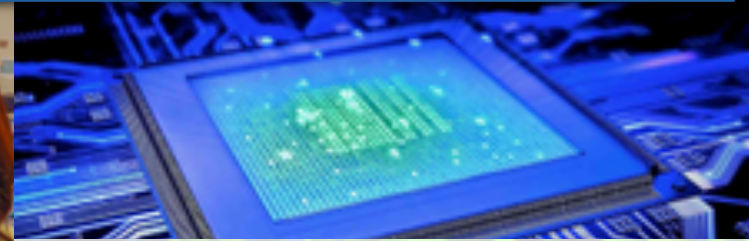
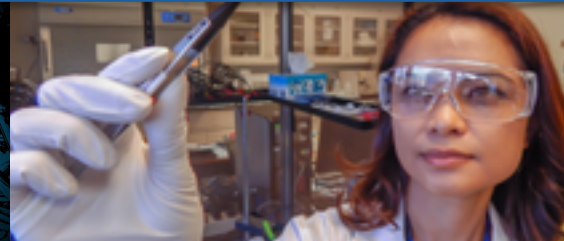
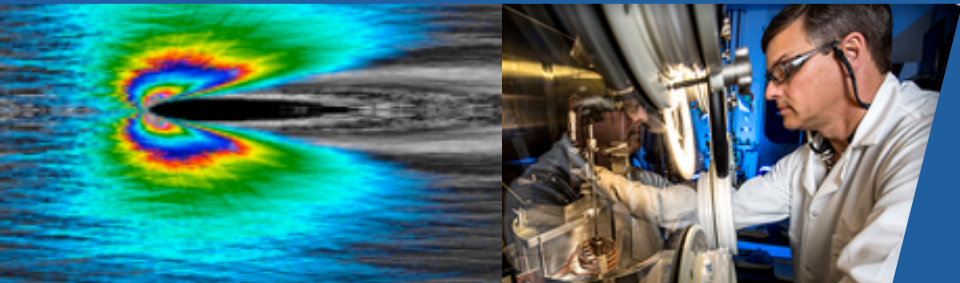


# High Energy Density Science Center: A Year In Review



Frank Graziani  
October 2, 2019



# The HED Center represents an important integrating element between academic and NNSA efforts



*Outreach to the academic  
HED Community*



*Link to LLNL programs*



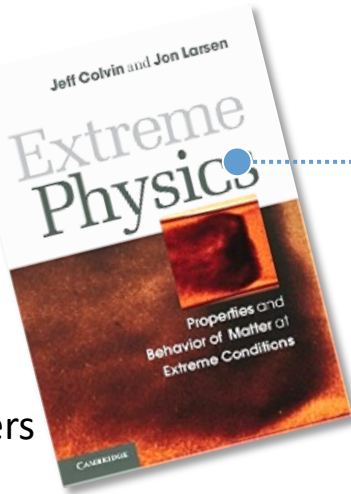
Collaboration and support of our partners and integrating those efforts with the programs is at the center of building an HED community



# The High Energy Density Sciences (HEDS) Center is helping to build a worldwide community in HED

## Education

Educating the next generation of researchers



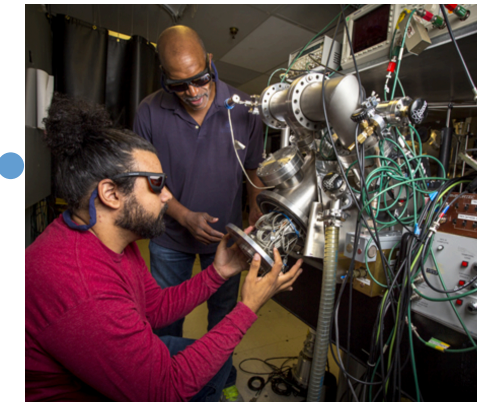
## Bridge to the Programs

Focus on HED areas of interest to the programs — drive a workforce pipeline



**Bridge to the HED Community**  
Seminars, Workshops and Outreach  
*Strengthening communication ties within the HED community*

