Title: Career Decisions and Los Alamos National Laboratory

Author(s): Regele, Jonathan David

Intended for: Recruiting talk

Issued: 2020-09-08

# Career Decisions and Los Alamos National Laboratory

**Jonathan Regele, PhD**

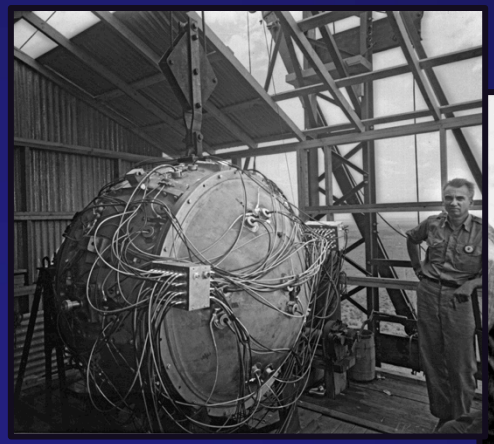
***XCP-4 – Continuum models and numerical algorithms***

***jregele@lanl.gov***

Los Alamos
NATIONAL LABORATORY
EST. 1943

# At Los Alamos, we deliver science and technology to protect our nation and promote world stability

- Our mission began by applying science and technology to address an international crisis
- Today, we are responsible for the design, engineering, and sustainment of the majority of the United States' nuclear weapons capabilities
- We also work to assess & reduce global nuclear danger
- We offer unparalleled career opportunities in science, engineering, manufacturing, business, and more



# We invest in robust and leading-edge science & technology programs to enable our mission

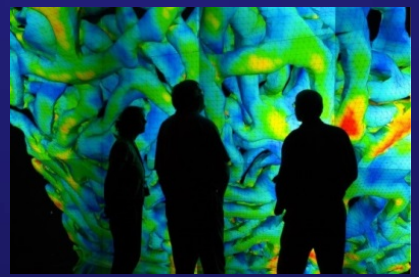
- The US stopped full-scale testing of nuclear weapons in 1992, but wants to maintain nuclear weapons capabilities indefinitely
- *Stockpile stewardship* requires physics and engineering insight enabled by experiment, computation, and theory
- Staying on the forefront of key science & technology areas is critical to US national security

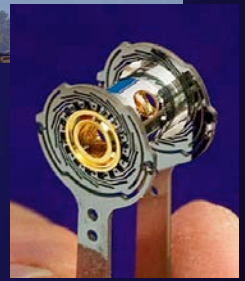
## Theory

$$G(\rho,T) = G_0(\rho)\left(1-\alpha\frac{T}{T_m(\rho)}\right)$$

$$\begin{aligned}
&\frac{\partial \rho}{\partial t} + \nabla \cdot \rho \boldsymbol{v} = 0,\\
&\frac{\partial}{\partial t}(\rho \boldsymbol{v}) + \nabla \cdot \rho \boldsymbol{v}\boldsymbol{v} + \nabla P_{\mathrm{tot}} = 0,\\
&\frac{\partial}{\partial t}(\rho E_{\mathrm{tot}}) + \nabla \cdot [(\rho E + P_{\mathrm{tot}})\boldsymbol{v}] = 0,\\
&\frac{\partial}{\partial t}(\rho e_{\mathrm{ion}}) + \nabla \cdot (\rho e_{\mathrm{ion}} \boldsymbol{v}) + P_{\mathrm{ion}} \nabla \cdot \boldsymbol{v} = 0,\\
&\frac{\partial}{\partial t}(\rho e_{\mathrm{ele}}) + \nabla \cdot (\rho e_{\mathrm{ele}} \boldsymbol{v}) + P_{\mathrm{ele}} \nabla \cdot \boldsymbol{v} = 0,\\
&\frac{\partial}{\partial t}(\rho e_{\mathrm{rad}}) + \nabla \cdot (\rho e_{\mathrm{rad}} \boldsymbol{v}) + P_{\mathrm{rad}} \nabla \cdot \boldsymbol{v} = 0,
\end{aligned}$$

