



Argonne Training Program on Extreme-Scale Computing

Introduction to ATPESC

Ray Loy
ATPESC 2020 Program Director


Slides: Thanks to Marta Garcia, ATPESC 2019 Program Director



Outline

 **Motivation**

 **Overview**

 **Curriculum**

 **Public training materials**

 **Applying for ATPESC 2020**

Motivation for ATPESC

- Today's most **powerful supercomputers** have **complex hardware architectures** and **software environments**
 - and even greater complexity is on the horizon on next-generation and exascale systems
- The **scientific and engineering applications** developed for these systems are themselves **complex**
- There is a **critical need for specialized, in-depth training for the computational scientists** poised to facilitate breakthrough science and engineering using these systems

ATPESC Overview

- Founded by Paul Messina in 2013
- Conceived as a 2-week retreat
- Renowned computer scientists and HPC experts from US national laboratories, universities, and industry serve as lecturers and guide hands-on sessions.
- Target audience: advanced doctoral students, postdocs, and early career computational scientists
- No fee to participate. Domestic travel, meals, and lodging provided.
- Competitive application process reviewed by committee
 - Must have experience in MPI and/or OpenMP
 - Experience with at least one HPC system
 - Concrete plans to conduct CSE research on large-scale computers

ATPESC Website

extremecomputingtraining.anl.gov

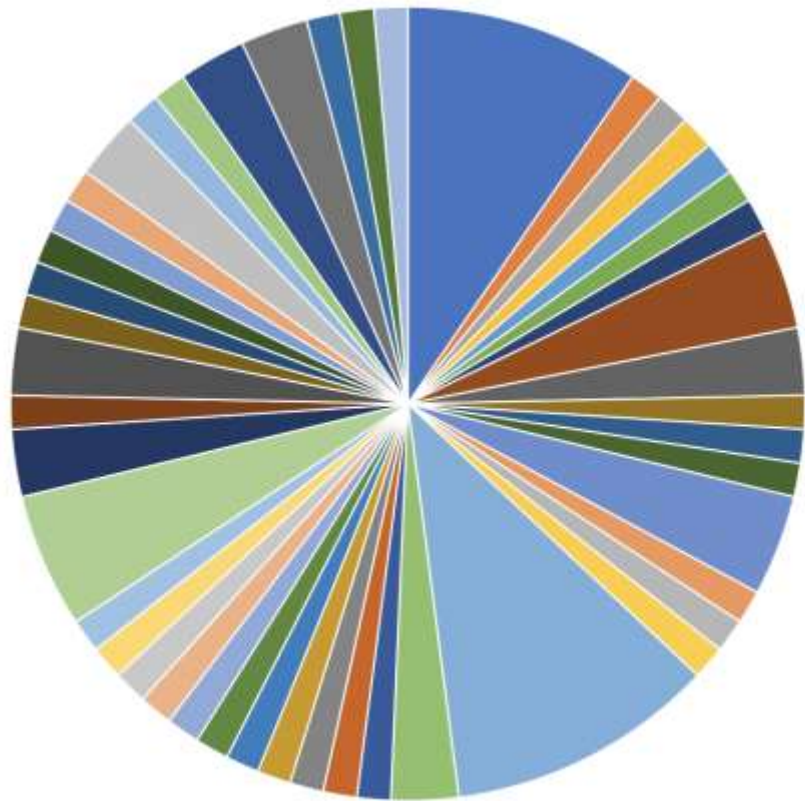


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ATPESC 2019

73 Attendees from
49 Institutions

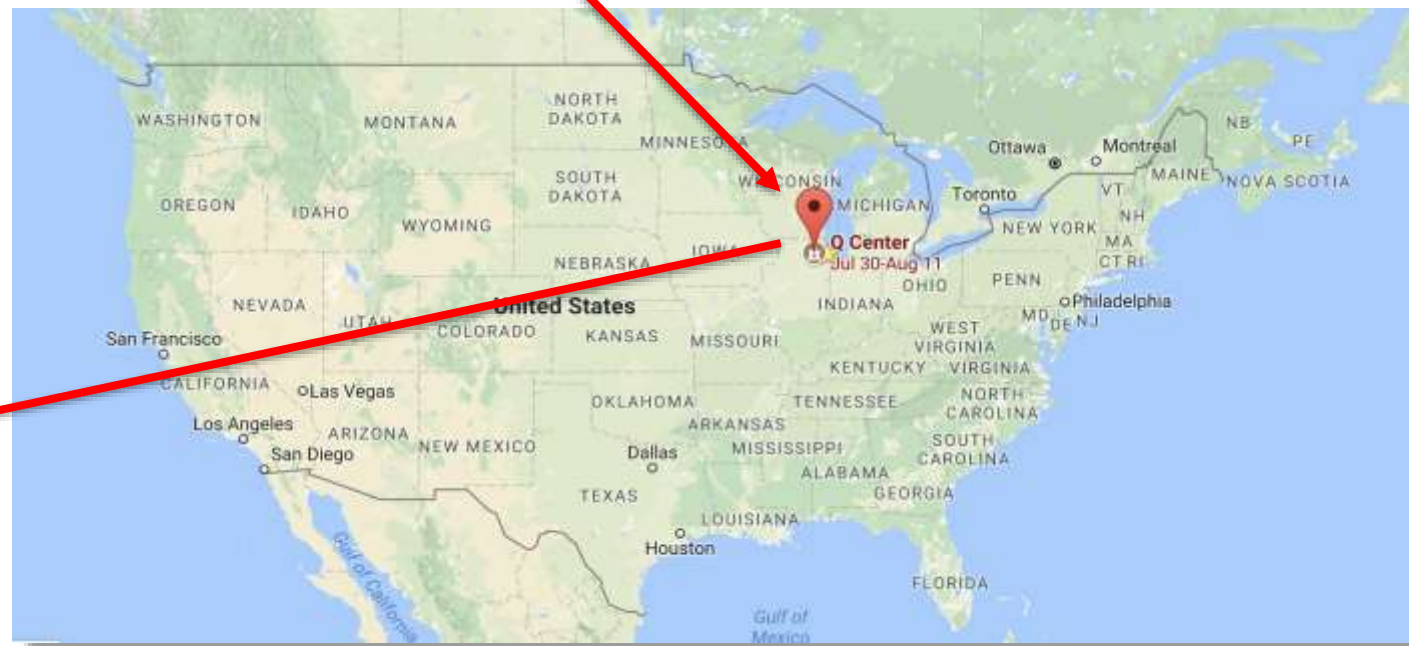
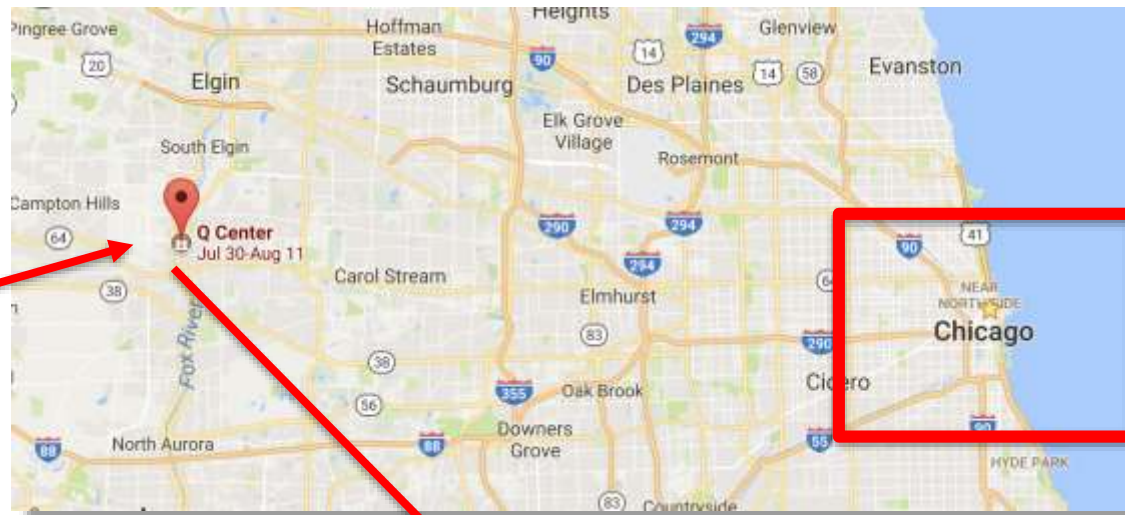


