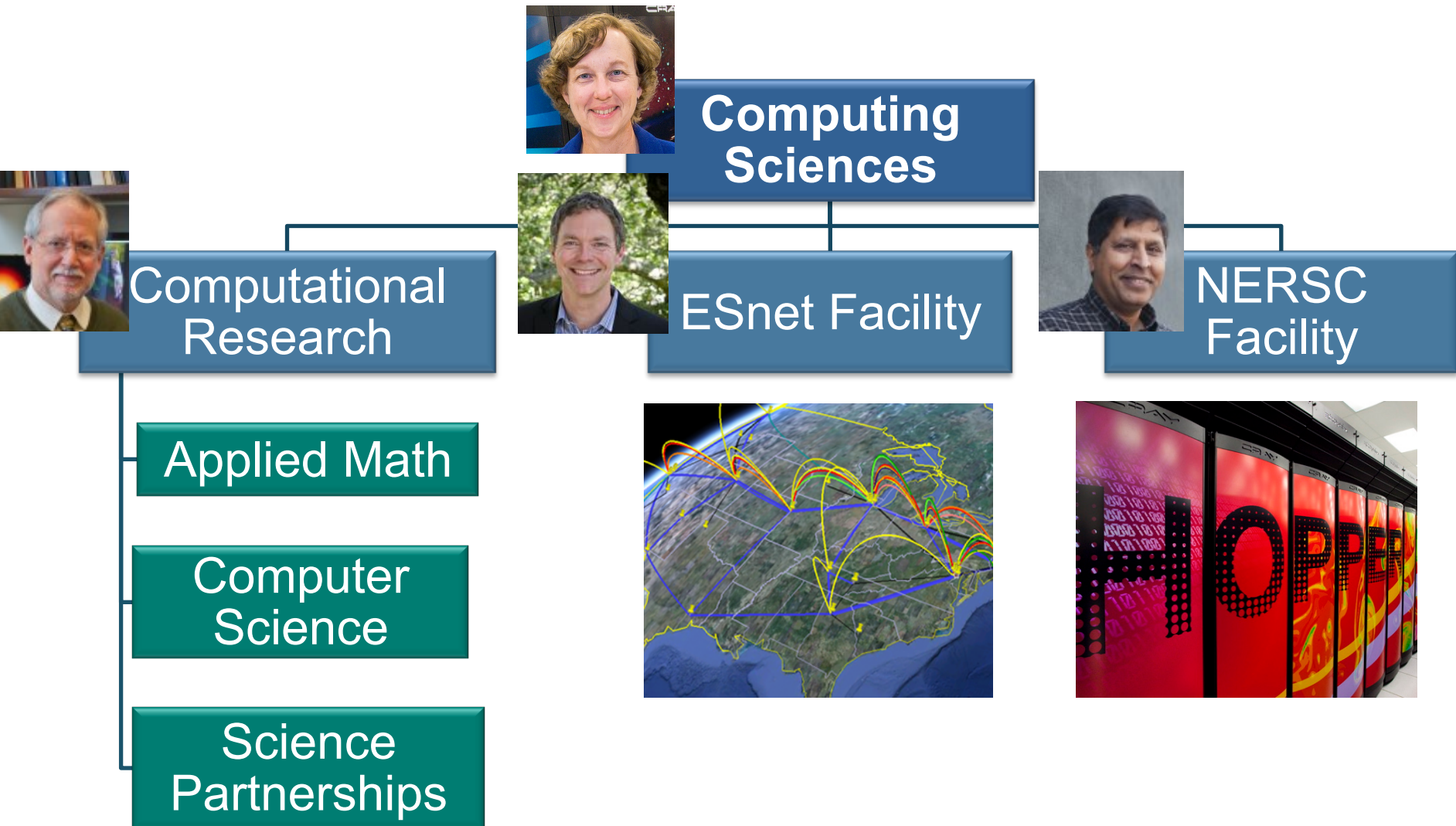# The Science in CRT

Kathy Yelick
Associate Laboratory Director
for Computing Sciences
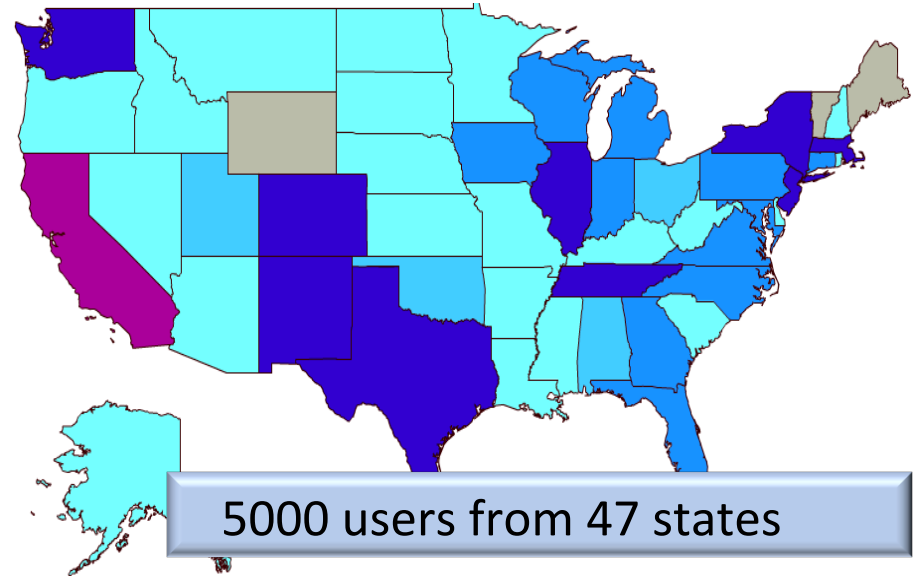
Computing Sciences at Berkeley Lab

The National Energy Research Scientific Computing Center Enables Science

5000 users from 47 states

1900+ publications per year

Petaflop and Petabyte systems for science

U.S. DEPARTMENT OF **ENERGY** | Office of Science

BERKELEY LAB
Lawrence Berkeley National Laboratory

Open Science at NERSC

my.nersc.gov/nowcomputing-cs.php

"Saving the World" at NERSC

Efficiency

Solar PV

Combustion

Climate Modeling

Energy Storage

Biofuels

