SAND2021-7421C

Sandia National Laboratories

Radiation Heat Transfer Challenges at Sandia

John Tencer, Sandia National Laboratories

ASME Summer Heat Transfer Conference, 2021

Multidimensional Radiative Transfer for Complex Conjugate Applications Workshop

U.S. DEPARTMENT OF ENERGY | NNSA

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About me

2005-2009

2009-2013

2013-Present

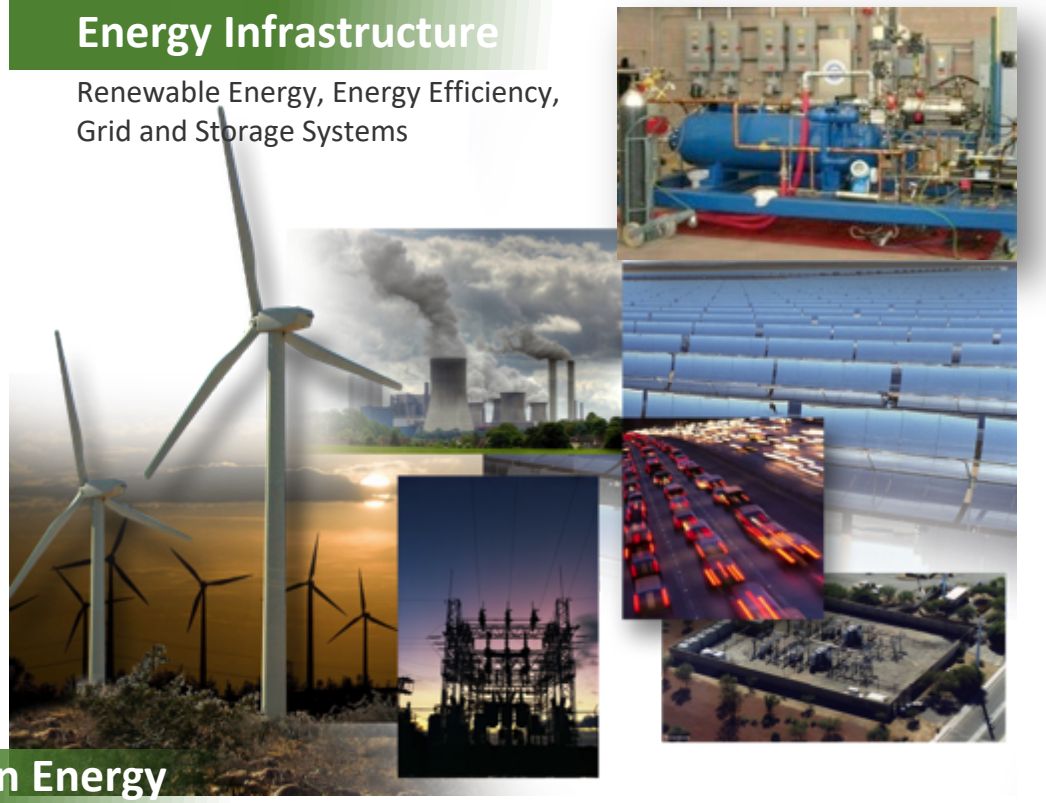
About Sandia

Integrated Military Systems

Remote Sensing and Verification

Renewable Systems & Energy Infrastructure

Renewable Energy, Energy Efficiency, Grid and Storage Systems



Warhead Systems Engineering and Integration

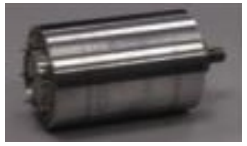
Major Environmental Test Facilities and Dia

