FUSION INDUSTRY ASSOCIATION

Opportunities for students in the fusion industry

Caroline Anderson
Head of Public Affairs & Communications
Fusion Industry Association

PPPL Seminar
June 11, 2025

Presentation Overview

- About me
- Industry & policy overview
- About FIA
- Student opportunities!
  - Opps at FIA directly
  - Opps in fusion industry

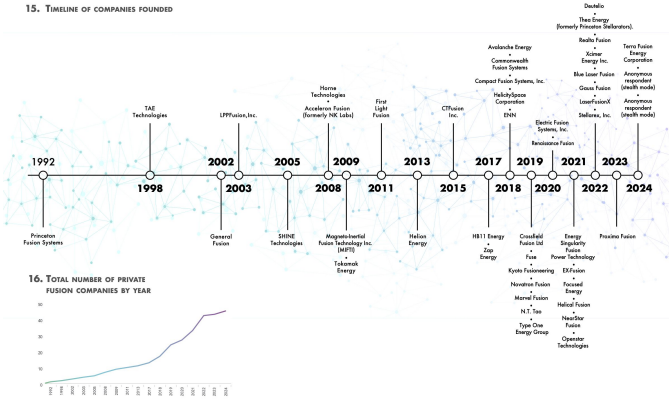
About me

- From Charlotte, NC
- Went to UNC Chapel Hill
  - BA degrees in Economics and Peace, War, & Defense
- Worked at a nonprofit that led economic development and conflict resolution programs in the Middle East
- Now at FIA! Been here for the last 3.5 years

Industry Overview

Industry Snapshot

- **45+ private fusion companies** worldwide
- **13 countries**
- **Over $8B investment** to date
- Accelerated commercialization timelines
- Global fusion workforce and supply chain
- Technical diversity
- Challenges remain - fusion is hard!

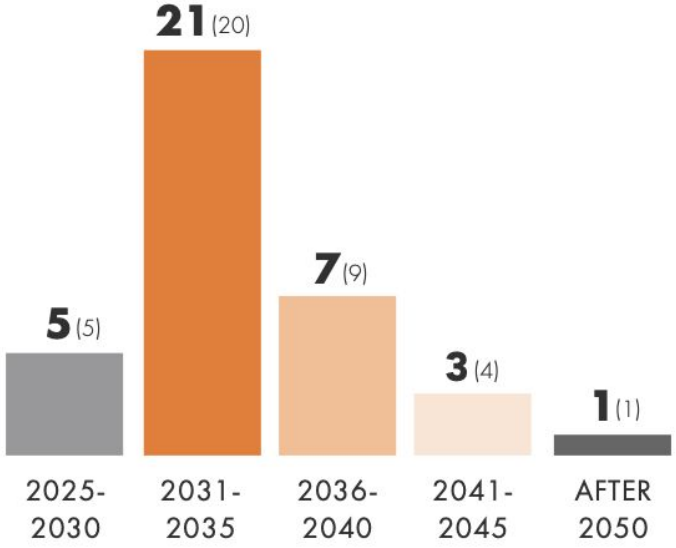


Timelines

13. Predictions

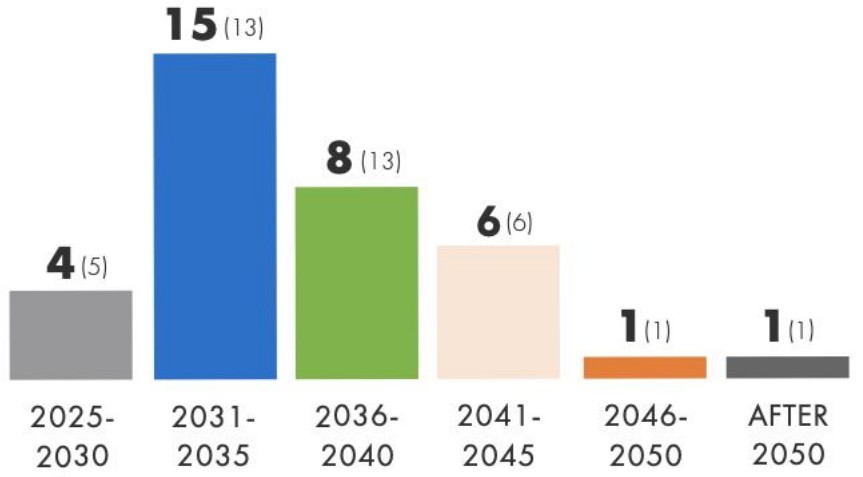
When will the first fusion plant deliver electricity to the grid? (37 responses)

**Last year's response in brackets*



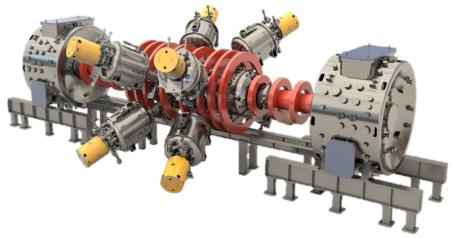
When will the first fusion plant demonstrate a low enough cost/high enough efficiency (Q) to be considered commercially viable? (35 responses)

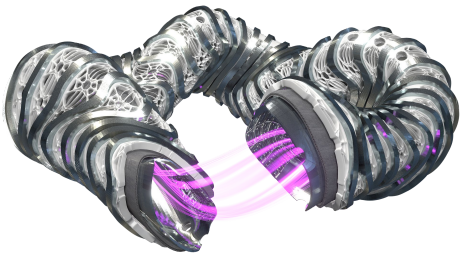
**Last year's response in brackets*

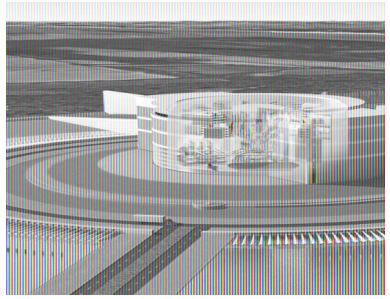


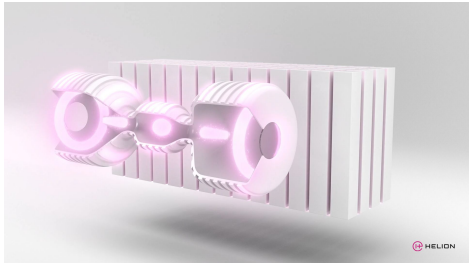
Fusion Industry Timeline

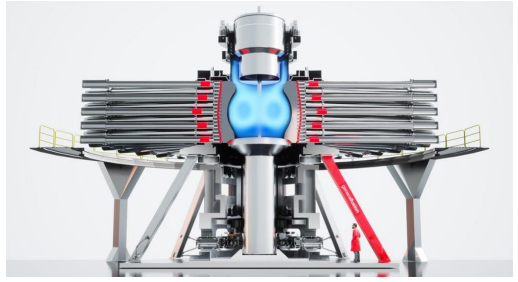
60 years of research	Mid 2020s	Late 2020s	Early 2030s	Mid 2030s
• Scientific basis for fusion energy	• Scientific Proof of Concept	• Design and build Pilot Plants	• Operate Pilot Plants, first sales	• Commercial Fusion, rapid scale-up to global deployment





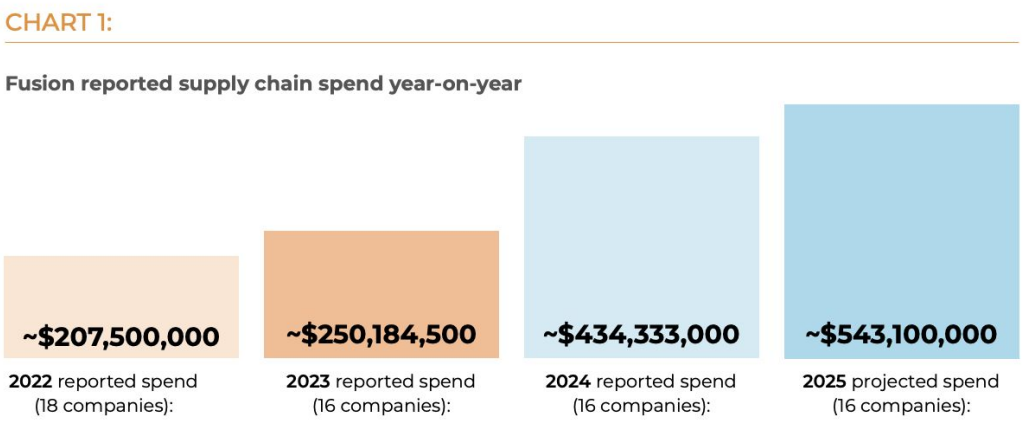


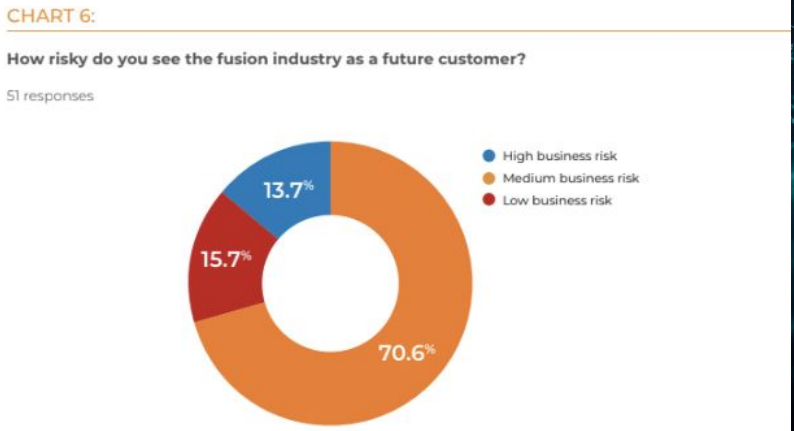




Supply chain growth

- Fusion companies spent over $434 million on their supply chain in 2024.
- Supply chain spending is anticipated to grow by another 25% in 2025.
- But 81% of fusion suppliers said that lack of certainty still makes scaling up difficult.





