

Workforce Development for DOE Computing Sciences



PESO Community Workshop

June 9, 2023

Lois Curfman McInnes and Mary Ann Leung

We face urgent workforce challenges: We must expand the pipeline and workforce for DOE high-performance scientific computing

DOE ASCAC Workforce Subcommittee Letter, Chapman et al., 2014,
<https://doi.org/10.2172/1222711>, states:

“All large DOE national laboratories face workforce recruitment and retention challenges in the fields within Computing Sciences that are relevant to their mission. ... Future projections indicate an **increasing workforce gap and a continued underrepresentation of minorities and females in the workforce unless there is an intervention.**”

The report also states:

“A common theme identified by many labs is that early exposure to the laboratory environment can attract better-qualified students into permanent laboratory roles.”

The report recommends:

“... provide a rich repository of DOE mission-oriented learning materials and engagement opportunities to attract and guide individuals towards careers in areas of DOE need.”

Computing Sciences:

- From ASCAC Workforce subcommittee letter: “We use this term throughout the document to cover multiple areas of importance to DOE including, but not limited to, Computational Science and Engineering. It includes fields such as Algorithms (both numerical and non-numerical); Applied Mathematics; Data Analysis, Management and Visualization; Cybersecurity; Software Engineering and High Performance Software Environments; and High Performance Computer Systems.”
- Also includes Data Sciences, Learning/AI, Networking, Computing Facilities, etc



Image credit: Current and future workforce, R. Giles et al.,
Transitioning ASCR After ECP, Oct 2020

ECP Task Force on Broadening Participation

Partnership among ANL, BNL, LBL, LLNL, LANL, ORNL, PNNL, SNL (including ALCF, NERSC, OLCF)

Task force began in August 2021

- **Bold underline** denotes task force leadership team
- * denotes thrust lead



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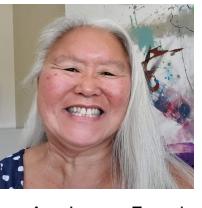
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Partnered with M.A. Leung to
establish the LBL Sustainable
Research Pathways Program



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**Thank you to ECP and DOE leadership for support, especially
Barb Helland and Christine Chalk**

Liaisons from the Computing Research Leadership Council

ECP Broadening Participation Initiative



A multipronged initiative to expand the pipeline and workforce for DOE high-performance computing (HPC)



HPC Workforce Development and Retention Action Group

We are influencing culture in DOE labs and communities to promote the workforce pipeline for — and the retention of — a diverse DOE lab HPC workforce.

We are fostering a community, within



Intro to HPC

We are providing accessible introductory material to HPC — thereby addressing gaps in — and expanding the pipeline of — people with foundational HPC skills.

This becomes a pathway to build experience for (and interest in)



Sustainable Research Pathways for HPC (SRP-HPC)

We are establishing a multilab cohort of students from underrepresented groups (and faculty working with them), who are working side-by-side with ECP teams on world-class HPC projects:

<https://www.exascaleproject.org/hpc-workforce>

Reference: *A multipronged approach to building a diverse workforce and cultivating an inclusive professional environment for DOE high-performance computing*, response to DOE RFI on Software Stewardship, ECP Task Force on Broader Engagement, Dec 2021, <https://doi.org/10.6084/m9.figshare.17192492>

Partnership with **Sustainable Horizons Institute**
<https://shinstitute.org/srp-hpc>



SUSTAINABLE HORIZONS INSTITUTE



Strongly encouraged to apply: Students from (and faculty working with) underrepresented groups (Black or African American, Hispanic/Latinx, American Indian, Alaska Native, Native Hawaiian, and Pacific Islanders, women, persons with disabilities, first-generation scholars, and other underrepresented populations)

Why ECP? Unique multilab partnership across DOE computing sciences (apps / math / CS / facilities)

- Strength in spanning multiple institutions / strength in numbers / network beyond what any individual lab could do
- Proactive outreach and deployment of DOE HPC tools and technologies to communities beyond traditional targets

Build on Sustainable Research Pathways (SRP) at LBL

(ref: [Leung ASCAC presentation](#), July 2021)



David Brown
Mary Ann Leung
Silvia Crivelli

Sustainable Research Pathways Program

- Build relationships centered on research collaborations
- Recruit
 - Faculty working with underrepresented students
 - Students from underrepresented backgrounds
- Provide opportunities for staff scientists
 - Research collaborations
 - Learn/contribute to diversity and inclusion efforts
- Supplement existing D&I Laboratory programs



- Started in 2015 at LBL, has expanded annually
- Steady pipeline of examples of successful pathways to DOE
- Expanded as multi-lab ECP partnership (program summers 2022 and 2023)
- Now expanding to other computational and data science projects through the Computational Research Leadership Council (CRLC)

