Fusion Energy Sciences Perspective

James W. Van Dam
Associate Director, Office of Science
Fusion Energy Sciences

Fusion Energy Sciences Advisory Committee Meeting
August 30, 2021
### Fusion Energy Sciences

<table>
<thead>
<tr>
<th>Category</th>
<th>FY 2020 Enacted</th>
<th>FY 2021 Enacted</th>
<th>FY 2022 Request</th>
<th>FY 2022 Request vs FY 2021 Enacted</th>
</tr>
</thead>
<tbody>
<tr>
<td>Advanced Tokamak</td>
<td>123,500</td>
<td>127,038</td>
<td>124,390</td>
<td>-2,648</td>
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<tr>
<td>Spherical Tokamak</td>
<td>101,000</td>
<td>104,331</td>
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<tr>
<td>Theory &amp; Simulation</td>
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<td>GPP/GPE Infrastructure</td>
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<td>Public-Private Partnerships</td>
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<td>Artificial Intelligence and Machine Learning</td>
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<td>Strategic Accelerator Technology</td>
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<td>3,073</td>
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<tr>
<td><strong>Total, Burning Plasma Science: Foundations</strong></td>
<td><strong>279,500</strong></td>
<td><strong>288,009</strong></td>
<td><strong>296,000</strong></td>
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<td>Long Pulse: Tokamak</td>
<td>14,000</td>
<td>15,000</td>
<td>15,000</td>
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<tr>
<td>Long Pulse: Stellartors</td>
<td>8,500</td>
<td>8,500</td>
<td>8,500</td>
<td>-</td>
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<tr>
<td>Materials &amp; Fusion Nuclear Science</td>
<td>47,500</td>
<td>49,000</td>
<td>59,500</td>
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<tr>
<td>Future Facilities Studies</td>
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<td>3,000</td>
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<td><strong>Total, Burning Plasma Science: Long Pulse</strong></td>
<td><strong>70,000</strong></td>
<td><strong>72,500</strong></td>
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<tr>
<td>ITER</td>
<td>-</td>
<td>-</td>
<td>2,000</td>
<td>+2,000</td>
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<tr>
<td><strong>Total, Burning Plasma Science: High Power</strong></td>
<td><strong>-</strong></td>
<td><strong>-</strong></td>
<td><strong>2,000</strong></td>
<td><strong>+2,000</strong></td>
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## FES Budget: Enacted and Requested (2)

<table>
<thead>
<tr>
<th></th>
<th>FY 2020 Enacted</th>
<th>FY 2021 Enacted</th>
<th>FY 2022 Request</th>
<th>FY 2022 Request vs FY 2021 Enacted</th>
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<tbody>
<tr>
<td><strong>Plasma Science and Technology</strong></td>
<td>42,500</td>
<td>32,700</td>
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<tr>
<td><strong>Measurement Innovation</strong></td>
<td>3,000</td>
<td>3,000</td>
<td>3,000</td>
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<tr>
<td><strong>Quantum Information Science (QIS)</strong></td>
<td>-</td>
<td>9,520</td>
<td>10,000</td>
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<tr>
<td><strong>Advanced Microelectronics</strong></td>
<td>-</td>
<td>5,000</td>
<td>5,000</td>
<td>-</td>
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<tr>
<td><strong>Other FES Research</strong></td>
<td>4,915</td>
<td>4,271</td>
<td>4,000</td>
<td>-271</td>
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<tr>
<td><strong>Reaching a New Energy Sciences Workforce</strong></td>
<td>-</td>
<td>-</td>
<td>3,000</td>
<td>+3,000</td>
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<tr>
<td><strong>FES SBIR/STTR</strong></td>
<td>14,085</td>
<td>-</td>
<td>-</td>
<td>-</td>
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<tr>
<td><strong>Total, Discovery Plasma Science</strong></td>
<td><strong>64,500</strong></td>
<td><strong>54,491</strong></td>
<td><strong>65,000</strong></td>
<td><strong>+10,509</strong></td>
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<tr>
<td><strong>Subtotal, Fusion Energy Sciences</strong></td>
<td><strong>414,000</strong></td>
<td><strong>415,000</strong></td>
<td><strong>449,000</strong></td>
<td><strong>+34,000</strong></td>
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<tr>
<td><strong>Construction</strong></td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>20-SC-61, Matter in Extreme Conditions (MEC)</td>
<td>15,000</td>
<td>15,000</td>
<td>5,000</td>
<td>-10,000</td>
</tr>
<tr>
<td>Petawatt Upgrade, SLAC</td>
<td></td>
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<td></td>
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<tr>
<td>14-SC-60, U.S. Contributions to ITER</td>
<td>242,000</td>
<td>242,000</td>
<td>221,000</td>
<td>-21,000</td>
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<tr>
<td><strong>Subtotal, Construction</strong></td>
<td>257,000</td>
<td>257,000</td>
<td>226,000</td>
<td>-31,000</td>
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<tr>
<td><strong>Total, Fusion Energy Sciences</strong></td>
<td><strong>671,000</strong></td>
<td><strong>672,000</strong></td>
<td><strong>675,000</strong></td>
<td><strong>+3,000</strong></td>
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## FY 2021 Appropriations

