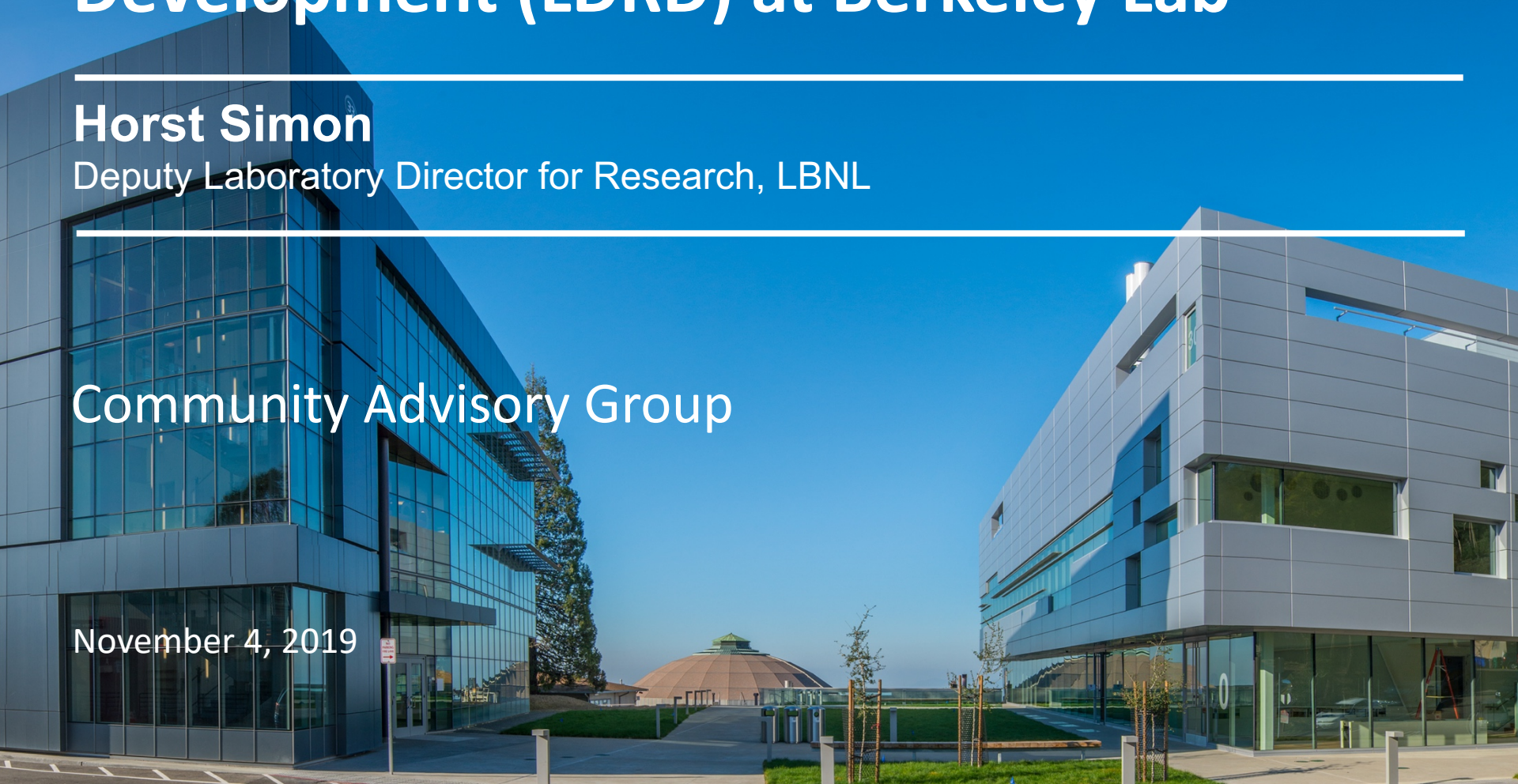# Laboratory Directed Research and Development (LDRD) at Berkeley Lab
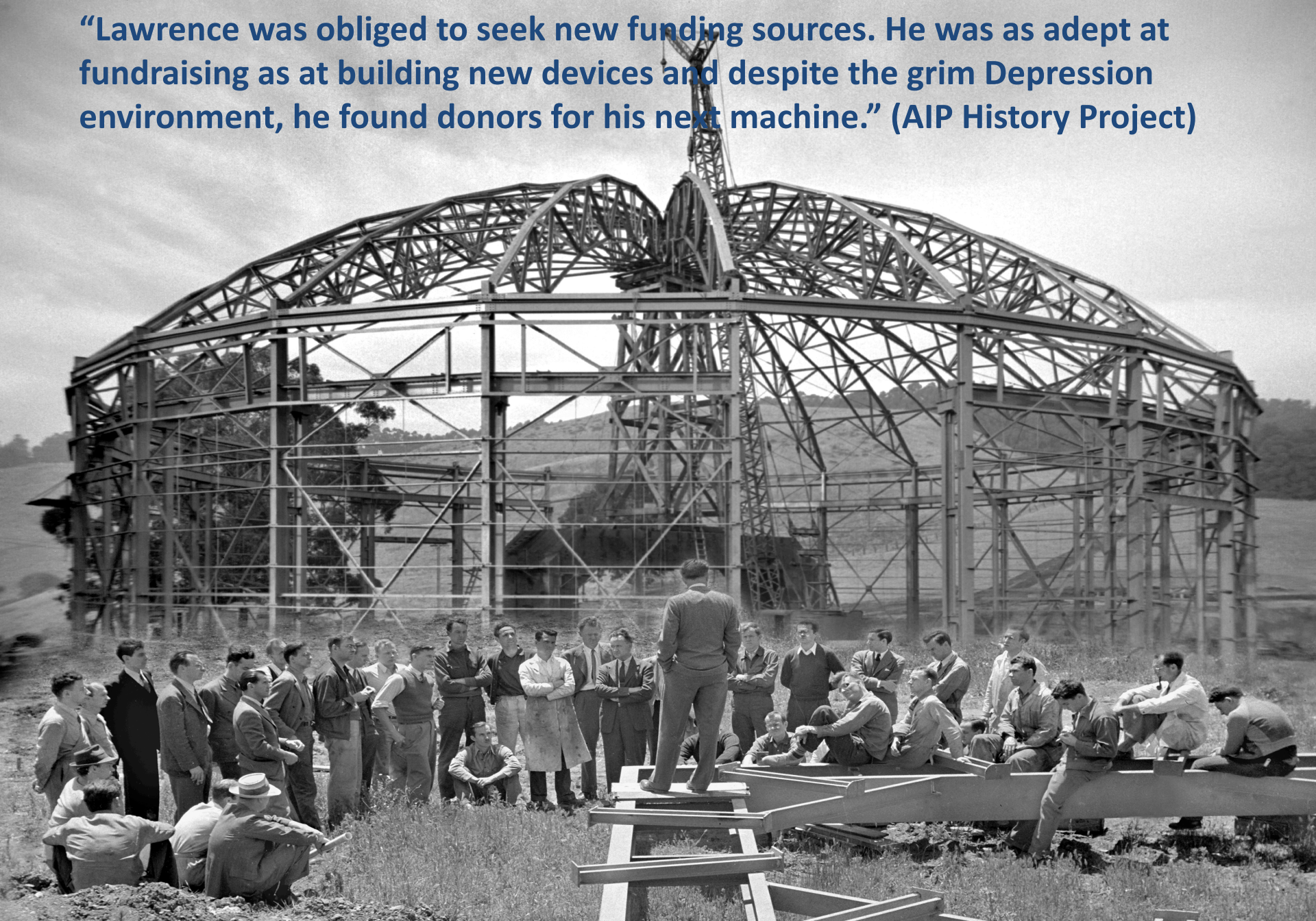
Horst Simon
Deputy Laboratory Director for Research, LBNL
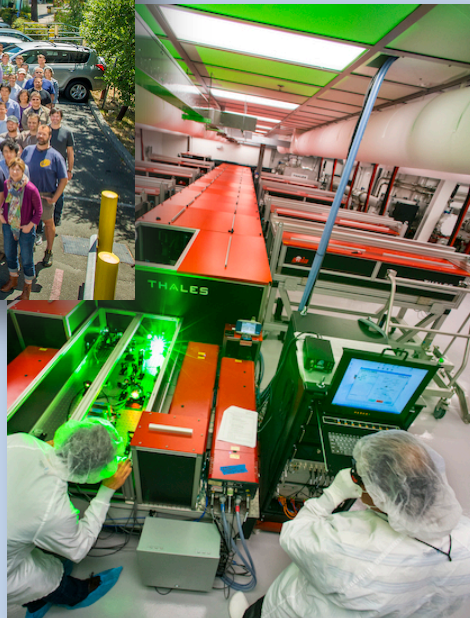
Community Advisory Group