## Simulation & Computing





## Experiments

# Diverse teams of 12,000 employees at Los Alamos work collaboratively to solve national security challenges

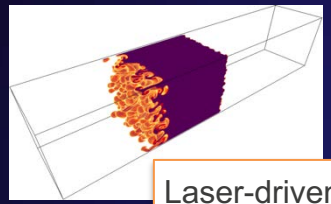
- 4000 Scientists and Engineers
  - 2200 PhD-level
  - 145 R&D100 awards,
    34 EO Lawrence awards,
    9 Presidential Early Career awards
- 400 Postdoctoral researchers
- 1500 summer students
- $2.8 Billion budget
- 36 square miles of facilities


Materials & Physical Data Group

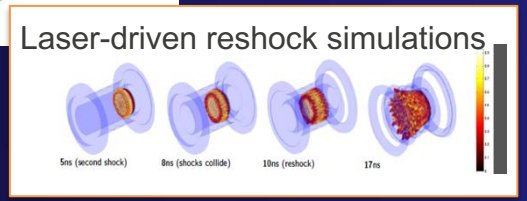
Physics Verification & Analysis Group

# Opportunities in computational science & engineering

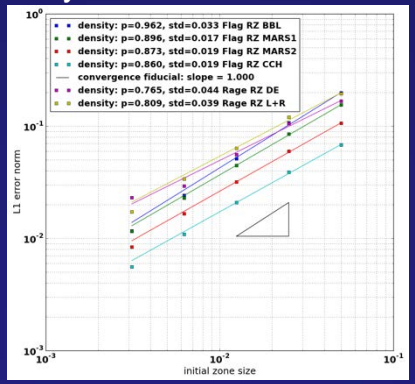
Richtmyer-Meshkov instability



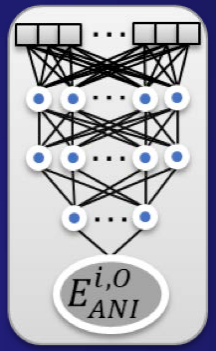
Laser-driven reshock simulations



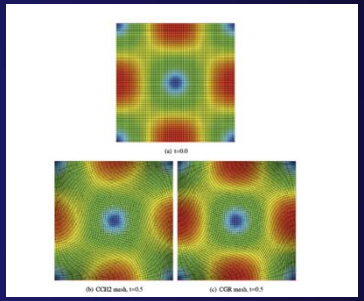

Verification, Validation & Uncertainty Quantification



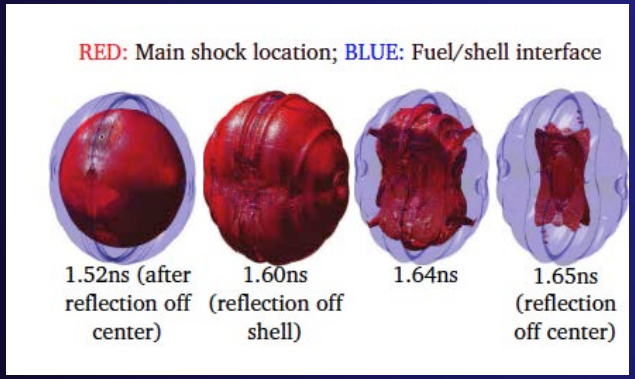

Machine Learning for inter-atomic potential calculations



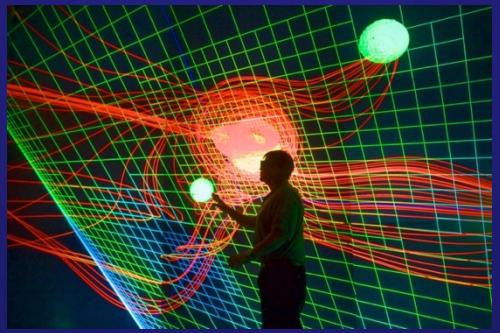

Numerical methods for multi-material compressible flow



