

# The Advanced Scientific Computing Research (ASCR) User Facilities

**Ben Brown, Director, Facilities Division**  
**Katherine Riley, Director of Science, ALCF**

**<https://science.osti.gov/ascr/officehours>**



U.S. DEPARTMENT OF  
**ENERGY**

Office of  
Science

[Energy.gov/science](https://energy.gov/science)

# Office of Science Statement of Commitment & other Guidance

- ◆ **SC Statement of Commitment** – SC is fully and unconditionally committed to fostering safe, diverse, equitable, inclusive, and accessible work, research, and funding environments that value mutual respect and personal integrity. <https://science.osti.gov/SW-DEI/SC-Statement-of-Commitment>
- ◆ **Expectations for Professional Behaviors** – SC’s expectations of all participants to positively contribute to a professional, inclusive meeting that fosters a safe and welcoming environment for conducting scientific business, as well as outlines behaviors that are unacceptable and potential ramifications for unprofessional behavior. <https://science.osti.gov/SW-DEI/DOE-Diversity-Equity-and-Inclusion-Policies/Harassment>
- ◆ **How to Address or Report Behaviors of Concern**– Process on how and who to report issues, including the distinction between reporting on unprofessional, disrespectful, or disruptive behaviors, and behaviors that constitute a violation of Federal civil rights statutes. <https://science.osti.gov/SW-DEI/DOE-Diversity-Equity-and-Inclusion-Policies/How-to-Report-a-Complaint>
- ◆ **Implicit Bias** – Be aware of implicit bias, understand its nature – everyone has them – and implicit bias if not mitigated can negatively impact the quality and inclusiveness of scientific discussions that contribute to a successful meeting. <https://kirwaninstitute.osu.edu/article/understanding-implicit-bias>

# ASCR Office Hours

- ◆ **Tuesday, July 9, 2024, at 2pm ET - Overview of the ASCR research proposal and review process.**

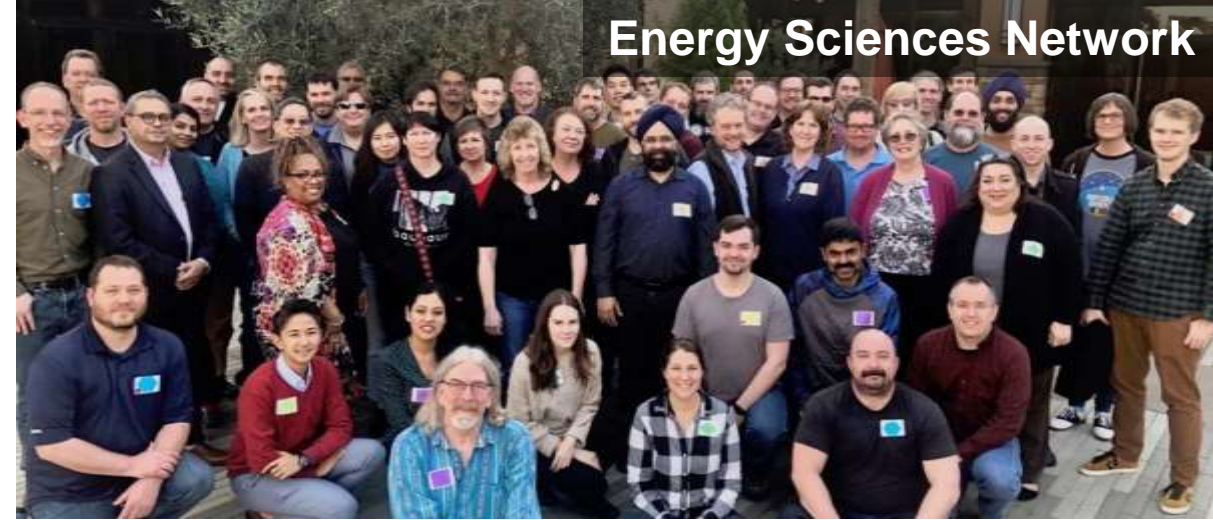
Check the ASCR website (<https://science.osti.gov/ascr/>) for Zoom registration links and videos of prior events:

- ◆ Tuesday, May 14, 2024 – Introduction to ASCR’s Applied Mathematics research program. ([Slides](#) | [Video](#))
- ◆ Tuesday, April 9, 2024 – Introduction to ASCR’s Computer Science research program. ([Slides](#) | [Video](#))
- ◆ Tuesday, March 12, 2024 – Introduction to ASCR and its program mission and history. ([Slides](#) | [Video](#))

# Open to you: ASCR Facilities Resources

- ◆ You can seek **computing allocations**
  - NERSC is predominantly allocated to Office of Science grantees and facility users
  - The LCFs are predominantly allocated via merit review of proposals
  - Quantum resources at OLCF and NERSC are allocated via merit review of proposals
- ◆ You can attend free **HPC training opportunities**
- ◆ You can access **advice and consultation for large data transfers**
- ◆ You can access **open source exascale code** for research applications
- ◆ You can apply for **internships, postdoctoral opportunities, and staff positions**

# The people of the ASCR Facilities





U.S. DEPARTMENT OF  
**ENERGY**

Office of  
Science

## Our Mission:

Deliver scientific discoveries and major scientific tools to transform our understanding of nature and advance the energy, economic, and national security of the United States.



