Visualizing large data on Cielo
From Sandia's perspective

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Sandia National Laboratories (SNL) Introduction

- Sandia's mission work reflects the nation's security challenges
  - ✓ Nuclear Weapons
  - ✓ Energy and Infrastructure Assurance
  - ✓ Nonproliferation
  - ✓ Defense Systems and Assessments
  - ✓ Homeland security and defense

Albuquerque, New Mexico

- Sandia's principal sites are in Albuquerque, New Mexico and Livermore California. Other facilities are in Carlsbad, New Mexico; Tonopah, Nevada; and on the island of Kauai, Hawaii

Livermore, California

Cielo from Sandia's perspective

- Cielo creates huge datasets that require visualizing.

- There are three ways to visualize this data for Sandian engineers:

  ✓ In-Situ Viz

  ✓ Remote server interactive visualization

  ✓ Copying datasets to Sandia

Cielo in Los Alamos, New Mexico

100 Miles
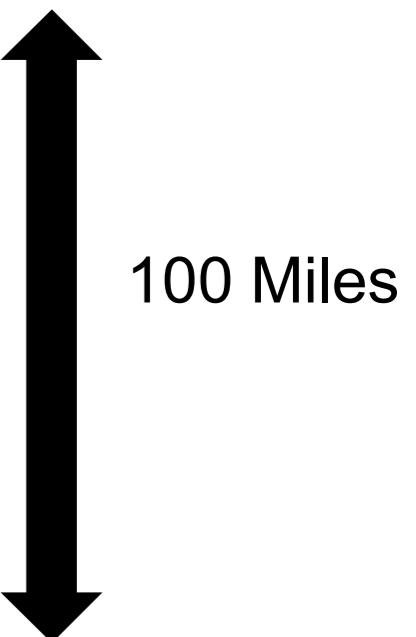
Engineers at Sandia in Albuquerque, New Mexico

Remote server visualization

- ## ParaView

  - ✓ Servers do the heavy lifting (file reads, clip, contour, volume rendering, rendering, etc.)

  - ✓ Client is just a GUI and displays images.

 - ✓ Real-time images are passed between client (at Sandia) and server (at Los Alamos)

  - ✓ Disadvantages

    - ✓ Fewer nodes, smaller memory

    - ✓ Simulation must write datasets to disk.