Z Machine

Light Initiated High Explosive

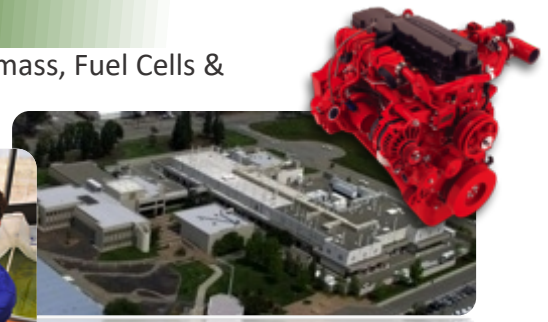
Annular core research reactor

Safety systems



Transportation Energy & Systems

Vehicle Technologies, Biomass, Fuel Cells & Hydrogen Technology



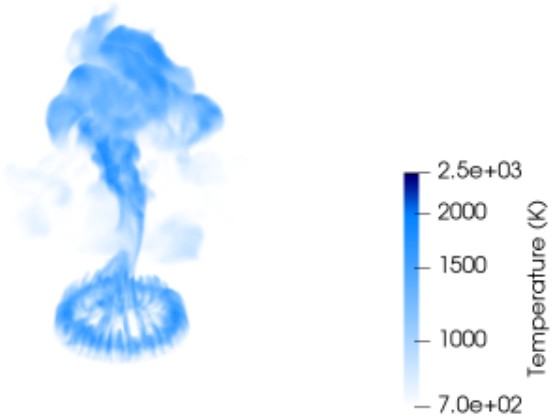
Particularly challenging applications

Accidents, Space Systems, CSP

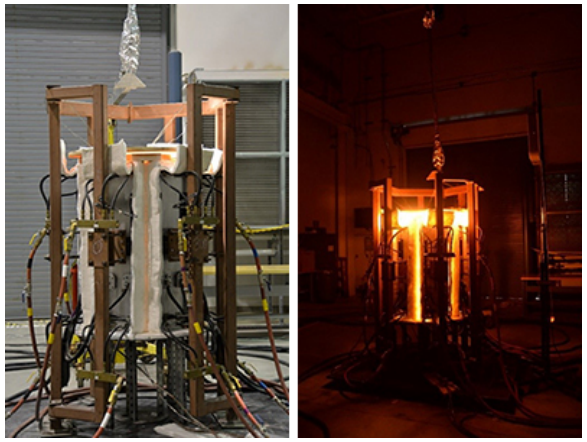
Abnormal Thermal Environments

Lab-scale calibration/validation efforts

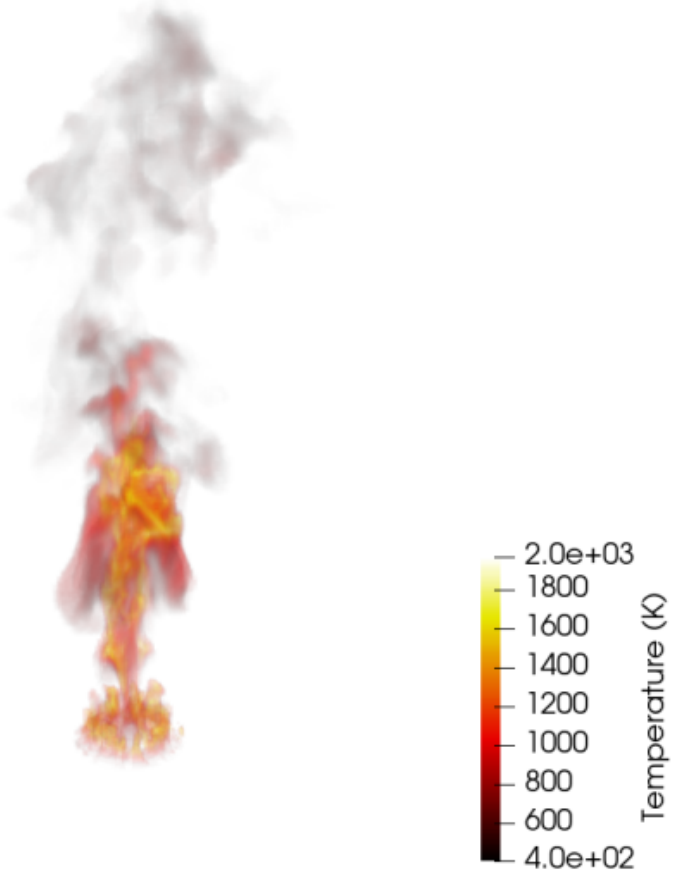
- Attempting to predict experimentally measured quantities (integrated)
- Discrete ordinates method
- Mostly gray-gas radiation although multi-group capability exists and does get exercised at this scale