Technology diversity

- **Multiple pathways:**
- **Fuel types:** deuterium-tritium, deuterium-helium-3, proton-boron.
- **Applications:** electricity, industrial heat, space propulsion, medical isotopes, marine propulsion

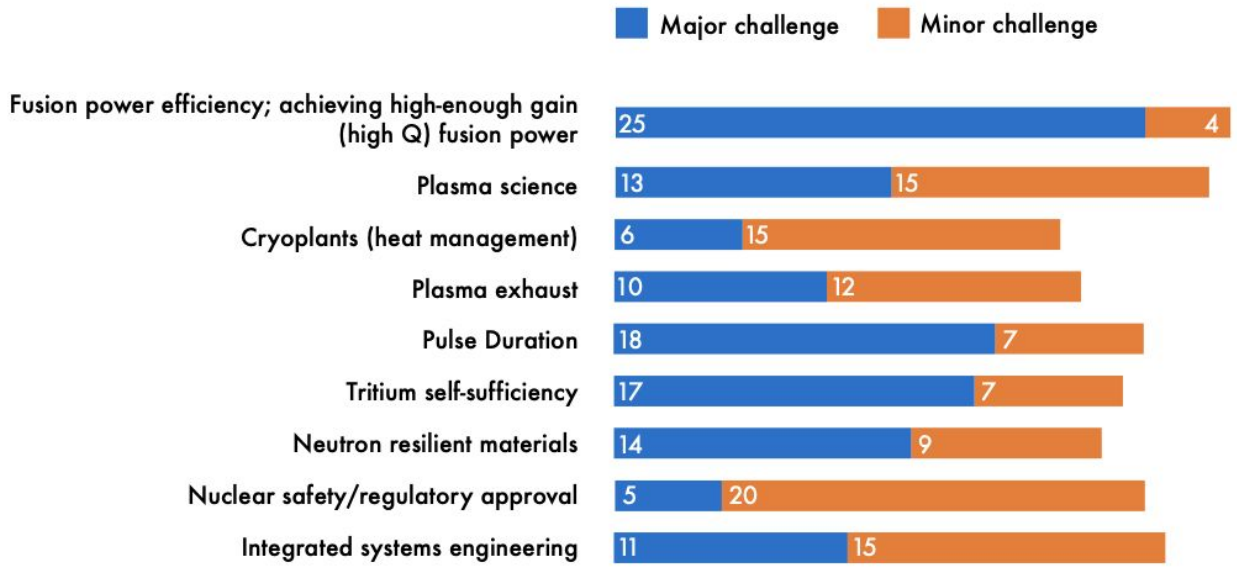
Specific approach

8	Stellarator
7	Laser-driven inertial confinement
3	Tokamak
3	Spherical tokamak
3	Field Reversed Configuration
2	Z-pinch
2	Magnetized target fusion
1	Levitated Dipole
1	Magnetic mirror
1	Centrifugal Magnetic Mirror
1	Magnetic-electrostatic confinement
1	Magnetized Liner Inertial Fusion (MagLIF)
1	Muon-catalyzed fusion with high density fuel
1	Open magnetic confinement (Mirror machine)
1	Magnetic electrostatic
1	Plectoneme
1	Poloidal magnetic confinement
1	Pulsed magneto-plasma pressurized confinement
1	Shock-driven inertial confinement
1	Short-Pulse Laser-Driven Inertial Confinement
1	Spindle cusp
1	Dense Plasma Focus
1	Electro-centripetal confinement
1	Agnostic

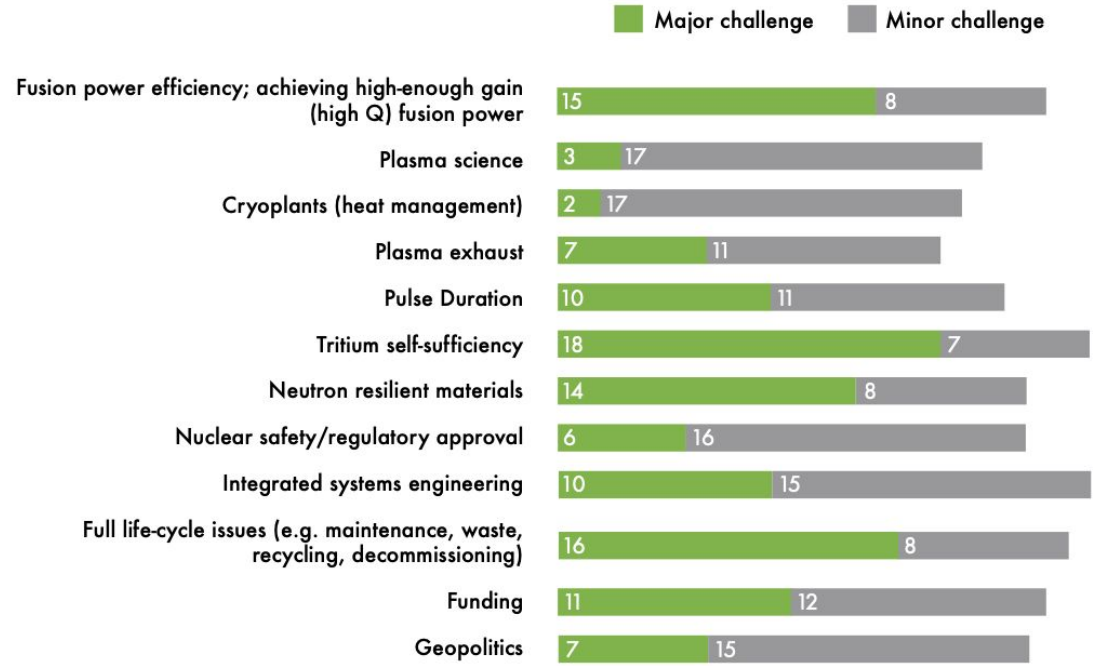
Challenges

14. Challenges

What do you see are the main challenges for fusion energy up to 2030?
(38 Reponses, non-reported answers indicate not seen as a problem/don't know)



What do you see are the main challenges for fusion energy after 2030?
(36 Reponses, non-reported answers indicate not seen as a problem in this timescale)



Policy Overview

A Global Race to Commercialization

To Help Tackle Climate Crisis, White House Touts Nuclear Fusion

South Korea to invest $866M in fusion energy development

Fusion energy startup Focused signs agreement with RWE, German state

White House forges deals with fusion pioneers

China Races Ahead: Breaking Down China's Record-Breaking Fusion Milestone

Germany boosts investment in fusion research to enhance collaboration

Fusion energy could be 'decisive building block' for Europe's energy security

European tech companies are racing to commercialise fusion energy

DOE Announces New Decadal Fusion Energy Strategy

Japan adopts national strategy on nuclear fusion as competition intensifies

Is China striding past Europe, America and Japan on nuclear fusion?

BUSINESS INVESTING TECH POLITICS VIDEO INVESTING CLUB PRO LIVESTREAM

How the U.S. is losing ground to China in nuclear fusion, as AI power needs surge

PUBLISHED SUN, MAR 16 2025-9:00 AM EDT

Katie Tarasov
@KATIETARASOV

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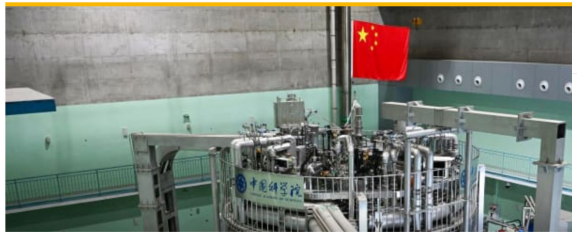
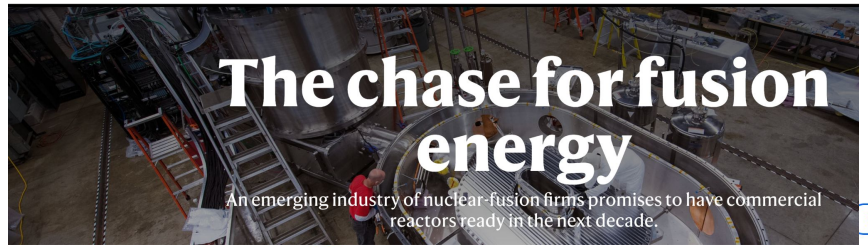


nature



Renewable energy + Add to myFT

Governments join race for commercial fusion power

Goal of abundant, zero-carbon electricity from fusing atoms brings together private and public sector

EMERGING TECHNOLOGIES

Is the world ready for the transformational power of fusion?

Policy Accelerating Fusion

- Governments announcing national fusion energy strategies, record funding
- Launching international partnerships on fusion
- Rise in public-private partnerships
- Solidifying fusion regulations

South Korea Announces KRW 1.2 Trillion to Prioritize Fusion Commercialization

Japan Announces National Strategy For Fusion Energy

G7 Includes Fusion Energy in Leaders' Communiqué

"Biggest piece of energy legislation in the UK's history" will support UK's fusion development

Canadian Roadmap For National Fusion Energy Strategy

German Hearing on Charting a Fusion Regulatory Framework

European Commission President Ursula von der Leyen Pushes for Fusion Acceleration in Europe

White House launches "International Partnerships in a New Era of Fusion Energy Development"

Growth in public-private partnerships

Notable public-private partnerships that have moved forward in the last year include:

- The US' Milestone-Based Fusion Development Program, that in June 2024 announced eight companies had signed contracts with the Department of Energy to deliver comprehensive pilot plant designs. INFUSE continues to award public-private partnership program projects.

- Germany's new "Fusion 2040" program that will invest directly into private companies

- Japan's "Moonshot" program

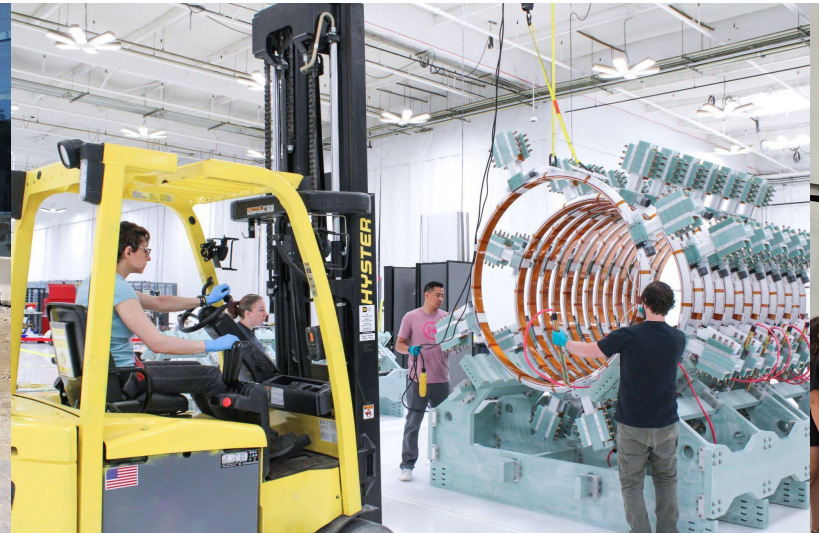
- The UK's ambitious new "Fusion Futures" program that invests in the key technology providers

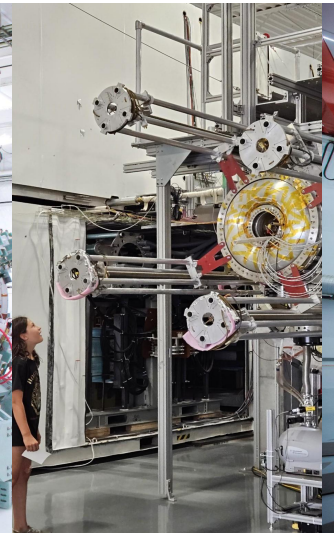
- The European Union's recent effort to create a consortium that will define how it will invest in private fusion by 2026

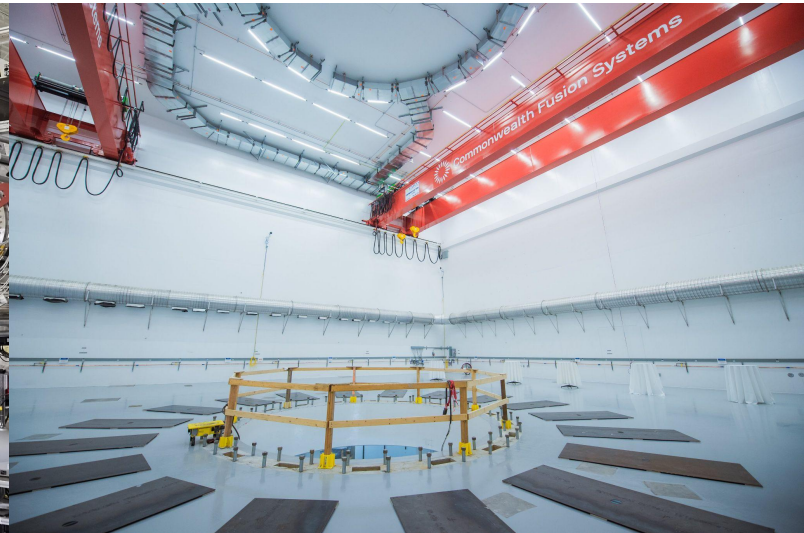
- ITER has announced its interest in public private partnerships and its intention to directly share knowledge with private fusion companies.

