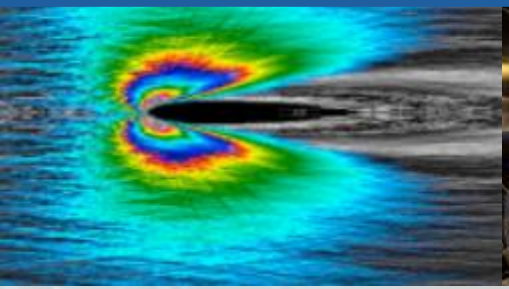
The High Energy Density Science Center: FY2020 A Year in Review




Frank Graziani
October 8, 2020



Felicie Albert
Jim Emig
Paul Grabowski
Bruce Remington
Ronnie Sheperd

LLNL-PRES-763593

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2020 A Year in Review ??

YES! 2020-A Year in Review

Thanks to B. Remington

Who are we?

Director

Frank Graziani

Deputy Director

Felicie Albert

Budget

Tracy Baldwin

Technology Facility

Jim Emig

Seminar Series

Paul Grabowski

Administrator

Jessica Letteer

Discovery Science

Bruce Remington

Outreach

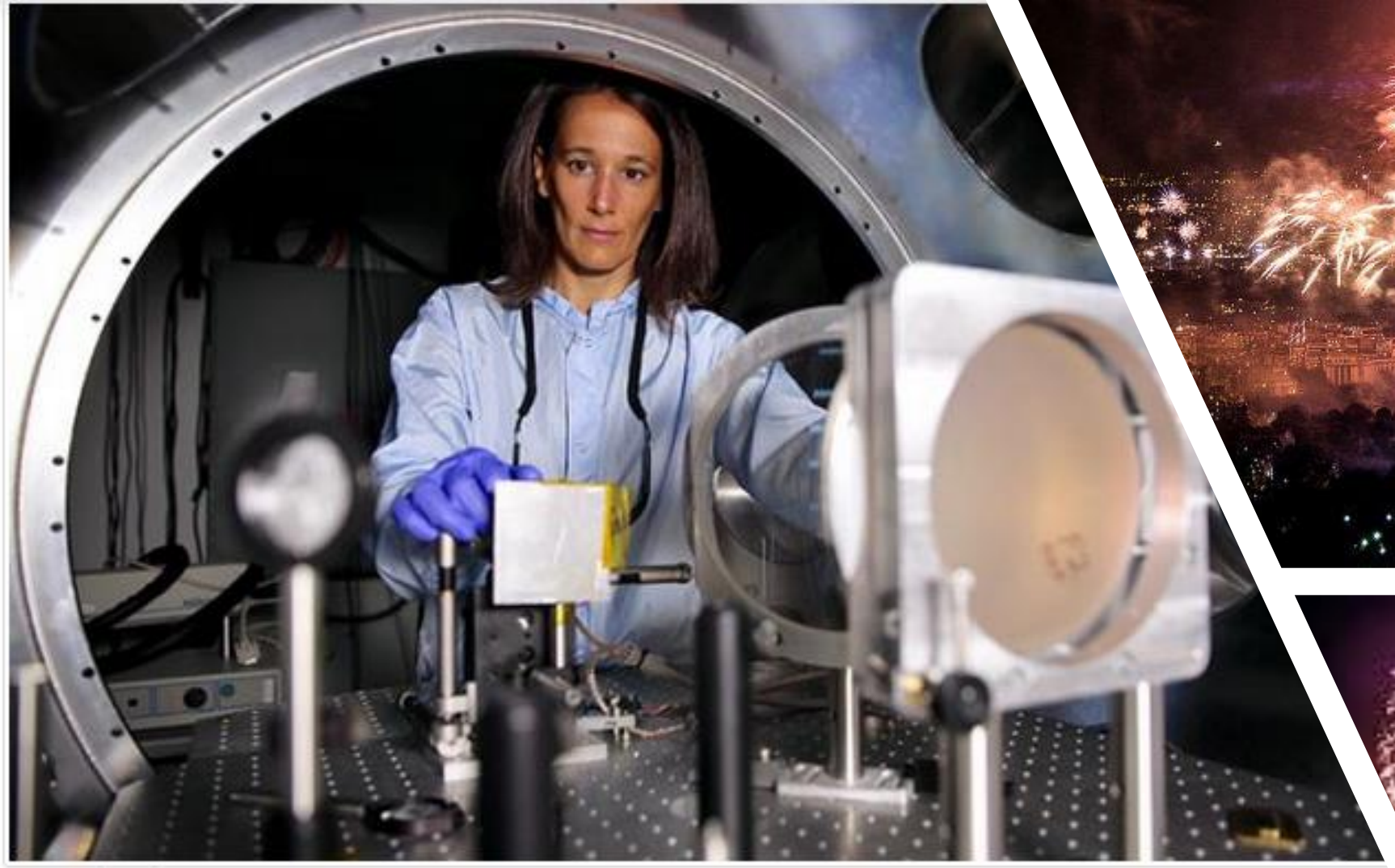
Ronnie Shepherd

Education

Camille Bibeau

LLNL Director of Strategic Diversity and Inclusion Programs

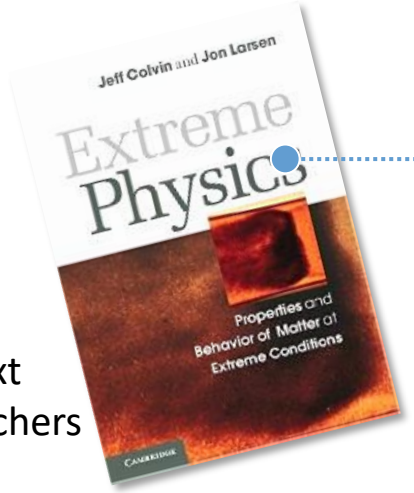
Tony Baylis



Félicie Albert elected NAS Kavli Fellow

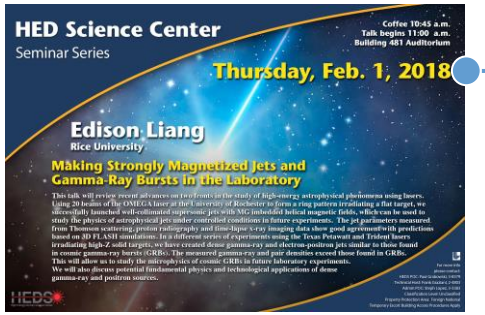
The HEDS Center is helping to build a worldwide community in HED by integrating academic and national laboratory efforts