Methanol Pool Fire Simulation
Courtesy of Josh Hubbard

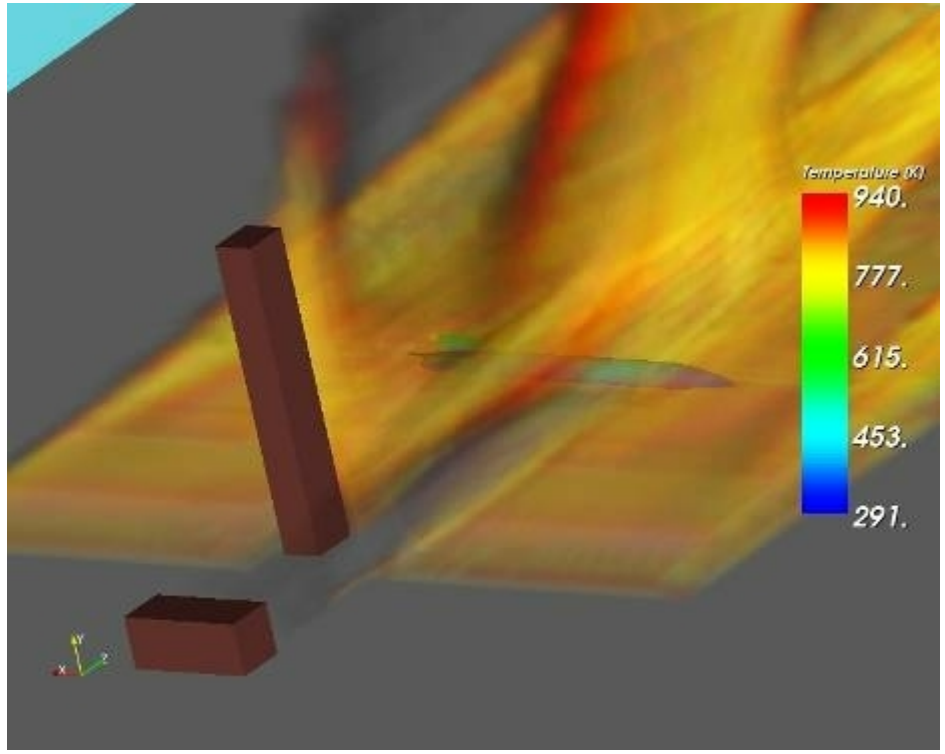


Six-panel radiant lamp array



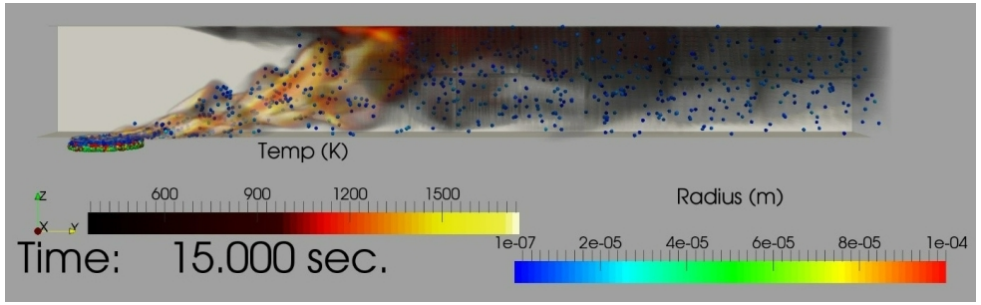
Heptane Pool Fire Simulation
Courtesy of Josh Hubbard

