

# The ParaView Coprocessing Library

## A Scalable, General Purpose *In Situ* Visualization Library

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Kitware Inc.

**Michel Rasquin Kenneth E. Jansen**  
University of Colorado at Boulder



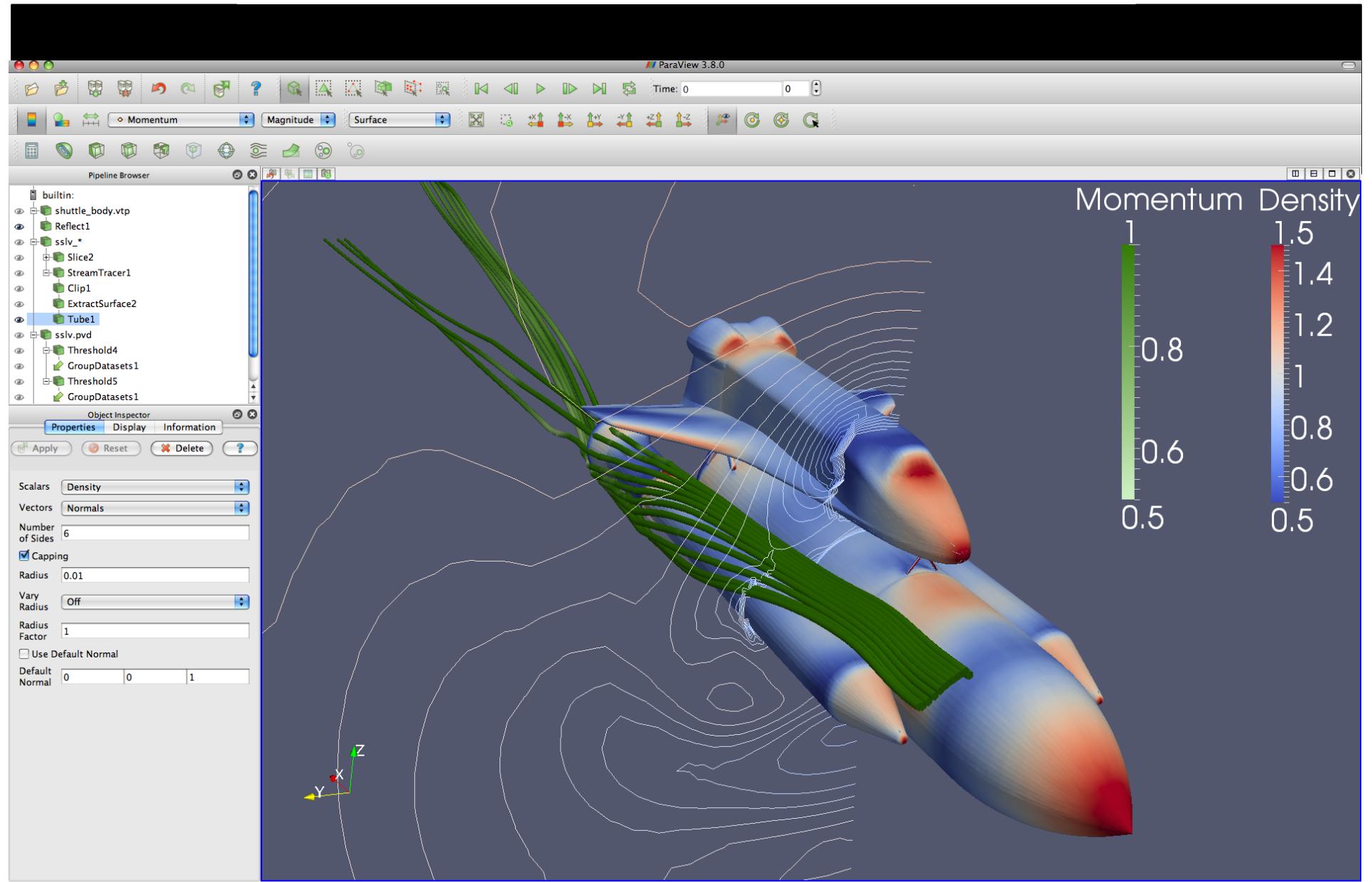
Sandia  
National  
Laboratories



University of Colorado  
Boulder

LDAV 2011  
SAND 2011-7859 C

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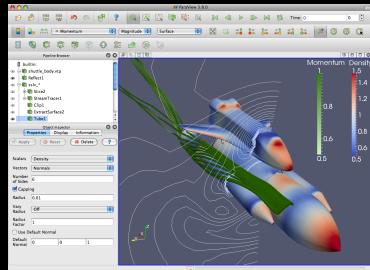
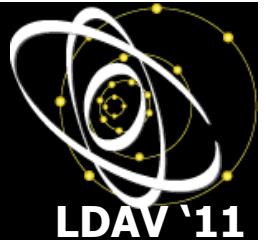
## Current ParaView Usage



- Used by academic, government, and commercial institutions worldwide.
  - Downloaded ~3K times/month.
- Landmarks of SNL usage:
  - 6 billion structured cells (2005).
  - 250 million unstructured cells (2005).
  - Billions of AMR cells with 100's of thousands of blocks (2008).
  - Scaling test over 1 Trillion structured cells (2010).