**Enabling Research in Relevant Areas**  
Providing the links to HED research collaborations



# Who are we?

*Director*



Frank Graziani

*Deputy Director*



Felicie Albert

*Technology Facility*



Jim Emig

*Seminar Series*



Paul Grabowski

*Administrator*



Jessica Letteer

*Discovery Science*



Bruce Remington

*Outreach*



Ronnie Shepherd

*Education*

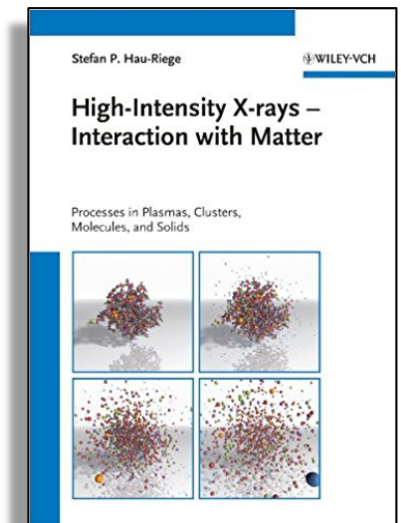
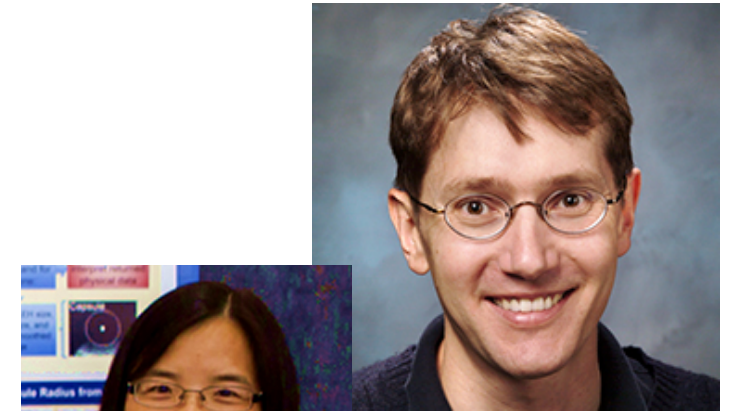


Camille Bibeau



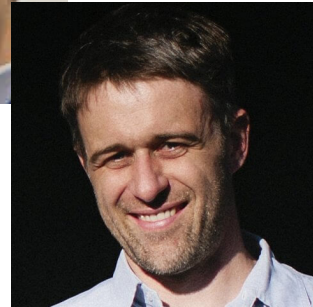
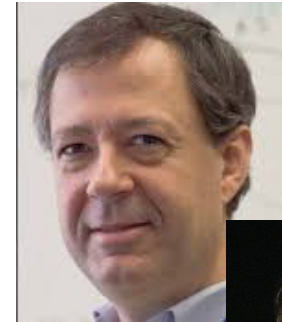
# Educating the next generation of HED scientists is important to maintaining a healthy and vibrant field

- Educating the next generation of HED scientists requires an international effort
  - Training the next generation of HED scientists guarantees a healthy and vibrant field
  - The challenge and excitement of HED science is its interdisciplinary nature
- HEDS Center has continued working with universities to present long and short courses
  - X-ray matter interaction and HED diagnostics
  - Short courses introduced with 8 universities involved (domestic and international)
  - Distance learning technology now seems stable (J. Bono, D. Hopkins, C. Nunez, C. Musto, U. Rodriguez)



# Educating the next generation of HED scientists is important to maintaining a healthy and vibrant field

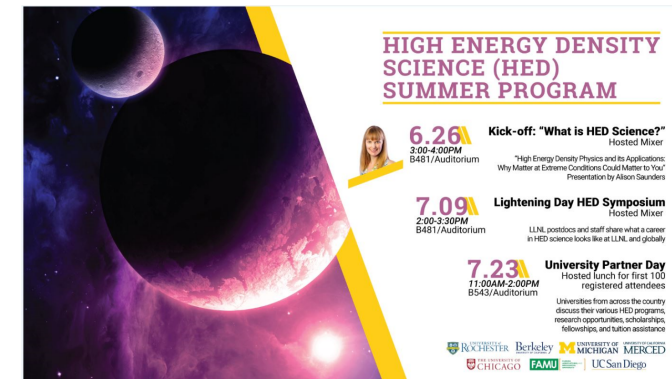
- The curriculum has been expanded to include new offerings
  - Through collaboration with UR, R. Betti offered a semester-long course on ICF physics
  - Rip Collins and Ryan Rygg- an overview of HED
  - P. Michel will do a 6-lecture LPI course in November
  - Quarter long HED diagnostics course and book-Kilkenny and Chen
- The HED Center is working with academic partners to discuss education in HED
  - Workshop at UCSD in December discussing education in HEDS
  - Co-organized by F. Beg (UCSD), R. Collins (UR) and F. Graziani
  - UCSD, UM, MIT, SLAC, Osaka, MSU, UR, Princeton, OSU, LANL, UC Merced, FAMU, Chicago, UN-Reno, UC Berkeley