<table>
<thead>
<tr>
<th>Fusion Energy Sciences</th>
<th>FY 2019 Enacted</th>
<th>FY 2020 Enacted</th>
<th>FY 2021 Enacted</th>
</tr>
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<tbody>
<tr>
<td></td>
<td>Dollars</td>
<td>Percentage</td>
<td>Dollars</td>
</tr>
<tr>
<td>Research</td>
<td>261,950</td>
<td>46.45%</td>
<td>253,000</td>
</tr>
<tr>
<td>Facility Operations</td>
<td>143,500</td>
<td>25.44%</td>
<td>128,500</td>
</tr>
<tr>
<td>Projects</td>
<td>148,346</td>
<td>26.30%</td>
<td>282,500</td>
</tr>
<tr>
<td>Other</td>
<td>10,204</td>
<td>1.81%</td>
<td>7,000</td>
</tr>
<tr>
<td>Total, Fusion Energy Sciences</td>
<td>564,000</td>
<td>100.00%</td>
<td>671,000</td>
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</table>
## FY 2021 FES Solicitations (FOAs & Lab Calls)

<table>
<thead>
<tr>
<th>FOA / Lab Call Title</th>
<th>Type</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>Collaborative Research in Magnetic Fusion Energy Sciences on Long-Pulse International Stellarator Facilities</td>
<td>FOA</td>
<td>Seven awards at $6.4M for three years</td>
</tr>
<tr>
<td>High-Energy-Density Laboratory Plasma Science (joint program with NNSA)</td>
<td>FOA</td>
<td>Twenty-one awards at $9.3M for three years ($3.1M from FES and $6.3M from NNSA)</td>
</tr>
<tr>
<td>Opportunities in Frontier Plasma Science</td>
<td>Lab Call</td>
<td>Awards to be announced soon</td>
</tr>
<tr>
<td>Co-Design Microelectronics R&amp;D Centers (with ASCR, BES, &amp; HEP)</td>
<td>Lab Call</td>
<td>Ten awards to DOE national labs under negotiation at $54M for up to three years (total SC funding)</td>
</tr>
<tr>
<td>Quantum Information Science Research for Fusion Energy Sciences (issued FY20)</td>
<td>FOA &amp; Lab Call</td>
<td>Ten awards (one in FY20 and nine in FY21) to universities, private industry, and national labs at $11M for up to three years.</td>
</tr>
<tr>
<td>SC Open FOA</td>
<td>FOA</td>
<td>FES uses the SC Open FOA more frequently since FY 2020:</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Eight awards for collaborative research on DIII-D at $10.5M per year for three years</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Four awards for research on STs at $5.4M for up to four years</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Six awards for Theory research at $3.3M for up to three years</td>
</tr>
<tr>
<td>SC Early Career Research Program</td>
<td>FOA &amp; Lab Call</td>
<td>Seven FES five-year awards, $14M total, $3.9M in FY 2021</td>
</tr>
</tbody>
</table>
Poloidal field coil #5
(17 meters in diameter, one of six ring-shaped PF coils required for the machine)

ITER Staff: currently 1,014 (5% from U.S.)