Abnormal Thermal Environments



Large-scale predictions

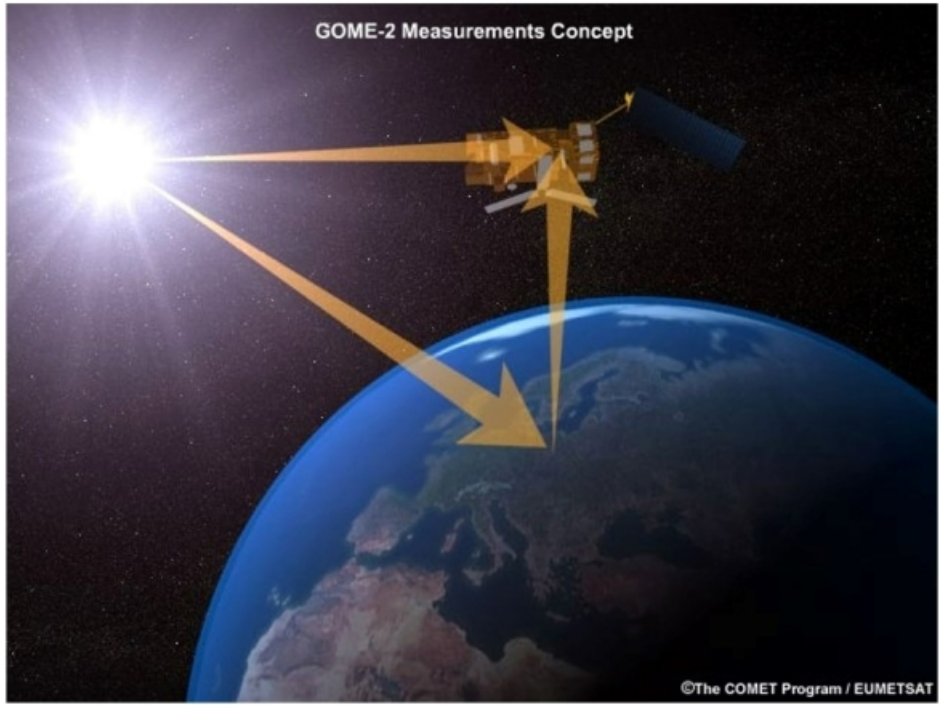
- Need surface fluxes to objects in/near fires
- Discrete ordinates method (sometimes underresolved)
- Almost exclusively gray-gas radiation