- Argonne National Laboratory
- Brookhaven National Laboratory
- CEA, Saclay
- Duke University
- Georgia Institute of Technology
- Illinois State University
- Iowa State University
- IT4Innovations National Supercomputing Center, VSB - TU Ostrava
- Lawrence Berkeley National Laboratory
- Los Alamos National Laboratory
- Massachusetts Institute of Technology
- NASA
- Naval Nuclear Laboratory
- Politecnico di Milano
- Rensselaer Polytechnic Institute
- Stanford University
- Texas A&M University
- The University of North Carolina at Chapel Hill
- University of California, Berkeley
- University of Cambridge
- University of Colorado Boulder
- University of Illinois at Urbana-Champaign
- University of Michigan
- University of Minnesota
- University of Washington
- BP America Inc.
- Brown University
- Courant Institute of Mathematical Science
- Fermi National Accelerator Laboratory
- Harvard University
- Instituto de Astrofísica de Canarias
- ISAE-SUPAERO
- King's College London
- Lawrence Livermore National Laboratory
- Marquette University
- Michigan State University
- National Renewable Energy Laboratory
- Northwestern University
- Queen Mary University of London
- SLAC National Accelerator Laboratory
- Technical University of Munich
- The Ohio State University
- University of Tennessee
- University of California, Irvine
- University of Cambridge
- University of Delaware
- University of Illinois at Urbana-Champaign
- University of Michigan
- University of Southern California

ATPESC 2019 Venue



Q Center



Curriculum Tracks and their leaders (*over 100 hours of content*)

- **Track 1: Hardware Architectures** – Pete Beckman
- **Track 2: Programming Models and Languages** – Rajeev Thakur and Yanfei Guo
- **Track 3: Data-intensive Computing and I/O** – Rob Latham and Phil Carns
- **Track 4: Visualization and Data Analysis** – Mike Papka and Joseph Insley
- **Track 5: Numerical Algorithms and Software for Extreme-Scale Science** – Lois McInnes and Mark Miller
- **Track 6: Performance Tools and Debuggers**– Ray Loy and JaeHyuk Kwack
- **Track 7: Software Engineering** – Anshu Dubey and Katherine Riley
- **Track 8: Machine Learning and Deep Learning for Science** – Venkatram Vishwanath and Prasanna Balaprakash

ATPESC 2019 Lecturers

- Corey Adams – Argonne National Laboratory (<https://www.anl.gov>)
- Yuri Alexeev – Argonne National Laboratory (<https://www.anl.gov>)
- Ann Almgren – Lawrence Berkeley National Laboratory (<https://www.lbl.gov>)
- Dener Alp – Argonne National Laboratory (<https://www.anl.gov>)
- Rommie Amaro – University of California San Diego (<https://ucsd.edu>)
- Jonathan Baker – The University of Chicago (<https://www.uchicago.edu>)
- Prasanna Balaprakash – Argonne National Laboratory (<https://www.anl.gov>)
- Reuben Budiardja – Oak Ridge National Laboratory (<https://www.ornl.gov>)
- Philip Carns – Argonne National Laboratory (<https://www.anl.gov>)
- David DeMarle – Kitware Inc (<https://www.kitware.com>)
- James Demmel – University of California, Berkeley (<https://www.berkeley.edu>)
- Jack Dongarra – The University of Tennessee Knoxville (<https://www.utk.edu>)
- Anshu Dubey – Argonne National Laboratory (<https://www.anl.gov>)
- Murali Krishna Emani – Argonne National Laboratory (<https://www.anl.gov>)
- Ian Foster – Argonne National Laboratory (<https://www.anl.gov>)
- Christian Glusa – Sandia National Laboratories (<https://www.sandia.gov>)
- Yanfei Guo – Argonne National Laboratory (<https://www.anl.gov>)
- Simon Hammond – Sandia National Laboratories (<https://www.sandia.gov>)
- Cyrus Harrison – Lawrence Livermore National Laboratory (<https://www.llnl.gov/>)
- Katrin Heitmann – Argonne National Laboratory (<https://www.anl.gov>)
- Richard Hornung – Lawrence Livermore National Laboratory (<https://www.llnl.gov/>)
- Jonathan Hu – Sandia National Laboratories (<https://www.sandia.gov>)
- Ryan Hulguin – ARM (<https://www.arm.com>)
- Joseph Insley – Argonne National Laboratory (<https://www.anl.gov>)
- Mark Jackels – DreamWorks Animation (<https://www.dreamworks.com>)
- Elise Jennings – Argonne National Laboratory (<https://www.anl.gov>)
- Egor Kazachkov – Intel (<https://www.intel.com>)
- David Keyes – KAUST (<https://www.kaust.edu.sa>)
- Sami Khairy – Argonne National Laboratory (<https://www.anl.gov>)
- Quincey Koziol – Lawrence Berkeley National Laboratory (<https://www.lbl.gov>)
- Robert Latham – Argonne National Laboratory (<https://www.anl.gov>)
- John Levesque – Cray Inc (<https://www.cray.com>)
- Glenn Lockwood – Lawrence Berkeley National Laboratory (<https://www.lbl.gov>)
- Ray Loy – Argonne National Laboratory (<https://www.anl.gov>)