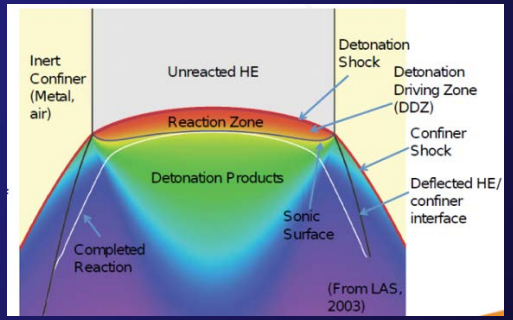
Inertial Confinement Fusion




High performance computing & visualization



Reactive high explosives modeling



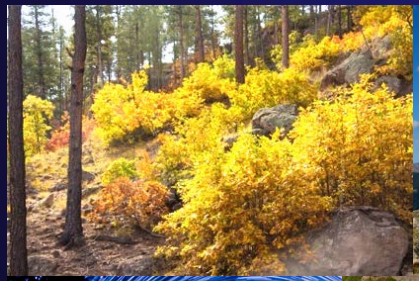

Los Alamos is the birthplace of computational physics

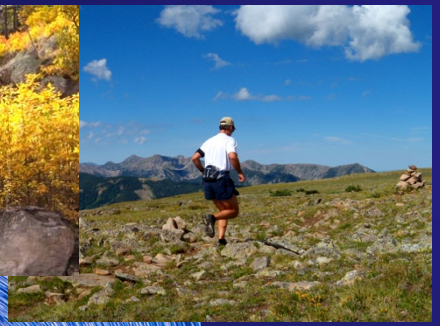
# Petascale Supercomputing is critical to Los Alamos' national security missions

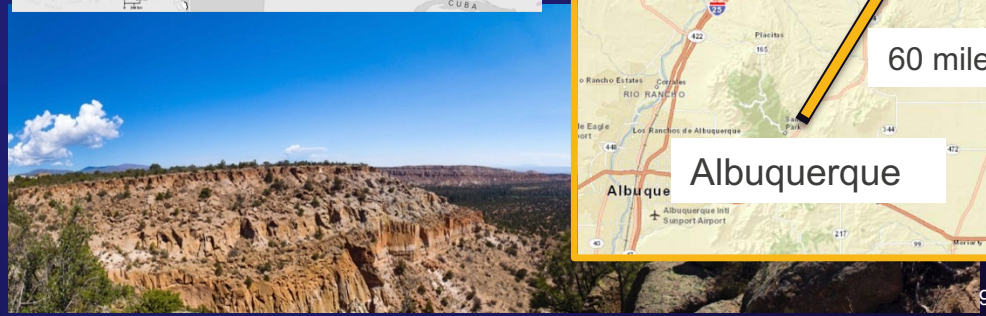
- Stockpile challenges are increasingly complex as systems continue to age
- DARHT, LANSCE etc  provide large data sets to resolve stockpile challenges
- Data sets require ever more capable machines that can quickly process information
- Capacity and Capability machines
  - Trinity
  - Fire, Ice

# Where we are: Northern New Mexico

- 40 miles to Santa Fe, 100 miles to Albuquerque
- 7000 feet above sea level: Low pollution and four seasons
- Abundant outdoor activities in nearby mountains, mesas, forests, and rivers
- High quality of life with moderate cost of living
- Rich Spanish & Native American cultural history