  - ✓ Advantages

    - ✓ Interactive, GUI based

Cielo

Simulation Code

Very large Sim files

ParaView Server

2d bitmaps

Sandia

ParaView Client
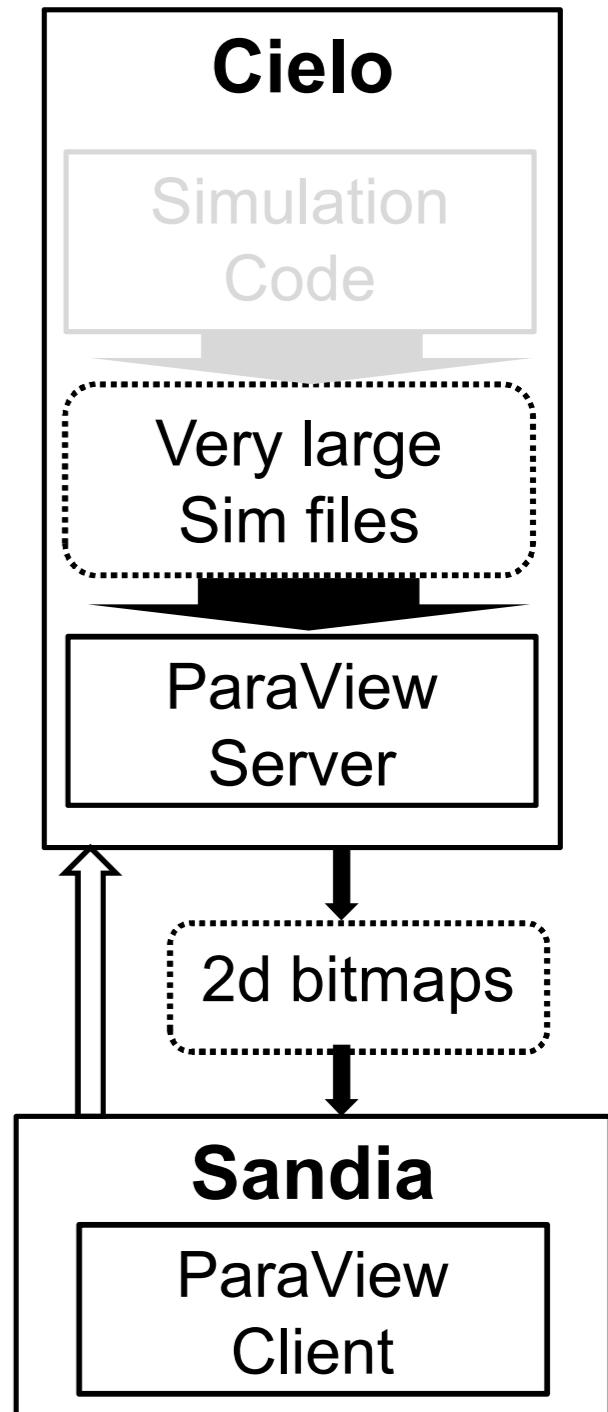
In-Situ Visualization

✓ Done by linking a visualization package to the simulation codes.

✓ Spyplot (CTH, Alegra)

✓ Paraview (CTH, Sierra, Alegra, NPIC, XRAGE, PHASTA....)

✓ Advantages
   ✓ Huge memory and lots of CPU

✓ Disadvantages
   ✓ Not interactive
   ✓ Must rerun simulation for new pictures

| Simulation Code |
| Visualization Code (ParaView) |

↓

| Pretty Pictures out |
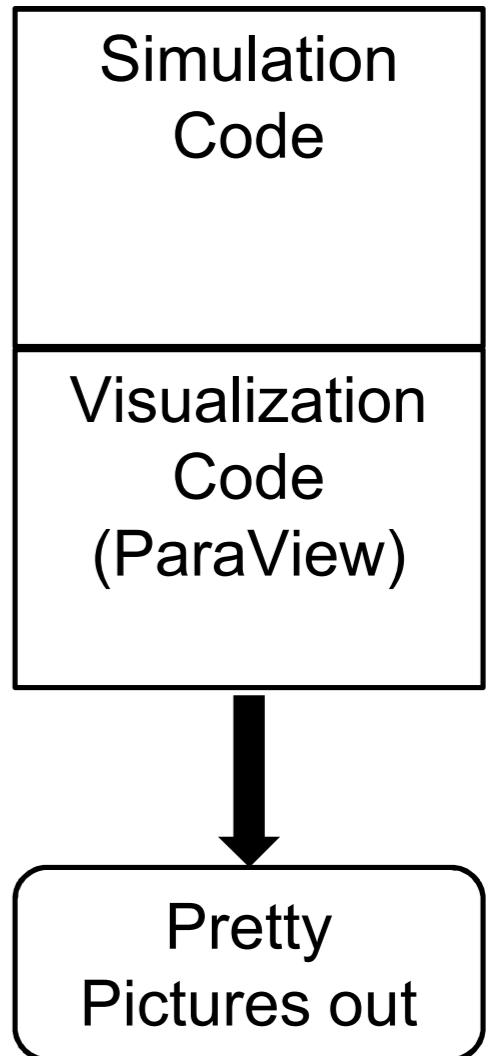
Movie from Cielo

✓ In-Situ (SpyPlot)

  ✓ Title: Impact Velocity

  ✓ Mission: Physical barriers to mitigate explosive threats

  ✓ Simulation: This is a thin wall structure acted upon by the blast from a nearby explosion.

  ✓ Steel fragments and explosive gas difficult to resolve.

  ✓ 32,000 cores creating 32,000 files, 4 billion cells

  ✓ Simulation ran for 1 week

  ✓ Visualization result was around 300 .jpg files that were copied to Sandia.