Education
Educating the next generation of researchers



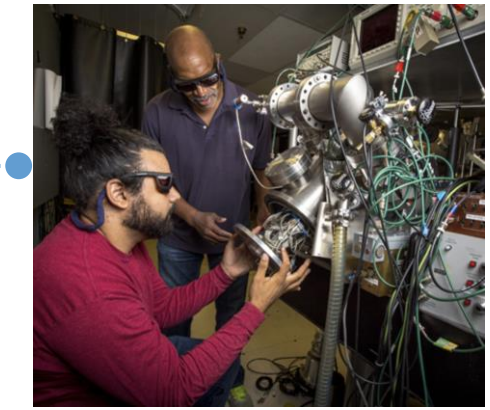
HEDS
High Energy Density Science Center

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



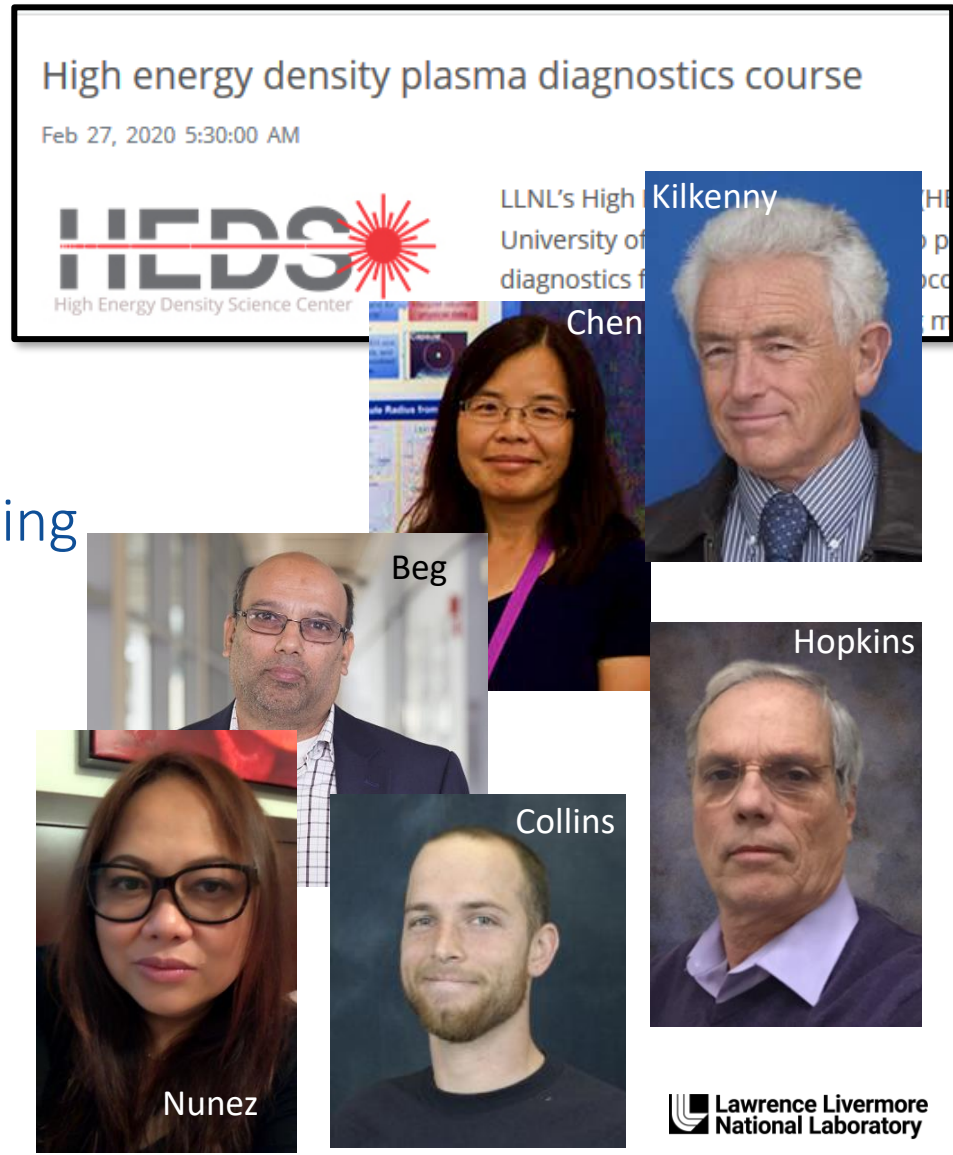
https://heds-center.llnl.gov/

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

- Our education efforts focus on:
  - Short (6-8 lectures) and long courses (quarter or semester)
  - Working with universities to support and advertise courses
- Since 2017, the Center has worked with universities to offer courses in HEDS
  - 2017 collaboration with USCD (Colvin)
  - Short courses in 2018 and 2019 on plasma diagnostics (Chen) and x-ray matter interaction (Hau-Riege)
  - R. Betti (UR) offered a semester-long course on ICF physics
  - Rip Collins (UR) and Ryan Rygg (UR)- an overview of HED
  - 6-lecture LPI course by P. Michel

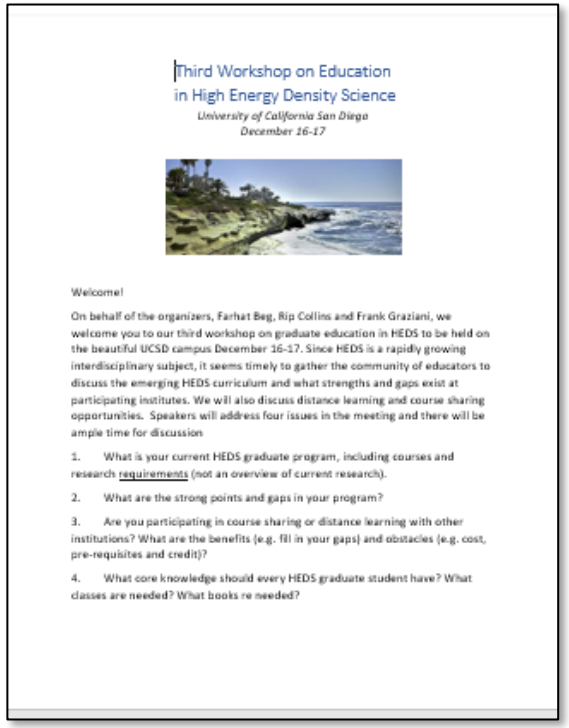
Educating the next generation of HED scientists is important to maintaining a healthy and vibrant field

- In 2020 new course offering in collaboration with UCSD
  - HED plasma diagnostics (Chen, Kilkenny, guest lecturers)
  - Quarter long course with TA, homework and exams
    - ~250 students/staff watched the series
  - COVID and shelter-in-place order came as class was starting
  - Superb LLNL-UCSD team effort led to its success
  - Video series planned with improved production
- New course ideas are in the works
  - Warm dense matter physics (UCSD, UR)
  - Experimental and computational spread over 1 year
  - What are your suggestions?



A workshop was held at UCSD in December 2019 to discuss graduate education in HEDS

- Workshop attendees came from a variety of universities
  - UM, MIT, Osaka, UR, Princeton, OSU, LANL, UC Merced, GA, FAMU, Chicago, UN-Reno, UC Berkley, Stanford, Morehouse
- Each speaker addressed
  - Graduate program in HEDS
  - Strong points and gaps
  - Current course sharing opportunities and obstacles
  - What constitutes a core curriculum?
- Challenges do remain
  - HEDS is based in a variety of departments-student preparation
  - Gaps exist even in a few universities with complete programs
  - Transfer of credit, registration, cost, quarter versus semester



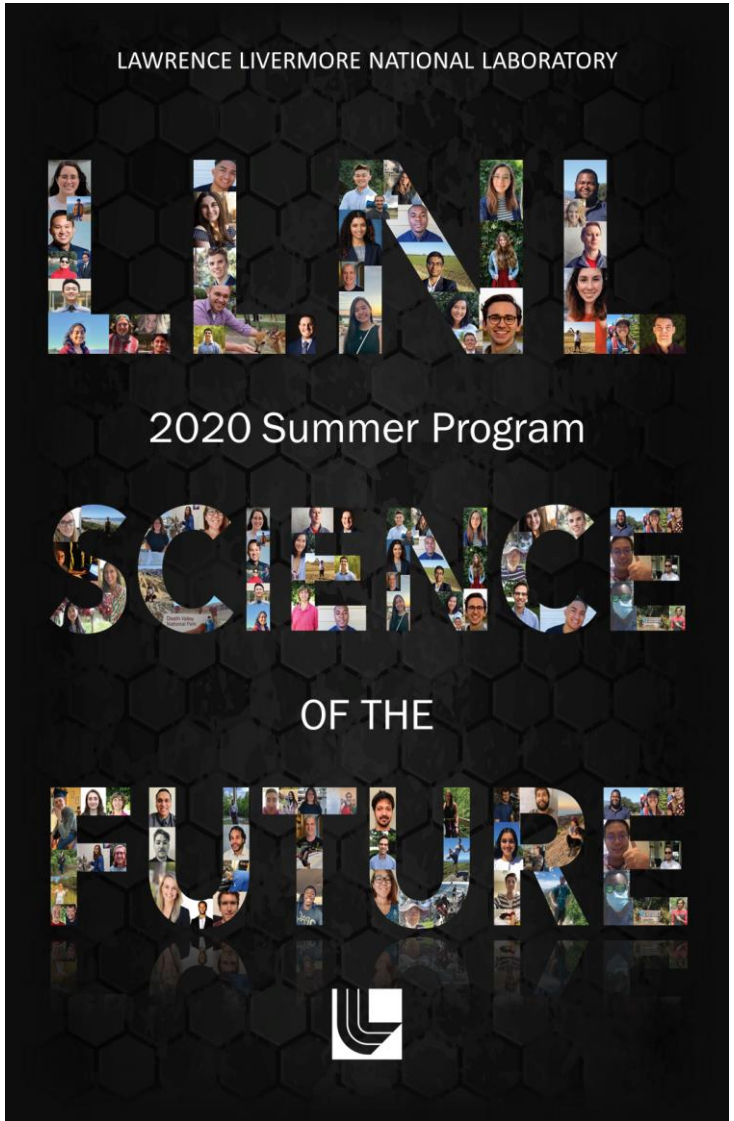
Third Workshop on Education
in High Energy Density Science
University of California San Diego
December 16-17

Welcome!