The Path to Commercialization

- Proof-of-concept machines are being built now. Pilot plants planned for early 2030s.
- Fusion developers are siting first fusion facility locations & making deals
- **Challenges to overcome:** sustained investment, regulatory certainty, skilled workforce, suppliers to scale to meet commercial timelines







FIA Overview

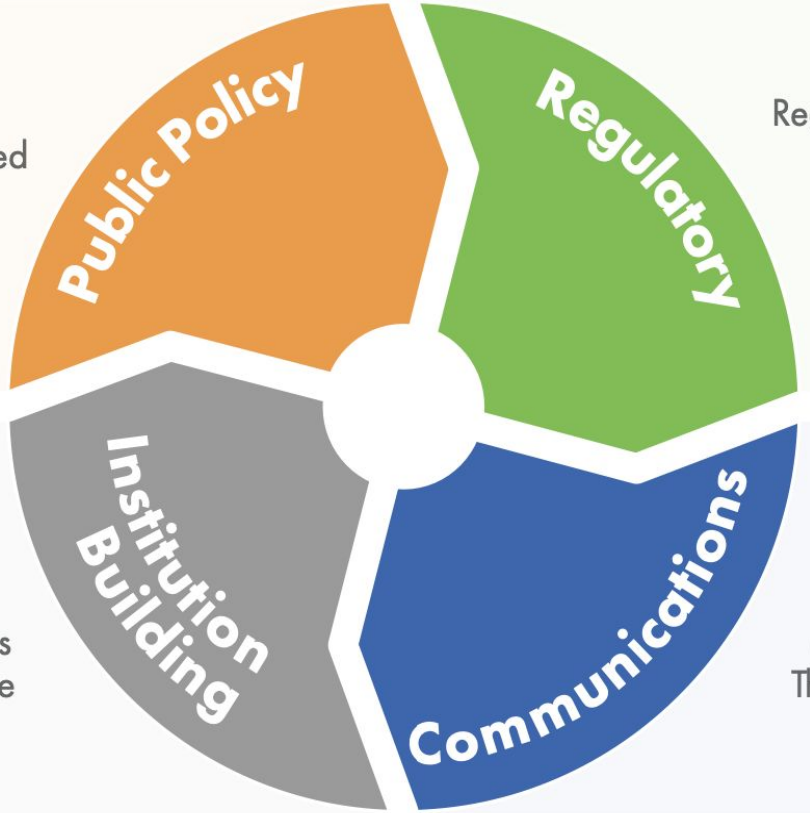
The FIA Mission

The Fusion Industry Association (FIA) is the unified voice of the global fusion industry. The FIA is a 501(c)(6) nonprofit membership organization dedicated to accelerating and deploying commercial fusion energy through policy advocacy and transparent public communication.

We collaborate globally with policymakers, investors, power producers, regulators, and affiliated companies to gain the investment and support needed to make fusion power a reality.

FIA's Strategic Focus

Key global governments have implemented the policies, supported by sufficient resources, to enable accelerating and scaling up commercial fusion energy.



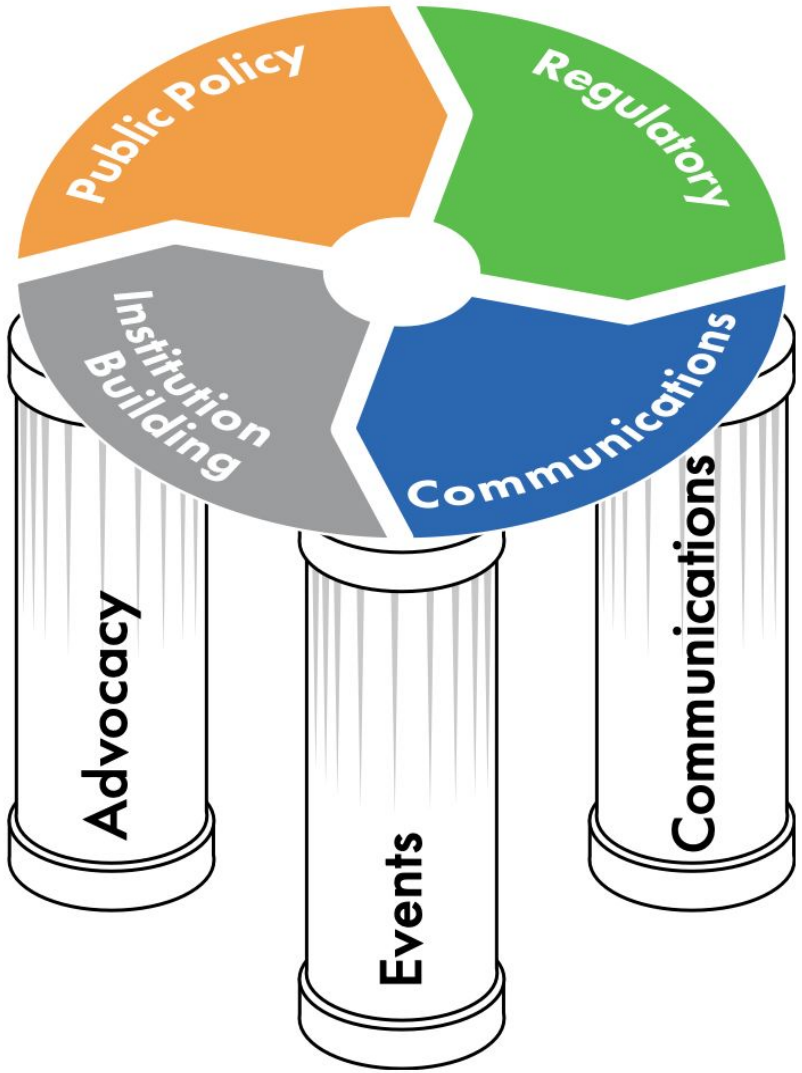
Regulatory, permitting, and export control frameworks support the commercialization and deployment of fusion energy around the world.

The FIA's influence is seen in all global fusion efforts. FIA's leadership and staff grow to support the mission. Membership is necessary for any participant in the global fusion energy economy.

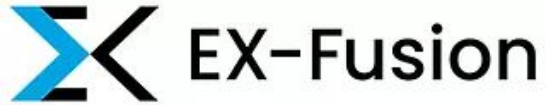
Stakeholders understand the promise of fusion energy, on an accelerated timeline, and actively support its deployment. The public is ready for fusion and does not oppose growth.

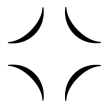
Three External Pillars of Action

Building on existing strengths, to achieve industry goals



FIA Membership





FIA Affiliate Members: Advocacy & Nonprofits

CleanTech Alliance™

BAYFUSION

ENERGY for the COMMON GOOD
Soon enough to make a difference

OAK RIDGE CHAMBER OF COMMERCE
IN BUSINESS FOR BUSINESS

TWI

SVC SOCIETY VACUUM COATERS

CLEARPATH ACTION

Livermore Lab FOUNDATION

OPTICA Formerly OSA
Advancing Optics and Photonics Worldwide

American Conservation Coalition

STELLAR ENERGY FOUNDATION

clf Conservation Law Foundation

TERRA PRAXIS

ETEC EAST TENNESSEE ECONOMIC COUNCIL

FIA Affiliate Members: Fusion Suppliers

FIA Affiliate Members: Fusion Customers

Setting up an Educational and Research partnership program...

Opportunities for students

3 ways for students to get involved @ FIA

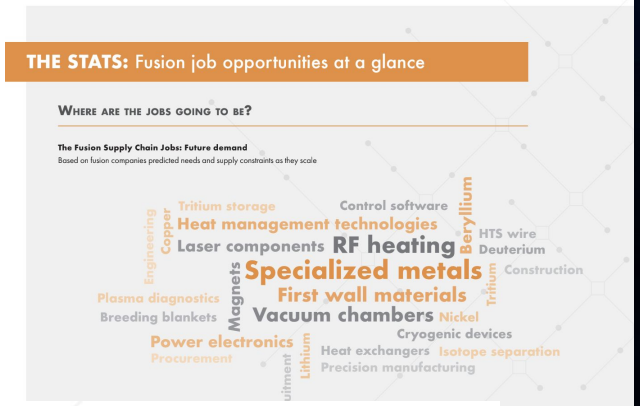
1. Partner with FIA through Education & Research Partnership
2. Join FIA's virtual Summer Seminar series
3. Intern at FIA in DC!

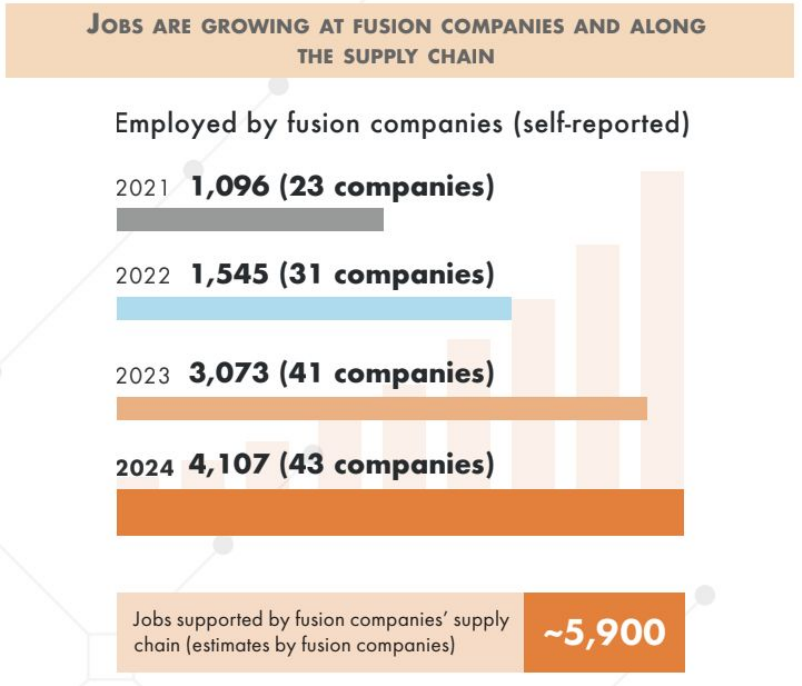
Bonus? Shamless plug?: stay connected w FIA on social media, newsletters, events, etc. We regularly update about what's going on in industry, policy, and FIA activity.

