime Allocation | Proposals and Beamline Schedules

Proposals and Beamtime Requests

General User Proposals for new experiments
at beamlines FAST, QM2, PIPOXS, HPBioSAXS, FlexX.

Beam Time Requests for existing proposals
at beamlines FAST, QM2, PIPOXS, HPBioSAXS, FlexX.

Rapid Access Proposals
at beamlines BioSAXS, FlexX.

Indicate possible experimental modes:
Remote, mail-in, joint venture, in-person only
Also assessed by CHESS scientists in feasibility review

Beamline Schedule

+ First schedule request with submission of proposal
+ Beamline scientists communicate beamtime allocations to users.
+ Beamline scientists develop **beamtime queue** with users, i.e. flexible beamline schedules that can be adjusted to accommodate changing needs.
+ Database tracks and documents scheduled beamtime and beamline usage.

CHESS Operation | Priorities and Trade-offs

Developing new experimental capabilities
Essential to enable world-class/leading science;
Installation, commission requires on-site staff;
Expected to be slow while social distancing constrains are in place.

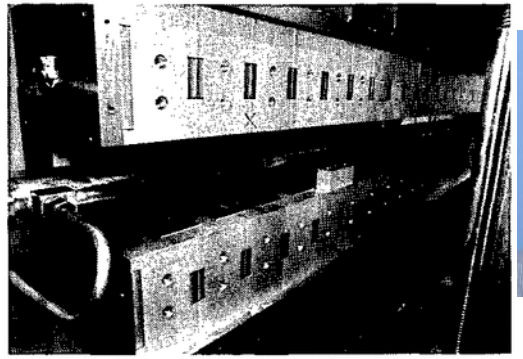
Training the next generation of X-ray scientists
Hands on/ remote training of students

Enabling new operational modes
Balance of/between user interest, resource needs to enable capabilities, impact, fit for beamline focus, expectations of funding partners etc.

Enabling world class science
Beamtime Allocation balances feasibility, impact, expectation for success, resource needs of proposed experiments etc.

Workload on CHESS staff
Only CHESS scientific/technical staff at beamlines will increase workload
+ Often repeated tasks typically done by users take up time
+ Developing automation, increasing reliability etc. requires time

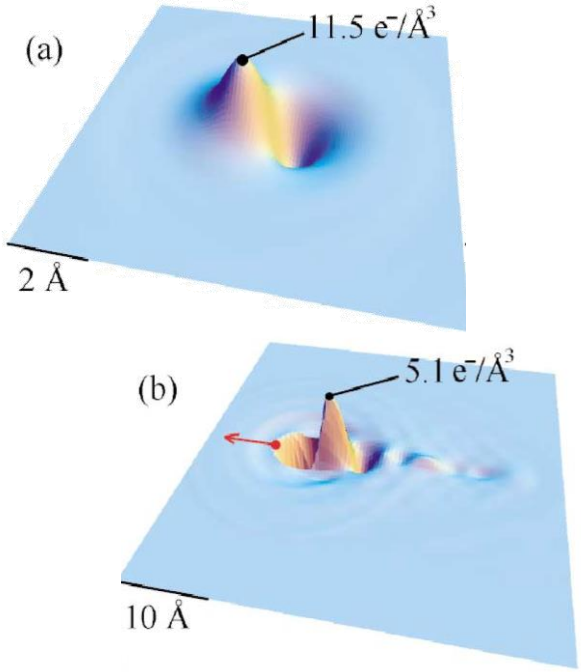

Developing new experimental capabilities
Training students
Enabling world class science
New operational modes
Workload on CHESS staff



The CHESS 25-pole wiggler, with gap open, viewed from the outer side of CESR.

The entire new CHESS facility has been described in an earlier SRN Correspondents' Report (*Sept.1989*).

The wiggler, which was designed and built at Cornell by CHESS staff scientist Ken Finkelstein, includes several novel features.



VOLUME 92, NUMBER 23 PHYSICAL REVIEW LETTERS week ending 11 JUNE 2004

Imaging Density Disturbances in Water with a 41.3-Attosecond Time Resolution

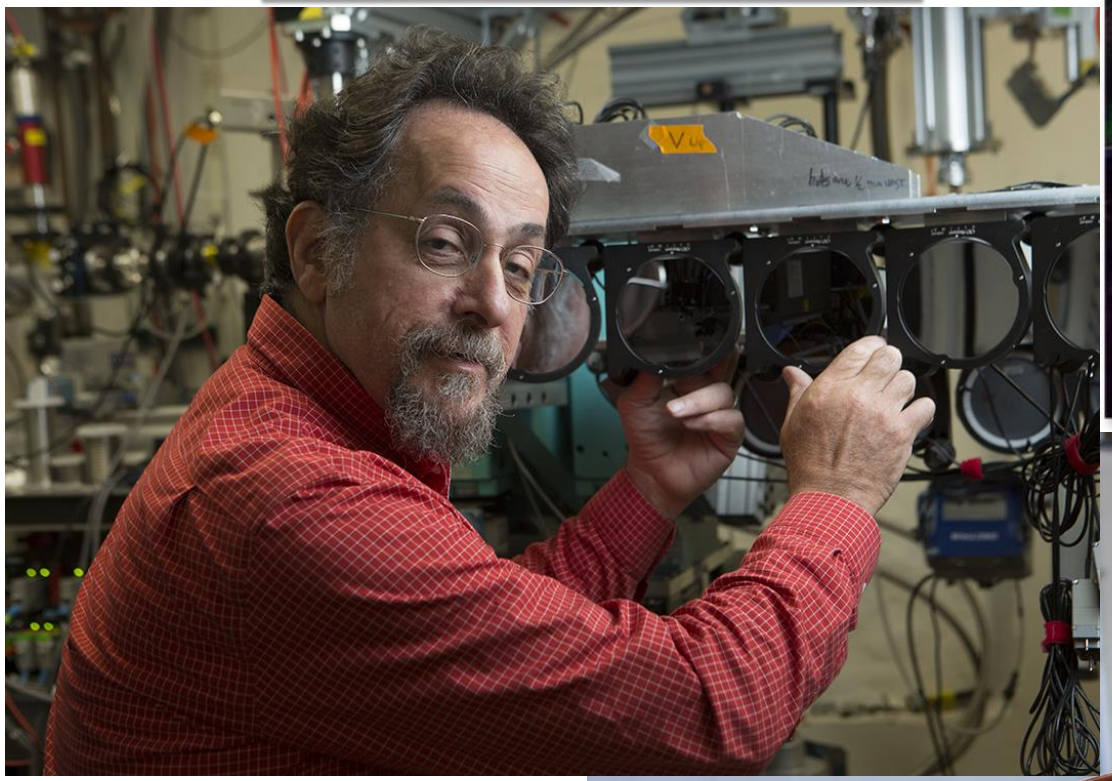
P. Abbamonte,[1,*] K. D. Finkelstein,[2] M. D. Collins,[1] and S. M. Gruner[1,2]

VOLUME 65, NUMBER 26 PHYSICAL REVIEW LETTERS 24 DECEMBER 1990

Solving the Phase Problem with Multiple-Beam Diffraction and Elliptically Polarized X Rays

Qun Shen and K. D. Finkelstein
Cornell High Energy Synchrotron Source and Department of Applied Engineering Physics, Cornell University, Ithaca, New York 14853
(Received 24 September 1990)

Ken Finkelstein is retiring after more than 32 years @ CHESS.



"Barrel" spectrometer @ PIPOXS