More than **34,000** researchers supported at more than **300** institutions and **17** DOE national laboratories



Steward **10** of the 17 DOE national laboratories

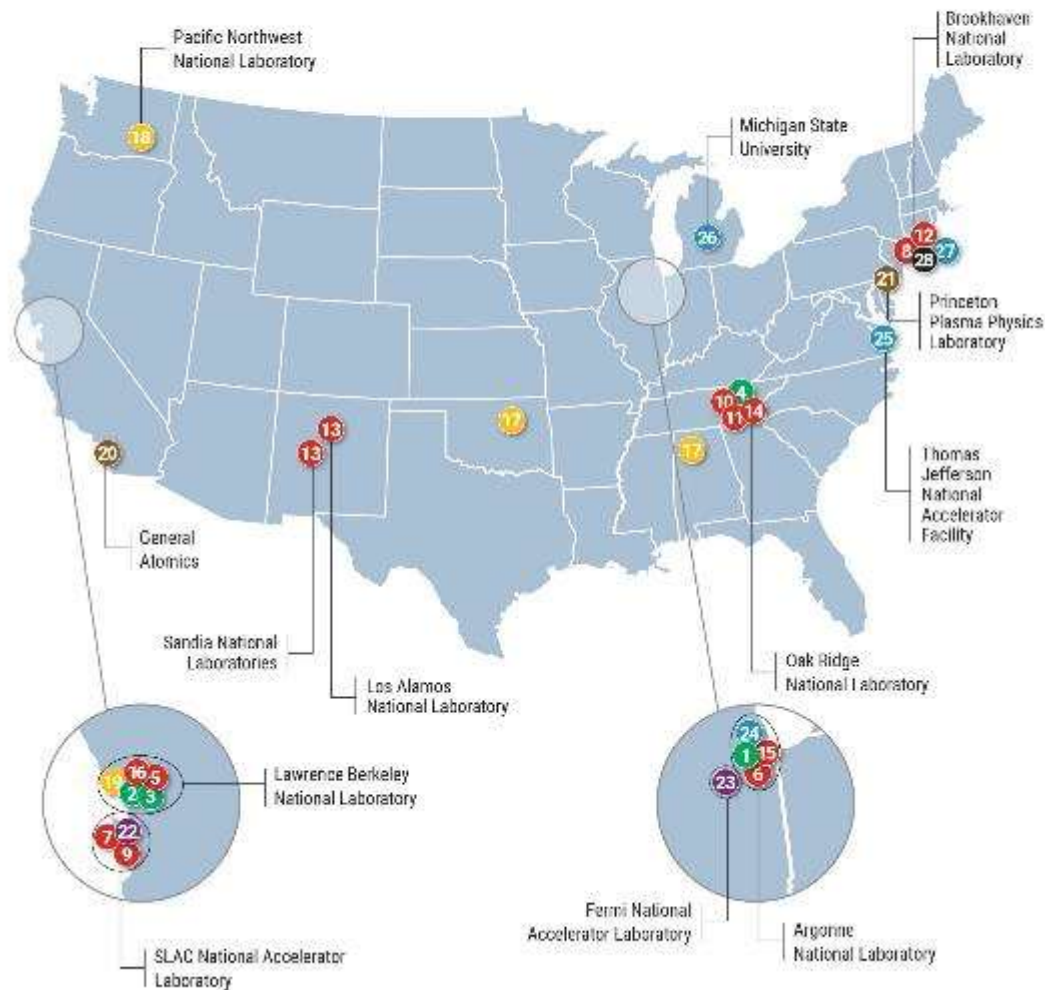


More than **37,000** users of **28** Office of Science scientific user facilities



**\$8.1B**  
(FY 23 enacted)

# U.S. Department of Energy Office of Science User Facilities



## Advanced Scientific Computing Research (ASCR)

- 1 Argonne Leadership Computing Facility (ALCF)  
Argonne National Laboratory
- 2 Energy Sciences Network (ESnet)  
Lawrence Berkeley National Laboratory
- 3 National Energy Research Scientific Computing Center (NERSC)  
Lawrence Berkeley National Laboratory
- 4 Oak Ridge Leadership Computing Facility (OLCF)  
Oak Ridge National Laboratory

## Biological and Environmental Research (BER)

- 17 Atmospheric Radiation Measurement (ARM) User Facility  
Fixed and Mobile Sites Across the Globe
- 18 Environmental Molecular Sciences Laboratory (EMSL)  
Pacific Northwest National Laboratory
- 19 Joint Genome Institute (JGI)  
Lawrence Berkeley National Laboratory

## Basic Energy Sciences (BES)

### LIGHT SOURCES

- 5 Advanced Light Source (ALS)  
Lawrence Berkeley National Laboratory
- 6 Advanced Photon Source (APS)  
Argonne National Laboratory
- 7 Linac Coherent Light Source (LCLS)  
SLAC National Accelerator Laboratory
- 8 National Synchrotron Light Source II (NSLS-II)  
Brookhaven National Laboratory
- 9 Stanford Synchrotron Radiation Lightsource (SSRL)  
SLAC National Accelerator Laboratory

### NEUTRON SOURCES

- 10 High Flux Isotope Reactor (HFIR)  
Oak Ridge National Laboratory
- 11 Spallation Neutron Source (SNS)  
Oak Ridge National Laboratory

### NANOSCALE SCIENCE RESEARCH CENTERS

- 12 Center for Functional Nanomaterials (CFN)  
Brookhaven National Laboratory
- 13 Center for Integrated Nanotechnologies (CINT)  
Sandia National Laboratories and Los Alamos National Laboratory
- 14 Center for Nanophase Materials Sciences (CNMS)  
Oak Ridge National Laboratory
- 15 Center for Nanoscale Materials (CNM)  
Argonne National Laboratory
- 16 The Molecular Foundry (TMF)  
Lawrence Berkeley National Laboratory

## Fusion Energy Sciences (FES)

- 20 DIII-D National Fusion Facility  
General Atomics
- 21 National Spherical Torus Experiment Upgrade (NSTX-U)  
Princeton Plasma Physics Laboratory