Talk by Dr. Kathryn McCarthy
US ITER: Central solenoid module #1 delivery
Other FES Projects

Material Plasma Exposure eXperiment (MPEX)

- New world-class plasma exposure facility for accelerated testing of fusion materials.
- CD-3A (Long-lead Procurement) approval achieved October 2020.
- Long-lead procurements awarded for magnets, gyrotrons, and high-voltage power supplies.

Matter in Extreme Conditions (MEC) Petawatt Laser Upgrade

- World-leading high-energy-density plasma science instrument.
- Conceptual design was finalized in support of CD-1 (Alternative Selection & Cost Range) approval in September 2021 timeframe.
Advanced Tokamak: After successful FY 2021 campaign, DIII-D is pursuing several facility enhancements

- DIII-D completed 18.7 weeks in FY21 with high system availability (88%)
  - Helicon system commissioned
  - Hydrogen campaign completed
  - Two new gyrotrons arrived

- Projects during 6-month maintenance period include
  - New helium liquefier
  - Internal 3D coil repairs
  - Additional gyrotrons & top launchers
  - Test fittings for HFSLH and neg. tri. armor
  - SAS1-W/V install with diagnostics
  - Collaborator diagnostics: DFSS, helium beam, WiSP, multichord divertor spectroscopy
Status of NSTX-U Recovery

• Overall, approximately 70% complete
• All production plasma-facing-component tiles are delivered to PPPL and ready for installation
• Delivery of the completed center stack casing is expected in the fall of this year
• New Recovery cost and schedule baseline (due to COVID-19 delays) will be reviewed in early FY22

Super-X divertor realized at MAST-U (Culham)

• Preliminary results show that heat flux is reduced by more than an order of magnitude using Super-X
• Super-X divertor idea was invented by U.S. scientists at the University of Texas – Austin
• 13 collaborative research awards for U.S. scientists to work at MAST-U
Nine FES SciDAC partnerships
- Entering their final year
- Progress status presentations are scheduled for October 2021
- FES and ASCR started planning for the SciDAC re-competition

WDM Exascale App
- Continues to make progress toward the coupling of the core and edge regions

AI/ML helps develop formula to predict the heat load width in tokamaks

Exascale Computing Project WDMApp
FY20 FOA: Five teams were supported to pursue materials modeling, real-time plasma behavior prediction, plasma equilibrium reconstruction, radio frequency modeling, and optimization of experiments with high-repetition-rate lasers.

FY21: Six pilot studies (identified from FY20 solicitation) supported in the areas of randomized methods for real-time plasma control, ML models for plasma pulse design optimization and validation, data-driven stellarator optimization, surrogate models for detached divertor control, optimization of inertial confinement fusion experiments, and physics-informed neural networks for disruption prediction and avoidance.

SC vision for AI/ML is to increasingly use learned models to improve experimental discovery, pursue questions semi-autonomously, merge simulation and AI, and include AI/ML as a common part of scientific activities.

FusMatML (Sandia, UTK, LANL) team is using AI/ML to deploy interatomic potentials for predictive atomistic simulations of materials.
Enabling R&D

- **High-Field Vertical Test Stand**
  - FES and HEP have joined forces to support the development of a unique world-class High-Field Vertical Test Stand.
  - First External Oversight Committee (EOC) meeting held in Jan. 2021 to solicit input on the magnet design and fabrication approach
  - Coil fabrication by LBNL to start in early 2022
  - Estimated completion by June 2025

- **Shattered Pellet Injector R&D**
  - ORNL has constructed an ITER-like SPI testbed and conducted experiments to inform the design of the ITER SPI system
  - This is the first step in determining the optimal fragment size distribution and shatter tube design needed for the ITER shattered pellet injection system
Long Pulse Tokamak: 10 multi-institutional teams continue to address gaps in tokamak physics basis using international facilities

- **JET**
  - Analysis of JET SPI studies continues including D2 SPI leading to benign termination of runaway electron (RE) beams
  - US is supporting ongoing DTE2 campaign: main ion CXS, EP collaborations, and scenario modeling
  - Isotope effect linked to small-but-finite electron mass that strongly affects the ion behavior