# ParaView Application Architecture



ParaView Client

pypython

Coprocessing

Qt Controls

Python Wrappings

ParaView Server  
Parallel Abstractions and Controls

VTK  
Core Visualization and Analysis Algorithms

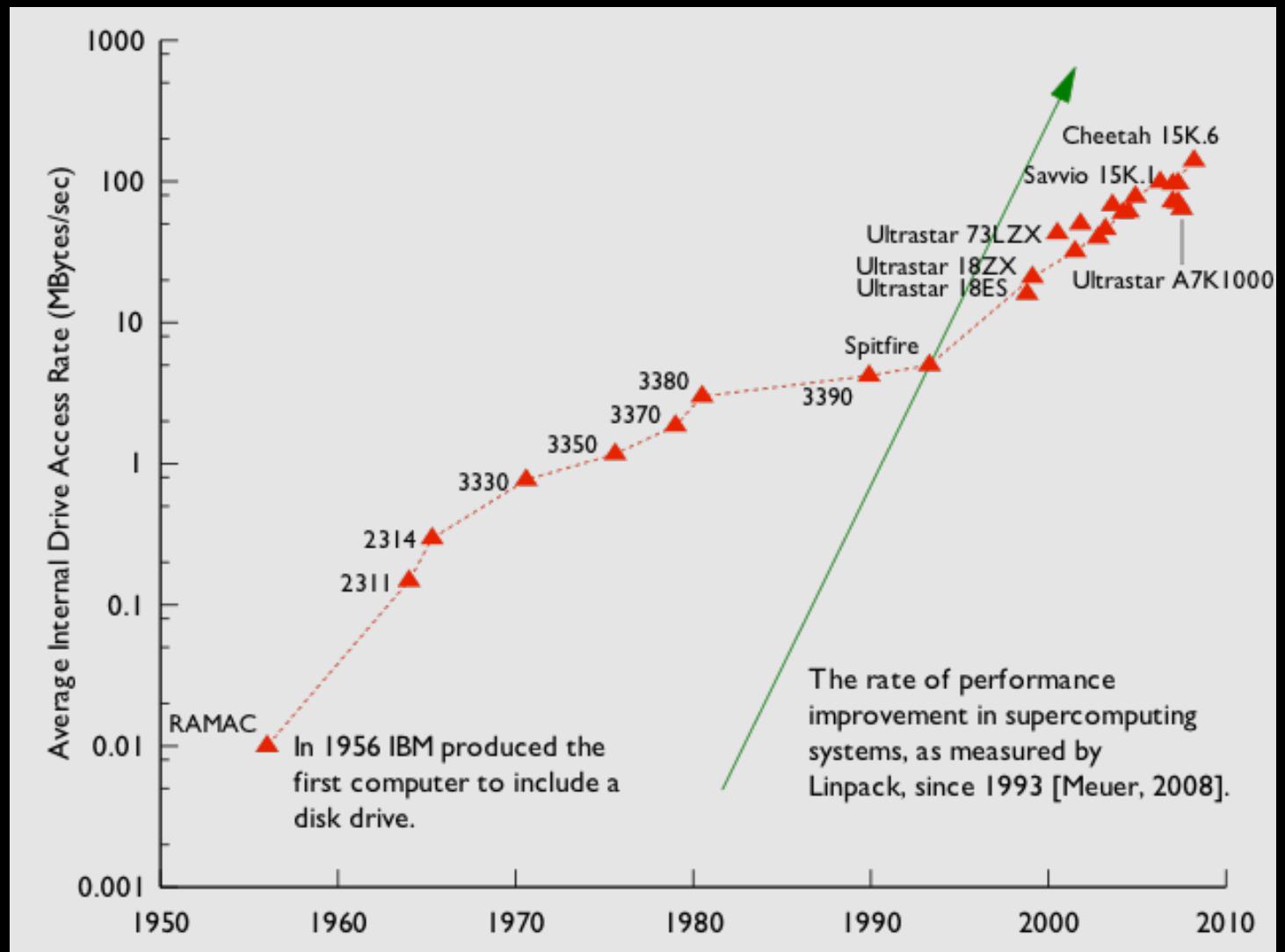