## High Energy Physics (HEP)

- 22 Facility for Advanced Accelerator Experimental Tests (FACET)  
SLAC National Accelerator Laboratory
- 23 Fermilab Accelerator Complex  
Fermi National Accelerator Laboratory

## Nuclear Physics (NP)

- 24 Argonne Tandem Linac Accelerator System (ATLAS)  
Argonne National Laboratory
- 25 Continuous Electron Beam Accelerator Facility (CEBAF)  
Thomas Jefferson National Accelerator Facility
- 26 Facility for Rare Isotope Beams (FRIB)  
Michigan State University
- 27 Relativistic Heavy Ion Collider (RHIC)  
Brookhaven National Laboratory

## Accelerator R&D and Production (ARDAP)

- 28 Accelerator Test Facility (ATF)  
Brookhaven National Laboratory

# The ASCR Facilities are Scientific User Facilities

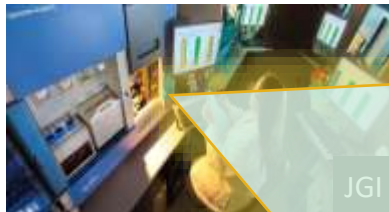
FY 2023  
28 scientific  
user facilities  
>37,000 users





# The ASCR Facilities are Scientific User Facilities

FY 2023  
28 scientific  
user facilities  
>37,000 users



**FREE**  
for  
non-proprietary use!

# The Office of Science Research Portfolio



## Advanced Scientific Computing Research

- Delivering world leading computational and networking capabilities to extend the frontiers of science and technology

## Basic Energy Sciences

- Understanding, predicting, and ultimately controlling matter and energy flow at the electronic, atomic, and molecular levels

## Biological and Environmental Research

- Understanding complex biological, earth, and environmental systems

## Fusion Energy Sciences

- Supporting the development of a fusion energy source and supporting research in plasma science

## High Energy Physics

- Understanding how the universe works at its most fundamental level

## Nuclear Physics

- Discovering, exploring, and understanding all forms of nuclear matter

## Isotope R&D and Production

- Supporting isotope research, development, production, processing and distribution to meet the needs of the Nation

## Accelerator R&D and Production

- Supporting new technologies for use in SC's scientific facilities and in commercial products

# ASCR Facilities provide world-leading computing, data, and networking infrastructure for extreme-scale science while advancing U.S. competitiveness

## High Performance Computing Facilities: ALCF, OLCF, NERSC



Argonne Leadership Computing Facility



Oak Ridge Leadership Computing Facility



NERSC at LBNL

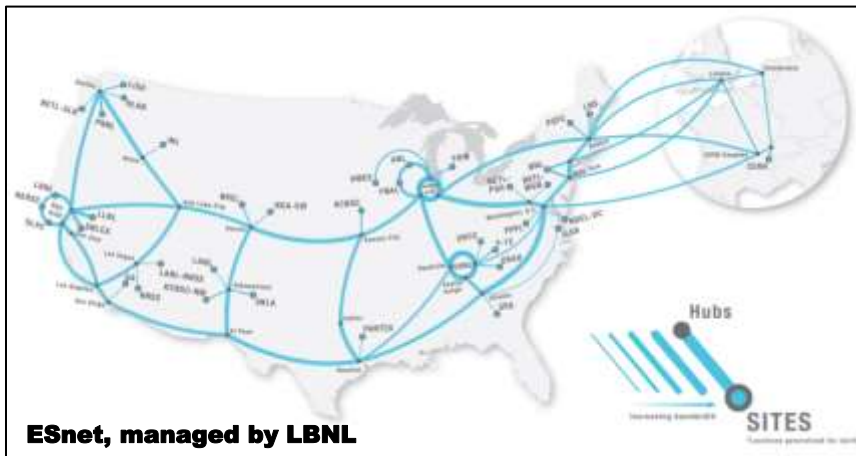
### Leadership Computing Facilities (ALCF, OLCF):

Unique national HPC resources for extreme-scale applications, delivering the exascale ( $10^{18}$ ) era of supercomputing

### High Performance Production Computing Facility (NERSC):

Dedicated HPC resource for the Office of Science research community, serving many thousands of users annually

## High Performance Network Facility: ESnet



### Energy Sciences Network (ESnet):

Connects all DOE national labs and dozens of other DOE sites to 150+ global research networks, commercial cloud providers, and the internet

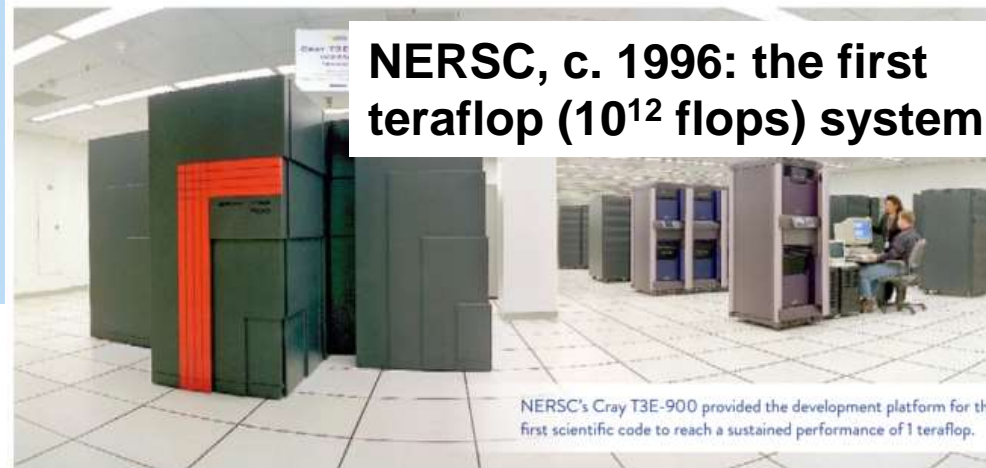
Engineered for lossless transmission of huge data flows

# ASCR – over 70 years of Advancing Computational Science

**Beginnings:** During the Manhattan Project, John Von Neumann advocated for the creation of a Mathematics program to support the continued development of applications of digital computing



Over 40+ years, ASCR has a rich history of investment in computational science and applied mathematics research, and revolutionary computational and network infrastructure.