November 4, 2019

"Lawrence was obliged to seek new funding sources. He was as adept at fundraising as at building new devices and despite the grim Depression environment, he found donors for his next machine." (AIP History Project)

LDRD at National Labs

**Fosters science and innovation
Strengthens S&T workforce**

**DOE Order 413.2B
Establishes and Sets Guidelines
for LDRD**

LDRD: High Impact, Innovative Science

- Advanced study of *hypotheses, concepts, or innovative approaches* to scientific or technical problems

- Experiments and analyses directed toward *proof-of-principle* or early determination of the utility of new scientific ideas, technical concepts, or devices

- Conception and preliminary *technical analysis* of experimental facilities or devices

- Support *high risk, high value* projects

LDRD Funds Award Winning Science from the Ground Level

Saul Perlmutter wins 2011 Nobel Prize for Discovery of Accelerating Universe

Postdocs hired by George Smoot and Perlmutter for their 1990s LDRDs are now leading the Computational Cosmology Center (Nugent, Borrill)

LDRD: Three Categories at Berkeley Lab
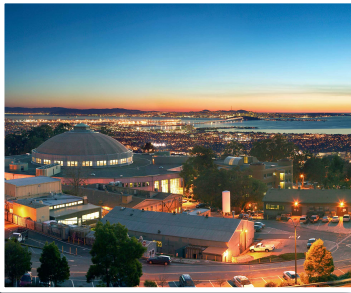
Labwide Initiatives: Foster the development of new teams and activities in fields that directly support the *high level strategic goals* of the laboratory
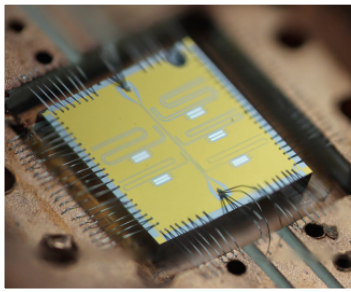
Area Initiatives: Introduce *new research activities* in one of the six areas of the lab

Early Career: Develop the *future scientific workforce* at the laboratory and prepare early career PIs for a successful scientific career

Lab-wide and LDRD Strategic Research Initiatives 2018-19

Lab-wide Initiatives:

- Electron Microscopy

- Microbes to Biomes/BioEPIC Science

- Quantum Information Systems

LDRD 2020 Lab-wide Initiatives:

- Energy Efficient Microelectronics and Computing Architectures for Beyond Moore's Law

- Genetically Encoded Composites

- Machine Learning for Science

- Solid State Energy Storage

- Water-Energy Resilience

- Early Career LDRD track

Today's Berkeley Lab is the result of strategic use of LDRD. We use LDRD to:

Initiate new capabilities

BERKELEY LAB MOLECULAR FOUNDRY · JBEI · CAMERA Applied Math

Reduce technical risk for major projects

LZ · ALS-U · CMB-S4 Next Generation CMB Experiment

Integrate across programs

Machine Learning for Science

Develop scientific leaders for the future

2019 Early Career LDRD cohort

U.S. DEPARTMENT OF ENERGY | Office of Science

BERKELEY LAB

Machine Learning for Science

Over 100 projects at the Lab are using or developing machine learning.

Lab LDRD Initiative   Summer School   "Data" Conference   Website: https://ml4sci.lbl.gov

Scalable Dimensionality Reduction for Interpretable Feature Extraction from Noisy Data

John Wu (CRD), Jonathan Ajo-Franklin (EGD), Michael Mahoney (EECS/UCB)

- ## Project Objective

  - Enhance interpretability of learning algorithms
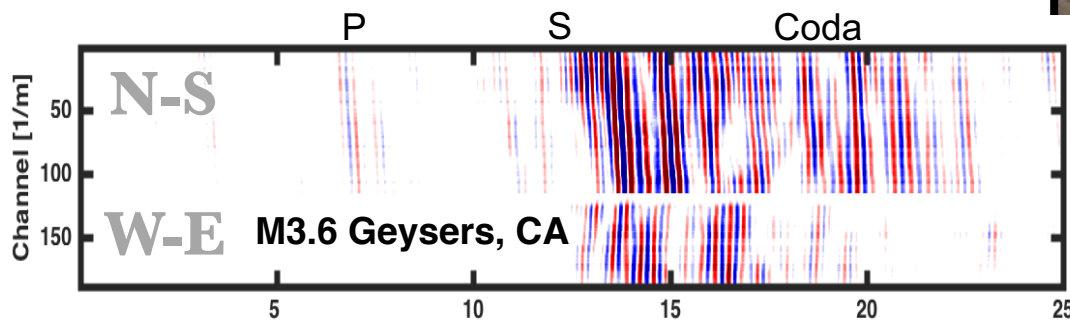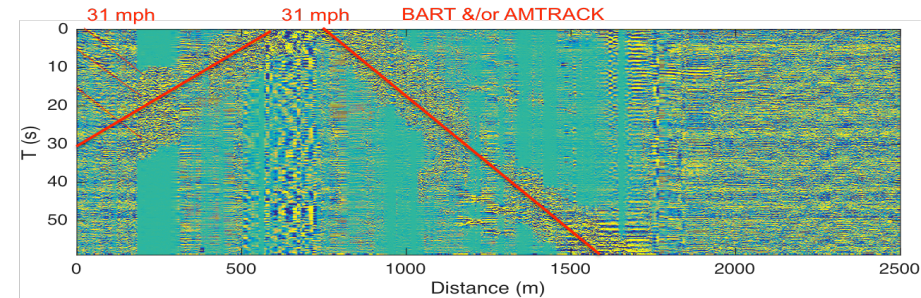 - Develop more efficient learning algorithms for large applications