Bethany Lusch – Argonne National Laboratory (<https://www.anl.gov>)
Tanwi Mallick – Argonne National Laboratory (<https://www.anl.gov>)
Tim Mattson – Intel (<https://www.intel.com>)
Lois McInnes – Argonne National Laboratory (<https://www.anl.gov>)
John Mellor-Crummey – Rice University (<https://www.rice.edu>)
Papka Michael – Argonne National Laboratory (<https://www.anl.gov>) / Northern Illinois University (<https://www.niu.edu>)
Mark Miller – Lawrence Livermore National Laboratory (<https://www.llnl.gov/>)
James Moawad – Intel (<https://www.intel.com>)
Gregory Nash – Intel NCLG (<https://www.intel.com>)
Jared O’Neal – Argonne National Laboratory (<https://www.anl.gov>)
Scott Parker – Argonne National Laboratory (<https://www.anl.gov>)
Nikolay Piskun – Rogue Wave (<https://www.roguewave.com/>)
Howard Pritchard – Los Alamos National Laboratory (<https://www.lanl.gov>)
Kenneth Raffenetti – Argonne National Laboratory (<https://www.anl.gov>)
Daniel Reynolds – Southern Methodist University (<https://www.smu.edu>)
Katherine Riley – Argonne National Laboratory (<https://www.anl.gov>)
Silvio Rizzi – Argonne National Laboratory (<https://www.anl.gov>)
Michael Salim – Argonne National Laboratory (<https://www.anl.gov>)
Robert Schreiber – Cerebras Systems (<https://www.cerebras.net>)
Sameer Shende – University of Oregon (<https://www.uoregon.edu>)
Yunong Shi – The University of Chicago (<https://www.uchicago.edu>)
Barry Smith – Argonne National Laboratory (<https://www.anl.gov>)
John Stone – University of Illinois at Urbana-Champaign (<https://illinois.edu>)
Michela Taufer – The University of Tennessee Knoxville (<https://www.utk.edu>)
Rajeev Thakur – Argonne National Laboratory (<https://www.anl.gov>)
Christian Trott – Sandia National Laboratories (<https://www.sandia.gov>)
Arturo Vargas – Lawrence Livermore National Laboratory (<https://www.llnl.gov/>)
Álvaro Vázquez Mayagoitia – Argonne National Laboratory (<https://www.anl.gov>)
Paullius Velesko – Intel (<https://www.intel.com>)
Jeffrey Vetter – Oak Ridge National Laboratory (<https://www.ornl.gov>)
Donald Willcox – Lawrence Berkeley National Laboratory (<https://www.lbl.gov>)
James Willenbring – Sandia National Laboratories (<https://www.sandia.gov>)
Huihuo Zheng – Argonne National Laboratory (<https://www.anl.gov>)

...Plus reviewers, admin staff, etc (>100 total)