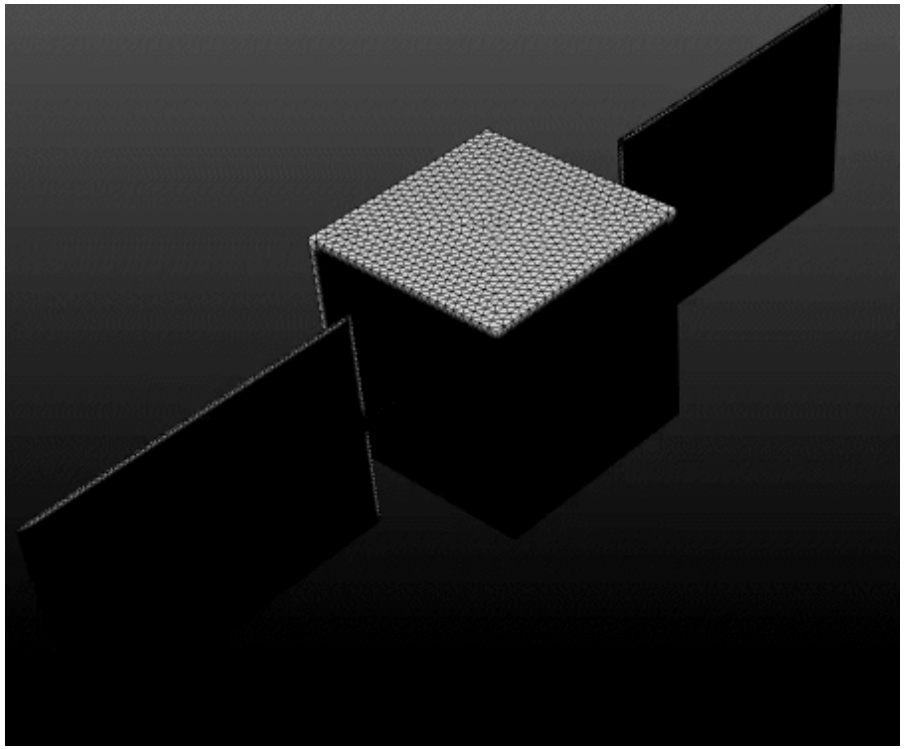


Space Systems

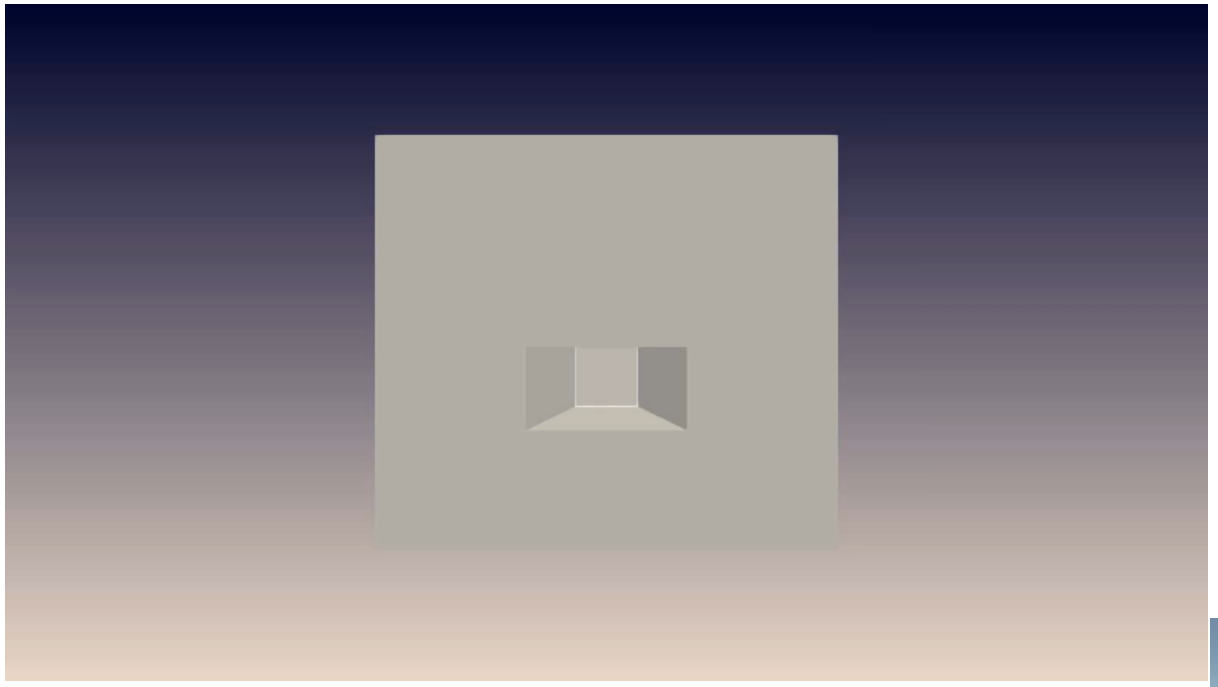
Predicting thermal loads on internal components

- Non-participating media (enclosure radiation)
- Dynamic viewfactors required to properly capture direct and reflected solar illumination throughout orbit
- Banded