Carbon Capture & Sequestration

Artificial Photosynthesis

"Saving the World" at NERSC

Materials for Efficient Lighting

Materials for Solar PV

Optimized Combustion Burners

Climate Modeling for Analyzing Impacts

Metagenomics for BioFuels

Chemistry for Catalysis in Batteries

Flows through Porous Media for Carbon Capture and Sequestration
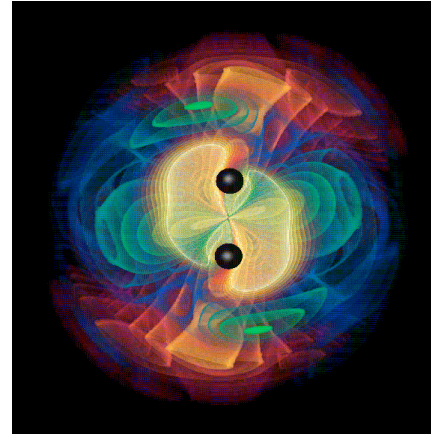
Quantum Dynamics of Photosynthesis

Using Computers for Science and Engineering

Computers are used to understand things that are:
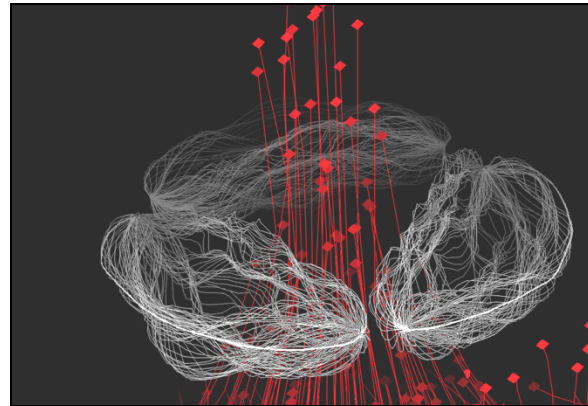
- **too big**
- **too small**
- **too fast**
- **too slow**
- **too expensive or**
- **too dangerous**