- ## Overview of Approach

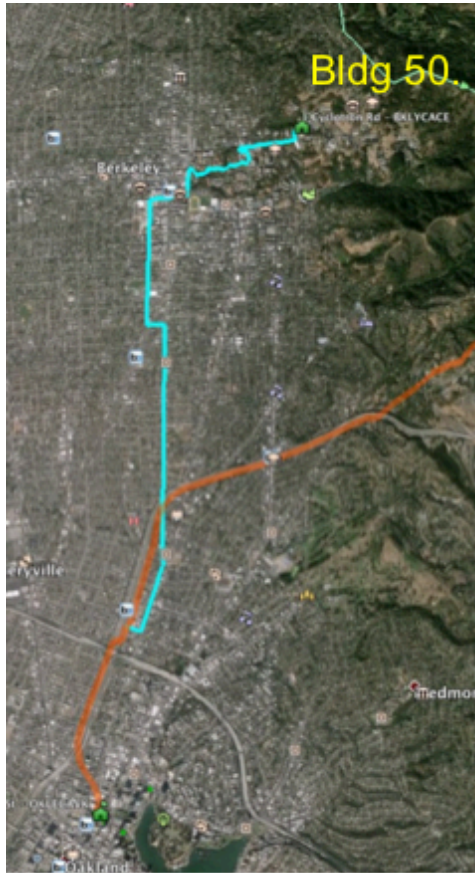 - Employ statistical mechanics to improve interpretability of learning procedures
  - Accelerate the convergence of optimization in learning algorithms
  - Scale algorithms on HPC systems for large data analysis

- ## Impact of Project
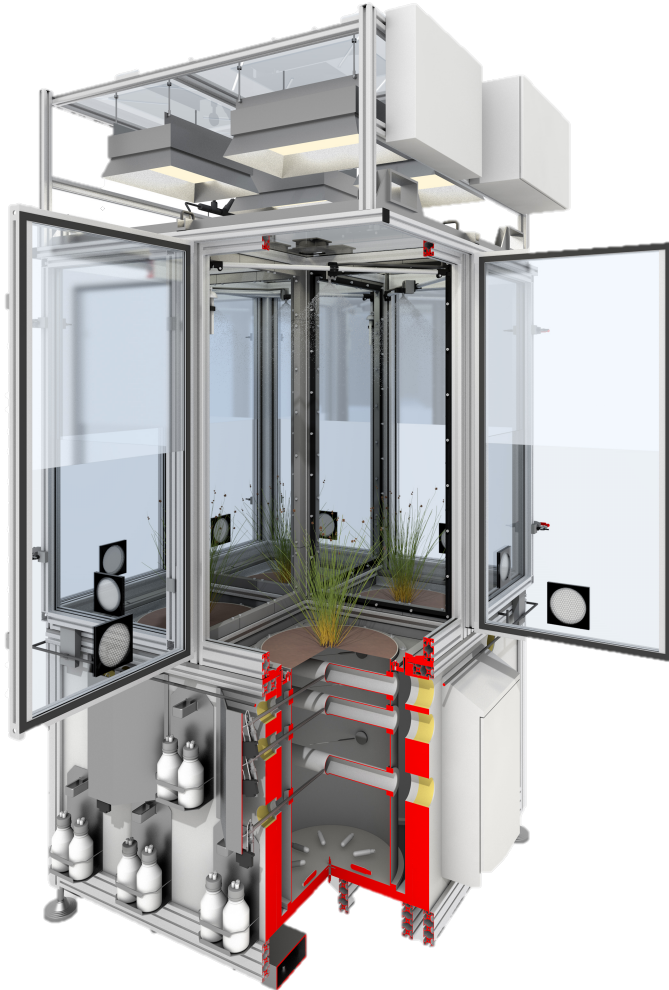
  - Unique scalable machine learning tools for big science
  - Addressing the challenges in experimental and observational data identified in DOE Computing's long-term plan

Application Driver:
Massive Seismic Datasets on Fiber

Bldg 50

BART

AMTRAK

31 mph   31 mph   BART &/or AMTRACK

Silixa iDAS
Recording Unit

P   S   Coda

N-S

W-E   M3.6 Geysers, CA

Improving bioenergy yield under drought stress from field to lab

GOAL: Submission to DOE ECRP

Summary

- "Success" = quantitative ($) + qualitative (all else)

- LDRD highly successful for Lab

- Significant contributions to DOE and the Nation

- Long-term investments

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Thank You