2022 RESEARCH INFRASTRUCTURE WORKSHOP

Operations and Management of NSF Major Facilities Best Practices and Lessons Learned

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Image Credit: Geodetic Facility for the National Center for Atmospheric Research (NCAR), National Ecological Observatory Network (NEON), and Advancement of Geoscience (GAGE).

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Optimizing Operations at the Ocean Observatories Initiative (OOI)

Paul K. Matthias, Sr. Program Manager

Image Credit: Geodetic Facility for the National Center for Atmospheric Research (NCAR), National Ecological Observatory Network (NEON), and Advancement of Geoscience (GAGE).

OOI Vision, Context, & History

A new vision for oceanographic research

- Seven marine arrays in the deep oceans served by a common cyberinfrastructure.
- Real-time data freely available online to anyone from more than 800 instruments.
- Six interdisciplinary science themes.
- 25-year lifetime.

Context

- 1 of 32 NSF Major Facilities, 1 of 3 in Ocean Sciences (with Research Fleet & IODP).
- Ending Year 4 of 5-year award funded at $44m/y.

History

- 2009-2018: PMO at Consortium for Ocean Leadership (COL).
- 2016: Commissioning Complete, O&M Begins.
- 2018: WHOI assumes PMO leadership facing major risks.
- 2021: Mid Award Review recommends renew over recompete or retire at next phase in 2023.

Lessons Learned: Management

- Organizational Structure
  - Established R2A2 and RACI
  - Upward and Outward PI, Inward PM
- Subaward Monitoring
  - Monthly Tracking Books
  - FSRs
- Reporting and Communication
  - Ad hoc, weekly, monthly, quarterly, and annual
- Established Program Metrics
  - Science Performance
  - Management Performance
  - Systems Performance
  - Usage
  - QA/QC
- Program Management Skills
  - Cost and Schedule
  - Communications
  - Risks and Opportunities

Lessons Learned: Engineering

- Process Documentation
- Risk and Opportunity Management
- Change Control and Configuration Management
- Requirements Management
- Quarterly Data Driven Reviews
- Identification of Obsolescent Equipment and Tech Refresh
- Engineering Document Enhancements
- Capability Maturity Model

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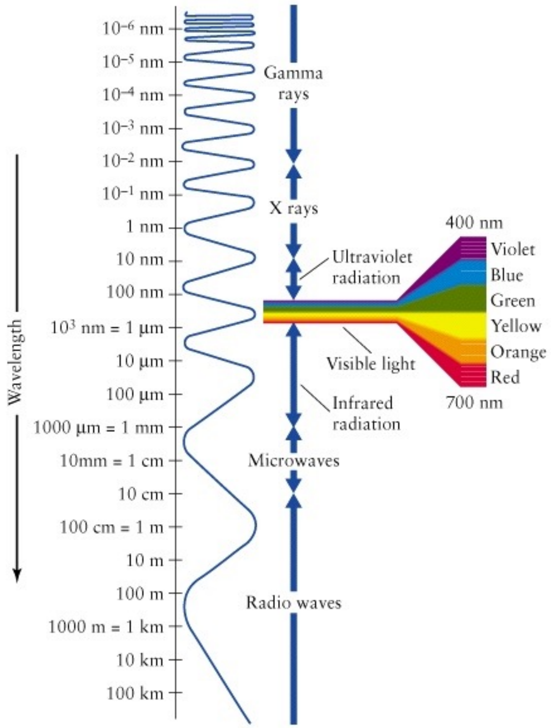
Challenges associated with a long-term, multi-disciplinary user facility

Joel Brock
Cornell High Energy Synchrotron Source (CHESS)

Image Credit: Geodetic Facility for the National Center for Atmospheric Research (NCAR), National Ecological Observatory Network (NEON), and Advancement of Geoscience (GAGE).