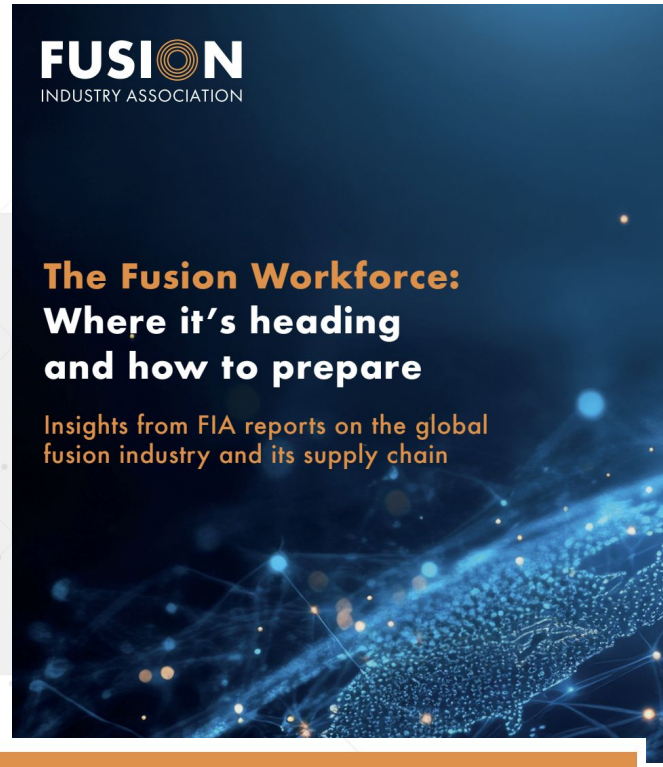
Opps to get involved in the fusion industry

- The workforce is growing

- The need for all backgrounds and skills is increasing as industry accelerates.
  - Less of an emphasis on Phds as fusion scales - more on engineers and other skills.







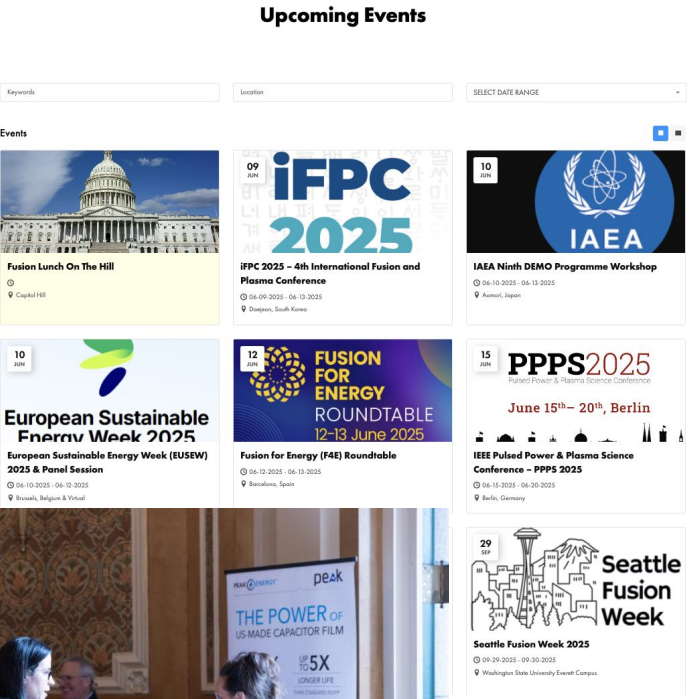
The skills needed by the fusion industry and its supply chain

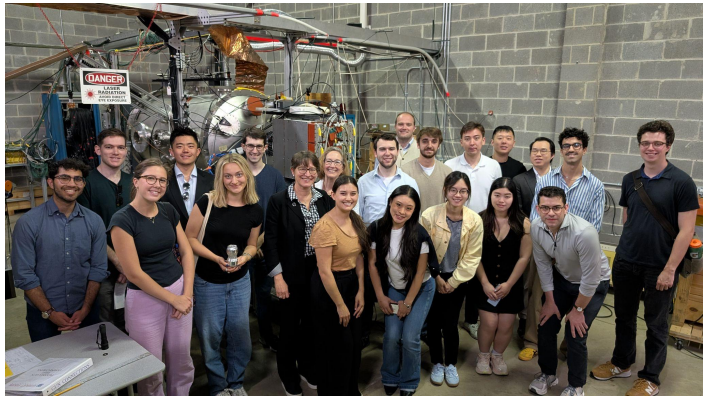
- Skills to develop specialized components such as for heat management, plasma-facing first wall, and vacuum pumps
- Precision engineering skills at the cutting edge
- Skills for large scale production of power electronics
- Scientists, including plasma physicists
- Nuclear and plant process engineers
- Engineers to design and assemble fusion machines and power plants
- Machine learning and digital engineering
- Those experienced in navigating new regulatory frameworks

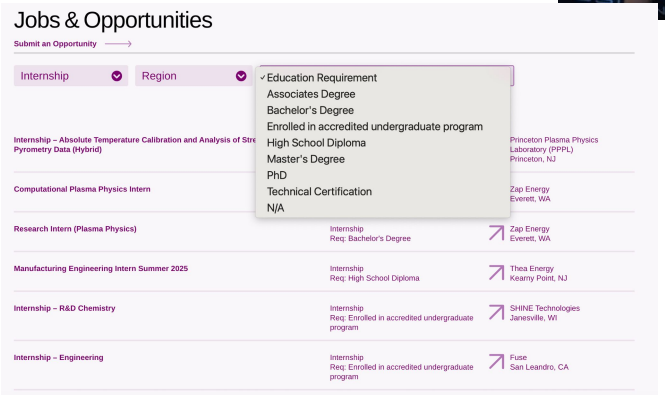
As of July 2024

How to do that…

- Join events & meet folks in person
  - Can volunteer @ events or email: “I’m a student - discount?”
- Stay up to date on fusion industry news - company announcements, partnerships, etc.
- Get your school to partner/explore fusion in some capacity
  - Examples…
    - An FIA intern last semester was in Georgetown’s energy policy club and organized a club trip out to NearStar Fusion - fusion developer in Virginia.
    - HBS did a business study on FIA
    - Spoke at a GW STEM event
    - UFA; FuSD; FIA partnership







FIA Membership Categories

Full Membership

Full Membership in the FIA is open to **private companies striving to develop economically viable commercial fusion energy**. Membership is led by the **FIA Board of Directors**, composed of leaders from companies paying dues above a defined threshold.

Affiliate Membership

Affiliate Membership is open to companies and individuals who want to participate in the FIA and are part of the growing fusion energy economy. Membership levels include **Fusion Suppliers** (for energy suppliers and service providers) and **Fusion Customers** (for energy distributors and end users). **Nonprofits and advocacy organizations** are also eligible to join for a reduced rate.

Education & Research Partnerships

Education & Research Partnerships with FIA are open to accredited universities, colleges, national labs, scientific/research institutions and individuals who support the advancement of fusion energy power and the global fusion industry.

Education & Research Partners: Levels & Benefits

Open to individuals, universities, national labs and institutions that support the fusion energy ecosystem

Partner Level & Annual Dues	SUPPORTING Partner *(Intended for Individuals)*	SUSTAINING Partner *(Intended for Universities, National Labs, or Institutions)*
Networking & Association Activities	• Invitation to all FIA public events • Membership in FIA Education & Research Partnership Working Group, which proposes policy action to the FIA • Participation in monthly FIA Partnership meeting	All benefits of SUPPORTING level, plus: • Invitations to FIA's private VIP and policymaker events, when deemed applicable by FIA • 2 tickets to FIA Annual Policy Conference • Opportunity to share internal openings on FIA Job Board • Opportunity for interns and young professionals at your organization to join virtual FIA Summer Seminar program
Communications & Promotional Support	• Access to FIA talking points on fusion energy development • Connections for press outreach / PR efforts	All benefits of SUPPORTING level, plus: • Organization logo on FIA website and promotional materials • Opportunity for brief description of organization activities or announcement published in FIA monthly membership newsletter (once annually)

For more information on member benefits, contact FIA Events and Membership Director, Melanie Goff at Melanie@FusionIndustryAssociation.org.

Thank you!

Feel free to reach out:

Caroline@FusionIndustryAssociation.org

"This program has fundamentally changed me as a scientist, and for that I am very thankful."

SCGSR 2023 S2 Awardee

U.S. Department of Energy

OFFICE OF SCIENCE

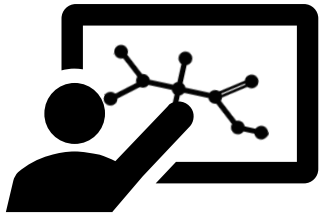
Office of **SC**ience **G**raduate **S**tudent **R**esearch (**SC GSR**) Program

Igor I. Slowing
Program Manager

U.S. DEPARTMENT of ENERGY | Office of Science

Igor I. Slowing

License in Chemistry
San Carlos University,
Guatemala, 1995



Organic Chemistry Professor
2 Universities, Guatemala
1996 – 2003

PhD in Organic Chemistry
Iowa State University,
2008

Scientist
US DOE Ames National Lab
2009 – 2022
Adjunct Professor of Chemistry
Iowa State University
2013 – 2022

Catalysis science, nanomaterials
chemistry, drug delivery.
> 100 peer reviewed publications,
~19,000 citations

Program Manager
US DOE WDTS
2022 –

SCGSR Program

Foster advanced workforce development in areas critically important to SC mission

Supports **PhD candidates** for conducting part of their **thesis research at DOE National Laboratories**