## WHY COMPUTATIONAL SCIENCE?

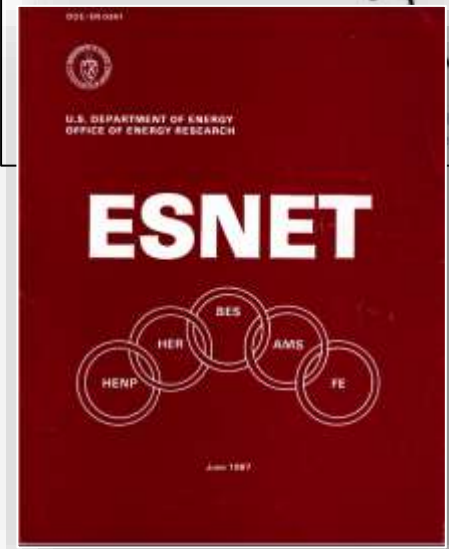
- Computational science adds a third pillar to researcher's toolkit along side theory and experiments
- Computational science is essential when experiments are too expensive, dangerous, time-consuming or impossible
- Computational science facilitates idea-to-discovery that leads from equations to algorithms
- Virtually every discipline in science and engineering has benefited from DOE's sustained investments in computational science

# The ASCR Facilities ecosystem began with the National Magnetic Fusion Energy Computing Center (later renamed NERSC) (1974) and ESnet (1985).



**CDC 7600**  
S/N 1 - delivered 01/69 retired 10/88  
Cost: \$5.1 million

- 36 million operations per second
- 4,000,000 bytes(chars) magnetic core memory
- Small core memory 65,000 sixty-bit words
- Large core memory 512,000 sixty-bit words
- 3,360 modules
- 120 miles of wire



**A legacy of project excellence**

ESnet through 6  
NERSC through 9  
OLCF through 5  
ALCF through 3  
Exascale Computing Project

# ASCR Facilities: History



Ewing "Rusty" Lusk at ANL's Advanced Computing Research Facility which fielded an array of early parallel systems.



NERSC's Cray T3E-900 provided the development platform for the first scientific code to reach a sustained performance of 1 teraflop.

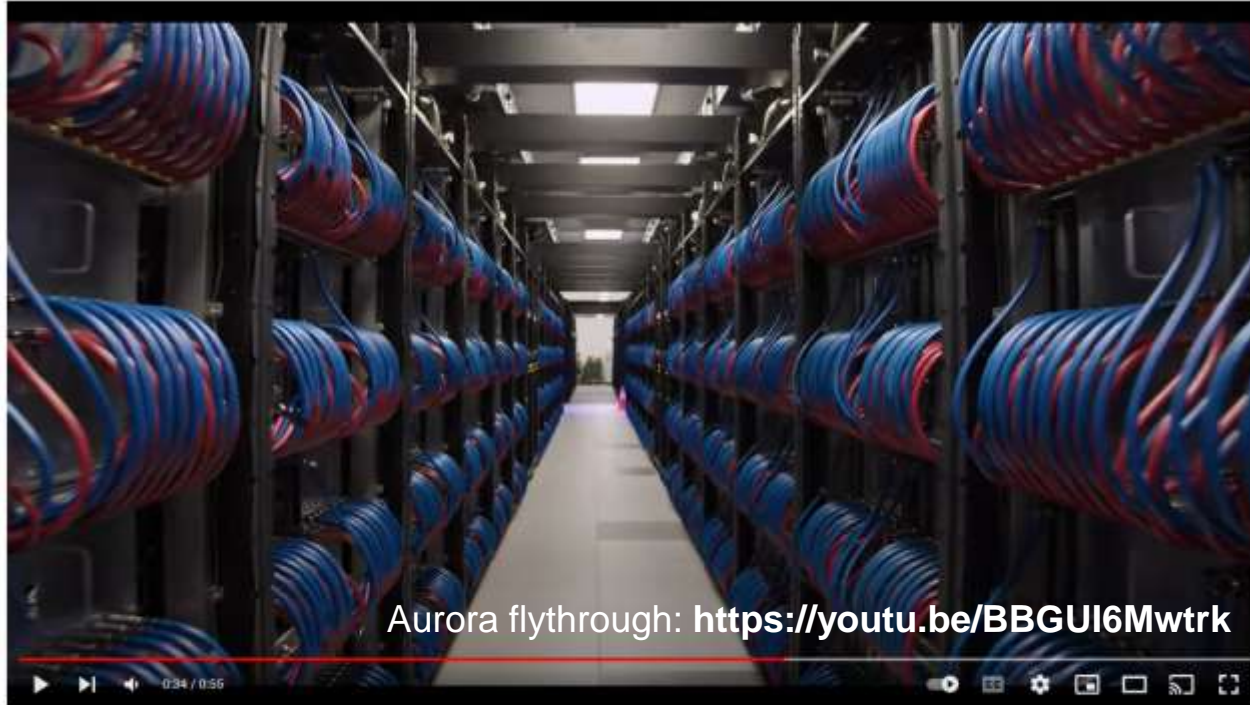


to address the grand challenge applications listed  
ORNL's Intel Paragon system was installed in 1995, comprising 3,072 processors to support research into Grand Challenge problems.