- **KSTAR**
  - Dual SPI studies conducted together with DIII-D and JET in support of ITER
  - Real-time disruption prediction tools (DECAF) installed in expanded KSTAR PCS

- **JT-60SA**
  - Two new teams are preparing to install XICS and FIDA diagnostics during planned 26-month vent after first plasma

- **Research continues at AUG, TCV, EAST, WEST, COMPASS-U**

**RE suppression by D2 SPI in JET**

**Wall heat flux**

**Wall heat loads are mitigated after RE suppression**
Long-Pulse & Domestic Stellarator

• An international team led by ORNL has been constructing a continuous, high-speed pellet system to fuel W7-X plasmas in quasi-steady-state conditions with significantly enhanced fueling, pumping, and heating capabilities. The system is being assembled at ORNL and will be fully tested in the fall of 2021.

• U.S. stellarator researchers are enhancing their diagnostic systems to prepare for the next major W7-X experimental campaign in late 2022.

• The upgrade of HSX is on schedule to resume operations by December 2021. The upgrade will implement a 70 GHz gyrotron to significantly improve the ECH system and provide a factor of 2 to 3 in electron density, increased heating power, and longer pulses.

Iron impurity transport during on- to off-axis ECH in W7-X

De-Convolutional Neural Network B field fluctuations in CTH
High Flux Isotope Reactor (HFIR)
- Continues to be a workhorse and center of excellence for both the domestic and international fusion materials research programs
- Nexus for current and proposed international collaborations, including Japan (QST, NIFS), EUROfusion, and the UK
- Actively developing novel irradiation capabilities to explore fusion relevant regimes, including helium effects studies, hydrogen charging experiments, and in-situ corrosion experiments

National Synchrotron Light Source II (NSLS-II)
- Synchrotron-based microstructural characterization techniques are increasingly powerful for application to fusion materials research
- Increased domestic and international interest in these synchrotron methods, which complement traditional characterization approaches
- New funding for direct collaborative experiments provide enhanced facility access through researchers at Stony Brook University

Temperature distribution calculations for in-situ corrosion experiments on HFIR

X-ray diffraction analysis at NSLS-II
U.S. Department of Energy Announces $54 Million to Increase Energy Efficiency in Microelectronics Technologies

*National Labs Will Lead Groundbreaking R&D in Computing, Communication, and Sensing for Broad Use Technologies*

- **August 25, 2021**: DOE today announced nearly $54M for 10 new projects led by DOE National Laboratories to increase energy efficiency in microelectronics design and production.

- Microelectronics are critical to nearly all modern technology, including smartphones, medical equipment, power plant and electricity grids, and automobiles.

- Advanced microelectronics hold the potential to power innovative solutions to challenges in clean energy, climate, and national security.

- FES is supporting 3 awards.

Need to move from the historical sequential R&D process to a co-design framework where each scientific discipline informs and engages the others, with multi-directional information flow.

FESAC Meeting, 30-31 August 2021
Interactions with other Agencies

- **NSF-DOE Partnership in Basic Plasma Science and Engineering**
  - $7.9M total FES funds provided in FY 2021
    - $5.5M for 14 new and renewal proposals
    - $2.4M facility operation funds for one-year BaPSF renewal
  - $7.3M average annual FES funding in last five years
  - MOU is being renewed for FY 2022

- **SC-NNSA Joint Program in High Energy Density Laboratory Plasma Science**
  - $3.1M total FES funds provided in FY 2021
    - 9 new and renewal proposals
  - $3.8M average annual FES funding in last five years

- **GAMOW Joint FOA/Lab Call with ARPA-E**
  - 14 awards in FY 2020, $15M total funding/3 years (+$15M from ARPA-E)
  - $5M funding by FES in FY 2021
LaserNetUS Updates

  - More than 450 participants.
  - Four best poster awards were given to:
    - 1 undergrad & 3 graduate students
    - $500 each, sponsored by AMSL (largest supplier of photolithography systems)