Berkeley SRP Alumni



Professor Chris Paolini, San Diego State University (HSI)

- Participated in SRP@LBL (2019, 2020, 2021)
 - student Angel Boada all 3 years
- ECP AD Subsurface project with lab mentor David Trebotich
- Team has continued thru SRP-HPC

Alexandra Ballow, Youngstown State University

- First-generation undergraduate in economically challenged community
- Conducted research through SRP@LBL in 2018 in John Wu's group
- Took advantage of SIAM CSE19 BE Lightning Talks to prepare for poster blitz for over 1000 SIAM community members
- Presented research through BE@CSE19; met Ann Almgren (Guided Affinity Group leader); returned to SRP@LBL in 2020
- Presented research at BE@CSE21
- Awarded 2021 DOE Computational Science Graduate Fellowship!

And more ...

Sustainable Research Pathways

Broadening participation of underrepresented groups

<https://shinstitute.org/sustainable-research-pathways-2022>

Collaborate with ECP teams

Two tracks*

- Faculty/student teams
- Students on their own



Addressing a National Imperative

The Exascale Computing Project is an aggressive research, development, and deployment project focused on delivery of mission-critical applications, an integrated software stack, and exascale hardware technology advances.

Application Development



Software Technology



Hardware & Integration



* Students from and Faculty working with underrepresented groups (Black or African American, Hispanic/Latinx, American Indian, Alaska Native, Native Hawaiian, and Pacific Islanders, women, persons with disabilities, first-generation scholars) are strongly encouraged to apply.

Inclusive recruiting: Underrepresented groups wherever they are: historically black colleges and universities (HBCU), hispanic-serving institutions (HSI), community colleges, liberal arts, public/state, high-research institutions



Build relationships based on R&D collaborations, with these goals:

- Jump-start and boost careers
- Foster a welcoming and inclusive HPC community
- Provide learning opportunities to advance diversity, equity, and inclusion
- Normalize inclusion, that is, help people learn how to work together and un-learn biases so that inclusion becomes a normal practice

Explore cutting-edge R&D opportunities at DOE labs, which provide the foundation for exciting careers and broad societal impacts

Students from underrepresented groups (and visiting faculty working with them) whom ECP projects identify and fund separately (e.g., through lab visitor programs) are welcome to join the "SRP Summer Experience" cohort activities.

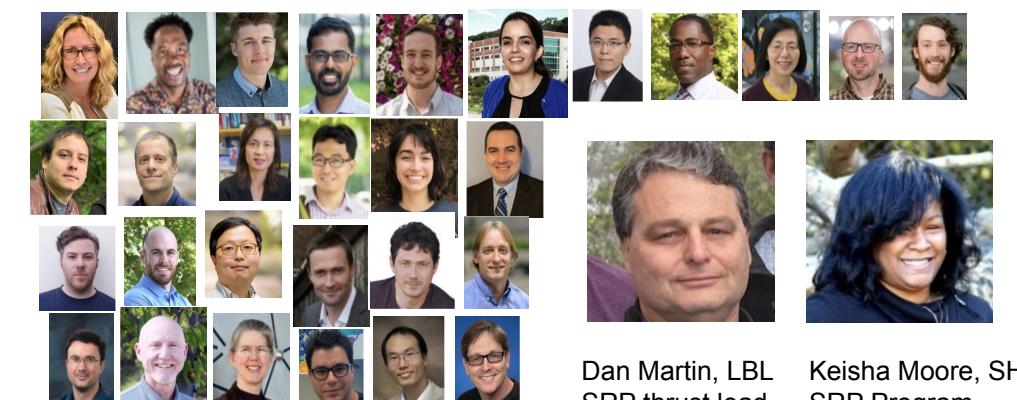
SRP-HPC (for summer 2022)

- **61 participants:** 13 student track, 16 faculty track (+29 students), 3 self-funded students
- 82% of overall participants (and all faculty-student teams) represent at least 1 element of diversity
- Many successful projects: SC posters, continuing relationships
- Mentors/hosts throughout ECP and Facilities community
 - ECP Application Development and Software Technology
- Matches for all participating labs
 - Ames, ANL, BNL, LBL, LANL, LLNL, ORNL, PNNL, SLAC

<https://shinstitute.org/srp-hpc>



SRP-HPC students and faculty, summer 2022



SRP-HPC mentors/co-mentors

Dan Martin, LBL
SRP thrust lead
for ECP

Keisha Moore, SHI
SRP Program
Coordinator

Two-pronged approach for Intro to HPC

Meet students where they are and provide HPC pathways



Co-Lead: Paige
Kinsley, ALCF



Co-Lead: Jini
Ramprakash, ALCF

- **Direct to students approach:** National labs regional “Intro to HPC” Bootcamp
 - One-week intensive HPC/AI course held by national labs, providing exposure to topics that will enhance applications to graduate programs
 - **Target Audience:** advanced undergrads (juniors and seniors), students in gap years, and early grad students in underrepresented groups
 - **Goal:** Collaboratively develop inclusive curriculum across DOE labs, including hands-on HPC, and make material available for community use
- **Through universities:** Intersect workforce needs with capabilities
 - **Target Audience:** MSI faculty in computing and computational science fields
 - **Goal:** Plan and implement MSI Faculty Curriculum Development Program to build modules on HPC/AI that can be incorporated into current course curricula