# Today: Exascale systems

**NERSC > 10,000 users!**  
**ESnet6 deployed**

Aurora at Argonne



Aurora Installation Flythrough

Argonne Leadership Computing Facility  
370 subscribers

Subscribe

Like Share Download Save



Frontier at Oak Ridge

ESnet6

ESnet's role: <https://vimeo.com/75733446>



# ASCR HPC system lifecycle timeline 2022-2035

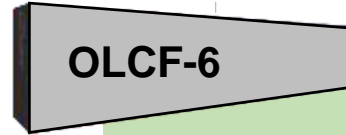
When “accepted,” a system enters a five-year operations window (green bar); the red bar indicates a possible 6<sup>th</sup> year life extension.

2022 2023 2024 2025 2026 2027 2028 2029 2030 2031 2032 2033 2034 2035

## ORNL OLCF



HPE/AMD



OLCF-6

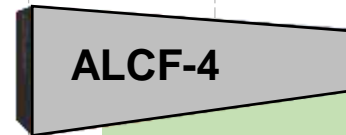


OLCF-7

## ANL ALCF



HPE/Intel



ALCF-4

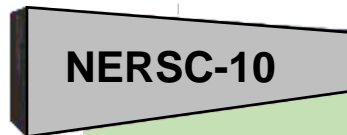


ALCF-5

## LBNL NERSC



HPE/AMD/NVIDIA



NERSC-10



NERSC-11

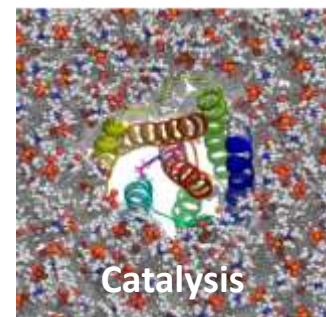
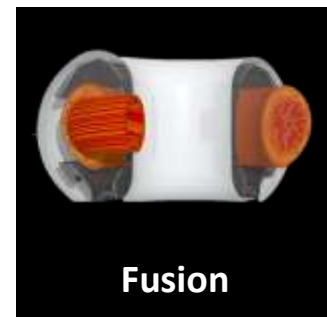
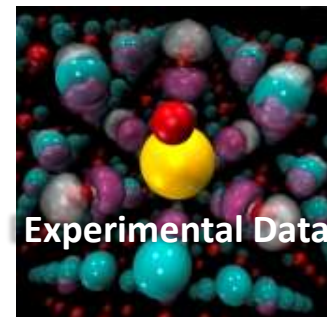
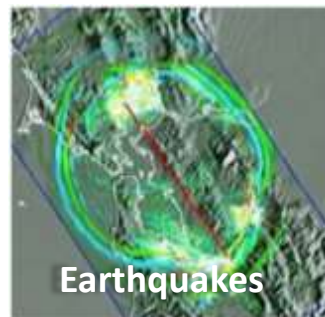
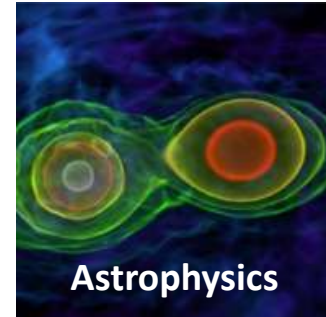
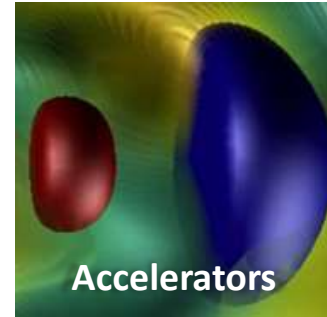
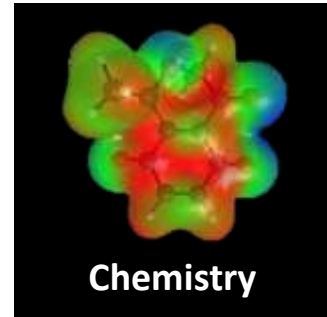
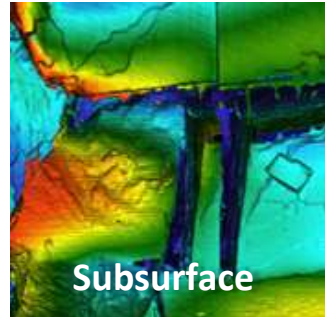
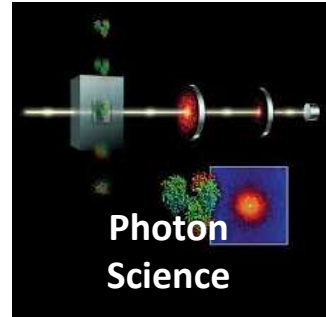
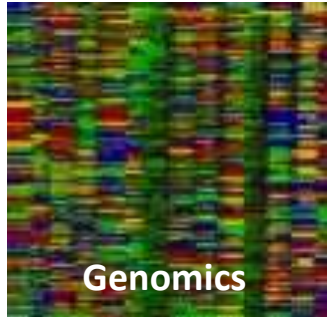
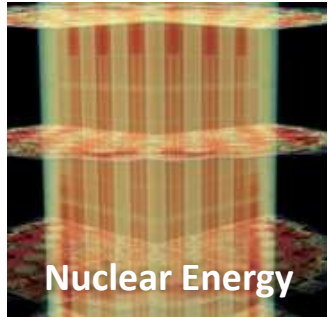
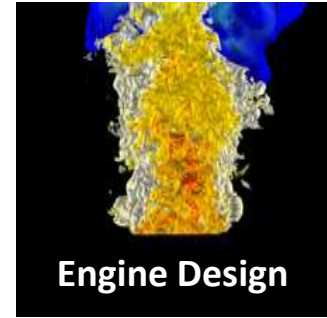
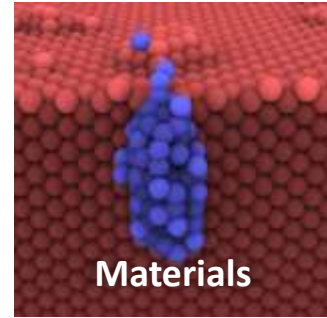
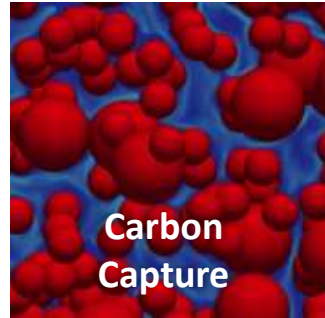
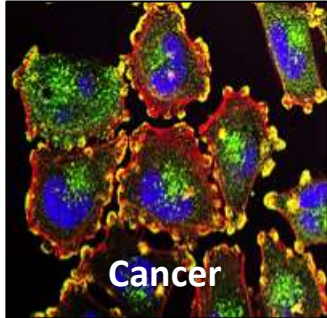