- LaserNetUS renewed in FY 2020
  - ALLS laser (Canada) joined the network
  - 9 funding awards, $18M total over 3 years ($6.6M in FY 2021)

- FY 2021: Three calls for experimental proposals were issued by the network
  - Applications received: 149
  - Awarded experimental time: 86
  - Success rate: 58%
  - Number of students involved: >130

- MOU with LaserLab Europe is in process

Total number of institutions who used LaserNetUS: 123
• **INFUSE** is now in its third year
• FY 2021: 2 Request for Assistance Calls, with $4.0M in research awards
• To date, **40** awards totaling **$7.8M** have been made, enabling **8** DOE national labs to collaborate with **22** fusion companies
• Universities to be included in FY 2022

[https://infuse.ornl.gov/](https://infuse.ornl.gov/)
ESnet Networking Requirements Review: FES Program

- Energy Science Network (ESnet) has been conducting a FES Network Requirements Review during 2021 to comprehensively survey FES stakeholders’ plans and processes in networking and data

**EXPECTED REVIEW OUTCOMES:**

- Identify technical gaps, bottlenecks, and opportunities that can be addressed by ESnet *with new or existing services*.
- **Forecast network capacity needs**, particularly sites anticipating data increases for *informed investments* in bandwidth, and services by ESnet and DOE.
- Ensure FES and ESnet *continue to be forward-looking* in preparation for ITER
- Build a robust relationship between ESnet and the FES community *to ensure continued alignment* in the short- and long-term.

**REVIEW OUTPUT: COMMON THEMES**

- Scientific Data Management: Storage, Dissemination, Mobility, and Volume
- ITER Challenges and Opportunities
- Remote Collaboration Requirements and Use Cases
- Multi-Facility Computational Workflows and Use Cases
- International and Transoceanic Networking
- Domestic Networking for Local and Wide-Area Uses Cases
- Software Infrastructure Requirements and Improvements
- Cybersecurity
Plasma and Fusion Undergraduate Research Opportunities (PFURO)

- **PFURO participants:**
  - Conduct 10 weeks of remote summer research guided by faculty/staff at US undergrad institutions
  - Participate in the 2-week *Intro to Plasma and Fusion* course hosted by PPPL (2021: June 14-June 25).
  - Join all workforce development seminars/workshops available for PPPL summer undergrad interns
  - Receive a $600 weekly stipend for the duration of the 10-week, 40hr/week research experience.
  - Participants are provided travel to Princeton.
  - Housing at the location of your internship (or $150 allowance per week, per student during 2020, 2021, and possibly 2022--dependent on the status of the COVID-19 pandemic).
  - Be sponsored to present their research at a national topical conference. Most students would present at APS-DPP, but it may also be GEC, ICOPS, SOFE, or another relevant topical conference.
  - Women and under-represented minorities are encouraged to apply.
August 30–September 3, 2021, virtual, hosted by MIT Plasma Science and Fusion Center

260 participants from the U.S. and abroad (e.g., India, Costa Rica, Europe)

- Provide young researchers with critical skill sets to tackle modern fusion energy research challenges through tutorials and classes on:
  - High performance computing; Parallel programming and GPU programming; Computational Statistics; Machine Learning; Optimization methods
## FY 2022 Budget Request

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<tr>
<th>($K)</th>
<th>FY 2019 Enacted</th>
<th>FY 2020 Enacted</th>
<th>FY 2021 Enacted</th>
<th>Percentage</th>
<th>FY 2022 Request</th>
<th>Percentage</th>
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<tbody>
<tr>
<td>Research</td>
<td>261,950</td>
<td>253,000</td>
<td>260,149</td>
<td>38.7%</td>
<td>297,230</td>
<td>44.0%</td>
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<tr>
<td>Facility Operations</td>
<td>143,500</td>
<td>128,500</td>
<td>129,211</td>
<td>19.2%</td>
<td>125,270</td>
<td>18.6%</td>
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<tr>
<td>Projects</td>
<td>148,346</td>
<td>282,500</td>
<td>280,000</td>
<td>41.7%</td>
<td>251,000</td>
<td>37.2%</td>
</tr>
<tr>
<td>Other</td>
<td>10,204</td>
<td>7,000</td>
<td>2,640</td>
<td>0.4%</td>
<td>1,500</td>
<td>0.2%</td>
</tr>
<tr>
<td><strong>Total, FES</strong></td>
<td><strong>564,000</strong></td>
<td><strong>671,000</strong></td>
<td><strong>672,000</strong></td>
<td><strong>100%</strong></td>
<td><strong>675,000</strong></td>
<td><strong>100%</strong></td>
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FY22 budget request is marginally into “modest growth scenario” of FESAC Long-Range Plan.