Example: Performance Tools and Debuggers Track

- [Introduction to Track: Performance Tools and Debuggers](#)
- [Presentation: Debugging and Profiling HPC Applications](#) (Ryan Hulguin, ARM)
- [Presentation: Techniques for Debugging HPC Applications](#) (Nikolay Piskun, Rogue Wave)
- [Hands-on: Debugging](#)
- [Presentation: Preparing an application for Hybrid Supercomputing using Cray's Tool Suite](#) (John Levesque, Cray)
- [Hands-on: Cray Tools](#)
- [Presentation: Gaining Insight into Parallel Program Performance with HPCToolkit](#) (John Mellor-Crummey, Rice Univ)
- [Presentation: TAU Performance System](#) (Sameer Shende, Univ of Oregon/Paratools Inc)
- [Hands-on: HPCToolkit, TAU](#)
- [Presentation: Profiling your application with Intel Vtune Amplifier](#) (Paulius Veleško, Intel)
- [Presentation: Intel Advisor and Roofline Model](#) [Hands-on: Intel Tools](#) (Egor Kazachov, Intel)
- [Dinner and Speaker]
- [Hands-on: Performance Tools and Debuggers](#)


ATPESC Computing Resources

The screenshot shows the 'User Facilities' page on the science.energy.gov website. The page is titled 'User Facilities at a Glance' and lists several national scientific user facilities. The facilities listed are:

- Argonne Leadership Computing Facility (ALCF)** at Argonne National Laboratory. The ALCF provides the computational science community with a world-class computing capability dedicated to breakthrough science and engineering.
- Energy Sciences Network (ESnet)** at Lawrence Berkeley National Laboratory. The ESnet is a high-speed network serving thousands of Department of Energy researchers and collaborators worldwide.
- National Energy Research Scientific Computing Center (NERSC)** at Lawrence Berkeley National Laboratory. The NERSC is the mission high performance computing facility for the Department of Energy's Office of Science, and is a world leader in accelerating scientific discovery through computation.
- Oak Ridge Leadership Computing Facility (OLCF)** at Oak Ridge National Laboratory. The OLCF provides the computational science community with world-class computing capability dedicated to breakthrough science and engineering.

The page also includes a sidebar with navigation links for 'All User Facilities', 'ASCR User Facilities', 'BES User Facilities', 'BER User Facilities', 'FES User Facilities', 'HEP User Facilities', and 'NP User Facilities'. There is also a 'CONTACT INFORMATION' section for the Office of Science.

 **ALCF** – Mira, Cetus, Vesta, Cooley, and Theta

 **ANL JLSE** – testbed systems

 **NERSC** – Cori

 **OLCF** – Summit

Source: <https://science.energy.gov/user-facilities/user-facilities-at-a-glance/ascr/>

ATPESC 2019 Dinner Speakers



Rommie Amaro
UC San Diego



Rob Schreiber
Cerebras



Mark Miller
LLNL



Jeffrey Vetter
ORNL



Katrin Heitmann
ANL



Ian Foster
ANL



Michela Taufer
ACM



Mark Jackels
DreamWorks



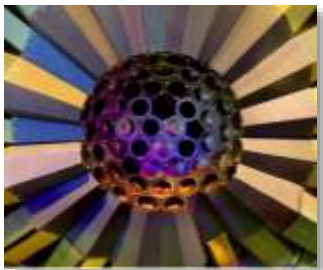
Yuri Alexeev
ANL

Argonne National Laboratory Tour



The Argonne Leadership Computing Facility (ALCF) is one half of the U.S. Department of Energy's (DOE) Leadership Computing Facility, which deploys two diverse high-performance computer architectures that are 10 to 100 times more powerful than typical research computing.

The Advanced Photon Source (APS) is one of the most technologically complex machines in the world. The APS provides the brightest high-energy X-ray beams in the Western Hemisphere to more than 6,000 scientists each year from every U.S. state, the District of Columbia, Puerto Rico, and countries in the world.



The Argonne Tandem Linac Accelerator System (ATLAS) is the world's first ion accelerator using superconducting devices for the energy gain. It is capable of accelerating ions of all elements, both stable and radioactive, from hydrogen to uranium for research into the properties of the nucleus, the core of matter, the fuel of stars.


The Nuclear Energy Exhibition Hall (NEE) showcases Argonne's rich heritage in the development of nuclear reactors and its current role in the development of next-generation reactors and fuel cycle technologies.