# ASCR Resources at the LCFs: See the INCITE website [doeleadershipcomputing.org](https://doeleadershipcomputing.org)



The image shows a screenshot of the INCITE website. The top navigation bar includes the INCITE logo (U.S. DEPARTMENT OF ENERGY LEADERSHIP COMPUTING) and menu items: ABOUT, GETTING STARTED, PROPOSALS, HPC RESOURCES, AWARDEES, CONTACT US, and an APPLY NOW button. The main content area features a large background image of server racks with the text "HPC RESOURCES" and "Computing resources available through INCITE." Below this, three red arrows with yellow outlines point to the names of the computing resources: Aurora, Frontier, and Polaris.

# The breadth of exascale-ready applications is remarkable; indicative of a sea change in computing abilities for DOE and the nation



# The ASCR Facilities user community is broad



# High Performance Computing Allocation Programs

	INCITE	ALCC	ERCAP	Director's Discretionary
<b>Allocation Program Mission</b>	Advance science and engineering	Advance DOE mission priorities; respond to national emergencies	Advance DOE Office of Science and SBIR/STTR research	Advance science and engineering
<b>Allocatable Time</b>	ALCF, OLCF: 60% NERSC: N/A	ALCF, OLCF: 30% NERSC: 10%	ALCF, OLCF: N/A NERSC: 80%	ALCF, OLCF: 10% NERSC: 10%
<b>Managing Office</b>	ALCF/OLCF	ASCR	DOE Office of Science Programs, SBIR/STTR	Each Facility
<b>Award Duration</b>	One year	One year (offset 6 months relative to INCITE)	One year	One year

For more information, see: <https://science.osti.gov/ascr/Facilities/Accessing-ASCR-Facilities>

# The best and most current information about ASCR Facility resources available to you are at the Facilities' websites:

## Resource descriptions:

- ◆ ALCF: <https://www.alcf.anl.gov/alcf-resources>
- ◆ OLCF: <https://www.olcf.ornl.gov/olcf-resources/>
- ◆ NERSC: <https://www.nersc.gov/systems/computational-systems-table/>

## Training opportunities and events:

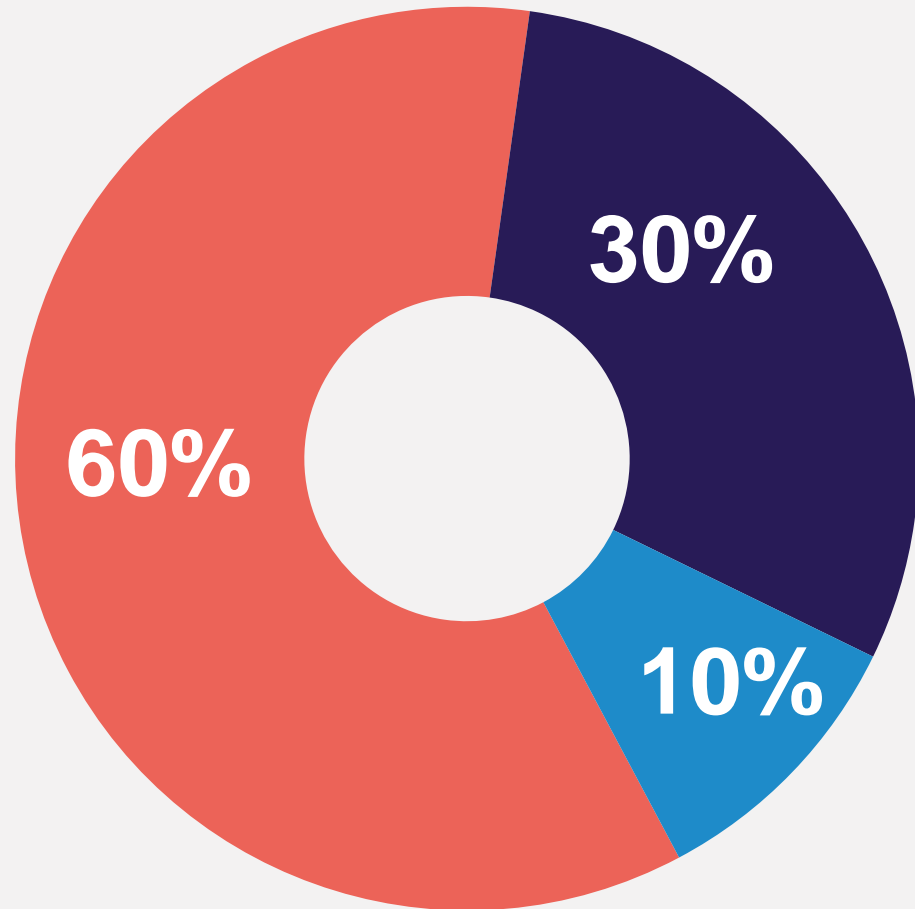
- ◆ OLCF: <https://www.olcf.ornl.gov/for-users/training/>
- ◆ ALCF: <https://www.alcf.anl.gov/events>
- ◆ NERSC: <https://www.nersc.gov/events/calendar/>