# The Center is providing outreach through seminars, workshops and campus interactions

- HED seminar series
  - Solicitation process
  - Target recognized and early career scientists
- Ambassador Program
  - New effort founded by Annie Kersting
  - UC campus outreach in targeted fields
- APS Bridge Program and National Mentoring
  - Effort to increase the number of physics degrees from underrepresented groups
- HEDS Center website
  - Links to courses, research points of contact, job opportunities
- HED Showcase for summer interns
  - Series to introduce students to education and career opportunities



# The Center is the focal point for facilitating and fostering research opportunities for academic and LLNL staff

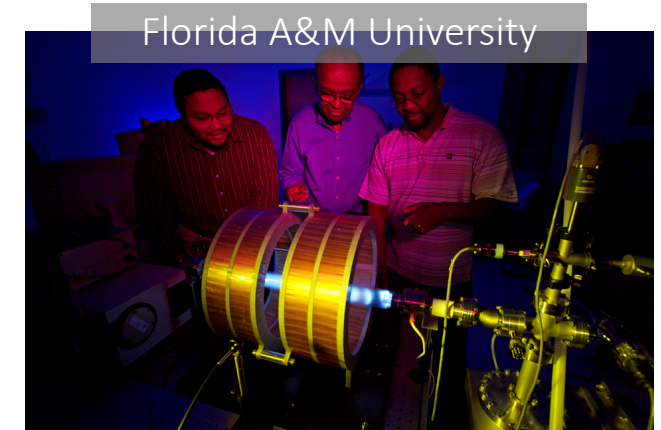
- UCOP funded *Frontiers in HEDS Center*
  - Materials at extreme conditions relevant to planets and impacts
  - Collaborate with Sarah Stewart's group at UC Davis
  - Explore the thermodynamics of giant impacts at Omega
  - Supported target Fab for 2 Campaigns at Omega EP
- NNSA HED Center for Matter under Extreme Conditions
  - Energy transport, material properties, in magnetized systems
  - Graduate student internships at LLNL
  - HEDS curriculum development
  - Support for experiments at JLF
- Facilitate US-Israeli collaborations
  - US-Israel collaboration-Avi Ravid (NRC-Soreq) and Y. Ping
  - Dov Shvarts collaboration





# The Center is the focal point for facilitating and fostering research opportunities for Minority Serving Institutions

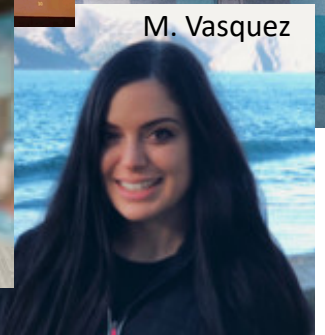
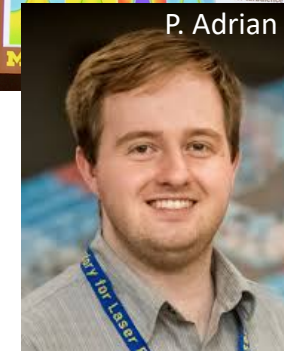
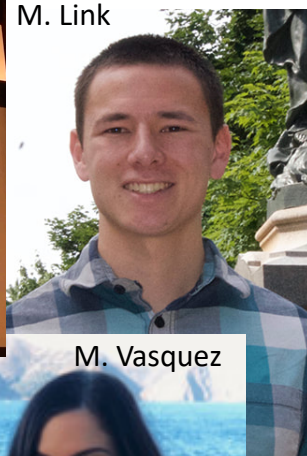
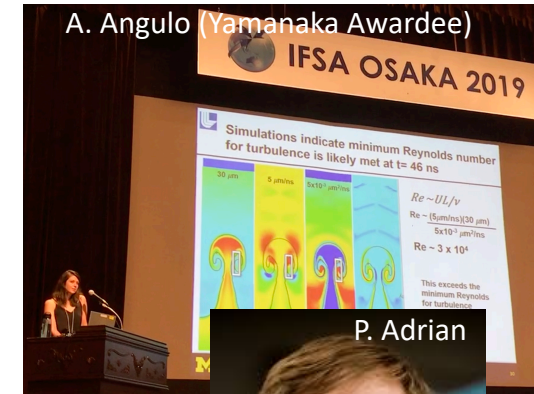
- Consortium for High Energy Density Science
  - Response to an MSIPP NNSA call for proposals
  - FAMU, UC Merced, Morehouse and LLNL
  - Dense plasma effects on ionization
  - Livermore Lab Foundation support
- Thesis student and postdoc are in residence at Center
  - Workforce pipeline
  - J. Clark: PhD student working with R. Shepherd (ALEPH at CSU)
  - D. Gebremedhin : PD working with P. Grabowski and J. Hittinger
  - CfHEDS summer workshop
    - Pis presented overview of work
    - Students and postdocs presented short talks