Developing project-based curriculum with DOE lab staff and running pilot bootcamp Aug 2023 at NERSC; inviting 2 MSI faculty in summer 2023 to build MSI-national lab curriculum program

Approach: HPC Workforce Development and Retention

- **HPC Workforce Development and Retention (HPC-WDR) Action Group was established in spring 2022. Made up of interested staff from the ECP community and DOE labs**

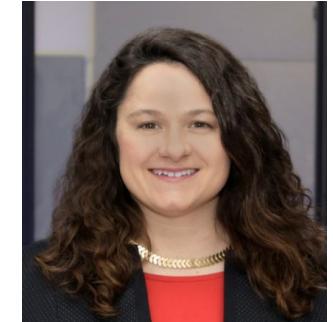
- Foster a community, within the HPC community, who come together on a regular basis to share ideas and best practices and learn from each other
 - Recruit and curate content for 2 key initiatives; develop recommendations and strategies for improvement

- **Leading a webinar series: HPC Workforce Development and Retention**

- Regular webinars (open to all)
 - Topics focus on improving workforce culture (diversity, equity and inclusion)
 - Speakers from DOE labs and broader community
 - Materials from the webinars are curated and archived online

- **Developing a website: Resources for HPC Workforce Development and Retention**

- Curate training, methodologies, best practices, and lessons learned regarding HPC Workforce Development and Retention, thus making resources available online, accessible to the community
 - Version 1.0: <https://hpc-workforce-development-and-retention.github.io/hpc-wdr/>



Lead, Suzanne
Parete-Koon, OLCF



Join the webinars

HPC Workforce Development and Retention Action Group



Amedeo Perazzo
SLAC



Andreas Kronfeld
Fermilab



Anshu Dubey
ANL



Ashley Barker
OLCF



Bob Robey
LANL



Carol Woodard
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Chris Oehmen
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Slaven Peles,
ORNL



Stefan Wild
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Suzanne Parete-Koon
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Terry Turton
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Tom Papatheodore
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Verónica Melesse
Vergara ORNL



Victor Mateevitsi
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Wael Elwasif
ORNL



William Godoy
ORNL



Yasaman Ghadar
ALCF

Promoting Inclusive and Equitable Research: PESO PIER Plan

- Multifaceted approach to advance diversity, equity and inclusion throughout all work in the project, with emphasis on two complementary layers of scope:
 - Activities within the project and
 - Partnerships with others to plan and lead work toward culture change in our community overall
- In both contexts, we will address:
 - **Recruitment and inclusion**, with emphasis on engaging diverse individuals from underrepresented groups as members of our teams and community
 - Cultivating **work environments** that promote mutual respect and professionalism, with emphasis on sharing best practices and effecting culture change
 - Planning for scholarly and **professional growth of community members**, with particular emphasis on research software engineers (RSEs) and early-career staff