On behalf of the organizers, Farhat Beg, Rip Collins and Frank Graziani, we welcome you to our third workshop on graduate education in HEDS to be held on the beautiful UCSD campus December 16-17. Since HEDS is a rapidly growing interdisciplinary subject, it seems timely to gather the community of educators to discuss the emerging HEDS curriculum and what strengths and gaps exist at participating institutes. We will also discuss distance learning and course sharing opportunities. Speakers will address four issues in the meeting and there will be ample time for discussion

1. What is your current HEDS graduate program, including courses and research requirements (not an overview of current research).
2. What are the strong points and gaps in your program?
3. Are you participating in course sharing or distance learning with other institutions? What are the benefits (e.g. fill in your gaps) and obstacles (e.g. cost, pre-requisites and credit)?
4. What core knowledge should every HEDS graduate student have? What classes are needed? What books re needed?

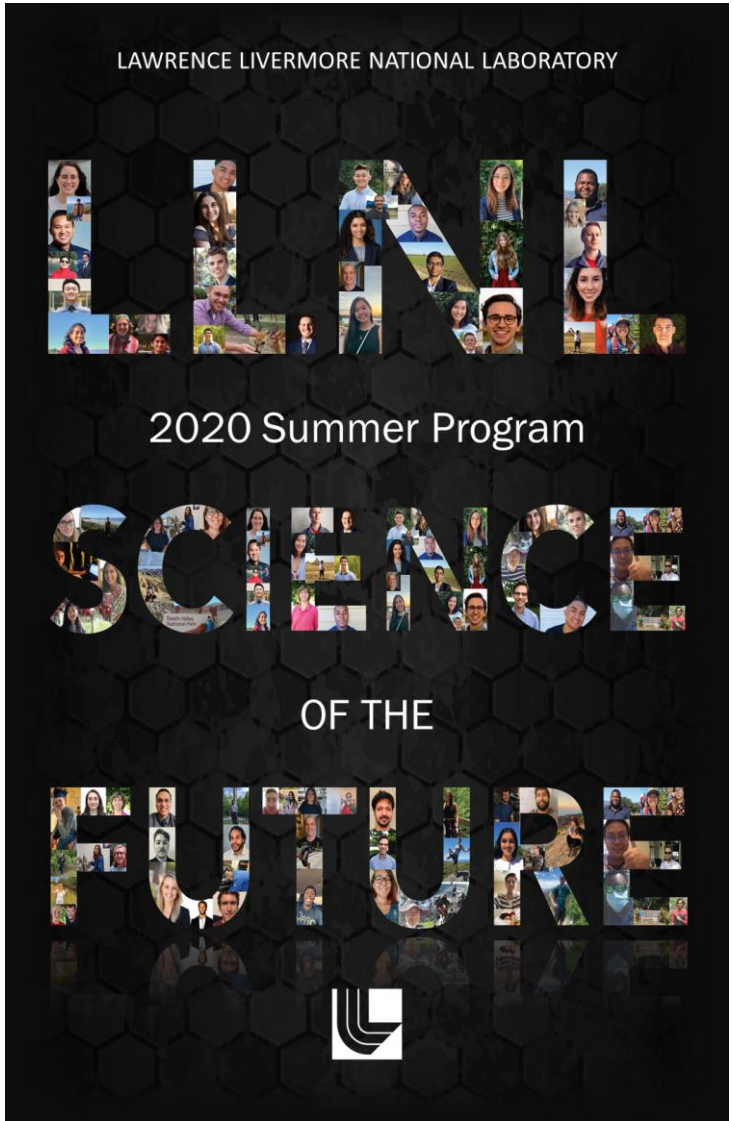
It took the hard work of a diverse group of people this year to make the off-site summer program at LLNL a success



- Mentors
- Hiring
- Onboarding
- IT
- Communication
- Enrichment Activities

It took the hard work of a diverse group of people this year to make the off-site summer program at LLNL a success

Thank You



- Mentors
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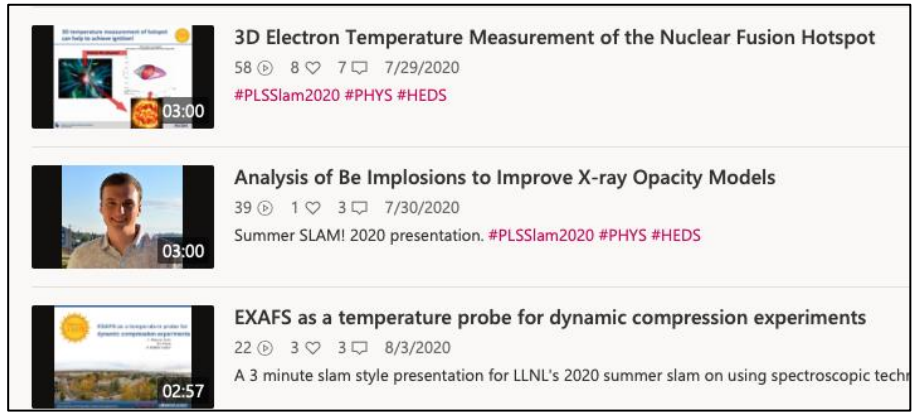
- Enrichment Activities

Despite COVID-19 the center co-hosted with JHEDS a vibrant virtual summer student program

- 25 students in the JHEDS/HEDS center summer program
- Weekly WebEx meeting organized by JHEDS and the center for students to present their work
  - Special events
  - Virtual NIF tour
  - Virtual summer slam by the students co hosted with PLS
  - Virtual summer SLAM by LLNL scientists judged by the students
- Livermore Lab Foundation provided additional support
  - Pre-COVID: Students funded to go to HEDS Summer School
  - Post-COVID: Students submitted applications for funding for support and HEDS staff determined need and amount on a case by case basis



Letrell Harris, Morehouse College

HEDS Summer support

The HEDS Center hosted undergraduate and graduate student interns

M. Link

K. Chin

K. Wong

M. Vasquez

A. Angulo

UM- High-resolution imaging of vortex dynamics at a hydrodynamically unstable interface [Nagel]

D. Gomez

Letrell Harris

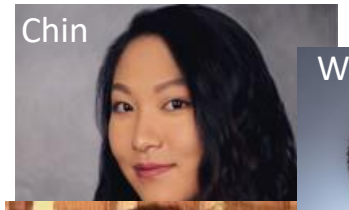
Z. Mauri

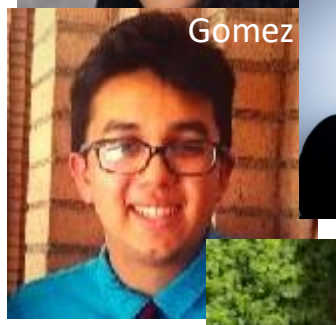
Z. Ye

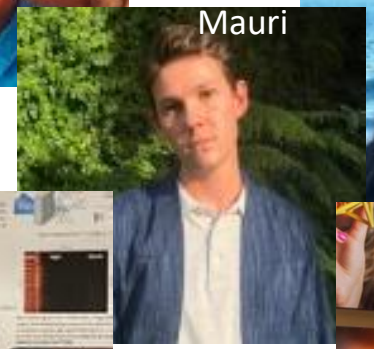
A. Diaz

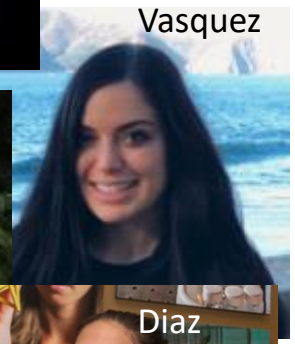
D. Massin

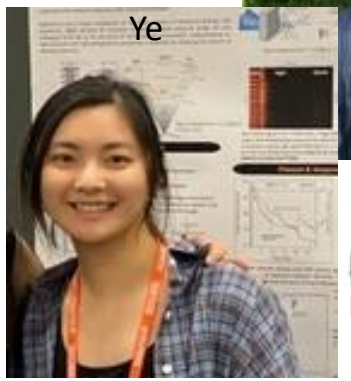
Columbia- 3D modeling of relativistic particle trajectory in the electron-positron-proton magnetic particle spectrometer [Chen]