# The Center provides support for internship opportunities for students

## ■ Internship and thesis opportunities

- M. Link (MSU-kinetic theory molecular dynamics)
- A. Angulo (UM-high-resolution imaging of vortex dynamics at a hydrodynamically unstable interface)
- A. Diaz (UC Berkeley-N body dynamics for pair plasmas)
- P. Adrian (MIT-extracting EOS from the Gbar experiments, T relaxation rates from ion stopping experiments)
- M. Vasquez (CalPoly SLO-analysis of Omega diffraction data)
- H. Fritze (Utah-Dynamic compression experiments)
- Hosted UCSD students –D. Zimmer. C. Chin, J. Turner





# New for 2020- Ideas coming out of the strategic plan are becoming a reality

Sabbatical  
program

Postdoctoral  
fellow

Strengthen ties  
with Japan

Outreach to MSI and  
undergraduate  
institutions



# A postdoctoral Fellow and sabbatical programs are new for 2020 and funded through WCI and the DO

## ■ HEDS Center Postdoctoral Fellow

- Opportunity for an early career researcher to work at LLNL, while promoting HEDS to a larger audience
- Showcases HED as a discipline of study and research
- Committee chaired by F. Albert and funded by WCI



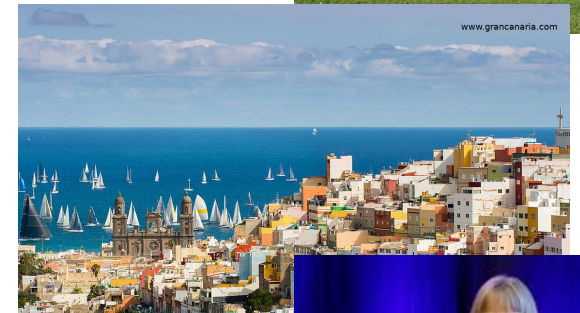
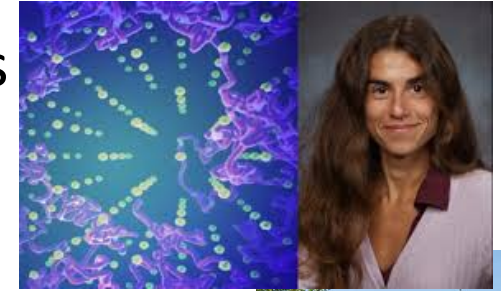
## ■ Mini-sabbatical program

- Brainchild of A. Kersting
- Sabbaticals open for 1-3 month duration
- F. Beg will be our first sabbatical visitor and funded out of the DO



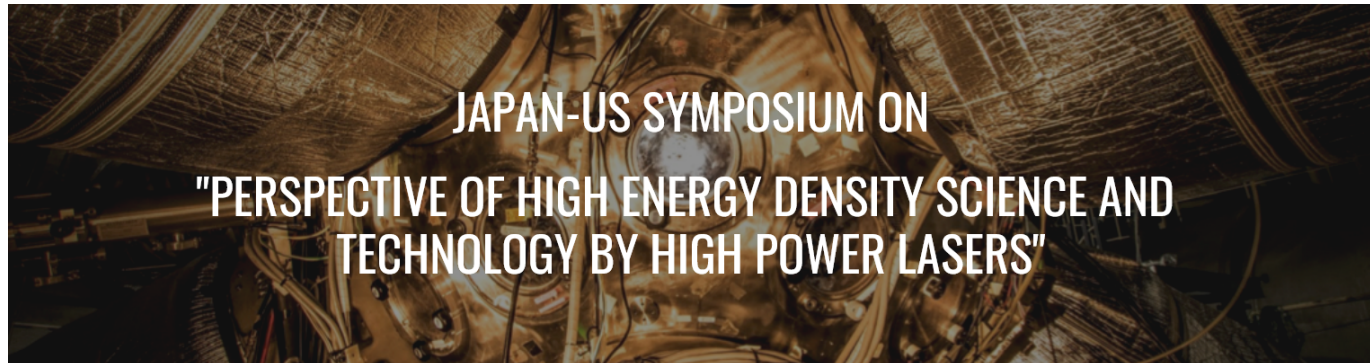
# Support of workshops and targeting MSI and undergraduate institutions is important for building a wider HED community