for experiments

Black holes

Diseases

Blood flow in the heart

Climate change

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BERKELEY LAB
Lawrence Berkeley National Laboratory
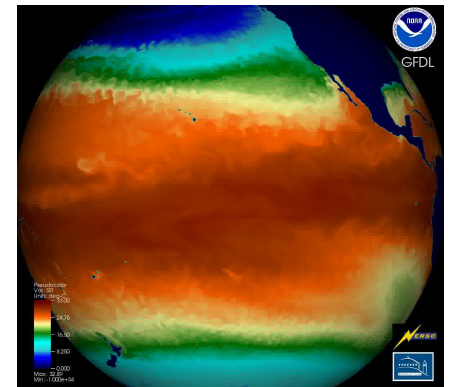
The ~~"Third Pillar"~~ of Science
"Four Paradigms"

Theory

Experiment

Simulation

Data analysis

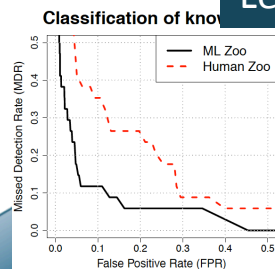# Faster Computers: More Detail and better solutions

200 Km

01/30/1979
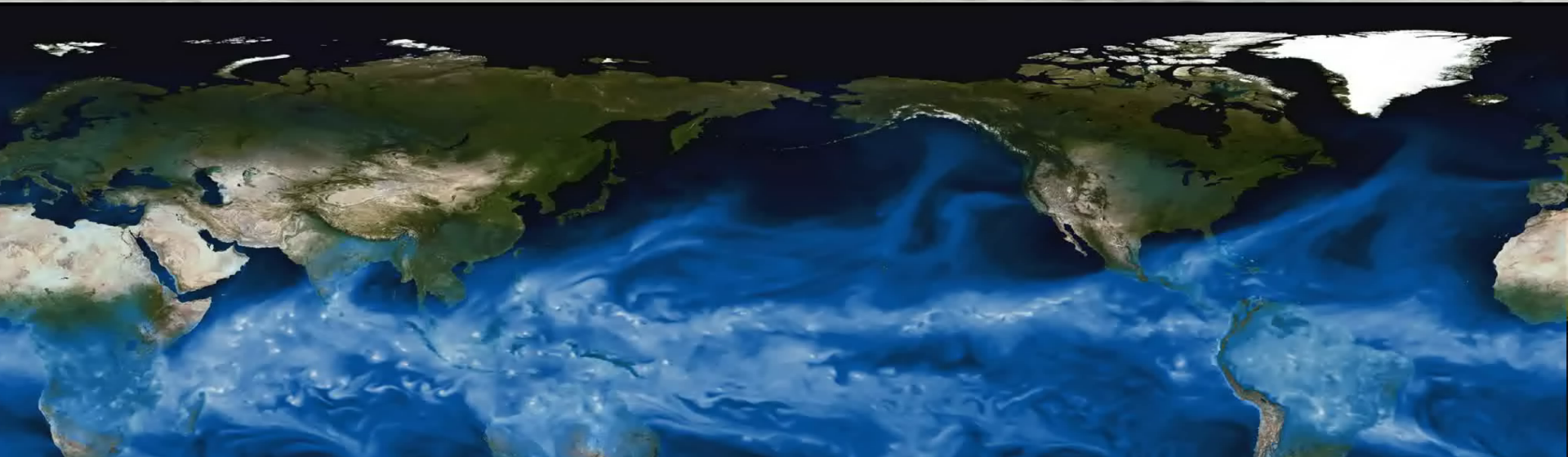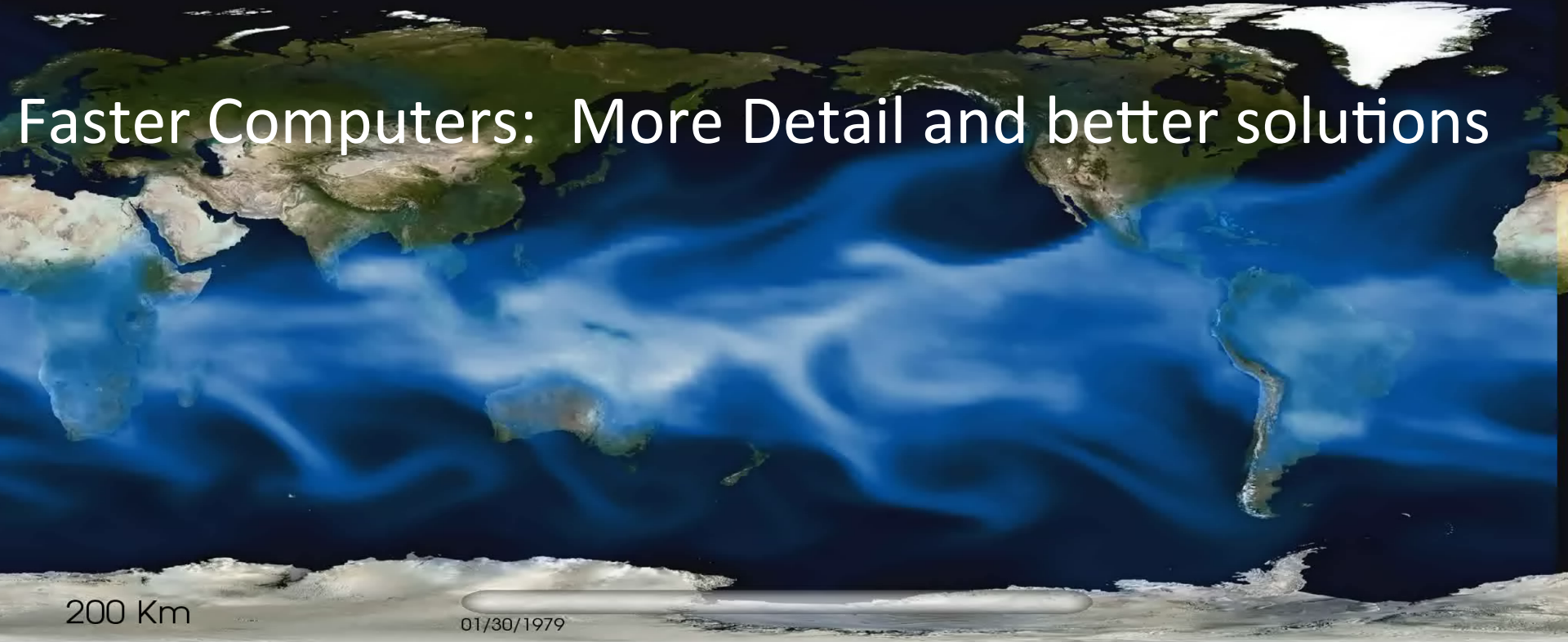
Michael Wehner, Prabhat, Chris Algieri, Fuyu Li, Bill Collins, Lawrence Berkeley National Laboratory; Kevin Reed, University of Michigan; Andrew Gettelman, Julio Bacmeister, Richard Neale, National Center for Atmospheric Research