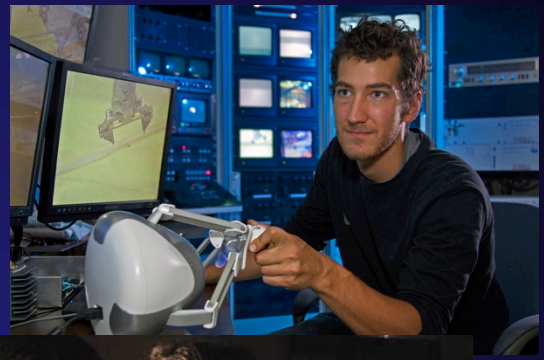


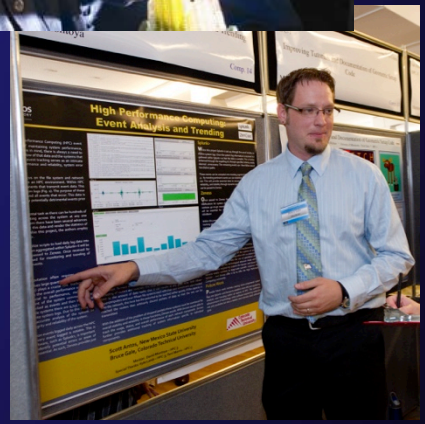


# Student and early-career opportunities

- Student Programs
  - Undergraduate internships in science & engineering:
    - Pay ranges from $13-$21/hr depending upon school progress
  - Post-Bachelor / Post-Masters:
    - Can be entry level or “gap year” between degree programs
    - Pay ranges from $23-$28/hr depending upon school progress
  - Post-Doctoral:
    - The most common entry level for PhD.  Minimum pay $74k/yr
    - Some candidates may qualify for Distinguished Postdoc appointments that start at $108k
- Scientific & Engineering Staff
  - Permanent positions with pay depending upon degree and experience, often pipelined via one or more of the student programs
  - Often requires the ability to obtain a security clearance, which normally requires US citizenship
- We work hard to find opportunities for dual-career couples in science and engineering





# Explore the opportunities for you at Los Alamos

**lanl.jobs**

or

**jobs.lanl.gov**

# My convergence upon LANL

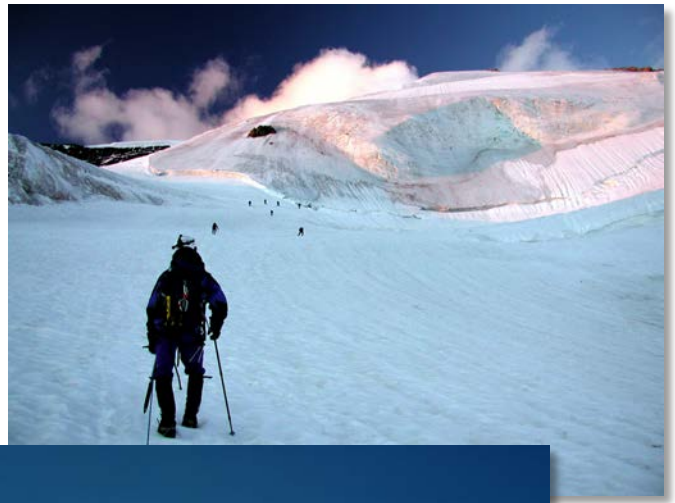
# College and Graduate school

- I’ve always been interested in rockets and things that go boom
- Also enjoy experiments and numerical methods
- Obtained Bachelors of Science in Physics and Mechanical Engineering at UC Irvine

- Went to CU Boulder for graduate school
- Master of Science in Physics
- PhD in Mechanical Engineering
- Dissertation on Detonation Initiation using the adaptive wavelet collocation method