- The Center supports workshops, outreach and community meetings
  - F. Coppari (Johns Hopkins and NASA-Ames)
  - J. Clark and R. Shepherd (UTEP), LaserNetUS
  - 2020 Research at High Pressure Gordon Conference
  - NLTE-11 Code Comparison Workshop
- Outreach to undergraduate and MSI
  - New funding for several early career staff to speak about HEDS
  - Target undergraduate and minority serving institutions
  - Builds upon the Ambassador Program





# In January 2019, HED and laser scientists from Japan and the US met to discuss areas of mutual interest in HED



*Professors Sentoku and Kodama  
F. Graziani, T. Land, T. Ma, and B. Remington*

- (1) Identify focus areas of R&D for potential long-term and sustainable collaborations
- (2) Identify opportunities for each country to host experiments by leveraging each country's unique facilities
- (3) Identify lead scientists for the various research areas
- (4) Define concrete steps and goals to carry this process forward
- (5) Follow on meeting with Professor Kodama in August concerning MEXT and DOE cooperation in HED R&D ( Albert, Graziani, Land and Kodama, Sentoku)

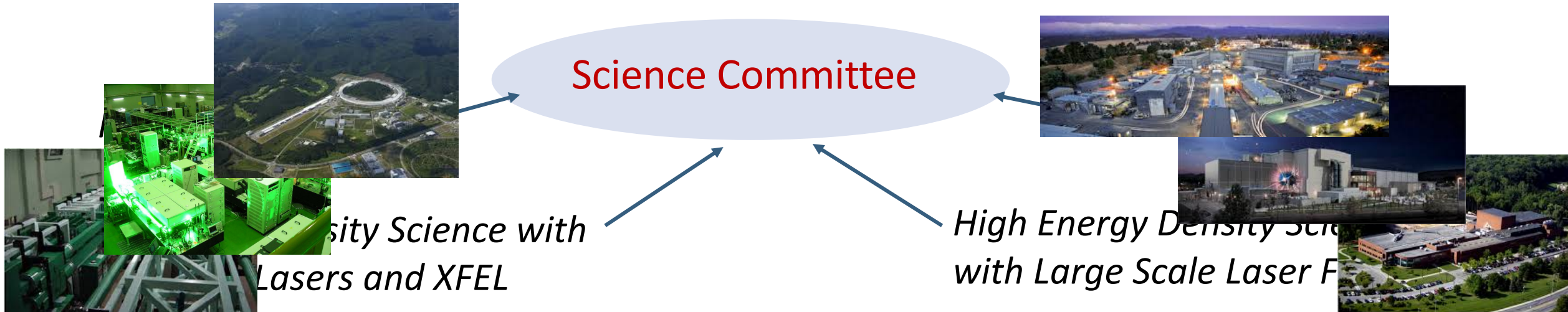
# The Project Arrangement functions as an umbrella that fosters Japan-US HED activities



PROJECT ARRANGEMENT  
UNDER THE IMPLEMENTING ARRANGEMENT  
BETWEEN  
THE MINISTRY OF EDUCATION, CULTURE, SPORTS, SCIENCE  
AND TECHNOLOGY OF JAPAN  
AND  
THE DEPARTMENT OF ENERGY OF THE UNITED STATES OF AMERICA  
CONCERNING COOPERATION IN RESEARCH AND  
DEVELOPMENT IN ENERGY AND RELATED FIELDS  
  