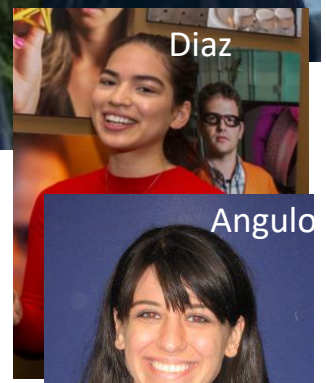










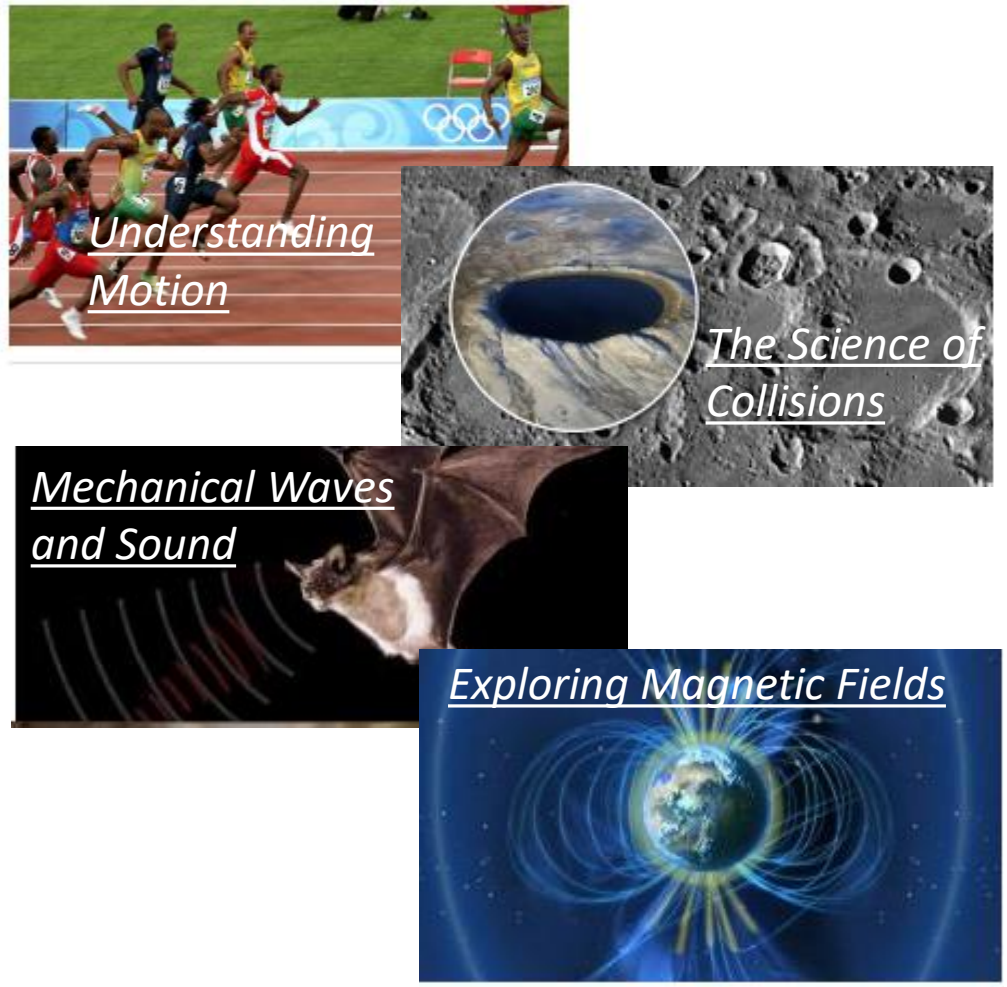


Dave Rakestraw mentored summer interns working on the development of physics curriculum using the sensors in phones

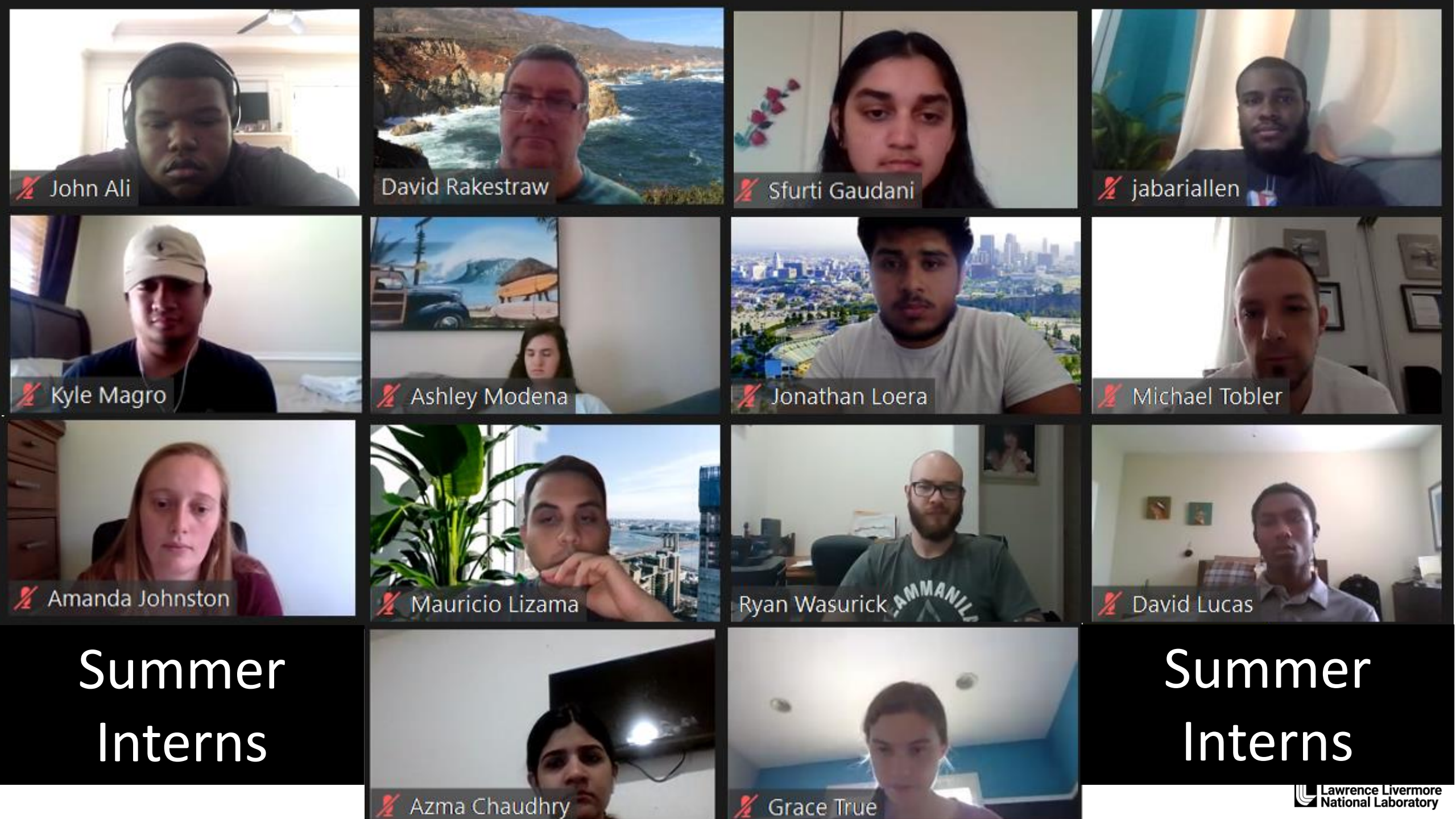
Students helped develop, test and refine a series of physics experiments that make use of the sensors in phones which include:

- 3-axis accelerometer
- 3-axis gyroscope
- 3-axis magnetometer
- Pressure transducer
- Microphones and speakers
- GPS system
- High resolution video camera
- High resolution timer

The material is available on the LLNL website and is being used in high school and college classes across this country this fall.