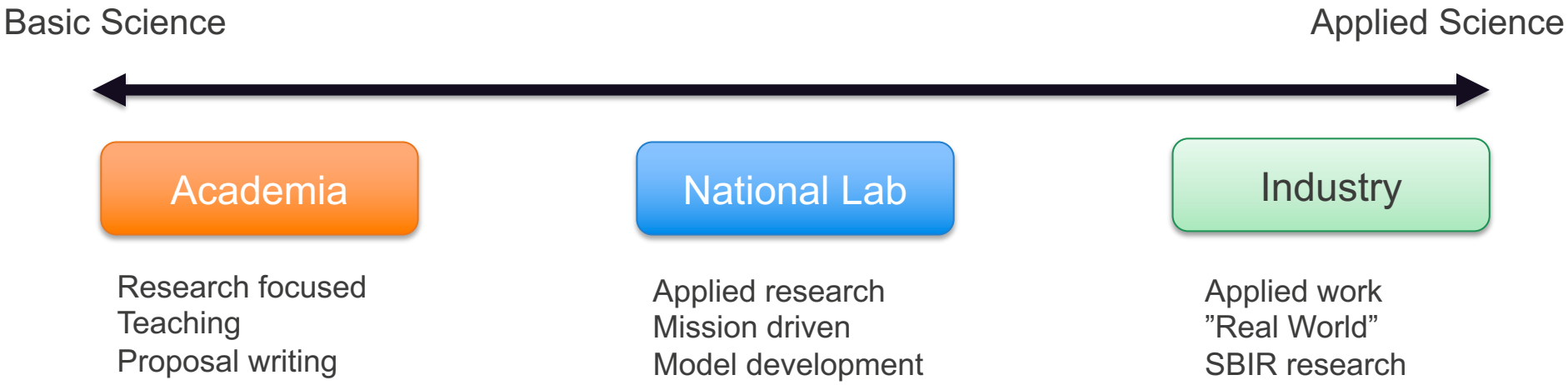
# Climbing Career

- Also began a climbing career in college
- Was climbing guide in Joshua Tree
- Climbed regularly in the Easter Sierra Nevada mountains
- Went to CU Boulder for graduate school/mountain climbing



# Career decision upon graduation

- Hoped I could get climbing/mountains out of my system
  - Unsuccessful
- Deciding what to do upon graduation was difficult
  - Climbing career → location requirements
  - Professional career → work environment



# Career path


2010
Postdoc
Caltech
2017
Scientist
LANL
2008
Graduate→
Industry
2012
Asst. Prof.
Iowa State

# Lesson's learned

- Industry is more applied than I ever imagined
  - Not really interested in your expertise
- Faculty's job is to fund student research and teach
  - Greatest intellectual freedom → still must obtain funding
  - Students perform research
  - Research is done on your own time for fun
  - Great experience → worth a try
- National lab is the best of both worlds
  - Basic/applied science motivated by applications and experiments
  - Still have students and postdocs working for you
  - Not required to obtain funding → still an option

# Lab Environment

Basic Science

Applied Science

**Theoretical Division**

Basic Science
Proposal writing (LDRD)
Publish or perish

**X Computational Physics**

Applied research
Funding varies
Publish if desired

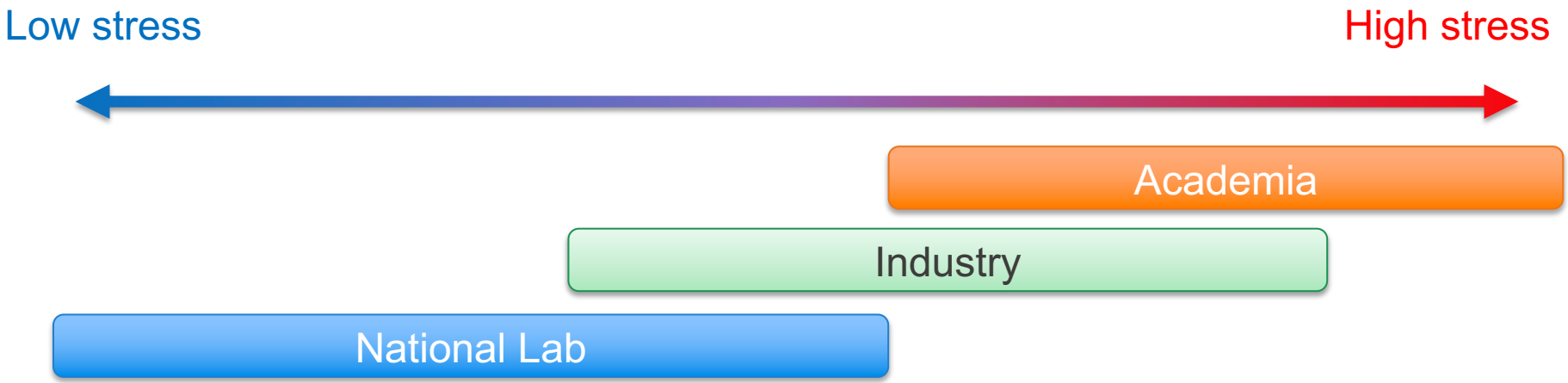
**X Theoretical Division**

Design focused
Programatic funding
Publishing not required

- Great flexibility exists within the lab environment
- Fairly easy to move around once inside
- Amazing collaboration opportunities
- Mentoring opportunities abound
- Work-life balance easy to achieve → goal for LANL employees
- Both technical and managerial career tracks available