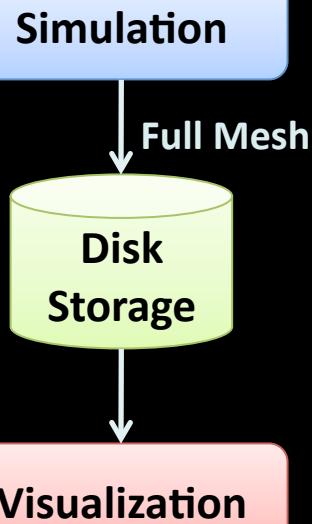
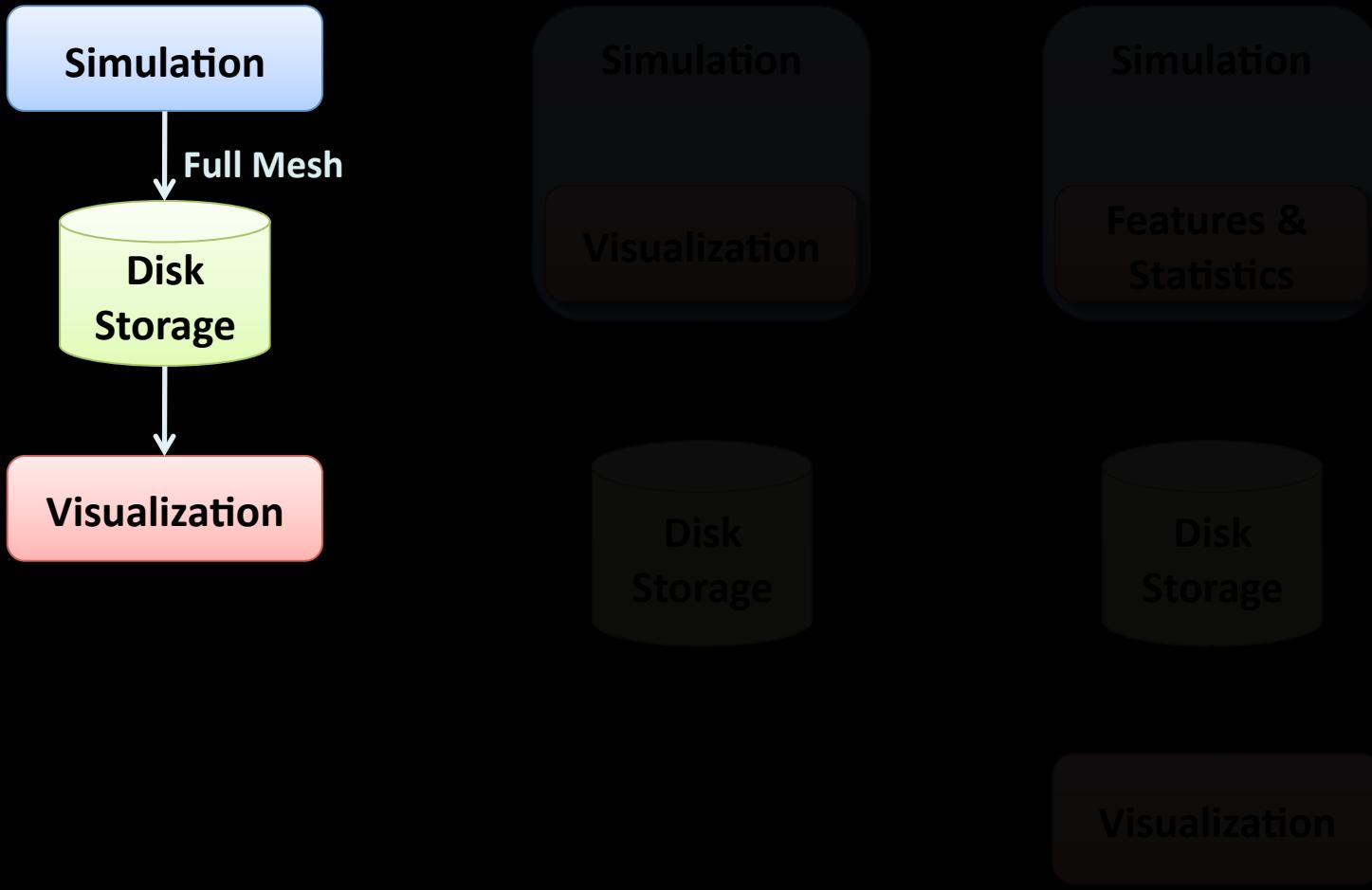
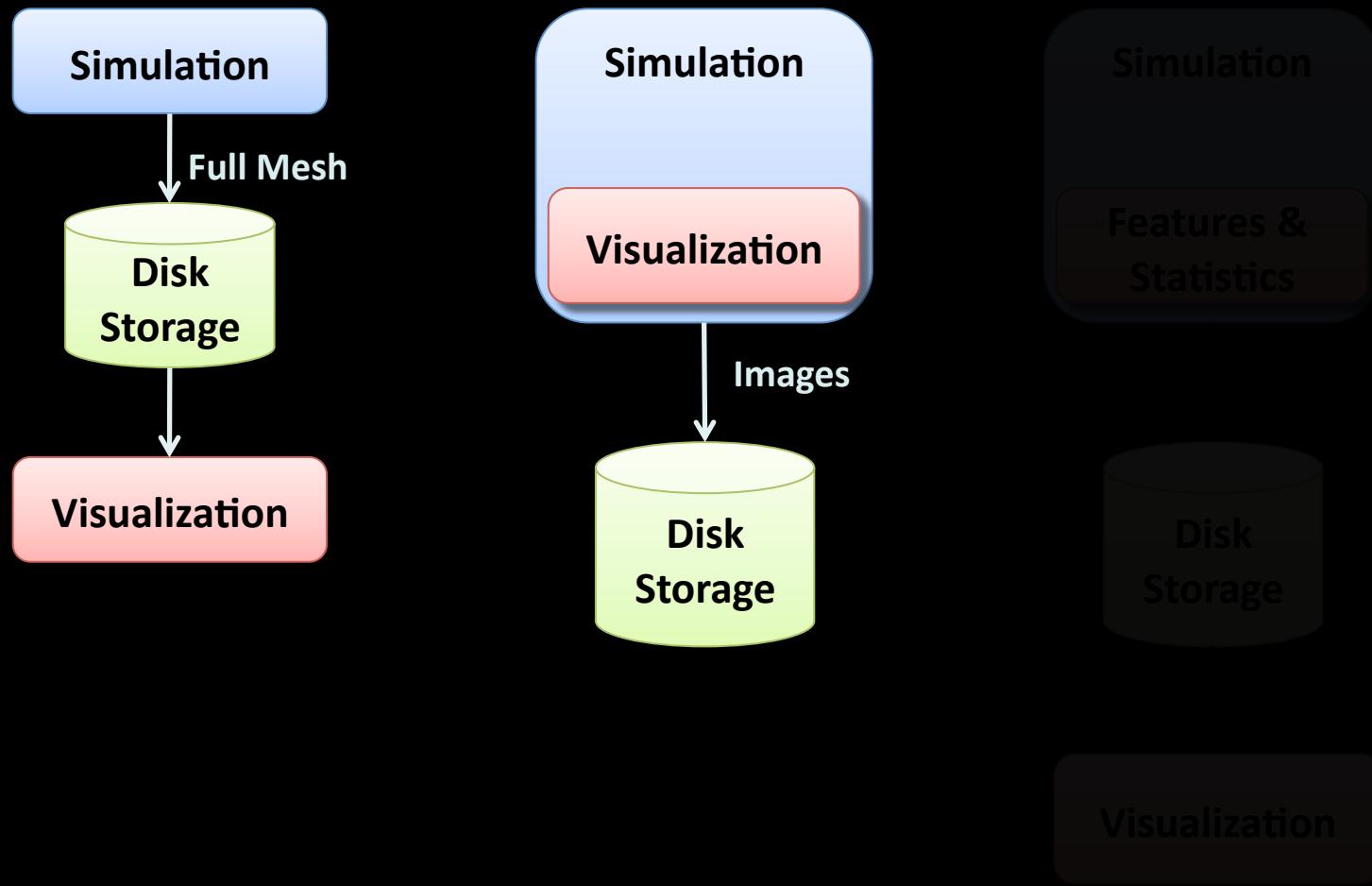