https://st.llnl.gov/sci-ed/distance-learning



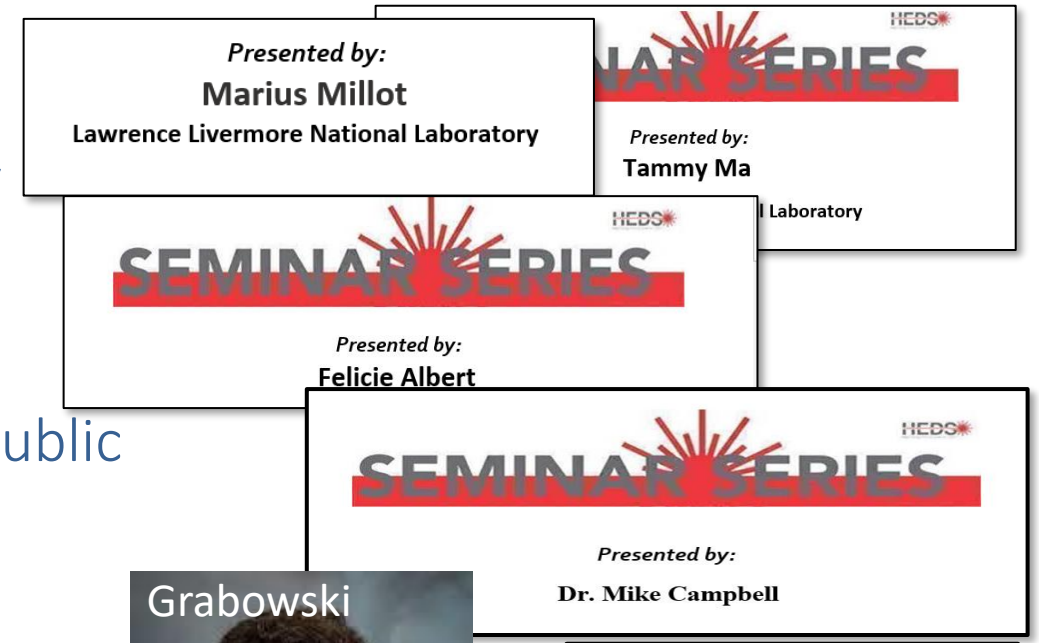
Summer Interns

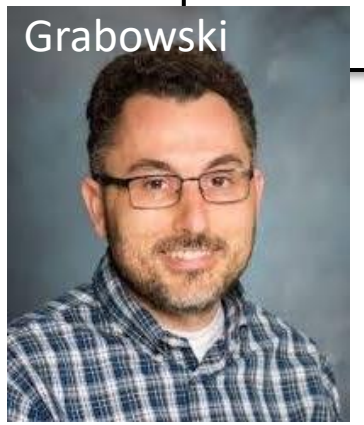
Summer Interns

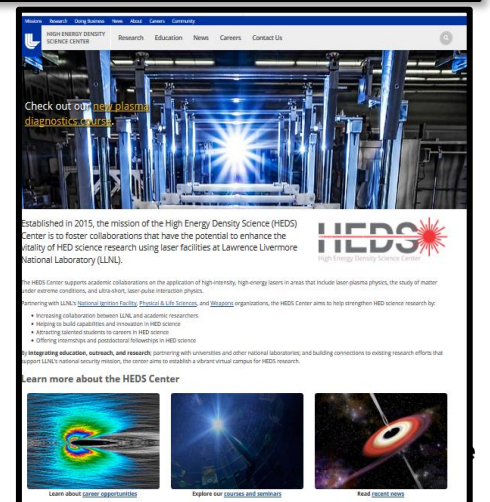
The Center provides outreach through seminars, workshops and campus interactions

- "Weekly" HED seminar series
  - Solicitation process that targets recognized and early career scientists
  - *https://heds-center.llnl.gov/education/seminars*
  - COVID prompted a change in course to on-line and public lectures
- HEDS Center website
  - Links to courses, research points of contact, job opportunities
  - Video series will soon be on the website

  (more about this later)

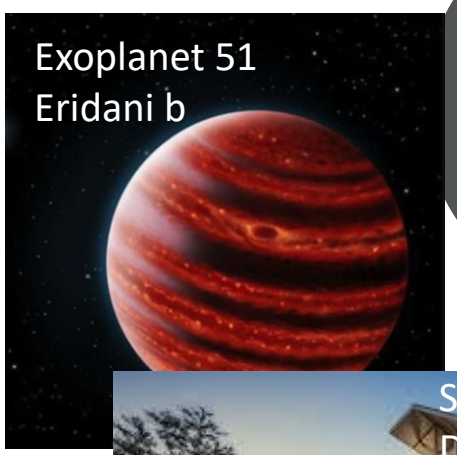


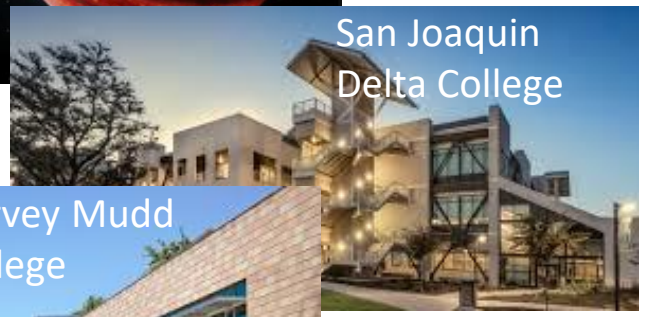


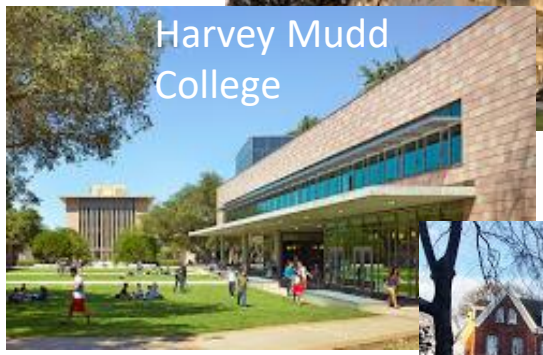


The Center provides outreach through seminars, workshops and campus interactions

- University outreach
  - LLNL Ambassador Program: F. Albert is the new speaker for HEDS
  - The HED Center provides a strong link between LLNL and the participating universities in Discovery Science experiments on NIF
  - Forging a connection to Texas A&M/HiP lectures by B. Remington
- Support for workshops
  - NLTE-11 Code Comparison Workshop , Spain
- We have a new activity for FY21, postponed due to COVID
  - HEDS speakers for undergraduate and community colleges (Art Pak, Alison Saunders, Camelia Stan)
  - Working with T. Baylis on outreach to K-12

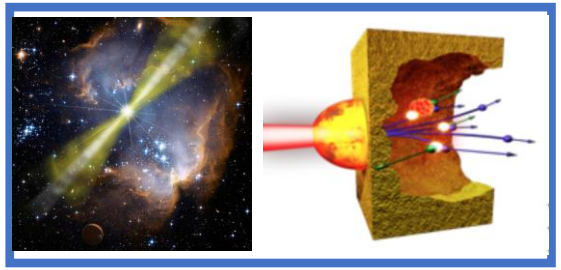


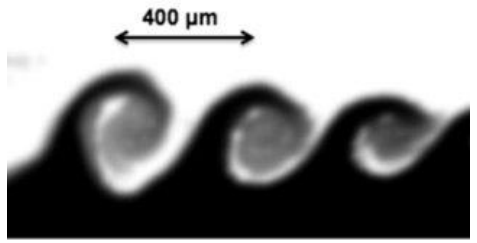


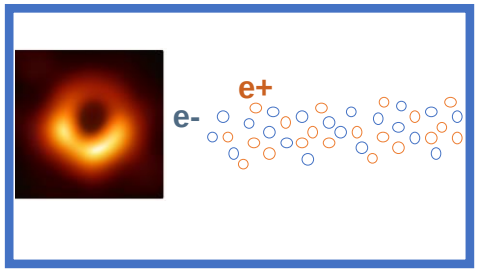


Prompted by COVID restrictions, we launched a new outreach activity- educational video series

- Omar hurricane (WCI, Theory)
  - HED Kelvin-Helmholtz physics/experiment
- Joe Ralph (NIF, Experiments)
  - Hohlraums and how their dynamics affects the implosion low mode symmetry
- Blagoje Djordjevic (WCI, Theory)
  - Short-pulse laser acceleration
- Jens Von der Linden (PLS, Experiments)
  - Trap relativistic matter-antimatter plasmas in magnetic bottles
- Andrea Schmidt (PLS, Experiments)
  - Dense plasma focus experiment
- Dave Schlossberg (NIF, Experiments)
  - Temperature measurements in NIF experiments