# Final thoughts

- If unsure, use path of least resistance
  - Academia → National lab → industry
- Academia is very rewarding and stimulating
- Lab provides unparalleled work-life balance

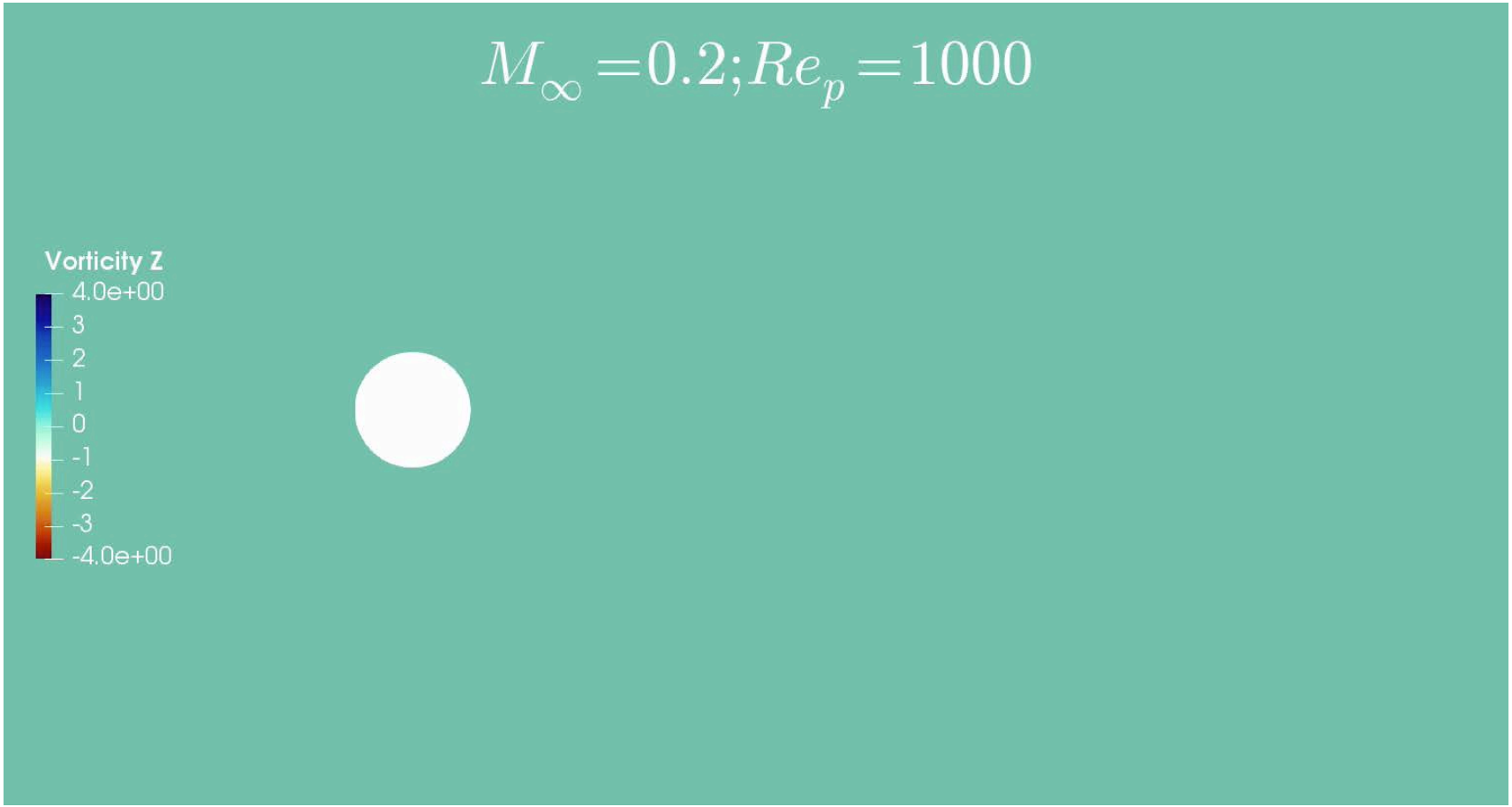


# Current research projects

- Model development for cerium particles reacting in hydrogen gas
  - Some particles are solid
  - Others are liquid
    - Experiments indicate breakup of liquid droplets
    - Unclear what causes the breakup to occur
    - Does not occur in non-reactive cases
- Drag coefficient as a function of Reynolds number, volume fraction and Mach number
- 2D simulation study of particle jetting phenomena