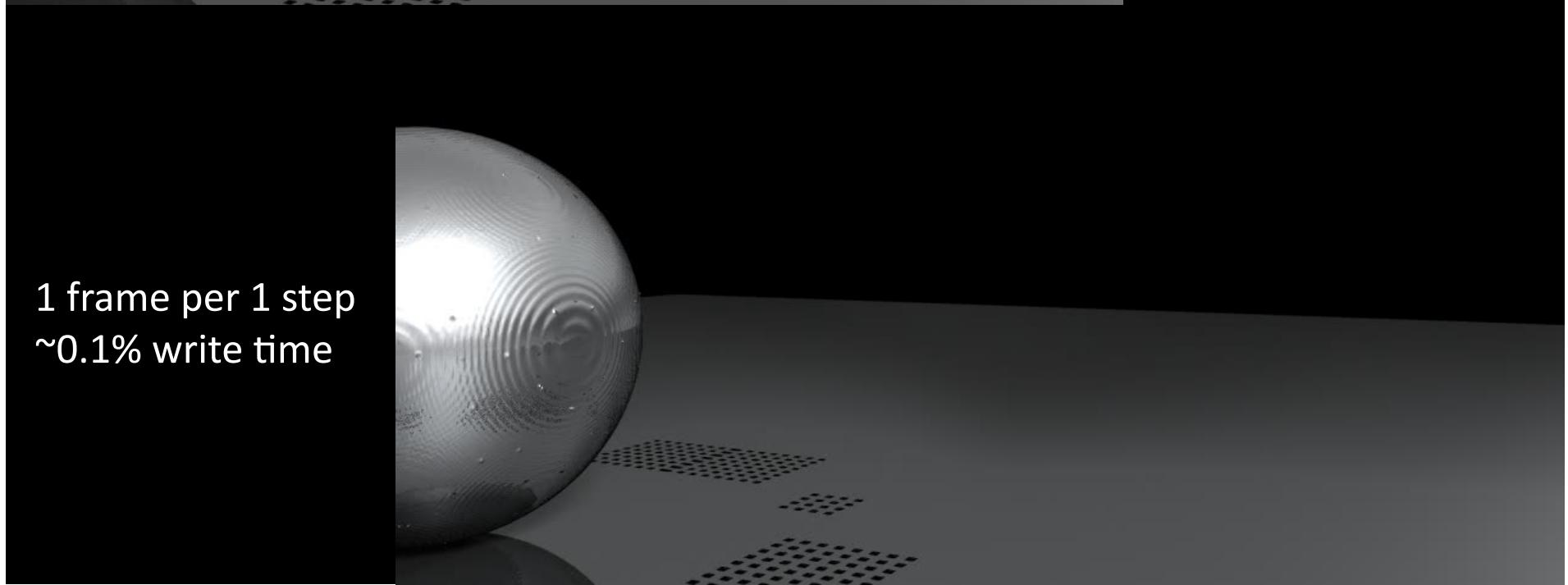
Image from Rob Ross,  
Argonne National Laboratory