Big Data in Astrophysics

Graphical models

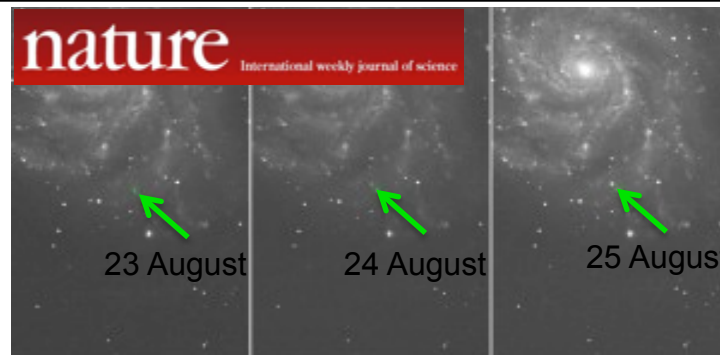Machine Learning

New simulation models and AMR code (Nyx)

Crowd sourced

Example: Astrophysicists discover early nearby supernova

Filtered

GB per night Manually analyzed

23 August   24 August   25 August

Computational Research and Theory (CRT) Facility will house Computing Sciences

- **Four story, 140,000 GSF**
  - 300 offices in collaborative office setting (2 20Ksf floors)
  - $124.9M UC Building, $19.9M DOE computing infrastructure
  - 20K -> 29Ksf HPC floor
- **Energy efficient**
  - Year-round free air and water cooling
  - PUE < 1.1
  - LEED Gold design
- **42MW to building**
  - 12.5MW provisioned
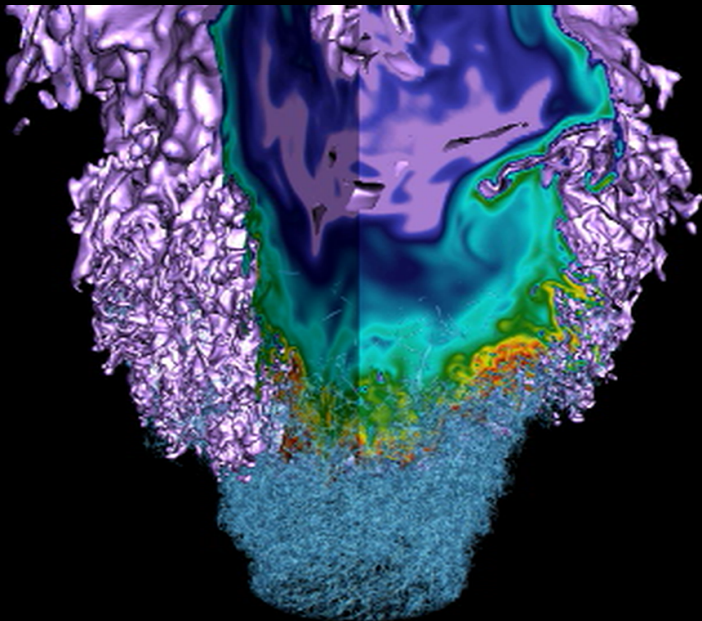 - Low cost WAPA power
- **Occupancy Spring 2015**