3 – 12 months in collaboration with a DOE National Laboratory scientist

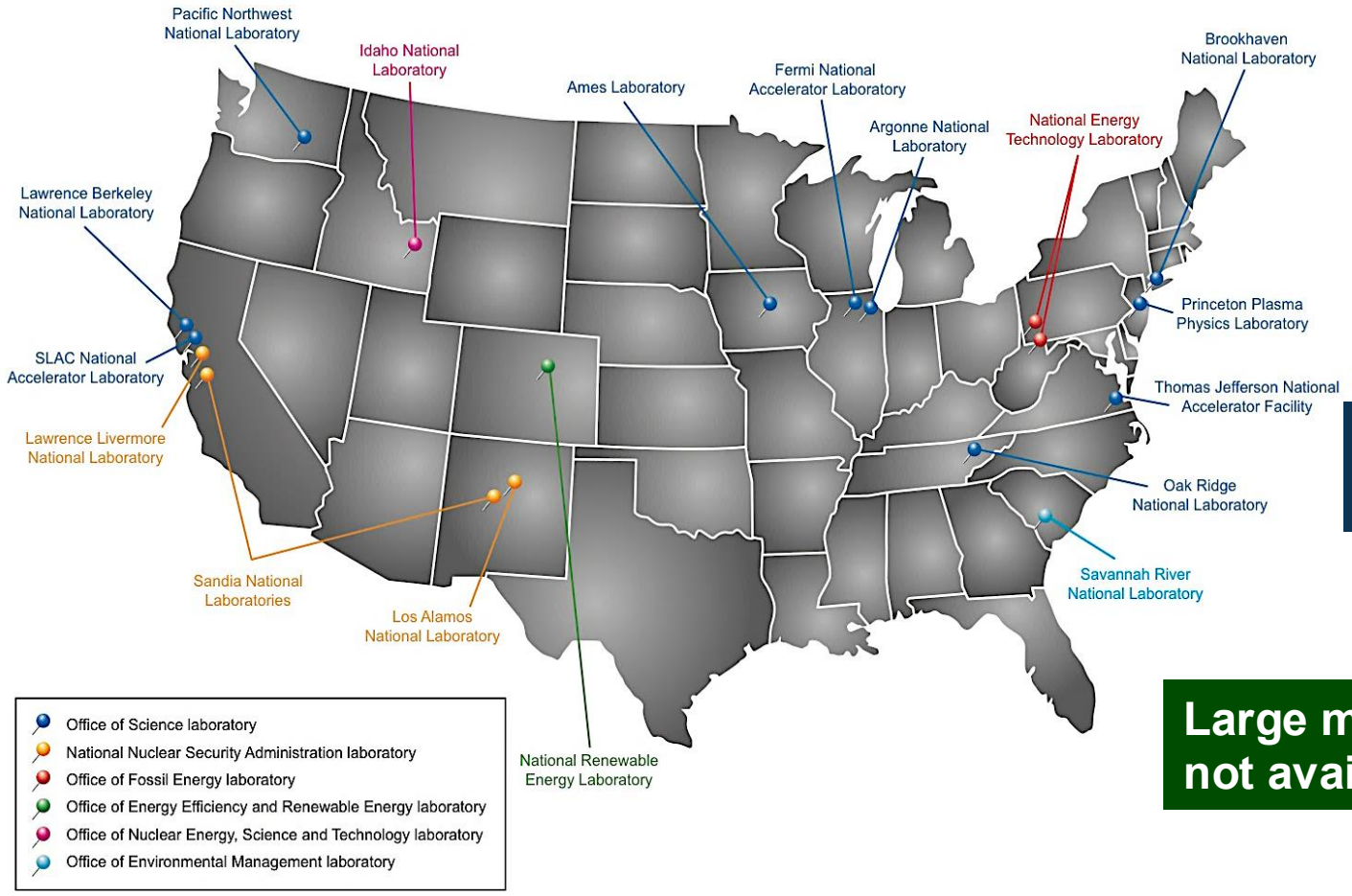
Become a Scientist in Residence
Build network and establish yourself in the field

- U.S. citizens or Lawful Permanent Residents
- Alignment with priority research areas
- New research experiences

Stipend: Up to $3,600/month
Travel Reimbursement: Up to $2,000

DOE National Laboratories:
A Unique Asset for Training and Scientific Discovery

Created as a home for large-scale, costly scientific facilities that universities cannot afford

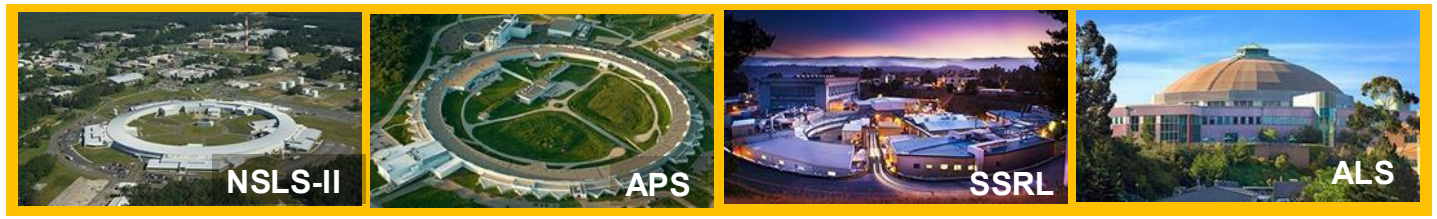


DOE National labs employ >30,000 scientists and engineers

World leading scientific user facilities, expertise, and resources

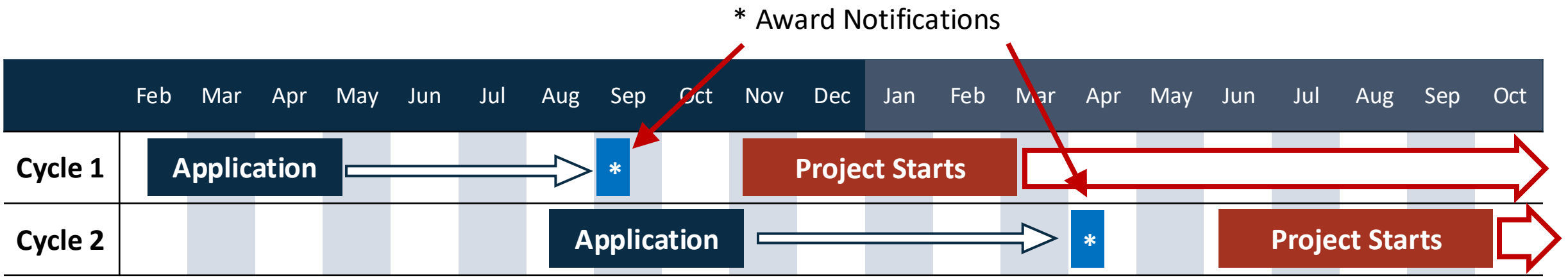
Large multidisciplinary research programs not available in universities or industry

28 Scientific User Facilities

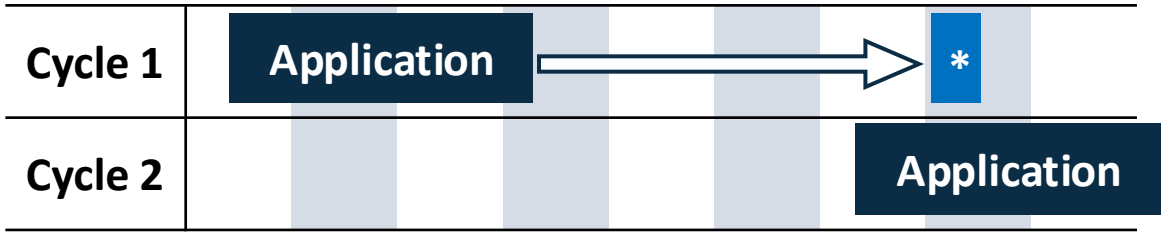


Over 37,000 users per year

2 Application Cycles per Year

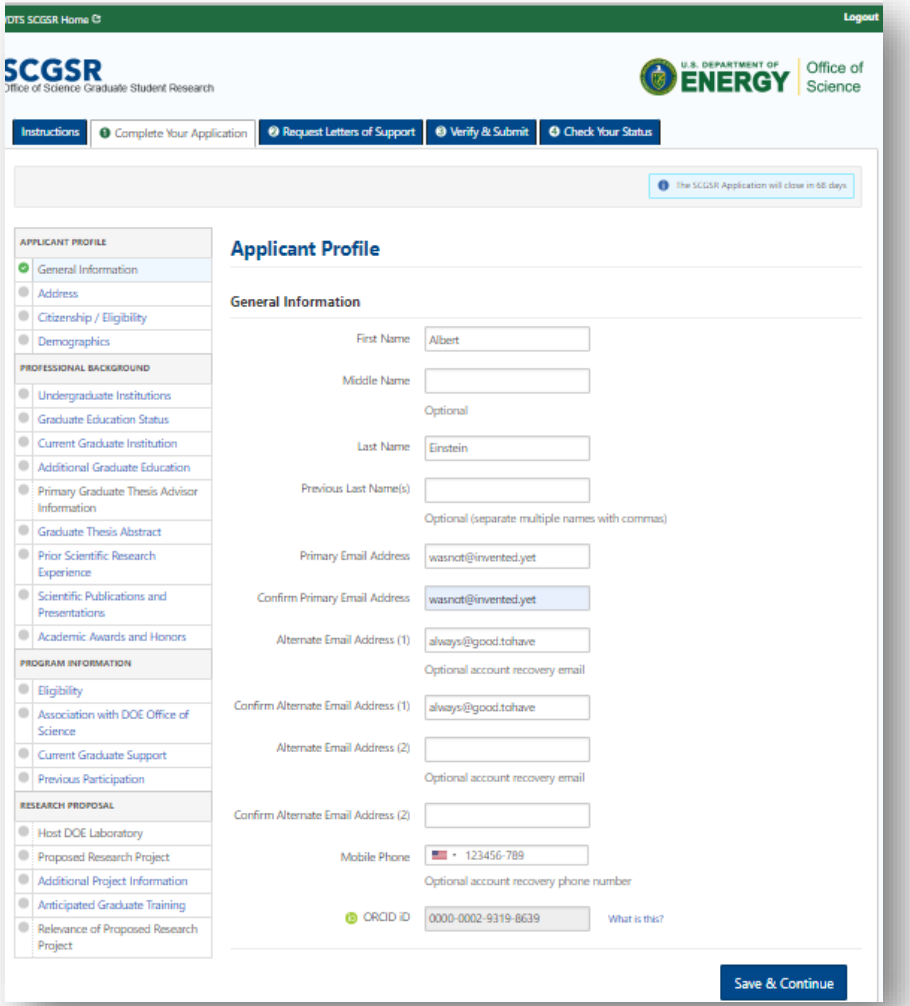


Following year:



2 Key Components of Application

- Establish a collaboration with a DOE National Lab scientist
  - Expertise
  - Techniques, methodologies
  - Instrumentation
- Research proposal
  - Part of your PhD dissertation
  - 3 pages long
  - 3 months – 1 year long project: you decide the length



Thank You!

Questions?

Find out more at

Or contact: Igor I. Slowing
Igor.Slowing@science.doe.gov
SC.SCGSR@science.doe.gov

Opportunities for Undergraduate and Graduate Students through the National Science Foundation

Jeremiah Williams
Program Director, Plasma Physics
Division of Physics
National Science Foundation

June 11, 2025

My Trajectory (so far. . .)

- Dickinson College (1994 – 1998)
  - Carlisle, PA
  - BS, Physics and Mathematics
- UCLA (1998 – 2000)
  - Los Angeles, CA
  - MS, Physics
- Illinois Wesleyan U. (2000 – 2003)
  - Bloomington, IL
  - Visiting Instructor
- Auburn University (2003 – 2007)
  - Auburn, AL
  - PhD, Postdoc
- Wittenberg U. (2007 – present)
  - Springfield, OH*
  - Professor
- NSF (2023 – present)
  - Alexandria, VA
  - Program Director (IPA), Plasma Physics

?