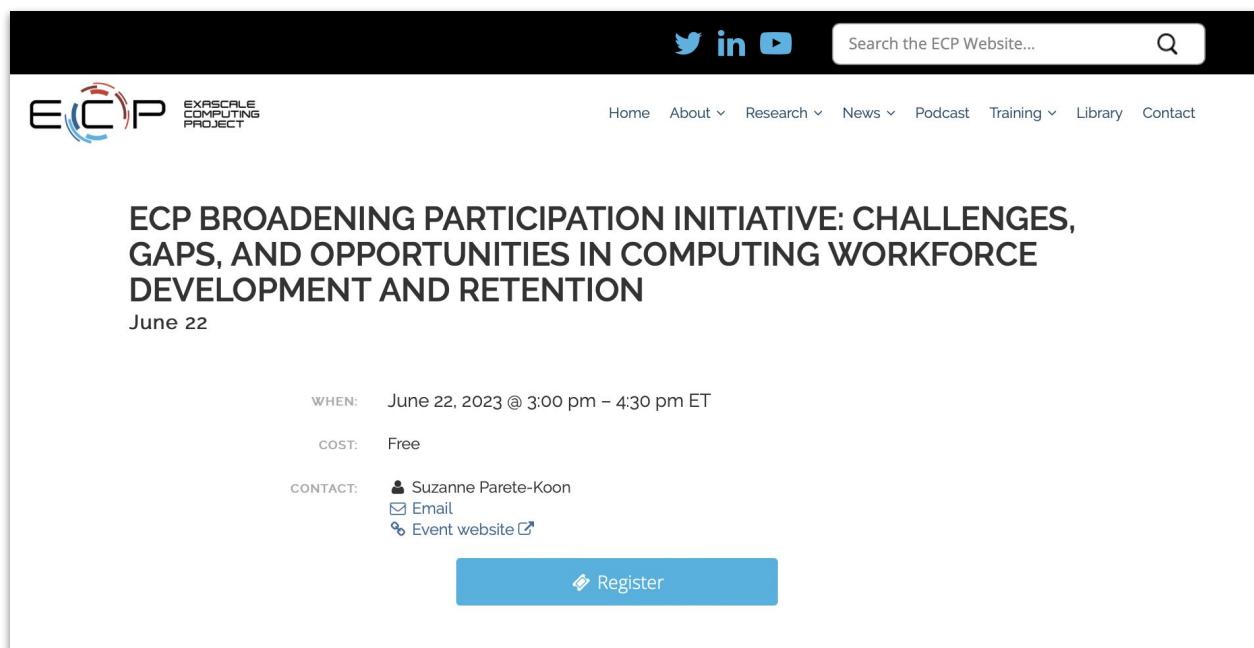
PESO PIER Plan

Collaborate with the ECP Broadening Participation Initiative, other seedling projects, and the broader community to advance diversity, equity and inclusion in the DOE computing sciences workforce, with emphasis on long-term community growth and successes in software sustainment.

- Determine and publish a code of conduct for PESO events and work
- Plan a series of events in spring/summer 2023 to build an understanding of current practices, challenges, gaps, and opportunities to advance DEI in the DOE computing sciences workforce
- **June-July:** Host events and publicly share early information on community experiences, challenges, insights, and highlights of best practices for advancing DEI in the DOE computing sciences workforce, including strategies for mentorship in scientific software projects
- **July-August:** Write a cohesive document that describes challenges, gaps, opportunities, and needs for work to advance DEI in the DOE computing sciences workforce; determine phase-1 goals and metrics to help assess the impact of activities that aim to advance DEI in our community
- **September:** Determine specific plans for multi-year work to address high-priority needs in advancing DEI in the DOE computing sciences workforce, with emphasis on long-term community growth and successes in software sustainment
- **October and beyond:** Execute these plans to address high-priority needs in advancing DEI in the DOE computing sciences workforce; evaluate progress using phase-1 goals and metrics, and refine plans based on enhanced understanding

Community Input on HPC Workforce Issues

- **Goals:**
 - Share information on community experiences, challenges, insights, and highlights of best practices for advancing DEI in the DOE computing sciences workforce, including strategies for mentorship in scientific software projects
 - Build an understanding of challenges, gaps, and opportunities to advance DEI in the DOE computing sciences workforce
 - Summarize in a written document (co-authored by interested members of the community) – all are welcome
- **Recent events**
 - May 18: LSSw Town Hall – Community discussion on workforce issues
 - June 2: Working session: Digest preliminary input, refine questions, draft-1 structure for document, invite additional input
- **Working sessions in June-July**
 - Community input:
<https://bit.ly/hpc-workforce-community-input2023>
 - June 22: Webinar and discussion:
<https://www.exascaleproject.org/event/ecp-challenges/>
 - July TBD: Writeups, feedback, refinement
 - Iterate until completion (by late July)
 - **Outcome: Document summarizing current practices, challenges, gaps, and opportunities to advance DEI in the DOE computing sciences workforce. The document is completely separate from any software sustainment proposals.**



The screenshot shows the ECP website's header with social media icons (Twitter, LinkedIn, YouTube) and a search bar. The main content area features the ECP logo and the title "ECP BROADENING PARTICIPATION INITIATIVE: CHALLENGES, GAPS, AND OPPORTUNITIES IN COMPUTING WORKFORCE DEVELOPMENT AND RETENTION". Below the title, it says "June 22". The event details are listed: "WHEN: June 22, 2023 @ 3:00 pm – 4:30 pm ET", "COST: Free", and "CONTACT: Suzanne Parete-Koon" with links for "Email" and "Event website". A blue "Register" button is at the bottom.

Breakouts

Day 2: Question 9: PESO is committed to workforce development, especially by reaching out to under-represented groups and creating a culture that is inviting, and by promoting the continued training of workforce members and stability of career paths.

- a. **What are the top three workforce challenges or impediments that you see in your organization(s)?**
- b. **What strategies and activities are currently helping to address workforce challenges? Should these be continued?**
- c. **What are the most promising new strategies and activities to address workforce challenges for the future and why?**

Also: Individual input via: <https://bit.ly/hpc-workforce-community-input2023>
And group discussion during webinar on June 22