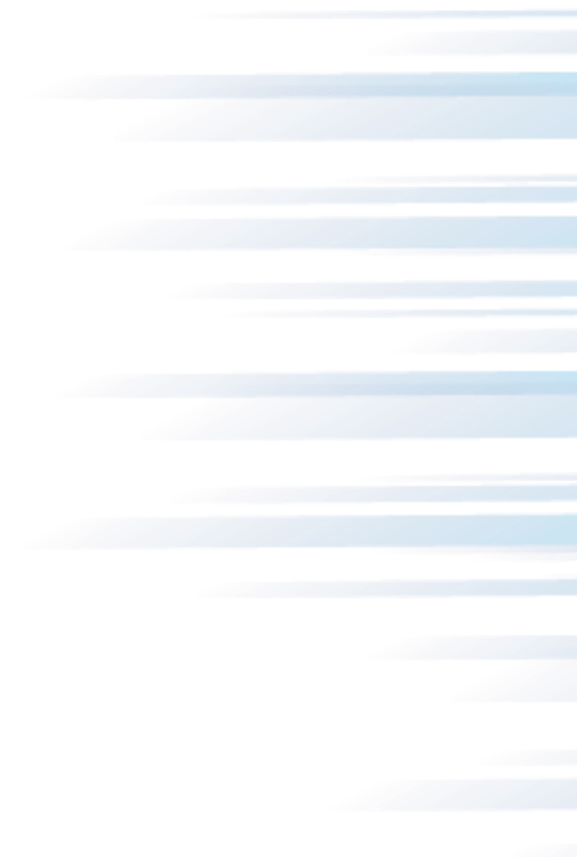


Goals for Attendees

 **Exposure to New ideas**

 **Take advantage of ATPESC Resources**

 **Talk F2F with Lecturers, other Participants, Support**



ATPESC Public Deliverables

- **Presentations**

The slides of the Lectures and Dinner talks are linked off the Agenda

- **Videos**

The videos of the Lectures will be available in September on the Argonne Youtube Channel and also linked from the ATPESC website

<https://www.youtube.com/user/ArgonneNationalLab>

- **Audio-only files**



MP3 audio files of the Lectures (2017-2019) will be available in September on the ATPESC website

<https://extremecomputingtraining.anl.gov>

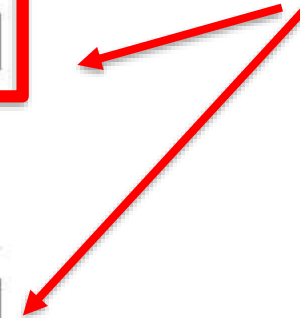
NEW!

Slides and Videos linked from ATPESC agenda

<https://extremecomputingtraining.anl.gov/agenda-2019/>

	Filter by track ▾	Filter by location ▾	Filter by days ▾
July 28, 2019			
2:00 pm - 4:00 pm	On-site Check-in Entrance 4 Lobby / Room D L202		More info >
4:00 pm - 4:30 pm	Presentation: Introduction to the ATPESC St. Charles Amphitheater  Marta García Martínez, ANL		More info >
4:30 pm - 5:30 pm	Presentation: Quick Start on ATPESC Computing Resources St. Charles Amphitheater  Ray Loy, ANL		More info >

Click here:
"More info"



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Presentation: Introduction to the ATPESC



Click here



LOCATION: **St. Charles Amphitheater**

DATE: **July 28, 2019**

TIME: **4:00 pm - 4:30 pm**



MARTA GARCIA MARTINEZ, ANL



Acknowledgments

Exascale Computing Project



EXASCALE COMPUTING PROJECT

Website: <https://exascaleproject.org>

This training and research was supported by the Exascale Computing Project (17-SC-20-SC), a collaborative effort of the U.S. Department of Energy Office of Science and the National Nuclear Security Administration.

ATPESC 2020

- If you or an associate is interested in attending
 - Subscribe to mailing list <https://extremecomputingtraining.anl.gov> (bottom of page)
 - Call for applications usually opens in early January
 - *Read the application instructions carefully*
 - Statement of Purpose and Letter of Recommendation should address how the candidate meets the prerequisites *in detail*.

The future... Aurora Exascale System