Location Supports Collaborations with Researchers and Networking

CRT Facility

Computer Science

CSE graduate program office

Mathematics
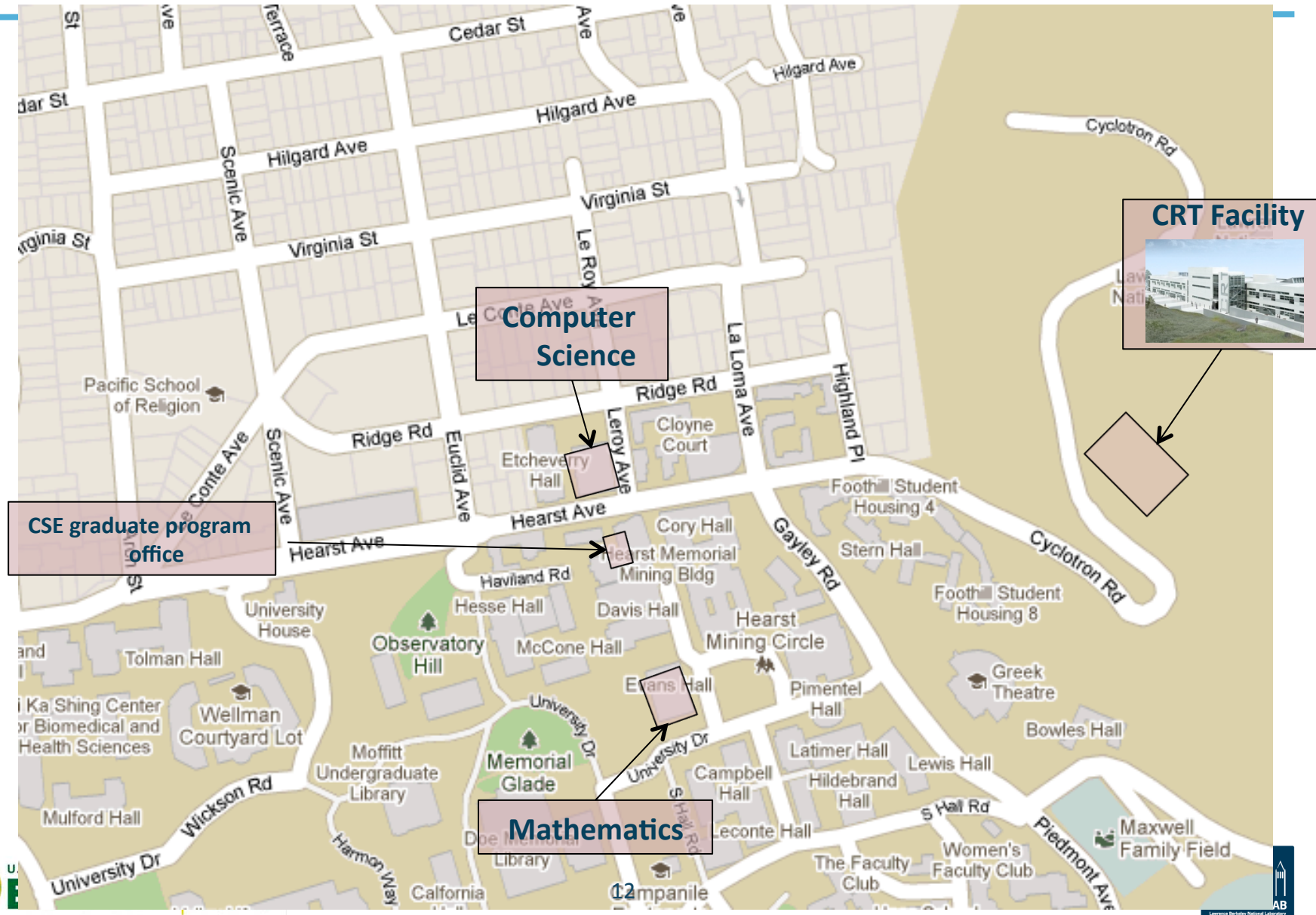
Math theory: low Mach formulation model for combustion
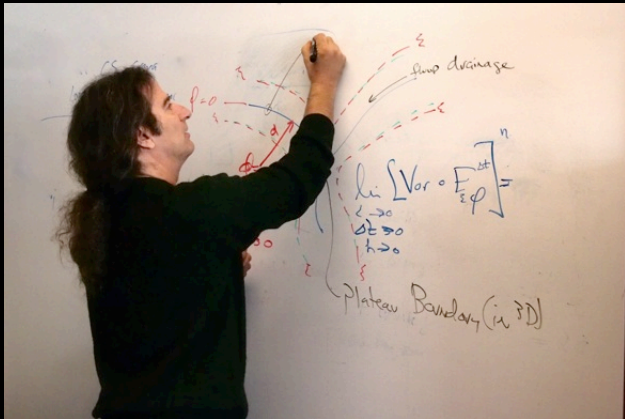
Computational science: AMR