National Science Foundation

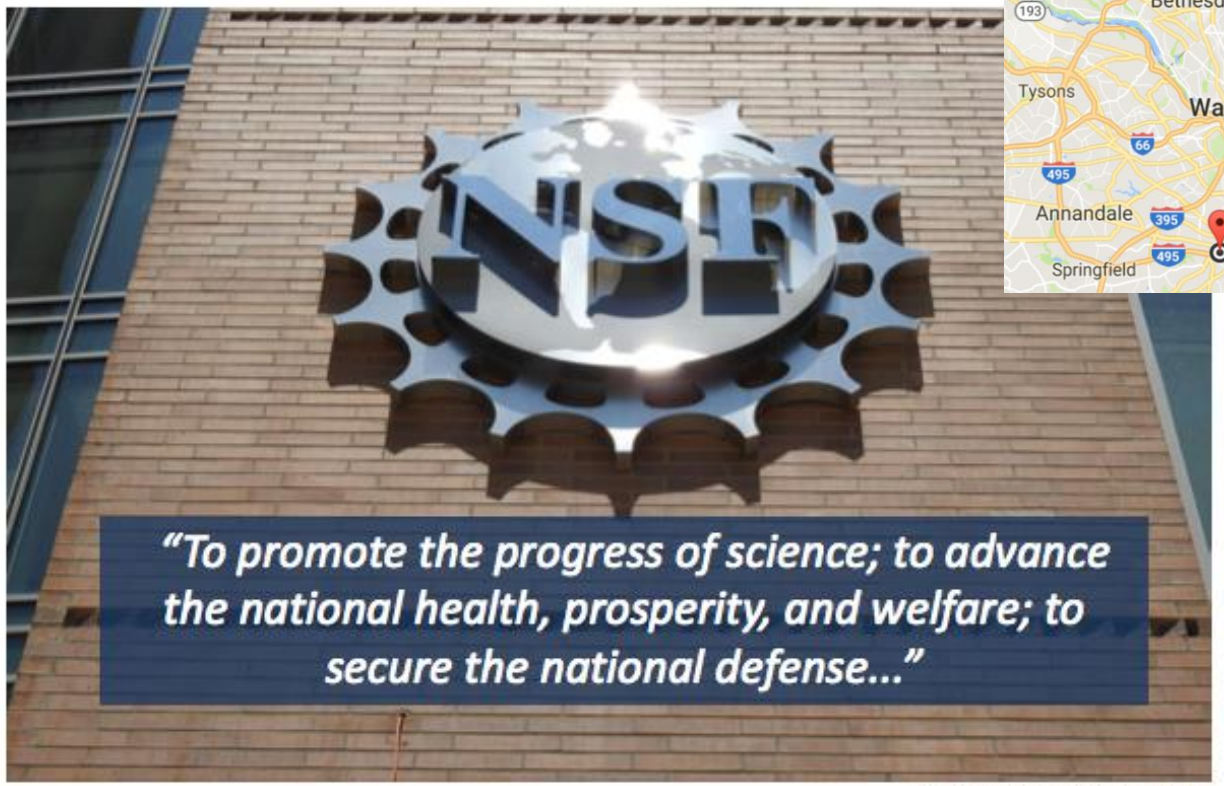
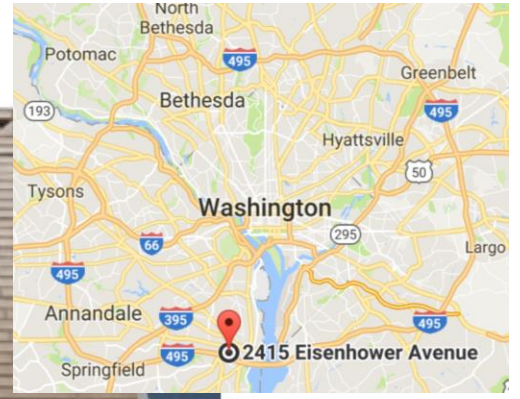


Photo Credit: Maria Barnes, NSF



[Who is NSF?]

FAST FACTS

$9.06B
NSF's Fiscal Year 2024 Enacted Budget

93%
Percent of budget committed to research, education and related activities

11K
Average number of awards NSF funds each year

1.9K
NSF-funded institutions

353K
People supported through NSF funding

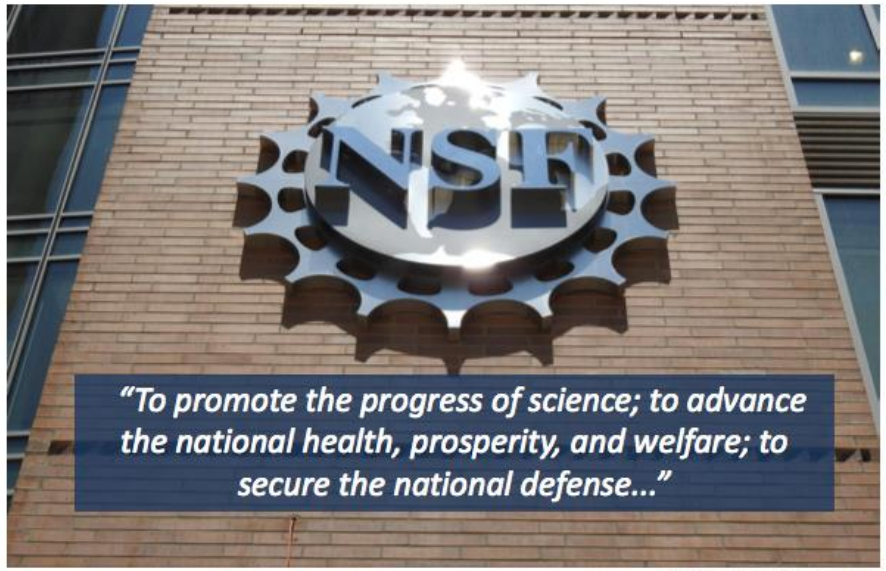
262
Total number of Nobel Prize winners who have received NSF funding

National Science Foundation

OD

Number of People Involved in NSF Activities

	FY 2024 Plan Estimate
Senior Researchers	60,400
Other Professionals	14,400
Postdoctoral Associates	5,500
Graduate Students	41,500
Undergraduate Students	37,300
PreK-12 Teachers	42,900
PreK-12 Students	128,100
Total Number of People	**330,100**



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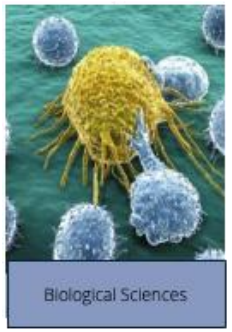
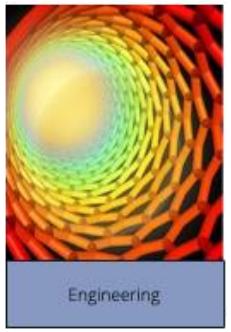
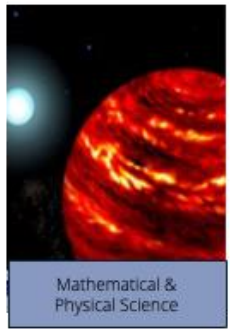
NSF Research Directorates



BIO



ENG

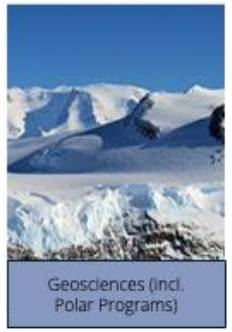


MPS

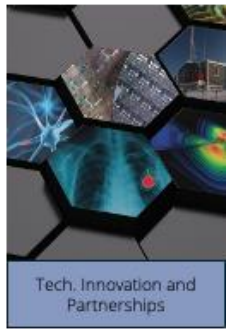
CISE

SBE

EDU



GEO



TIP

FAST FACTS

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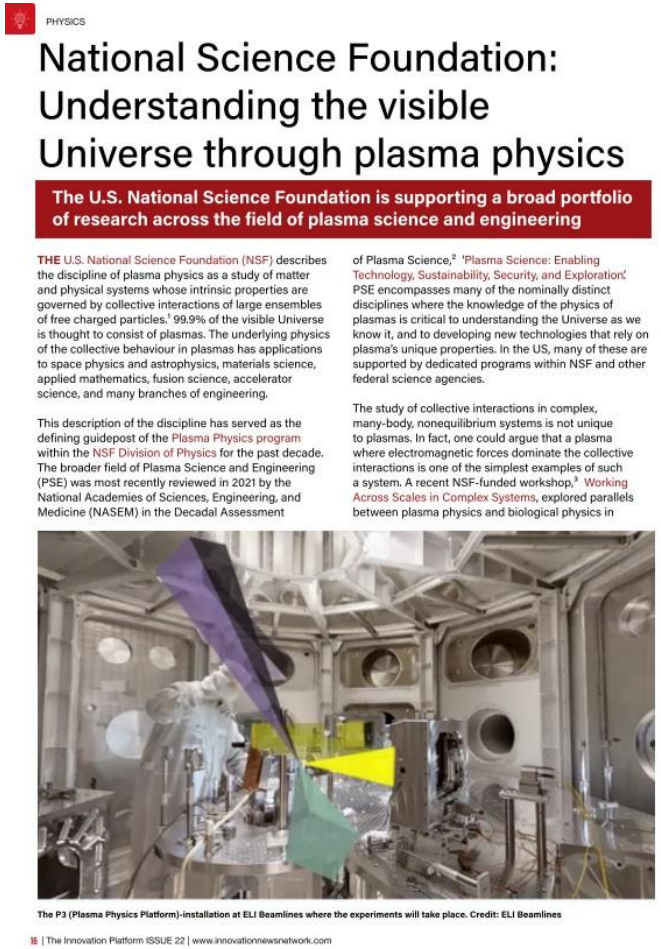
Plasma Physics at the National Science Foundation

- Plasma Physics is a study of matter and physical systems whose intrinsic properties are governed by collective interactions of large ensembles of free charged particles. 99.9% of the visible Universe is thought to consist of plasmas. The underlying physics of the collective behavior in plasmas has applications to space physics and astrophysics, materials science, applied mathematics, fusion science, accelerator science, and many branches of engineering.
- The Plasma Physics program supports research that can be categorized by several broad, sometimes overlapping, sub-areas of the discipline, including: magnetized plasmas in the laboratory, space, and astrophysical environments; high energy density plasmas; low temperature plasmas; dusty, ultra-cold, and otherwise strongly coupled plasmas; non-neutral plasmas; and intense field-matter interaction in plasmas



PHYSICS

National Science Foundation: Understanding the visible Universe through plasma physics

The U.S. National Science Foundation is supporting a broad portfolio of research across the field of plasma science and engineering

THE U.S. National Science Foundation (NSF) describes the discipline of plasma physics as a study of matter and physical systems whose intrinsic properties are governed by collective interactions of large ensembles of free charged particles.[1] 99.9% of the visible Universe is thought to consist of plasmas. The underlying physics of the collective behaviour in plasmas has applications to space physics and astrophysics, materials science, applied mathematics, fusion science, accelerator science, and many branches of engineering.

This description of the discipline has served as the defining guidepost of the Plasma Physics program within the NSF Division of Physics for the past decade. The broader field of Plasma Science and Engineering (PSE) was most recently reviewed in 2021 by the National Academies of Sciences, Engineering, and Medicine (NASEM) in the Decadal Assessment of Plasma Science,[2] 'Plasma Science: Enabling Technology, Sustainability, Security, and Exploration.' PSE encompasses many of the nominally distinct disciplines where the knowledge of the physics of plasmas is critical to understanding the Universe as we know it, and to developing new technologies that rely on plasma's unique properties. In the US, many of these are supported by dedicated programs within NSF and other federal science agencies.