# **Additional information about allocation programs, from the Leadership Computing Facility perspective**

**Katherine Riley, Director of Science at ALCF and INCITE Program Manager**

LCF Allocation Programs	INCITE <b>60%</b>	ALCC <b>30%</b>	Director's Discretionary <b>10%</b>
<b>Mission</b>	High-risk, high-payoff science that requires LCF-scale resources*	High-risk, high-payoff science aligned with DOE mission	Proposal preparation Strategic LCF programs ECP
<b>Call</b>	1x/year – Opens in April, Closes June	1x/year – Opens in November, Closes February	Rolling
<b>Duration</b>	1-3 years, yearly renewal	1 year	3m,6m,1 year
<b>Typical # Projects</b>	<b>10-30 projects/resource (system dependent)</b>	<b>5-15 projects/resource</b>	<b>~100 of projects/resource</b>
<b>Average Award Range</b>	~700K Frontier node-hours ~700K Aurora node-hours* ~200k Polaris node-hours	~700K Frontier node-hours ~700K Aurora node-hours* ~100K Polaris node-hours	~10K Frontier node-hours ~10K Aurora node-hours* ~1-2K Polaris node-hours
<b>Review Process</b>	Scientific Peer-Review Computational Readiness	Scientific Peer-Review Computational Readiness	Strategic impact and feasibility
<b>Managed By</b>	INCITE management committee (ALCF & OLCF)	DOE Office of Science	LCF management
<b>Readiness</b>	<b>High</b>	<b>Medium to High</b>	<b>Low to High</b>
<b>Availability</b>	Open to all scientific researchers and organizations <b>Capability &gt; 20% of resource</b>		

# ALCF Allocation Programs



## **INCITE: Innovative and Novel Computational Impact on Theory and Experiment**

- Yearly call with computational readiness and peer reviews
- Open to all domains and user communities

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## **ALCC: ASCR Leadership Computing Challenge**

- Yearly call with peer reviews
- Focused on DOE priority
- Exascale Computing Project (ECP)

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## **DD: Director's Discretionary Program**

- Rapid, small allocations for project prep and immediate needs
- Readiness Programs
- Strategic Program
- Proprietary Projects