FESAC Meeting, 30-31 August 2021
## Recent planning reports

<table>
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<tr>
<th>Title</th>
<th>Source</th>
<th>Date</th>
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<tr>
<td><strong>Opportunities in Intense Ultrafast Lasers</strong></td>
<td>NASEM</td>
<td>Dec 2017</td>
</tr>
<tr>
<td><strong>Burning Plasma Research</strong></td>
<td>NASEM</td>
<td>Jan 2019</td>
</tr>
<tr>
<td><strong>Brightest Light Initiative: The Future of Intense Ultrafast Lasers in the U.S.</strong></td>
<td>Community workshop</td>
<td>Workshop held Mar 2019</td>
</tr>
<tr>
<td><strong>A Community Plan for Fusion Energy and Discovery Plasma Sciences</strong></td>
<td>FES Community Planning Process</td>
<td>Mar 2020</td>
</tr>
<tr>
<td><strong>Plasma Science: Enabling Technology, Sustainability, Security, and Exploration</strong></td>
<td>NASEM Decadal Assessment</td>
<td>May 2020</td>
</tr>
<tr>
<td><strong>Powering the Future: Fusion and Plasmas (A Long-Range Plan)</strong></td>
<td>FESAC</td>
<td>Feb 2021</td>
</tr>
<tr>
<td><strong>Key Goals and Innovations Needed for a U.S. Fusion Pilot Plant</strong></td>
<td>NASEM</td>
<td>Feb 2021</td>
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</table>

** Talk by Prof. Troy Carter

** Talk by Dr. Richard Hawryluk
New Long-Range Plan recommends strengthening the domestic program to aim at a Fusion Pilot Plant.

- Fusion nuclear science
- Fusion materials R&D
- Fusion facilities systems studies

Material Plasma Exposure Experiment

Long Pulse

Foundations

Fusion User Facilities

Theory & Simulation

International Collaborations

Electricity on the grid

- Advanced computing (SciDAC)
- Artificial intelligence
- Quantum information science
- Advanced manufacturing
- High-temperature superconductor magnets

“Powering the Future: Fusion and Plasmas”
(Fusion Energy Sciences Advisory Committee, 2021)


### Compare FY22 Request to FY21 Enacted

- **Up $7.6M**
- **Down $3.9M**
- **Constant**
  - Planning IFE BRN Workshop
  - Initiate Future Facilities Studies $3M
- **Up $5M**
- **Up $4.3M**
  - Constant (i.e., Microelectronics $5M)
- **Up $11M (note: SC initiatives)**
### Compare FY22 Request to FY21 Enacted

- **Up $4M**
- Some funding in Materials to study target options
- **Down $12M**

#### Portfolio Elements

<table>
<thead>
<tr>
<th>Portfolio Elements</th>
<th>Scenarios</th>
</tr>
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<tbody>
<tr>
<td></td>
<td>Constant Level of Effort</td>
</tr>
<tr>
<td></td>
<td>Significant loss of US leadership &amp; significant opportunities</td>
</tr>
<tr>
<td>MPEX</td>
<td>Yes</td>
</tr>
<tr>
<td>FPNS</td>
<td>Yes, but highly delayed</td>
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<tr>
<td>MEC Upgrade*</td>
<td>No, but develop further*</td>
</tr>
<tr>
<td>EXCITE</td>
<td>No</td>
</tr>
<tr>
<td>Mid-Scale Stellarator</td>
<td>No</td>
</tr>
<tr>
<td>BCTF</td>
<td>No</td>
</tr>
<tr>
<td>Solar Wind Facility</td>
<td>No</td>
</tr>
<tr>
<td>HHF-Component</td>
<td>No</td>
</tr>
<tr>
<td>Multi-PW Laser</td>
<td>No</td>
</tr>
<tr>
<td>High Rep. Rate Laser</td>
<td>No</td>
</tr>
<tr>
<td>Midscale Z-Pinch</td>
<td>No</td>
</tr>
<tr>
<td>VNS</td>
<td>No</td>
</tr>
</tbody>
</table>