CONCERNING HIGH ENERGY DENSITY SCIENCE



Science Committee



# From the US perspective, the Japan-US Science Committee should function in a number of advocacy roles

## Science Committee



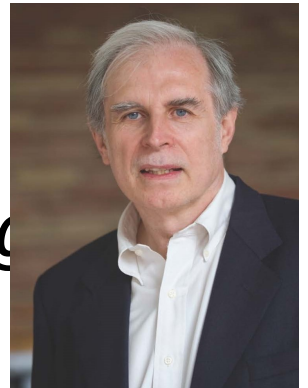
*Identify barriers*



*Help form vision for future endeavors should govt. funds become available*



*Advocate for funding of large scale*



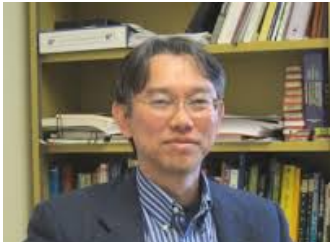
*Help encourage scientific collaborations*





# Depending on level of support, Japan-US collaboration has several options

## *Current status*



## *Without significantly more investment, what can we do?*

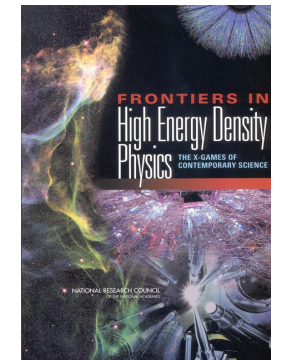
- Education
- The exchange of students
- Faculty sabbaticals
- Encourage collaborations
- Discovery Science and LaserNetUS to form collaborations
- Support for LaserNetJP