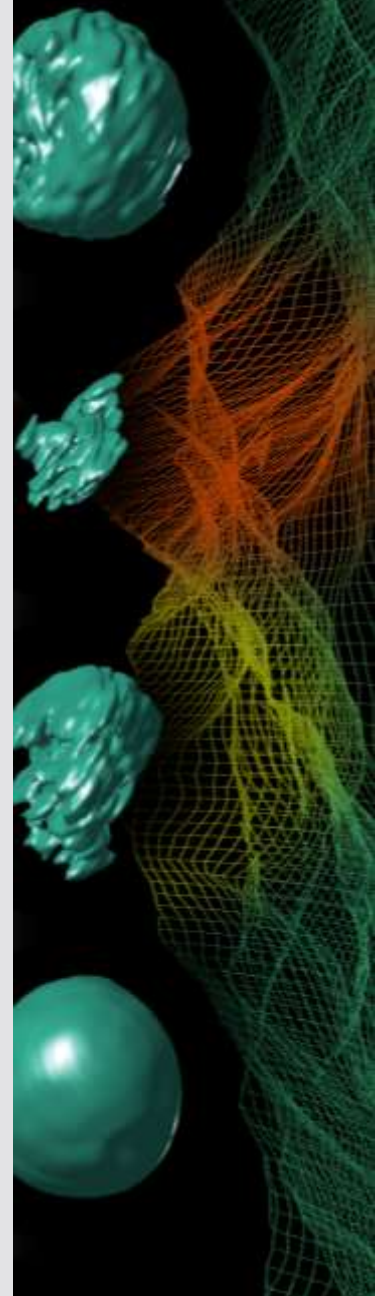
# DD

## Director's Discretionary

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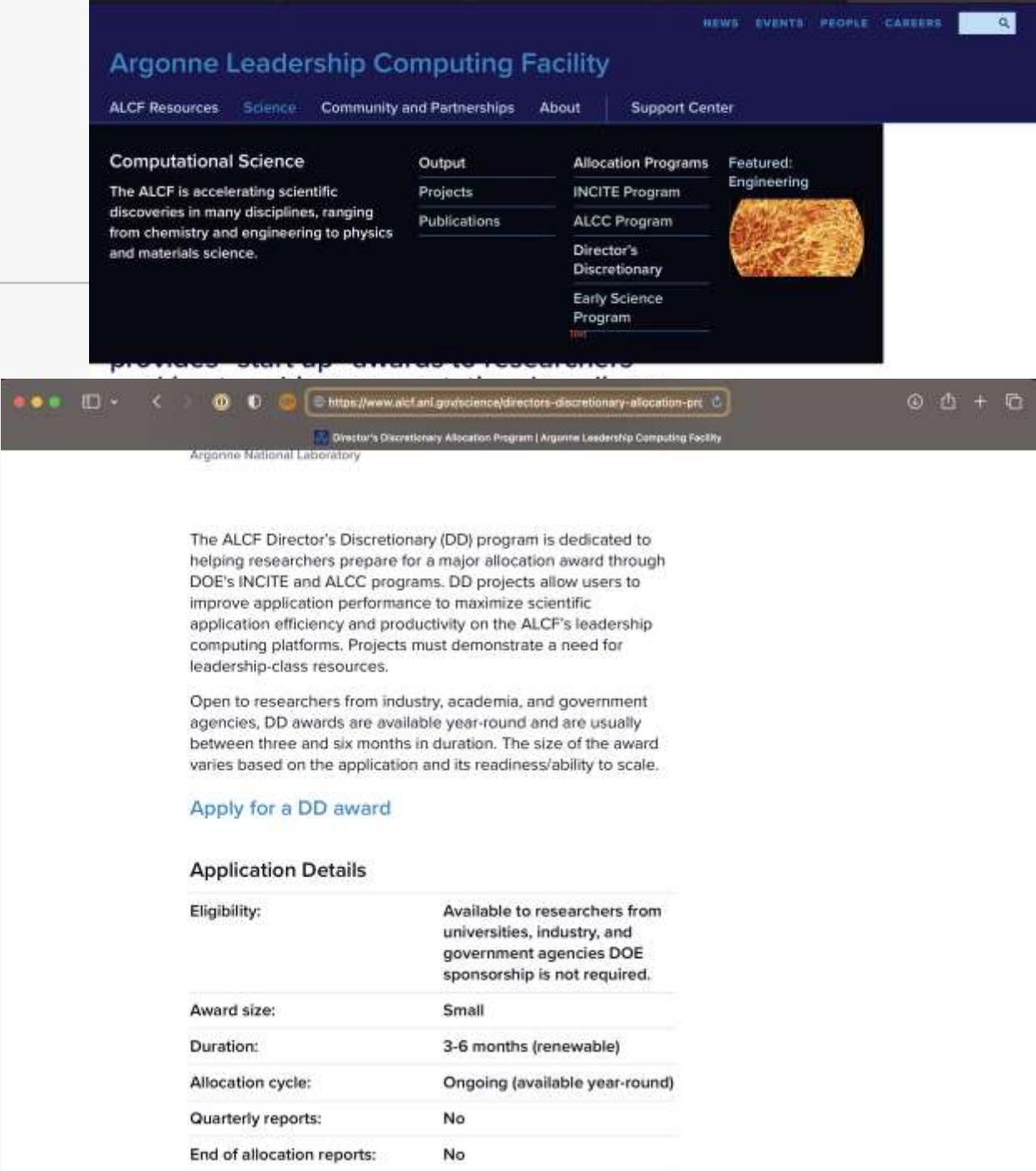
- **Purpose:** A “first step” for projects working toward a major allocation
- **Eligibility:** Available to all researchers in academia, industry, and other research institutions
- **Review Process:** Projects must demonstrate a need for high-performance computing resources; reviewed by ALCF
- **Award Size:** Low 10 thousand of node-hours
- **Award Duration:** 3-6 months, renewable
- **Total percent of ALCF resources allocated: 10%**

- **Award Cycle**  
Ongoing (available year-round)



# Applying to DD

- Process is designed to be quick
  - Short application, ~2 week turn around
- Demonstrate a need for LCF resource
- Evaluate viability and porting to LCF resources
- Work toward an INCITE or ALCC



The screenshot shows the Argonne Leadership Computing Facility website. The main navigation bar includes "ALCF Resources", "Science", "Community and Partnerships", "About", and "Support Center". The "Science" section is highlighted, with sub-sections for "Computational Science", "Output", "Allocation Programs", and "Featured: Engineering". The "Computational Science" section describes the ALCF's role in accelerating scientific discoveries. The "Output" section lists "Projects" and "Publications". The "Allocation Programs" section lists "INCITE Program", "ALCC Program", "Director's Discretionary", and "Early Science Program". The "Featured: Engineering" section features a glowing orange and yellow image.

The browser address bar shows the URL: <https://www.alcf.anl.gov/science/directors-discretionary-allocation-prg>. The page title is "Director's Discretionary Allocation Program | Argonne Leadership Computing Facility".

The main content area describes the ALCF Director's Discretionary (DD) program, which is dedicated to helping researchers prepare for a major allocation award through DOE's INCITE and ALCC programs. DD projects allow users to improve application performance to maximize scientific application efficiency and productivity on the ALCF's leadership computing platforms. Projects must demonstrate a need for leadership-class resources.

Open to researchers from industry, academia, and government agencies, DD awards are available year-round and are usually between three and six months in duration. The size of the award varies based on the application and its readiness/ability to scale.

[Apply for a DD award](#)

**Application Details**

Eligibility:	Available to researchers from universities, industry, and government agencies DOE sponsorship is not required.
Award size:	Small
Duration:	3-6 months (renewable)
Allocation cycle:	Ongoing (available year-round)
Quarterly reports:	No
End of allocation reports:	No

# ALCC

## ASCR Leadership Computing Challenge

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- The DOE's ALCC program allocates resources to projects directly related to the DOE's energy mission, as well as national emergencies, and for broadening the community of researchers capable of using leadership computing resources.
- **Eligibility:** Available to researchers in academia, industry, and other research institutions
- **Review process:** DOE peer reviews all proposals for scientific/technical merit; appropriateness of approach; and adequacy of personnel and proposed resources
- **Award size:**
  - 10,000-200,000 Polaris node-hours
  - ~ 250K – 1M Aurora node-hours
- **Award duration:** 1 year
- **Total percent of ALCF resources allocated:** 20-30%

- **Award Cycle**  
July 1 to June 30

Nov Call  
Plan for  
LOI