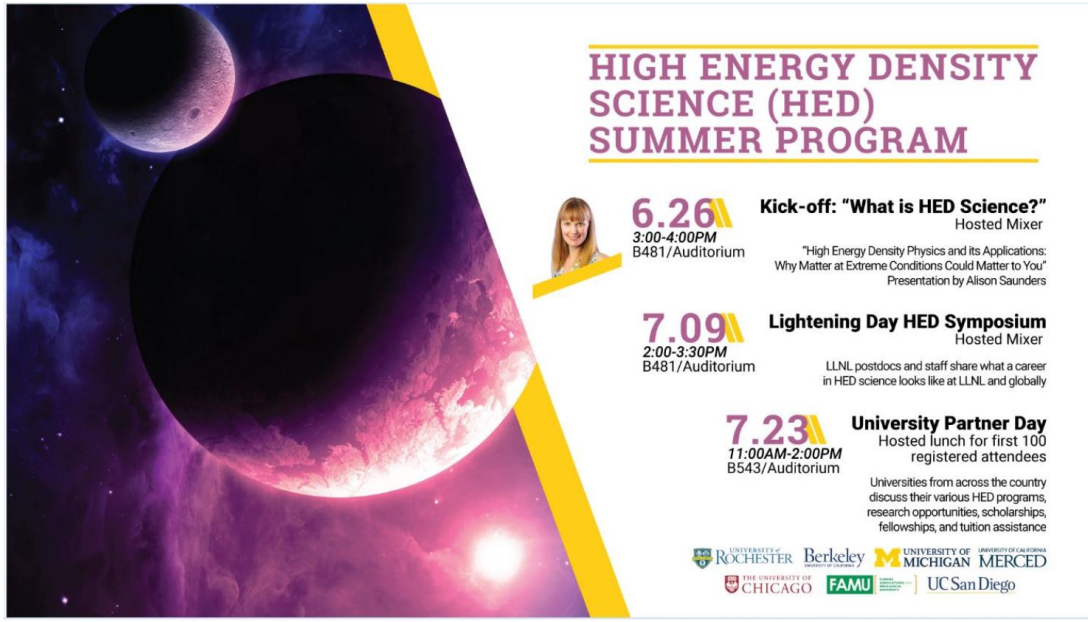


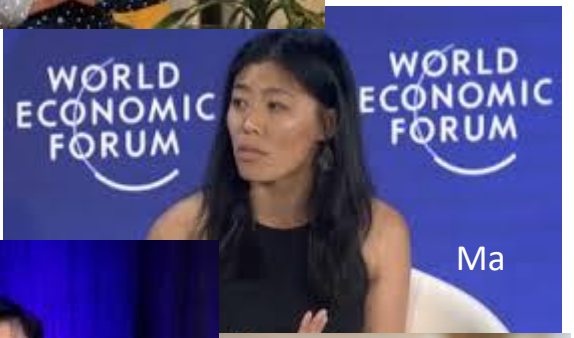




If you are interested in doing a video for us, contact F. Albert

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



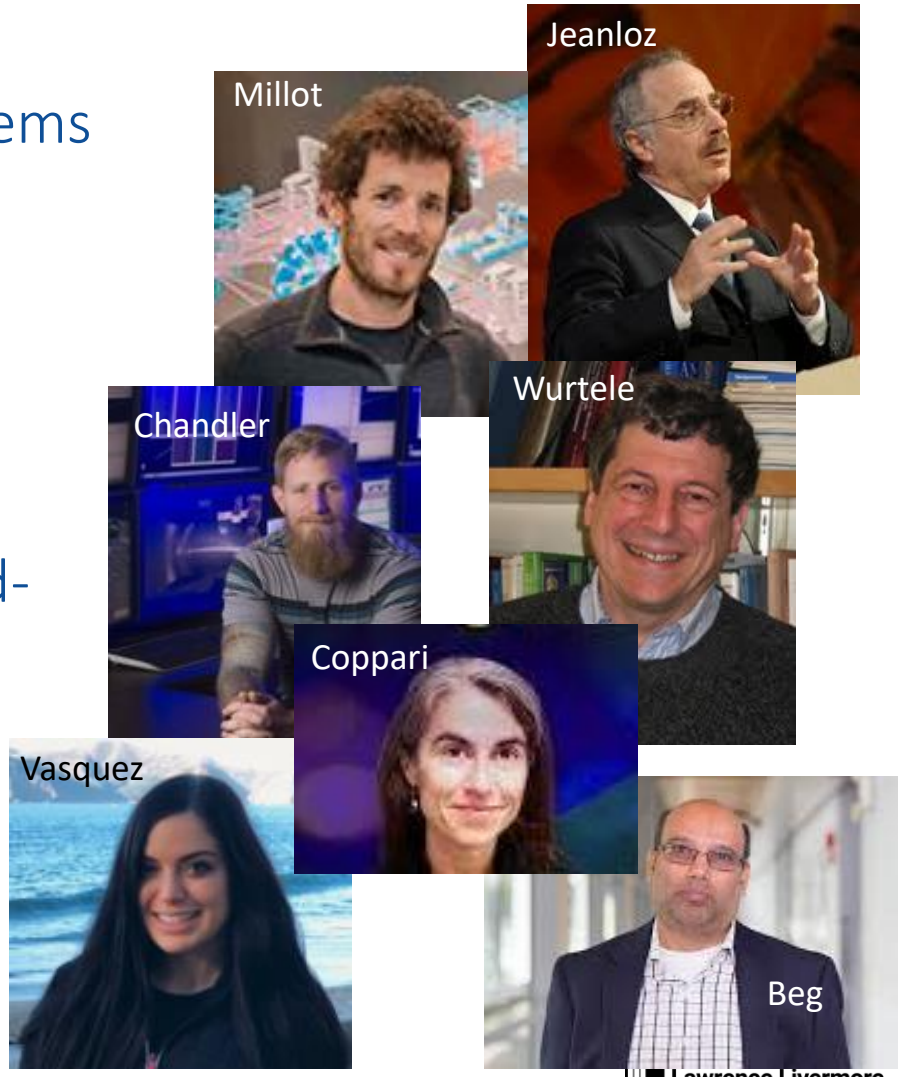


The HEDS Center is working with WCI to re-establish a named faculty position in HED science

- Target early career faculty whose specialty is HEDS
- Establishes HEDS as a discipline at various universities
- Establishes a stable pipeline of research talent to LLNL

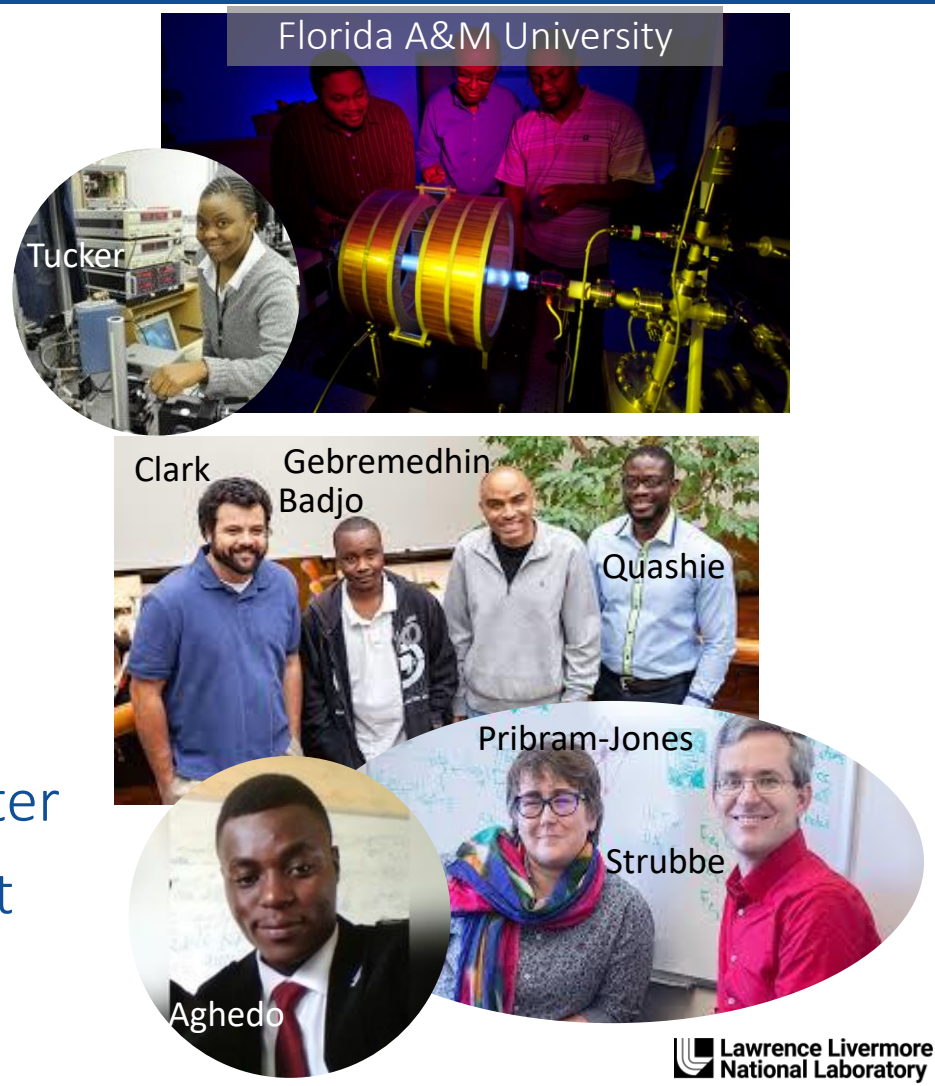
The Center is the focal point for facilitating and fostering research opportunities for academic and LLNL staff