Introduction to CHESS

- **X-rays** are short wavelength or energetic light.
- **X-rays** are uniquely suited to penetrate opaque material and non-destructively probe the structure of matter on length scales ranging from shipping containers to medical x-rays to the atomic-scale.
- **Synchrotrons** are exceptionally bright sources of x-rays. If a medical x-ray unit is a candle, a synchrotron corresponds to the lights at a football stadium.



https://science-edu.larc.nasa.gov

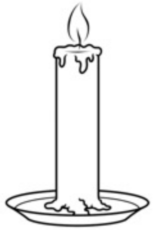
CHESS is a high-energy, 3rd-generation synchrotron x-ray facility.

CHESS is powered by a large particle accelerator operating at 6.0 GeV and up to 200 mA located 5 stories below the Cornell University campus.

CHESS is funded by multiple partners who operate x-ray beamlines and provide a proportionate share of the core facility's operating budget.

Annual operating budget is roughly $25M with over 240 employees and ~1000 users/year.

CHESS began in 1980. Partner model began in 2019.



http://www.sportingnews.com

CHESS operates the sub-facility Center for High Energy X-ray Science (CHEXS) and is constructing the High Magnetic Field (HMF) facility* for NSF.

**see presentation by Ernie Fontes*

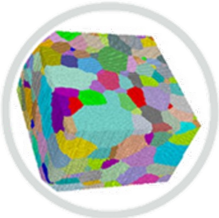
Current CHESS Partners

- NSF: Center for High Energy X-ray Science (CHEXS) at CHESS National User Facility
  - 4 Beamlines (spectroscopy, quantum materials, materials processing, high-pressure biology)
  - Technical R&D
  - Education and Outreach
- AFRL: Materials Solutions Network at CHESS (MSN-C) DOD Research Facility
  - 2 Beamlines (structural materials and functional materials)
  - Outreach to OEMs in Aerospace Sector
- NIH: MacCHESS 1 Beamline (2 x ½ in collaboration with NSF)
  - Service beamlines for the MX and Bio-SAXS communities
- NYSTAR: Matching award for MacCHESS

Current Experimental Stations

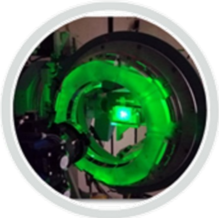
CHEXS / MacCHESS

Beamtime allocations through peer-reviewed proposal process.



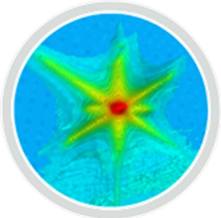
FAST Beamline

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

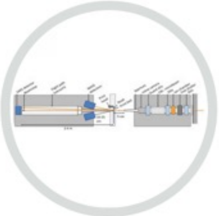
Biomolecular structure from solution; High-pressure studies in biophysics; Deep Life; Food Science.

FlexX/ HPBio-MX Beamline

MX; Serial crystallography; High pressure MX.

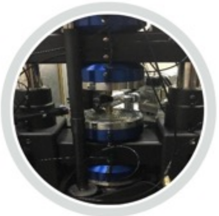
MSN-C:

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

Some Lessons Learned

NSF is optimized to support discipline-based, individual investigator awards.

- NSF can only make 5-year grants.
- Facility must look "new" and deliver unique capabilities every five years.
- Facility must develop funding strategies to cover infrastructure costs.

NSF does not have mechanisms to deal with:

- Inflation
- Operating Contingency for known risks (e.g., replacing critical components as they wear out).
- Operating Contingency for unknown risks (e.g., supply chain issues created by the pandemic)

Multi-divisional support for facilities

- Mid-Scale Research Infrastructure program dealt with multi-divisional project funding.
- There is no similar mechanism for multi-divisional operational funding. Facility leadership must work closely with NSF leadership to create and maintain partnerships.

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Using Cross-Pollination and Integration to Drive Operational and Future Project Success

Krista Laursen
NCAR Director's Office
Asst. Director of Administration & Strategic Implementation (Interim)

Image Credit: Geodetic Facility for the National Center for Atmospheric Research (NCAR), National Ecological Observatory Network (NEON), and Advancement of Geoscience (GAGE).