FESAC Meeting, 30-31 August 2021
Compare FY22 Request to FY21 Enacted

Initiate ITER research team $2M
INFUSE up $2M; include universities
Constant
Constant

Congressional line item   ITER Request down $21M
## FY 2022 SC cross-cutting research initiatives

### FES commitments ($K)

<table>
<thead>
<tr>
<th>Initiative</th>
<th>FY 2020 Enacted</th>
<th>FY 2021 Enacted</th>
<th>FY 2022 Request</th>
</tr>
</thead>
<tbody>
<tr>
<td>Accelerator Science and Technology</td>
<td></td>
<td></td>
<td>3,073</td>
</tr>
<tr>
<td>Artificial Intelligence and Machine Learning</td>
<td>7,000</td>
<td>7,000</td>
<td>7,000</td>
</tr>
<tr>
<td>Fundamental Science to Transform Advanced Manufacturing</td>
<td></td>
<td></td>
<td>3,000</td>
</tr>
<tr>
<td>Integrated Computational and Data Infrastructure</td>
<td></td>
<td></td>
<td>4,037</td>
</tr>
<tr>
<td>Microelectronics</td>
<td>5,000</td>
<td></td>
<td>5,000</td>
</tr>
<tr>
<td>Quantum Information Science</td>
<td>7,520</td>
<td>9,520</td>
<td>10,000</td>
</tr>
<tr>
<td>Reaching a New Energy Sciences Workforce (RENEW)</td>
<td></td>
<td></td>
<td>3,000</td>
</tr>
<tr>
<td><strong>Total, Research Initiatives</strong></td>
<td><strong>14,520</strong></td>
<td><strong>21,520</strong></td>
<td><strong>35,110</strong></td>
</tr>
</tbody>
</table>
FY 2022 Initiative: Reaching a New Energy Sciences Workforce (RENEW)

- Outreach
- Listening tours and roundtables to:
  - Gain understanding about challenges
  - Develop evidence-based solutions

- Identify unique Office of Science lab opportunities
- Partner with Minority Serving Institutions and professional societies
- Implement action plan

- Competitively support new traineeship awards resulting in:
  - Hands-on experience, mentoring, and enhanced workforce diversity, equity, and inclusion
  - Track post-traineeship outcomes
  - Assess program effectiveness
“Inertial fusion energy (IFE) utilizes advances in lasers, pulsed power technology, and other innovative drivers to achieve fusion at high fuel density. The enormous progress made with indirect drive at the National Ignition Facility, direct drive, magnetic drive inertial confinement fusion (ICF), and heavy ion fusion underpin the promise of IFE. An IFE program that leverages US leadership and current investments should be targeted.”

FESAC Long Range Plan (page 34)
NIF and HEP

- National Ignition Facility
  - Lawrence Livermore announced a milestone in laser fusion
  - Talk by Dr. Mark Hermann

- High Energy Physics (HEP)
  - Many U.S. scientists work at/with the Large Hadron Collider at CERN
  - Talk by Dr. James Siegrist
Public Reusable Research (PuRe) Data Resources are:

- data repositories,
- knowledge bases,
- analysis platforms,
- and other activities that aim to make data **publicly available** in order to advance scientific or technical knowledge.

PuRe Data Resource designations **highlight** and **improve stewardship** of SC-supported community data efforts with strategic impact on the SC mission.

In December 2020, SC convened a virtual roundtable of its scientific user facilities to discuss facility challenges and lessons learned during the COVID-19 pandemic, as well as facility practices, best practices, and innovations that could be adopted going forward.

Roundtable participants included facility staff, users, and user executive committees.