- **NNSA HED Center for Matter at Extreme Conditions**
  - Energy transport, material properties, in magnetized systems (F. Beg of UCSD leads CMEC)
  - Host students at LLNL
  - HEDS curriculum development
  - Support for experiments at Jupiter Laser Facility
- **High Pressure research at Berkeley and Davis**
  - Funding for UCOP funded Frontiers in HEDS Center ended-2/20
  - HEDS Center continues to support HiP work
  - CalPoly student (mentor: Coppari) joins Jeanloz group
  - C. Chandler interactions with GS (T. Antoun)
  - J. Wurtlele plasma physics (postponed)
    - Lectures by LLNL staff and tour of NIF for students

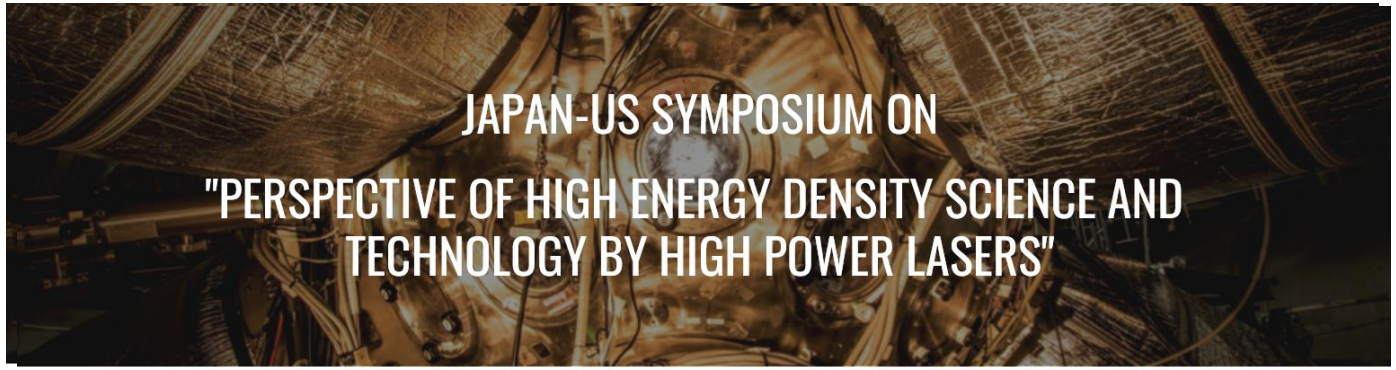


The Center is the focal point for facilitating and fostering research opportunities for Minority Serving Institutions

- Consortium for High Energy Density Science
  - MSIPP NNSA funded effort renewed
  - FAMU, UC Merced, Morehouse and LLNL
  - Dense plasma effects on ionization
- Graduate student and postdoc are in residence at Center
  - Workforce pipeline
  - J. Clark: PhD student working with R. Shepherd
  - D. Gebremedhin : PD from FAMU in residence at the Center
  - A. Aghedo: FAMU graduate student working with F. Albert and N. Lemos



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



(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

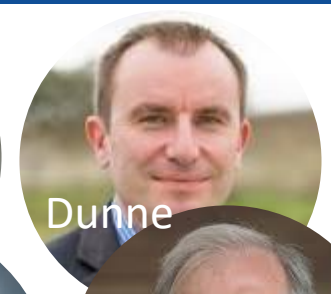
(3) Identify lead scientists for the various research areas

(4) Define concrete steps and goals to carry this process forward

(5) Follow on meeting with Professor Kodama in January 2020 **MEXT and DOE cooperation in energy and HED R&D**

The interactions between Japan and the US in HEDS made progress but were suspended due to COVID

- January 2020 visit by Professor Kodama, Director, Institute of Laser Engineering
  - Japan-US Science committee established
  - J-Epoch: high repetition MW-laser facility
- Japan and US agreed on new levels of engagement
  - Education
  - Research areas in lasers and HED science were agreed upon
  - LLNL would work with Japan to identify existing campaigns where scientist from Japan would fit
  - Use of NIF Discovery Science and LaserNetUS to foster collaborations
  - Visiting professor, vi entist, and and student internships
  - Japan-US workshop




Lawrence Livermore National Laboratory

Perspectives on Japan-US Collaborations in HED and Laser Science

F. Albert, K. Budil, G. Fox, F. Graziani, M. Herrmann, T. Land, J. Wisoff

Lawrence Livermore National Laboratory

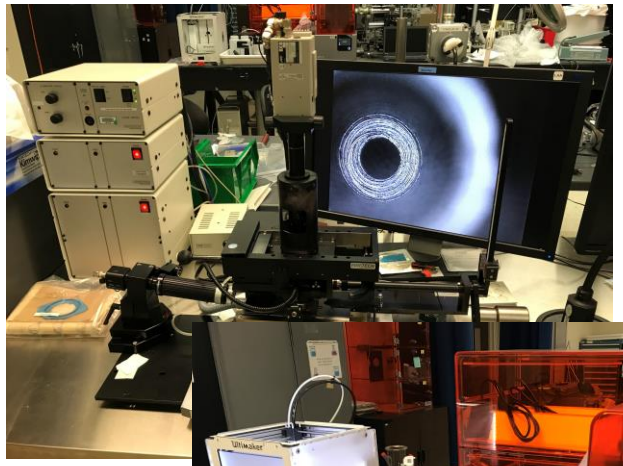
1. Introduction

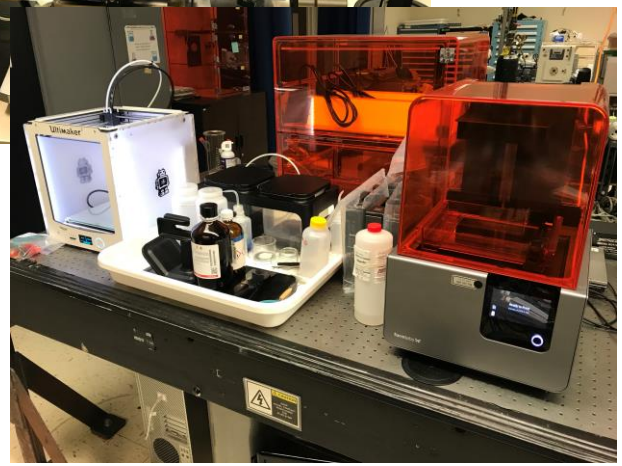
Japan and the U.S. have a long and mutually beneficial history, working together and the larger global community in high energy density science (HEDS) and the science and technology of high-power lasers. The Japan-U.S. collaboration in HED science offers several dividends to both countries. There is a great deal of interest in the study of materials at extreme conditions and understanding the physics basis toward attaining fusion. Ex mental and computational facilities exist in Japan and the U.S. for the pursuit of the perspective, the technical ties that bind the two countries offers st The U.S. has long had interests in the Pacific rim and strengthening a strategically.

The HEDS Center helps provide support for the HEDS B161 technology center

The Building 161 technology facility is a multi use facility, managed by PLS, for researchers to design, build and deliver targets and diagnostics.

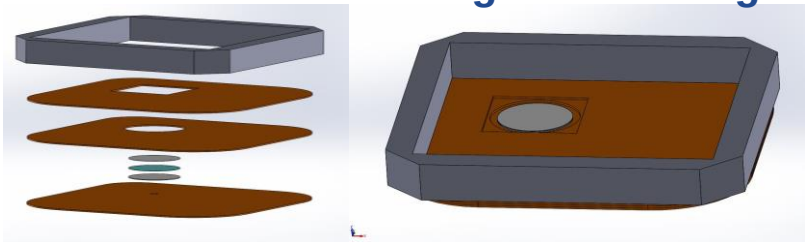
Work-stations



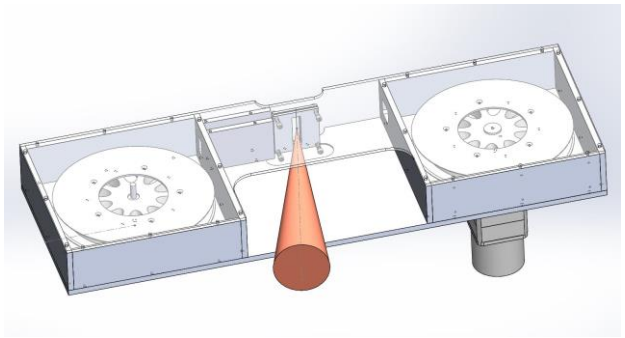


Target fabrication

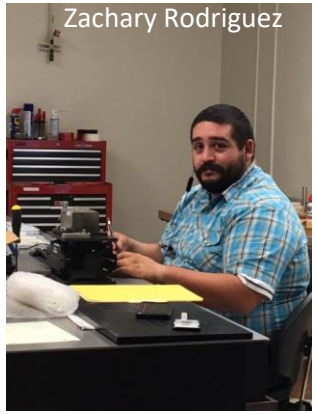
PXRDIP diffraction targets for Omega

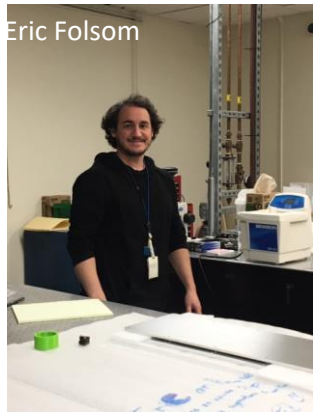


High repetition rate target cassette



Staff





A sabbatical program and a HEDS Center Postdoctoral Fellow, new for FY20, will continue in FY21