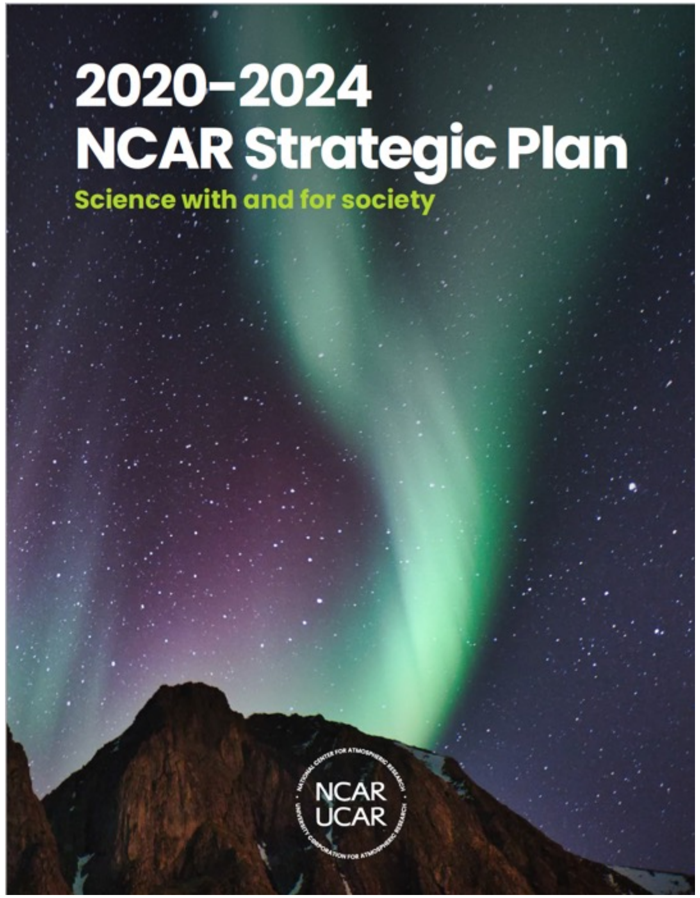
NCAR: Science With and For Society

- The National Center for Atmospheric Research (NCAR) is **a Federally Funded Research and Development Center (FFRDC) dedicated to the study of the atmosphere, the Earth system, and the Sun**.

- Created to provide the atmospheric and Earth science research community with the **facilities, support, and research capabilities that a single university might not otherwise have**.

- NCAR provides long-term basic and applied research and development (R&D) expertise, leadership, and management and science support to the entire Earth System user community on behalf of its sponsor, NSF.

- With guidance from NSF and the broader scientific community, **NCAR operates in the public interest, under open skies, providing scientific access to the broader community**.



Research Infrastructure Development and Support for the Community

Past

High-performance Instrumented Airborne Platform for Environmental Research

MREFC project delivered under budget in 2005

NCAR-Wyoming Supercomputing Center (NWSC)

NSF-funded design, construction, and commissioning project completed early and under budget in 2012

Present

Airborne Phased Array Radar (APAR)

NOAA-supported Preliminary Design development; NSF MSRI-2 proposal currently under review

COronal Solar Magnetism Observatory (COSMO)

NSF-funded COSMO Site and Design Advancement (COSADA) project currently underway

In addition to execution of these targeted, large-scale infrastructure development projects, NCAR has a multi-decadal tradition of providing facility support for the community via ground and airborne research platforms, HPC and data archival and analysis resources, and community models.

Integration as a Driver for Research Infrastructure Success

- **Integration within/across NCAR to build high-performing teams to propose, implement, and operate new research infrastructure**.

  ✓ Identify and recruit individuals with necessary expertise (project management, proposal and project administration, engineering, contracts, etc.) from across the organization to join project teams…beginning in the project/proposal development phase if at all possible.
  ✓ Ensure the engagement and active involvement of operations personnel in the project development, execution, and transition to operations phases.

- **Integration of external (non-NCAR/UCAR) partners into project teams to gain access to critical expertise and ideas and broaden impact**.

  ✓ Seek out and engage with university partners early in the project development lifecycle to create opportunities for the ongoing two-way exchange of ideas and promote capacity building.
  ✓ Build partnerships with private industry and other federal agencies to leverage additional resources needed to execute large, complex projects and multiply the positive impact of new research infrastructure on the broader community.