Discussions covered topics such as user research and facility operations in virtual and physically distanced contexts; user training and engagement; computation, data, and network resources; and crosscutting issues.
FY 2021 Early Career Research Awards

- FES made two university awards and five laboratory awards in FY 2021

Prof. Petros Tzeferacos
Univ Rochester
HED Magnetized Plasma
Turbulence - Simulations, Experiments and Theory

Prof. Mona Ghassemi
Virginia Tech
Prediction of Breakdown in Air and Solid Dielectrics: A Complete Plasma Model from Discharge Initiation to Flashover

Dr. Mark Boyer
PPPL
Machine learning approaches for spherical tokamak scenario optimization and rt control

Dr. Andrea Schmidt
LLNL
Neutron Yield Scaling with Current in Dense Plasma Focus Z-Pinch Discharges

Dr. Daisuke Shiraki
ORNL
Precision Science and Control of Pellet Fueling for Optimizing Tokamak Plasma Scenarios

Dr. Emma McBride
SLAC
First Principles Measurements of Temperature and Transport Properties in Warm Dense Matter

Dr. Matthew Beidler
ORNL
Hybrid Kinetic-Fluid Modeling of Tokamak Disruption Mitigation

Talk by Dr. Félicie Albert

FESAC Meeting, 30-31 August 2021
Fusion and Plasma Sciences:

- Dustin Froula (U. Rochester)

  For innovative research in laser plasma physics including pioneering spatiotemporal pulse shaping techniques, focused laser plasma instability research, and novel high-resolution Thomson scattering methods that has significantly advanced the Department of Energy’s mission.

Talk by Prof. Dustin Froula
Call for Nominations: 2021 E.O. Lawrence Awards

- **Recognizes:** Mid-career U.S. scientists and engineers for exceptional contributions and achievements in research, technical, and engineering supporting the broad missions of DOE and its programs to advance the national, economic, and energy security of the U.S.

- **Awards considered in nine categories:**
  - Atomic, Molecular, and Chemical Sciences
  - Biological and Environmental Sciences
  - Computer, Information, and Knowledge Sciences
  - Condensed Matter and Materials Sciences
  - Energy Science and Innovation
  - Fusion and Plasma Sciences
  - High Energy Physics
  - National Security and Nonproliferation
  - Nuclear Physics

- **Eligibility:**
  - Mid-career, defined as within 20 years of earning highest degree
  - United States citizen
  - Recognized for achievement in research principally funded by DOE
  - Recognized primarily on the scientific impact and technical significance of their work relative to its discipline and/or related mission

- **Deadline for nominations:** Tuesday, **September 21 (extended), 2021, 5:00 PM (ET)**
  - Nominations made online: [https://apps.orau.gov/Award/Lawrence](https://apps.orau.gov/Award/Lawrence)
  - Additional information (eligibility, category descriptions, review process): [https://science.osti.gov/lawrence](https://science.osti.gov/lawrence)

Questions: [SCLawrence.Award@science.doe.gov](mailto:SCLawrence.Award@science.doe.gov)
The SCGSR Program provides supplemental awards to outstanding graduate students to spend 3 to 12 months conducting part of their doctoral thesis/dissertation research at a host DOE national laboratory/facility in collaboration with a DOE laboratory scientist.

**FES awardees for 2020 Solicitation 2; 2021 Solicitation-1 awards are in process**

**Roland Hesse**  
University of Nebraska-Lincoln  
*A Numerical Study of Plasma Wavebreaking*  
(Host lab: LBNL)

**Davis Easley**  
University of Tennessee-Knoxville  
*Development of a synthetic spectroscopy toolkit for analysis of W-II emission lines at WEST*  
(Host lab: ORNL)

**2021 Solicitation-2: Application due November 10, 2021, 5:00 PM ET**

Full details, requirements, FAQs, and link to application at:  
[https://science.osti.gov/wdts/scgsr/](https://science.osti.gov/wdts/scgsr/)

**Program Contact:**  
[sc.scgsr@science.doe.gov](mailto:sc.scgsr@science.doe.gov)
FES staffing status

In addition to the Theory position (recently posted), we anticipate another opening--for an MFE program manager.

IPAs and detailees are also possible.
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