- Sabbaticals were put on hold in FY20 but hopefully will resume
  - Mini-sabbatical sponsored by A. Kersting
    - F. Beg of UCSD
  - F. Delmotte (University of Paris)will lecture on laser optics
  - W. Fox (Princeton) is tentative
- HEDS Center Postdoctoral Fellow
  - Opportunity for an early career researcher to work at LLNL, while promoting HEDS to a larger audience
  - Plan to hire a 2-year fellow every year, funded by WCI
  - Application package and review process similar to the Lawrence Fellowship

The center selected a new 2-year Postdoctoral Fellow, supported by WCI/ICF

First HEDS Center Fellow (selected out of 32 applicants)

Andrew Longman, PhD University of Alberta

"Coupling of Structured Light to Plasma for Magnetic Field Generation, Particle Guiding, and Control of Laser-Plasma Interactions"

LLNL Mentor: Pierre Michel (starting November)

Andrew will be giving the HEDS Seminar next week!

Thanks to the committee who helped the HEDS center with the selection:

Felicie Albert (NIF)-Chair
Richard Kraus (PLS)
John Moody (NIF)
Art Pak (NIF)
Yuan Ping (PLS)
Kumar Raman (WCI)
Heather Whitley (WCI)

Posting for 2nd cycle on careers.llnl.gov
Job ID #107516

Deadline November 15th

https://careers-llnl.ttcportals.com/jobs/5597706-high-energy-density-science-heds-center-postdoctoral-fellowship

The seminar series enabled interactions between VTU and WCI scientists

Aug 23, 2018 – Virgina Tech Srinivasan HEDS Center seminar

Aug 23, 2018 – Lee and Bhuvana have follow-up conversation about MHD

June – Aug 2019 – Masti participates in WCI's HEDP Summer

Aug 2019 – Masti awarded inaugural HEDP Fellowship/Carrier hired

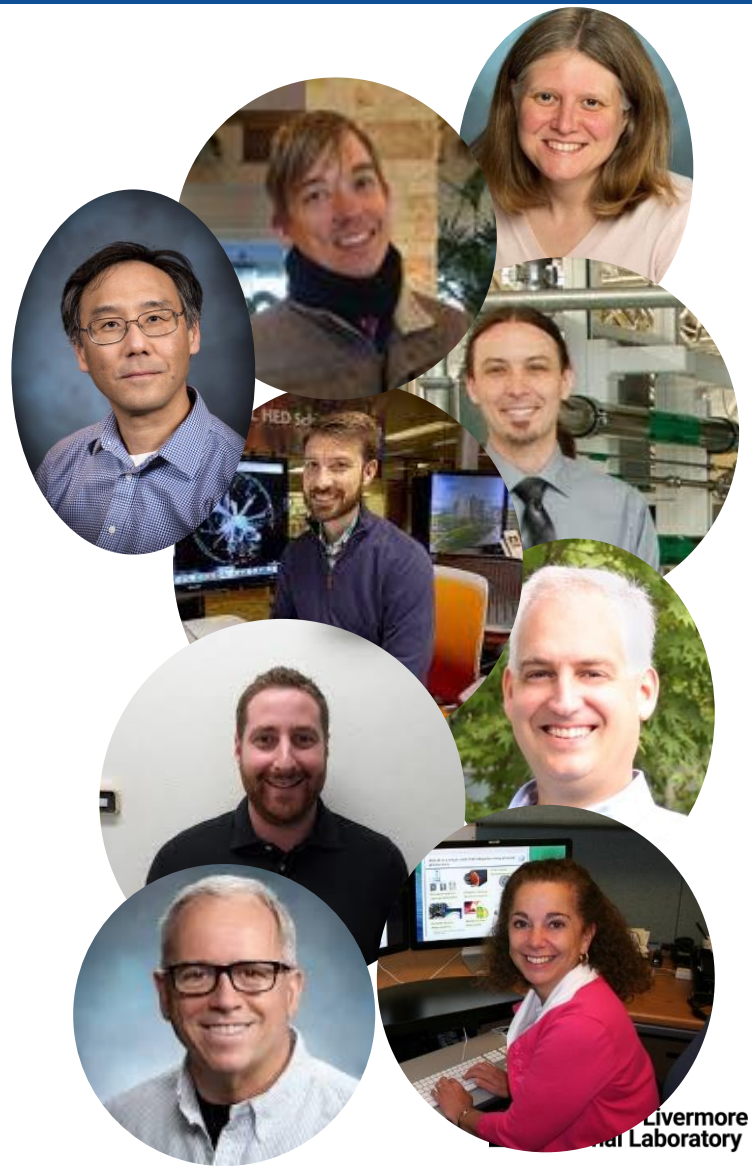
March 2020 – Carrier to use LLNL Multiphysics code to model high fidelity experimental data acquired at Mykonos pulsed power driver at SNL

June 2020 – Masti submits journal article to HEDP journal

May 2021 – Masti expected graduation

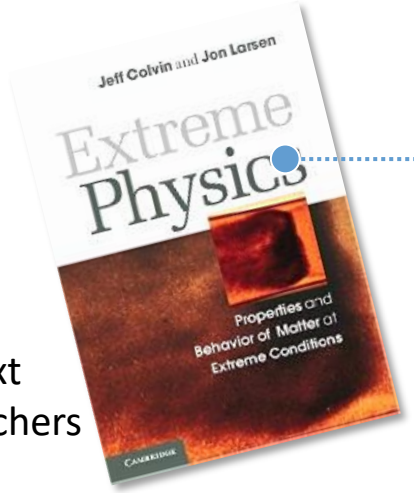
WCI has introduced the Academic Collaboration Team (ACT) as a way of fostering LLNL-academic interactions

- WCI wants to develop university relations in support of WCI programs
  - Innovation, basic science, an informed independent perspective
  - Product is data, technology, methods
  - Hiring pipeline and workforce education
- ACT roles and responsibilities
  - Rose McCallen of WCI is coordinating ACT
  - Proposals consist of PI's from academia and LLNL
  - Topics derived from input by APDs, line management, project teams, PIs, individuals
  - Selection process is based on a "blind" review by a committee



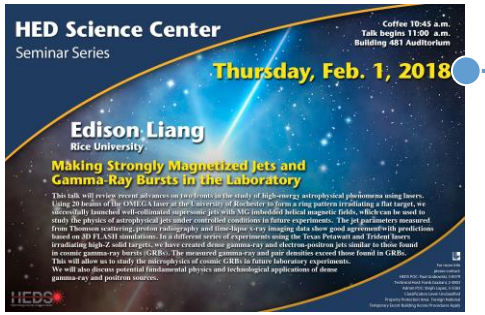
The High Energy Density Sciences (HEDS) Center is helping to build a worldwide community in HED

Education
Educating the next generation of researchers



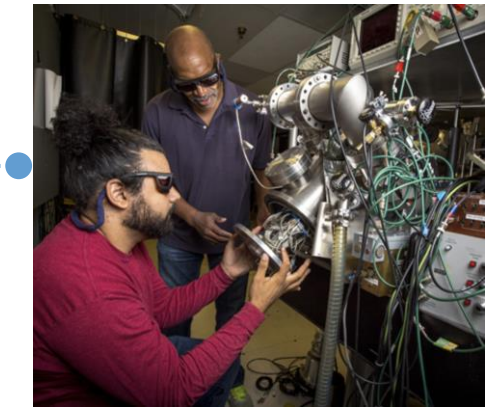
HEDS
High Energy Density Science Center

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



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