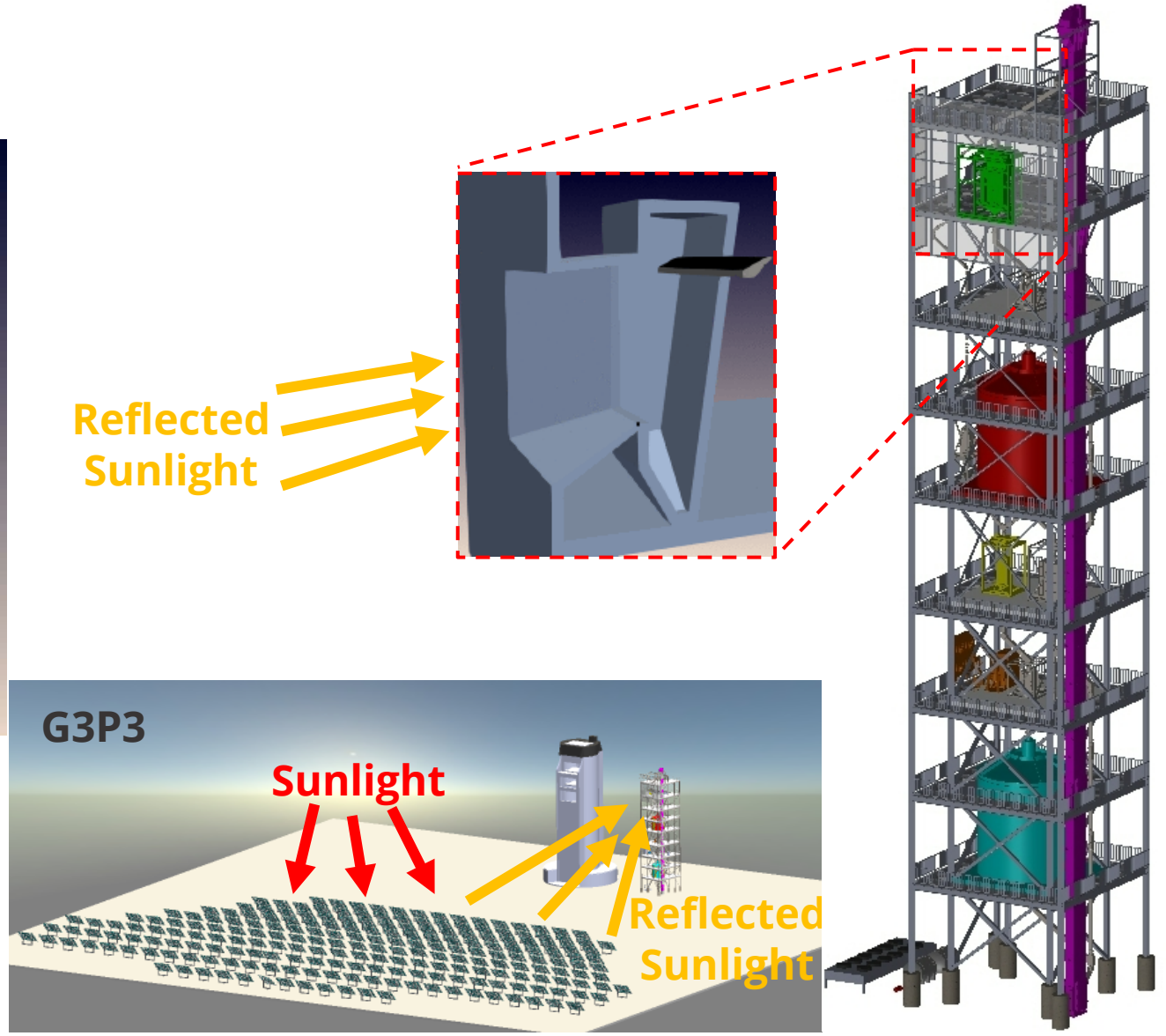


Energy Systems



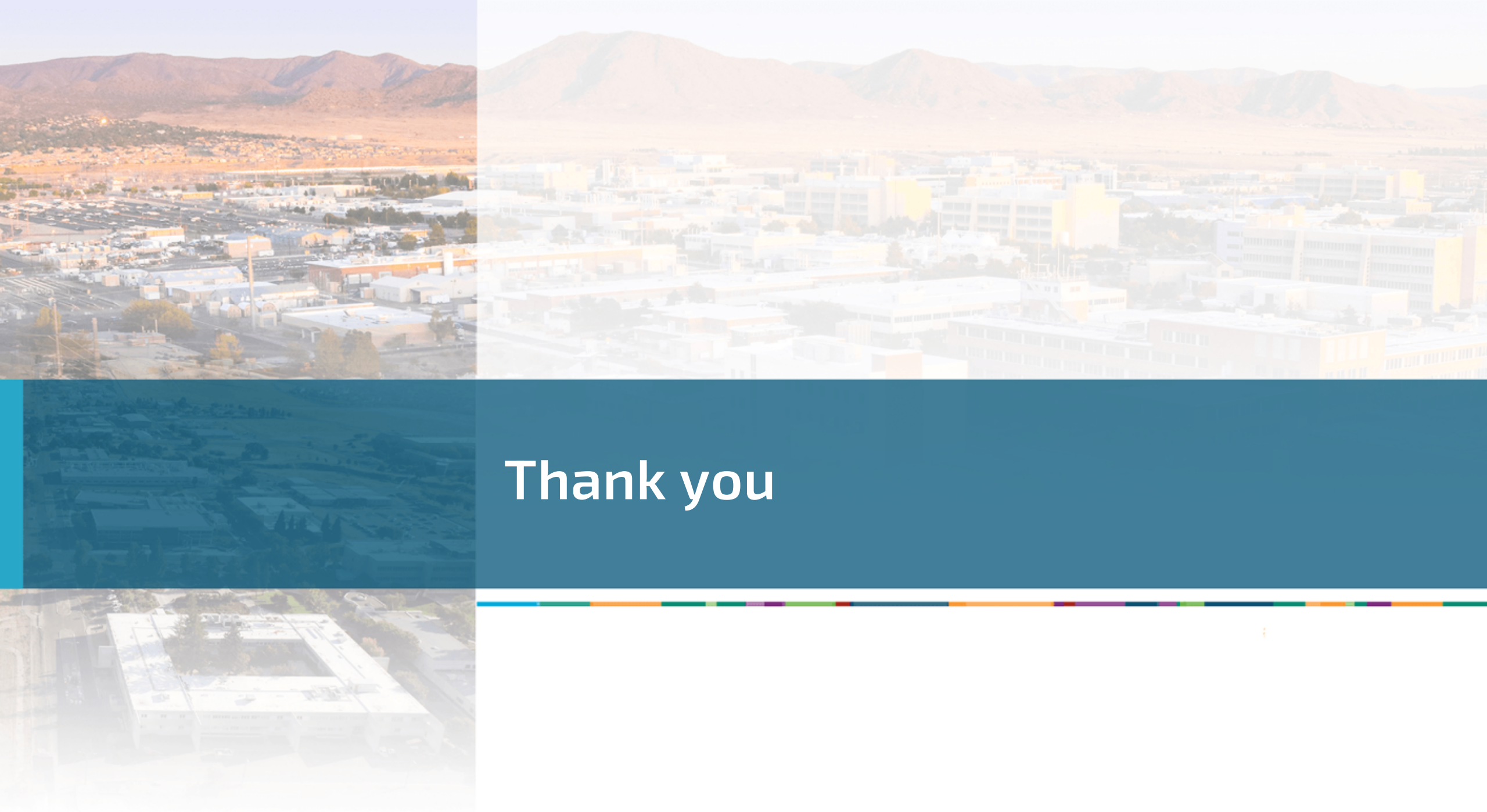
Component/System performance predictions

- Falling particle receiver
- Fully coupled analysis
- Monte-Carlo for simulating mirror field
- Discrete ordinates within the cavity
- Banded radiation



Depiction of G3P3 at the National Solar Thermal Test Facility at Sandia

Courtesy of Brantley Mills



Thank you