Simulations reveal features not visible in lab,
resulting in improved designs

Experiments demonstrate feasibility

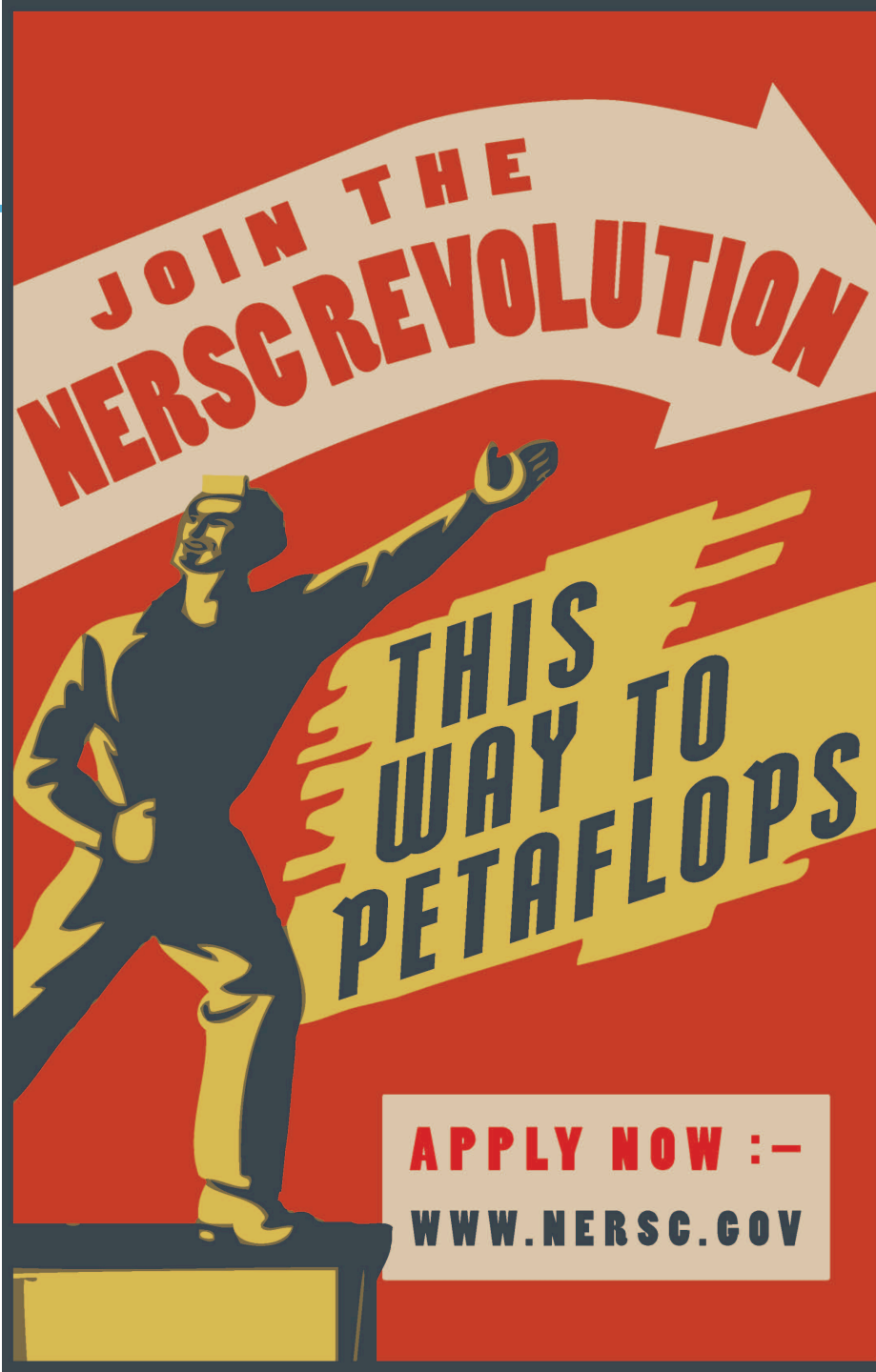*End Result: low-emission, high-efficiency burner technology licensed by industry*
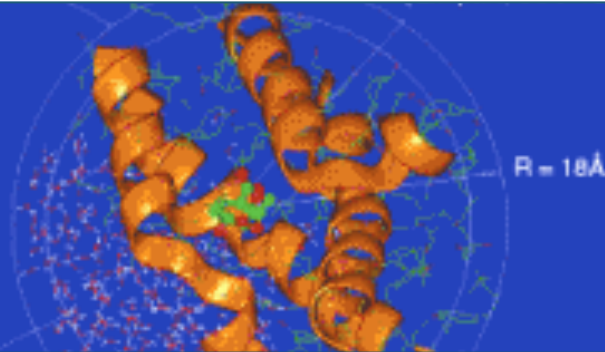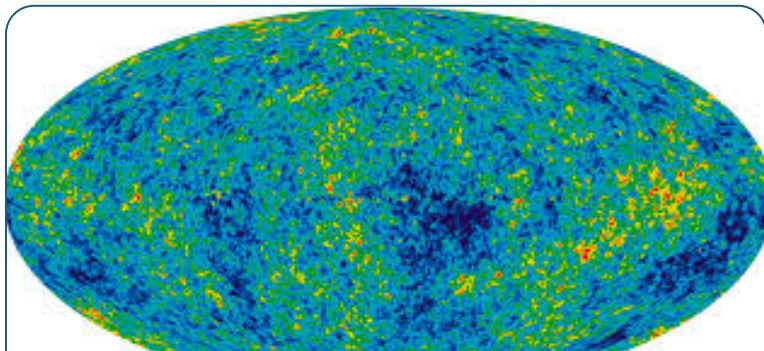
Providing "Petaflops" to the People

Nobels at NERSC

John Kuriyan for
Martin Karplus

Saul Perlmutter

George Smoot

Warren Washington