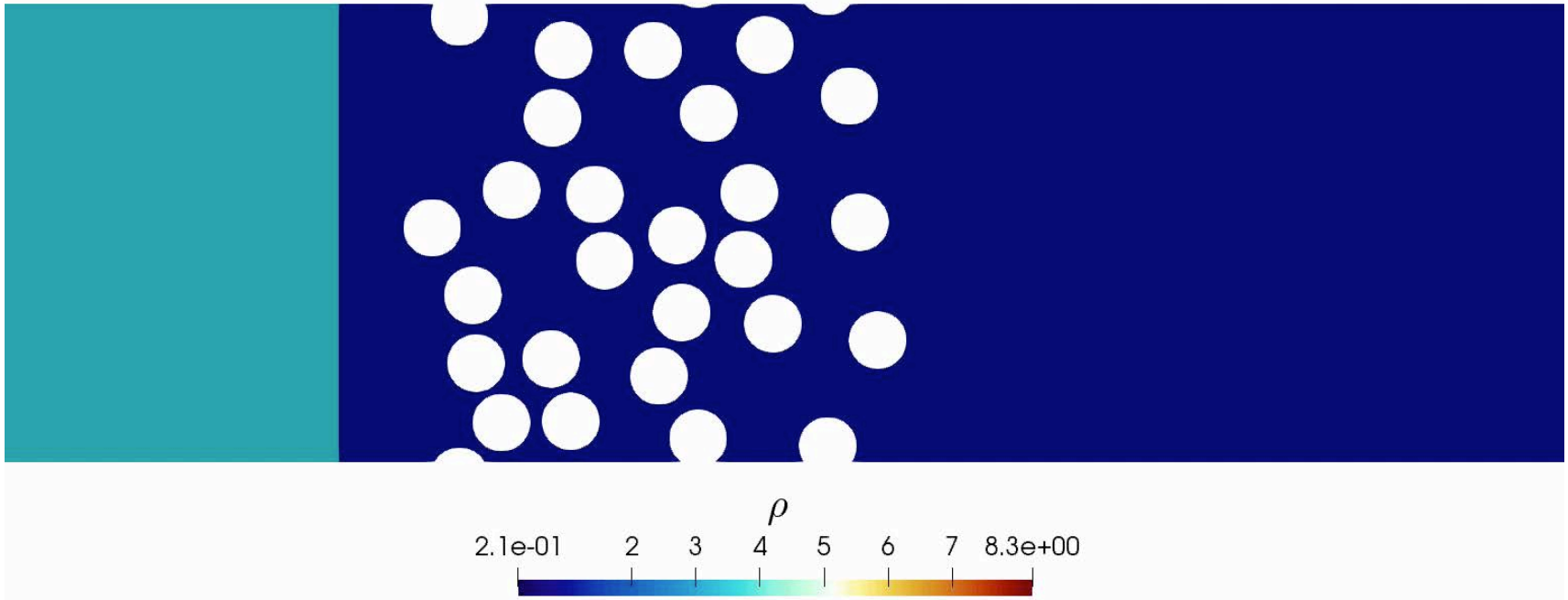
# Research motivation

# Validation of cylinder drag

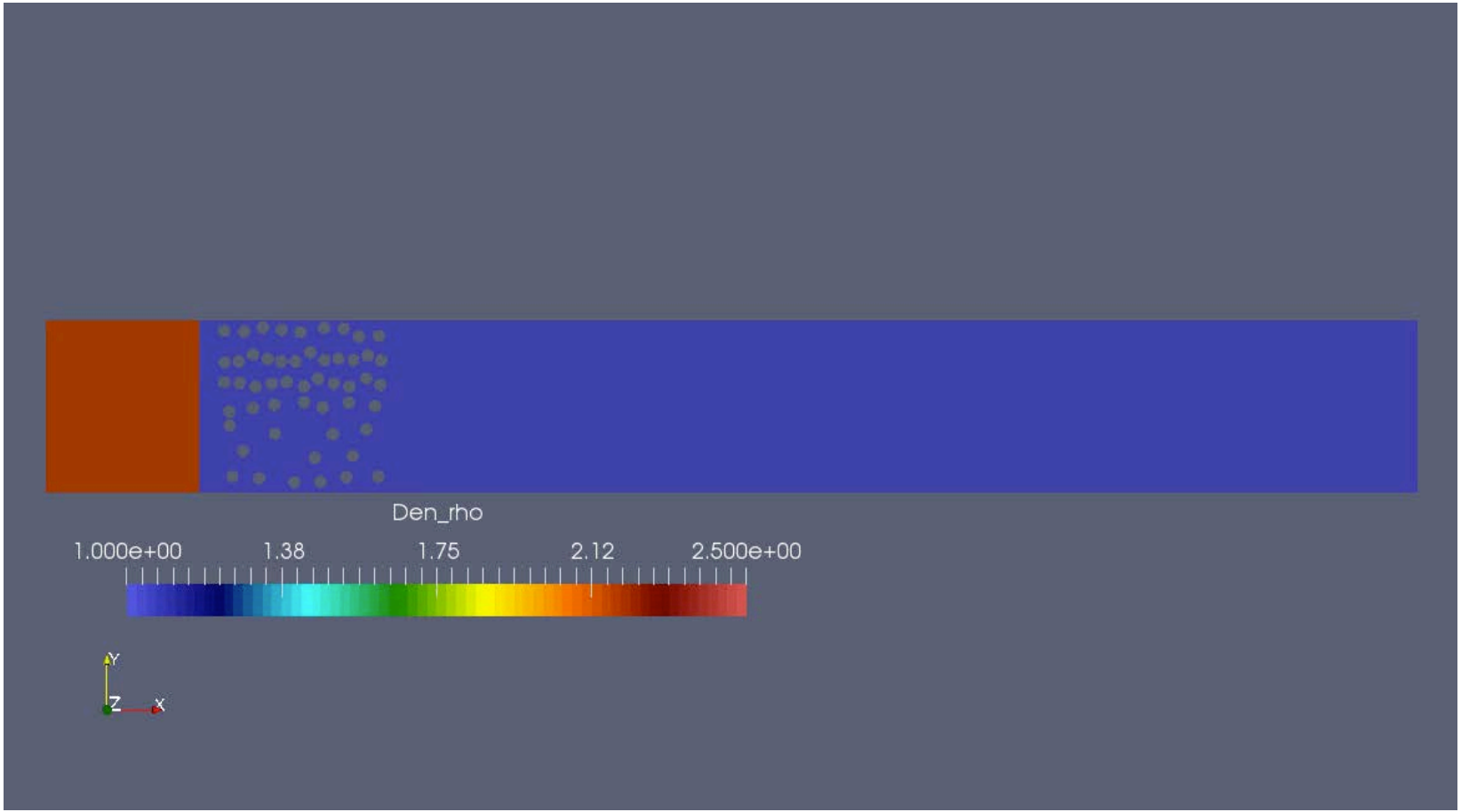


# Testing shock induced particle collisions

$$M_s = 2.58; \phi = 32\%; Re_p = 75E+03; \rho_p/\rho_2 = 10$$



# Summer student project



# Research & photo credits

- Slide 5: RMI & reshock by Grinstein, et al.; ICF calcs by Haines, et al.; Compressible flow calcs by Burton, et al.
- LANL Photos on all slides
- Photos by Mark Schraad and Scott Doebling on Slide 7; used with permission