17

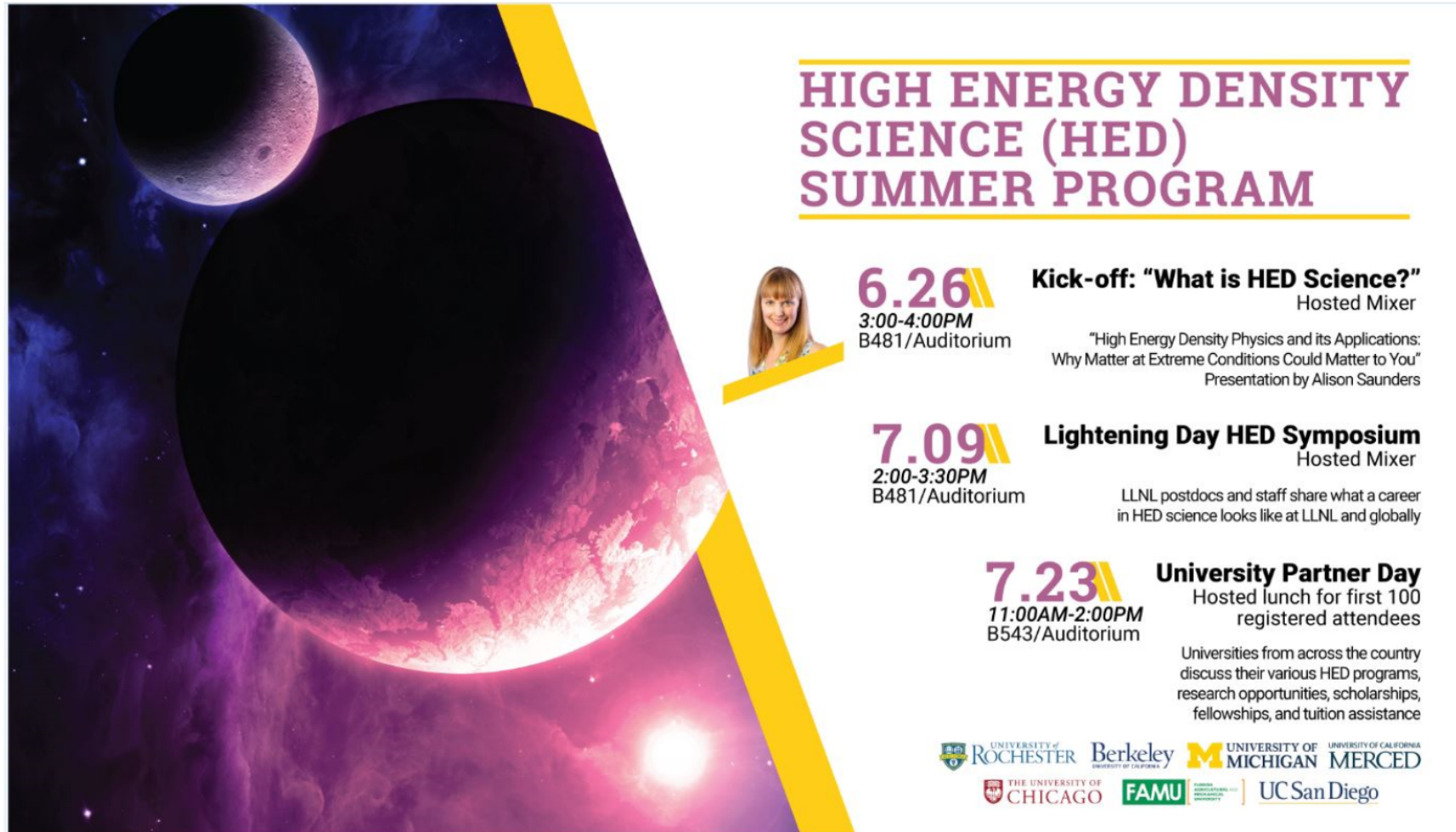


## *Governmental funding*



Capture and advocate ideas for larger scale efforts and grand challenges





# The HEDS center is becoming a focal point for student, postdocs and staff to bring new ideas










## HIGH ENERGY DENSITY SCIENCE (HED) SUMMER PROGRAM

 **6.26**   
3:00-4:00PM  
B481/Auditorium  
**Kick-off: "What is HED Science?"**  
Hosted Mixer  
"High Energy Density Physics and its Applications:  
Why Matter at Extreme Conditions Could Matter to You"  
Presentation by Alison Saunders

**7.09**   
2:00-3:30PM  
B481/Auditorium  
**Lightening Day HED Symposium**  
Hosted Mixer  
LLNL postdocs and staff share what a career  
in HED science looks like at LLNL and globally

**7.23**   
11:00AM-2:00PM  
B543/Auditorium  
**University Partner Day**  
Hosted lunch for first 100  
registered attendees  
Universities from across the country  
discuss their various HED programs,  
research opportunities, scholarships,  
fellowships, and tuition assistance

 UNIVERSITY OF ROCHESTER  Berkeley  UNIVERSITY OF MICHIGAN  UNIVERSITY OF CALIFORNIA  
 THE UNIVERSITY OF CHICAGO  FAMU  UC San Diego



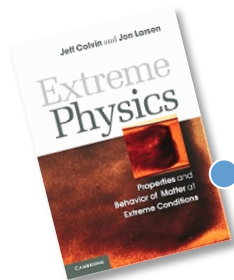
# The HEDS center is becoming a focal point for student, postdocs and staff to bring new ideas

- Re-establish a named faculty position in HED science
  - Target early career faculty who specialty is HEDS
  - Helps in establishing HEDS as a discipline at various universities
  - Establishes a stable pipeline of research talent to LLNL
- Idea grew out of discussions with T. Ma and R. Shepherd
  - A. Wan is POC in WCI and he is working with us
  - Proposal for 3-4 faculty appointments
  - Ideas being discussed
    - Summer support for faculty member, postdoc and student
    - Purchase of equipment
    - Limit appointment to a finite time





# The High Energy Density Sciences (HEDS) Center is helping to build a worldwide community in HED



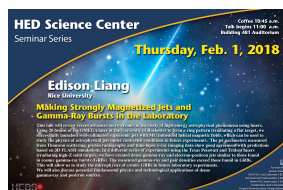
## Education

*Expanded course offerings*  
*Expanded academic participation*  
*Meeting at UCSD of academic partners*



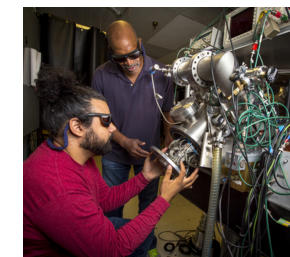
## Bridge to the Programs

HEDS Center Postdoc  
Named faculty position  
Expanded intern program



## Bridge to the HED Community

*Seminar series*  
*Support for workshops*  
*Outreach programs to campuses*  
*HED Showcase*  
*HEDS Center website*



## Enabling Research in Relevant Areas

Support for UC and NNSA funded research efforts  
Support for MSIPP and CfHEDS  
Japan-US and Israeli-US ties in HEDS  
Mini-sabbatical program  
NIF DS

<https://heds-center.llnl.gov/>