The study of collective interactions in complex, many-body, nonequilibrium systems is not unique to plasmas. In fact, one could argue that a plasma where electromagnetic forces dominate the collective interactions is one of the simplest examples of such a system. A recent NSF-funded workshop,[3] Working Across Scales in Complex Systems, explored parallels between plasma physics and biological physics in

The P3 (Plasma Physics Platform)-installation at ELI Beamlines where the experiments will take place. Credit: ELI Beamlines

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The Innovation Platform, Issue 22

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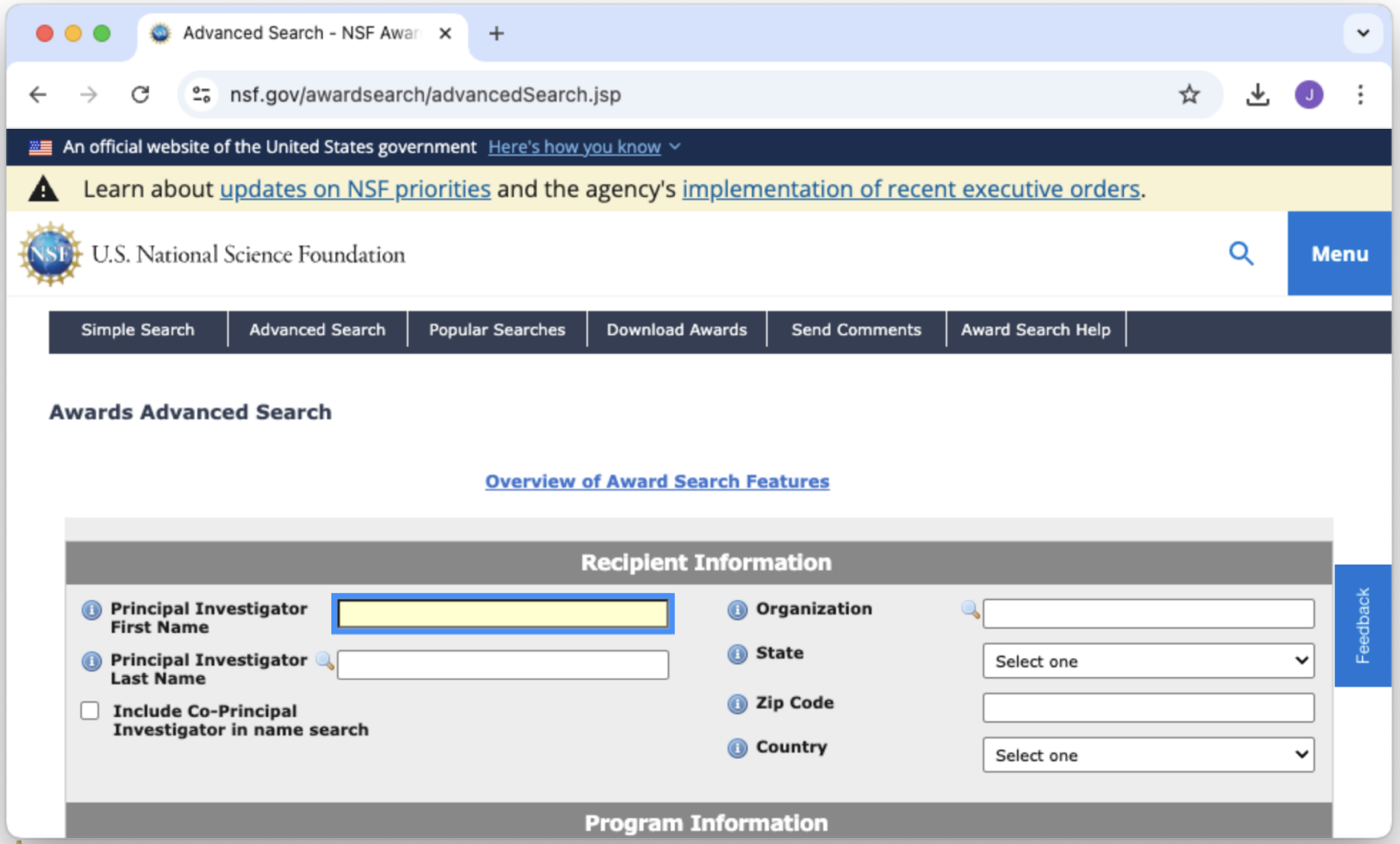
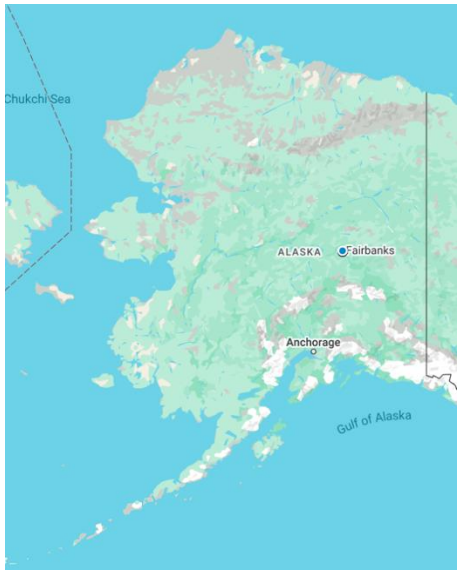
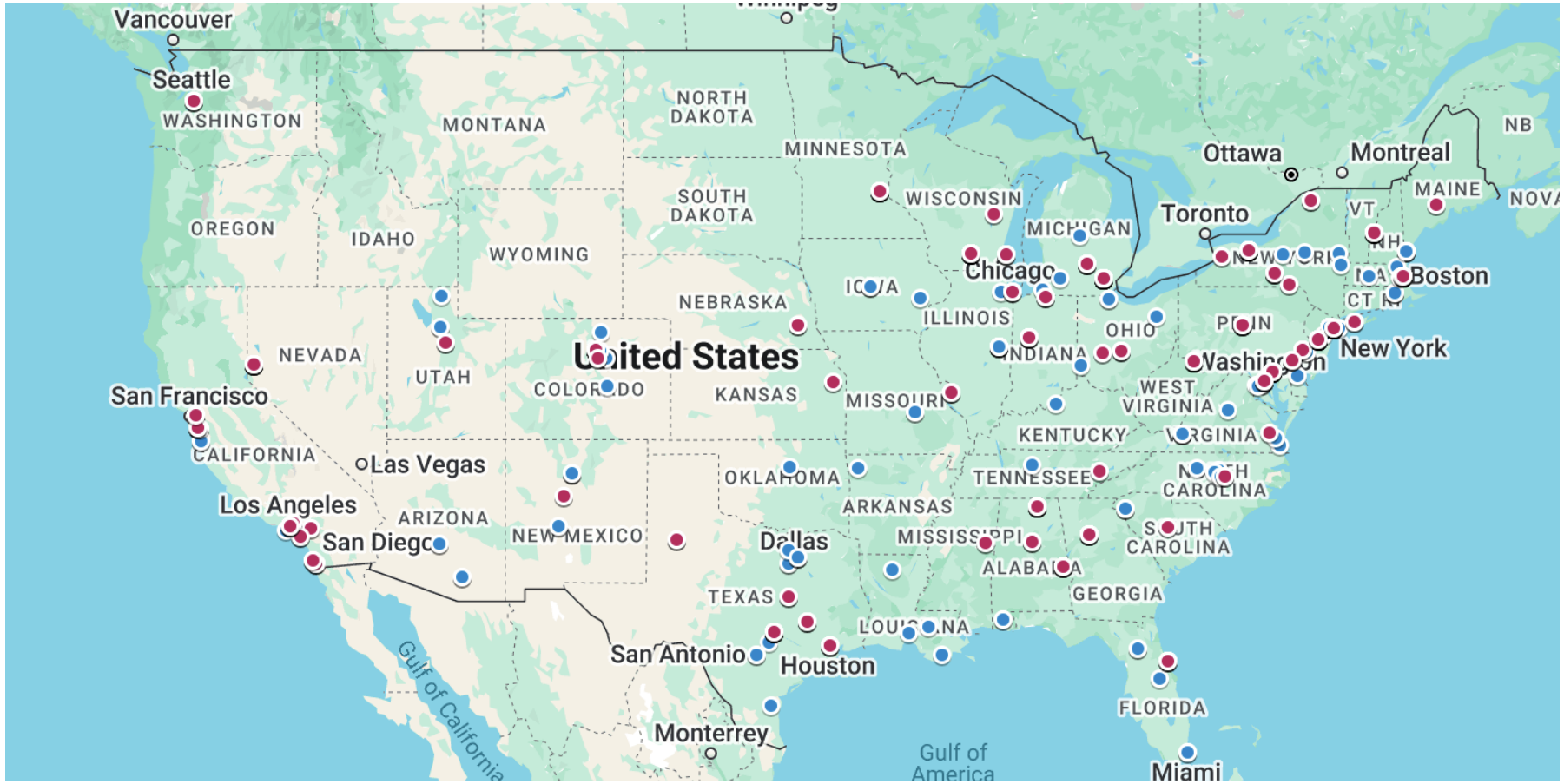
Plasma Physics at the National Science Foundation



NSF Award Search

Plasma Physics at the National Science Foundation

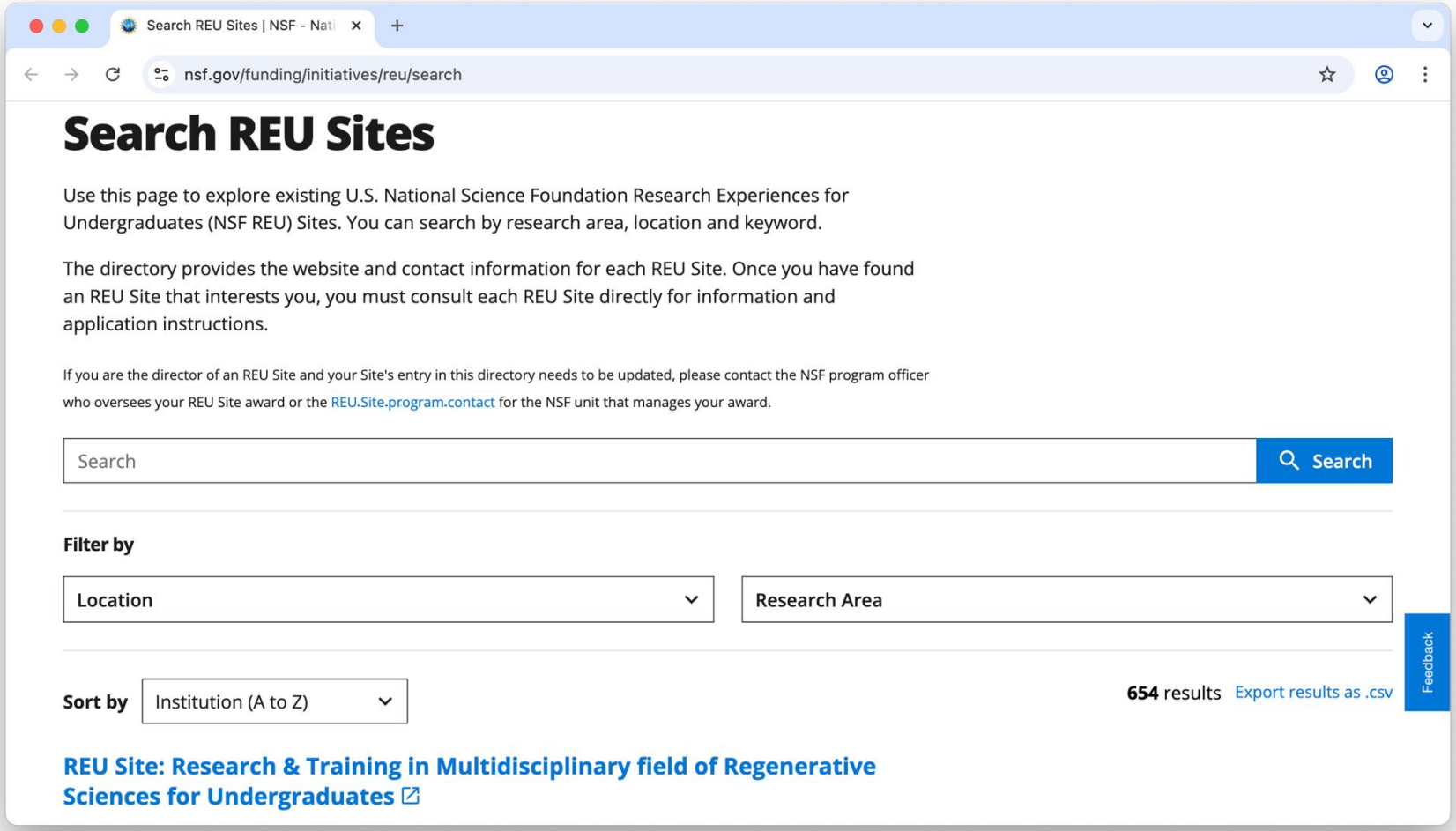




NSF Research Experience for Undergraduates

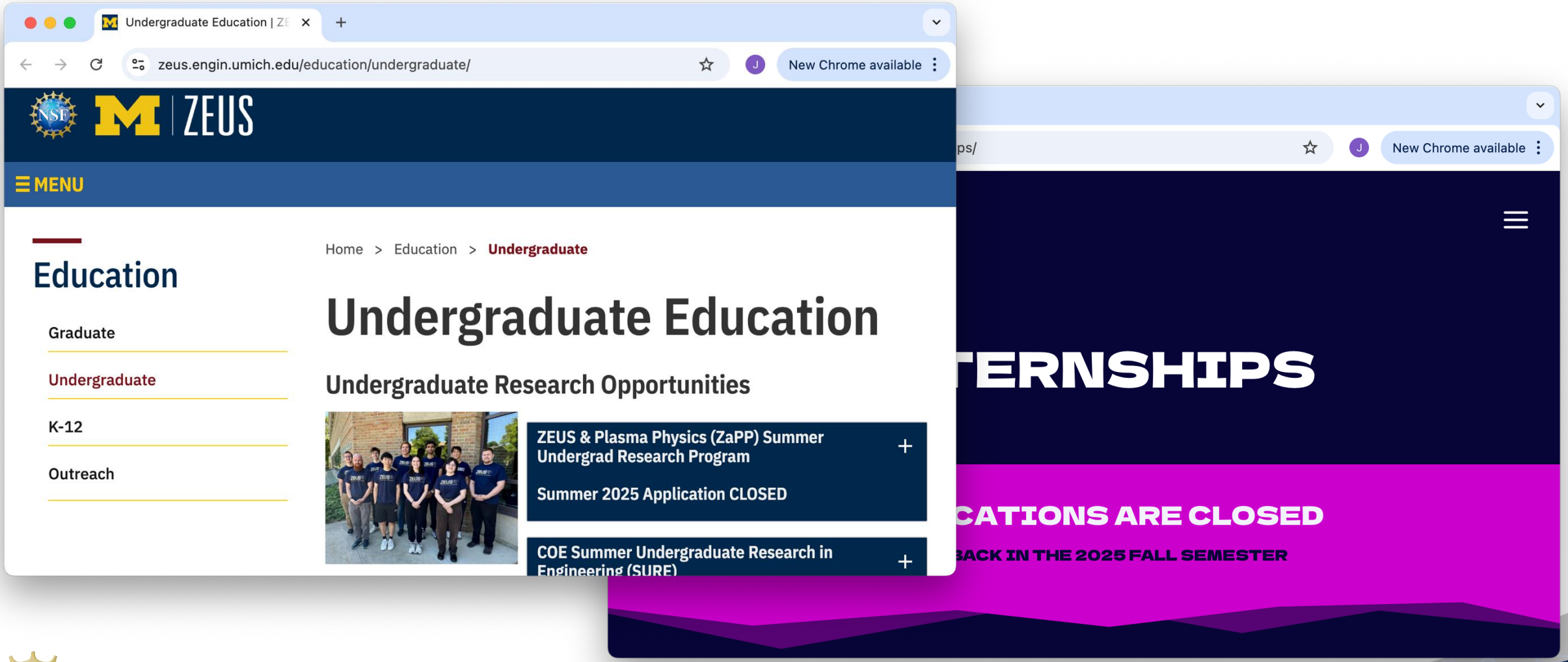
- Supports intensive research by undergraduate (college and university) students pursuing an associate or bachelor's degree and who are U.S. citizens, permanent residents or U.S. nationals are eligible to apply in any area of research funded by NSF.
- Individual REU opportunities may establish additional criteria that further restrict eligibility.

NSF Research Experience for Undergraduates



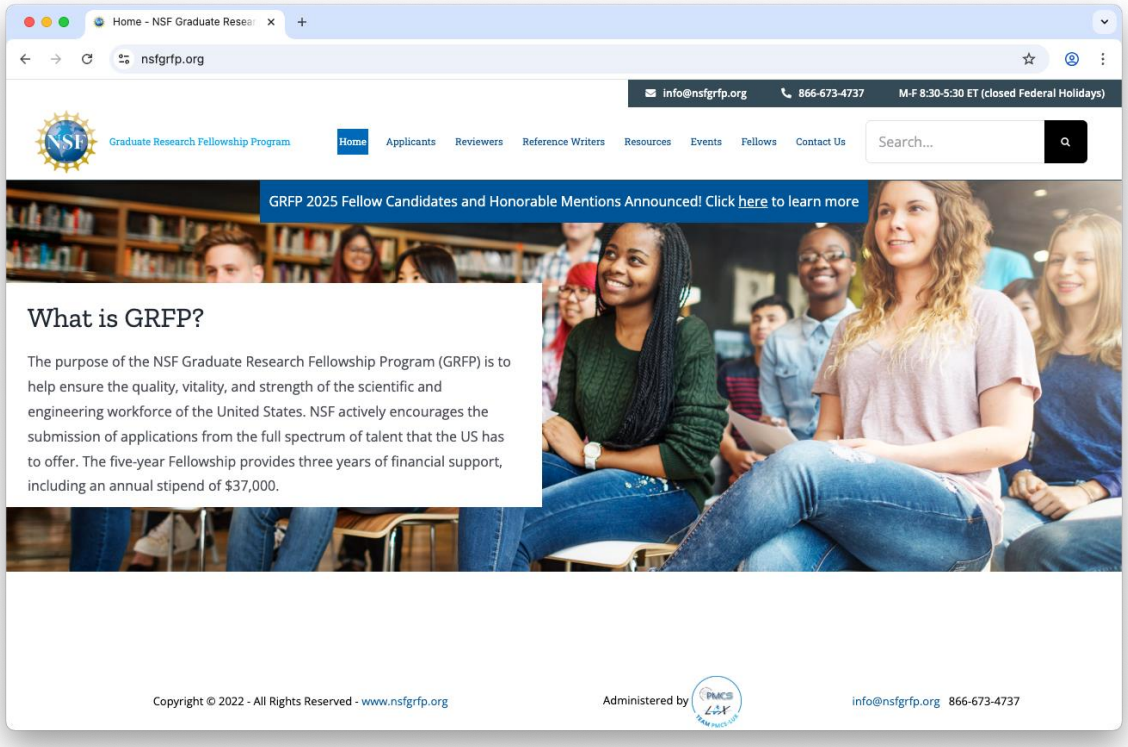
REU Site Search

Summer Experiences NSF Centers and Facilities



Graduate Research Fellowship Program (GRFP)

- Supports fellowships for outstanding graduate students who are pursuing full-time, research-based masters and doctoral degrees in science, technology, engineering or math or STEM education.



GRFP Program Page

Non-NSF website on GFRP

[NSF 24-591]

About the Graduate Research Fellowship Program

- The overall goal of the Graduate Research Fellowship Program is to recruit individuals into Science, Technology, Engineering, and Mathematics (STEM) fields
  - To select, recognize, and financially support individuals who have demonstrated the potential to be high achieving scientists and engineers, early in their careers
  - NSF actively encourages submission of applications from the full spectrum of talent that the U.S. has to offer

- Five Year Fellowship period that provides three years of financial support
  - $37,000 stipend + $16,000 educational allowance directly to institution
  - Payment covers all tuition and mandatory fees (no cost to the student)

GRFP - Eligibility

- U.S. citizens, nationals, and permanent residents
- Early-career: undergraduate & graduate students
- Pursuing research-based master's and/or doctoral degrees (no professional degrees) in STEM or STEM Education

Level 1: Seniors/bachelor's degree: no graduate study

Level 2: 1st-year graduate students

- Joint bachelor's-master's (completed 3 years)

Only apply once

Level 3: Second-year graduate students

- No more than 1 academic year completed in 1st graduate degree program
- For joint BS/MS holders ONLY, can apply as 1st year doctoral students if went directly into PhD program, after completing joint bachelor's-master's degree)

Level 4: Returning graduate students

- > 2-year interruption in graduate study
- No doctorates or >1 academic year in graduate program
- NOT ENROLLED in graduate program at application deadline

- Full-time enrollment in graduate degree program at accredited, non-profit US institution of higher education

GRFP – Application Packet

- Personal Information, Education, Work/Research Experience, Proposed Major Field of Study, Honors, Awards, Publications
- Personal, Relevant Background and Future Goals Statement (3-page PDF)
  - Tell your story; demonstrate your potential for STEM research; Discuss experiences (professional and personal) that contributed to your motivation and preparation for pursuing a STEM career
- Graduate Research Statement (2-page PDF)
  - Communicate your proposed research plan to non-specialist
- Transcripts (PDFs; mandatory, required for all degree programs)
- Letters of reference
  - 3 (up to 5) reference letter writer names and 2 (3) are mandatory (recommended)

GRFP – Review Criteria

- Intellectual Merit
  - How important is the proposed activity to advancing knowledge within its own field or across different fields?
- Broader Impacts
  - How well does the proposed activity benefit society or advance desired societal outcomes?
- Applicants are reviewed based on:
  - Their demonstrated potential for significant achievement in STEM
  - Using a comprehensive, holistic approach
  - A balanced consideration to all components of the application
    - Including the educational and research record, leadership, outreach, service activities, plans for the future, individual competencies, experiences, and other attributes

Summer Schools – A very incomplete listing

- Discovery Science Center Summer School for Matter at Extreme Conditions in the Laboratory and the Cosmos
- Summer School on Extreme Electrodynamics and Plasma Physics
- AI/ML for Fusion Summer School*
- Polar Aeronomy and Radio Science (PARS) Summer School
- NASA Heliophysics Summer School
- Space Weather Summer School
- High Energy Density Summer School -Foundations of High Energy Density Physics
- U.S. Particle Accelerator School
- US Low Temperature Plasma Summer School

Questions?

REU Site Search

GRFP Program Page

e-mail me
(jdwillia@nsf.gov)

Link