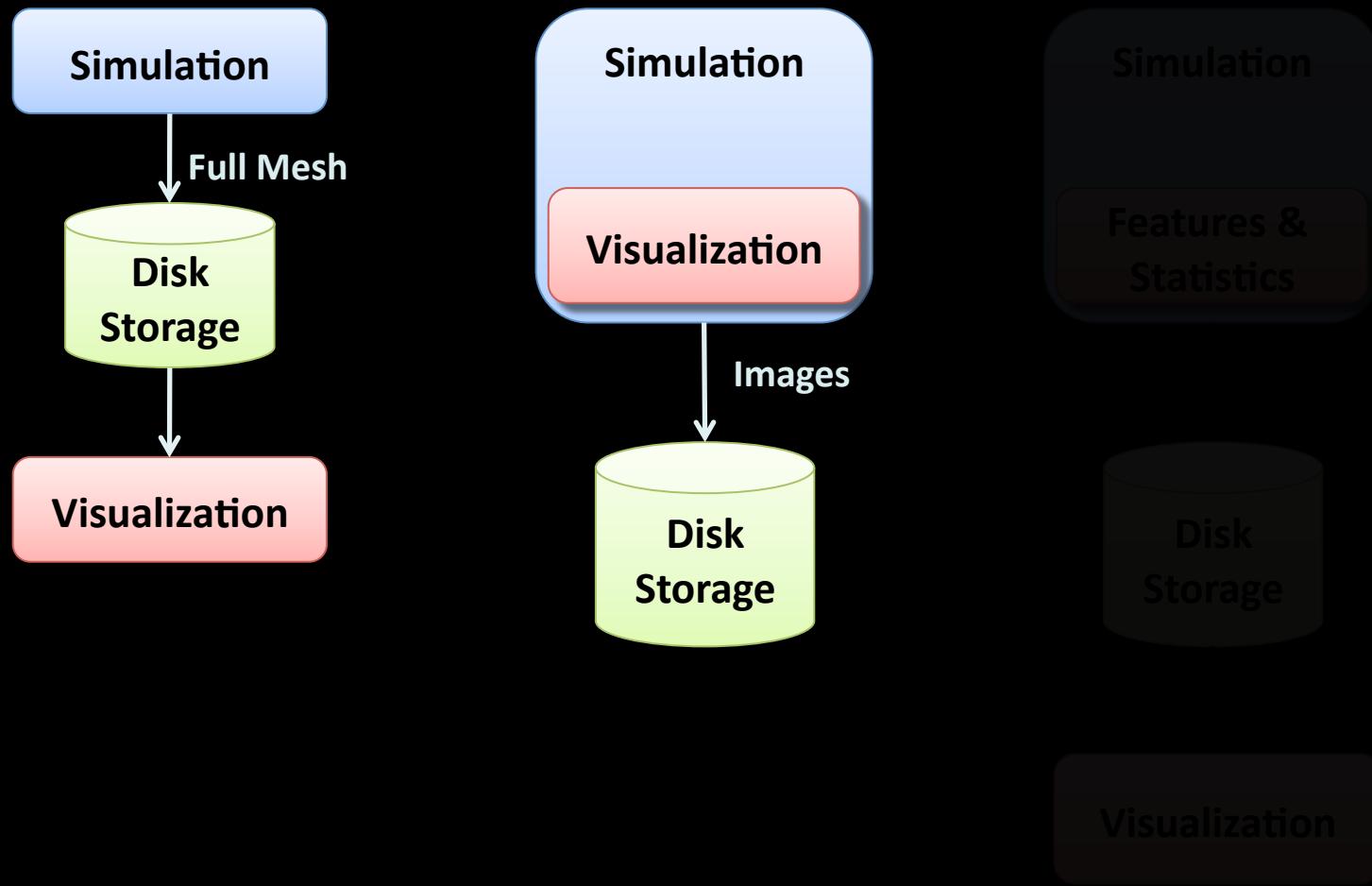


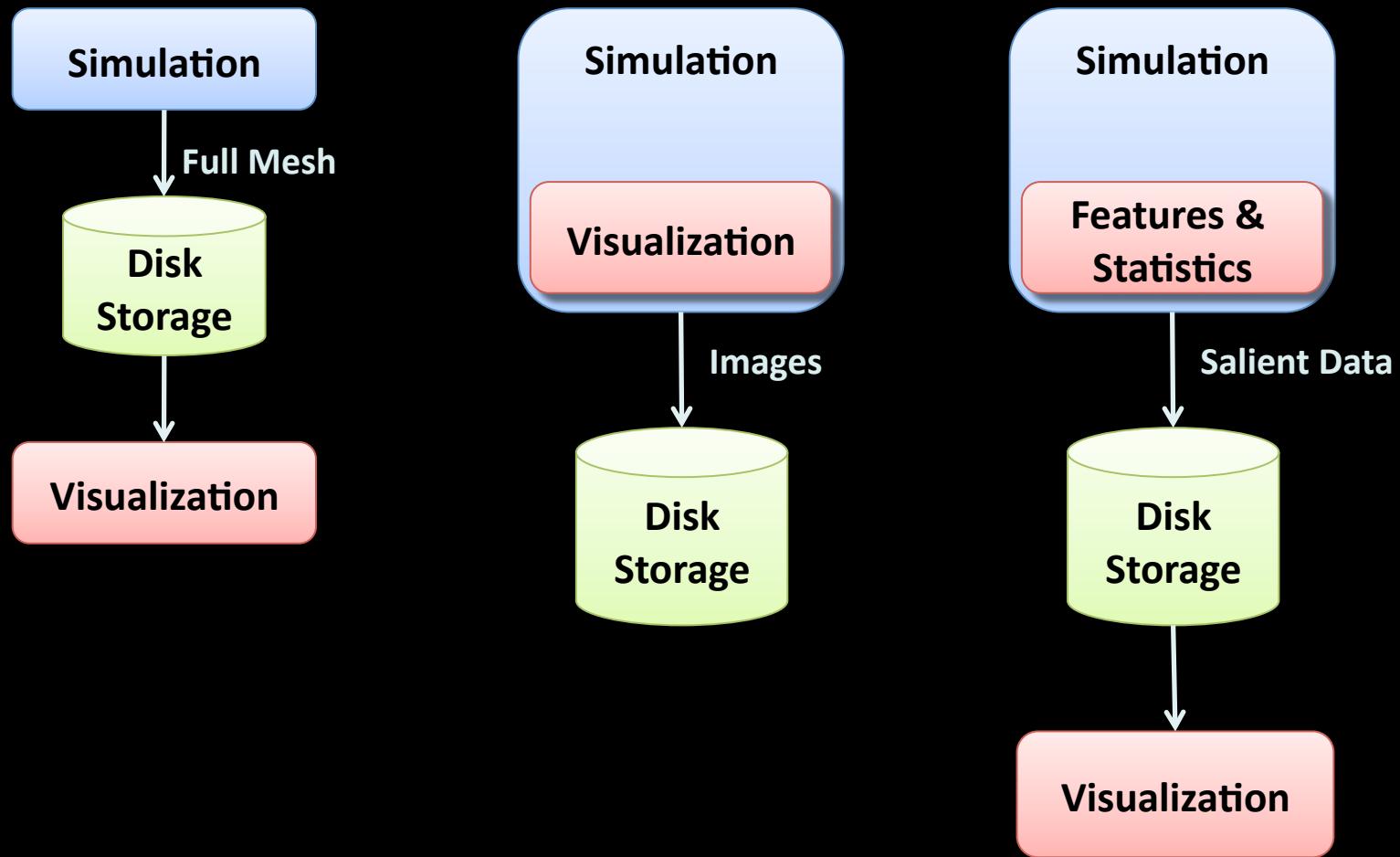


1 frame per 100 steps  
~1% write time



1 frame per 1 step  
~0.1% write time

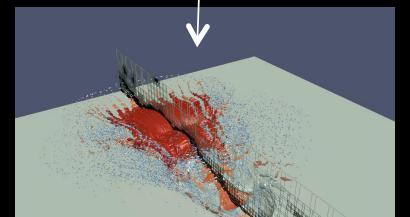




## Simulation

ParaView  
Coprocessing

Output  
Processed  
Data

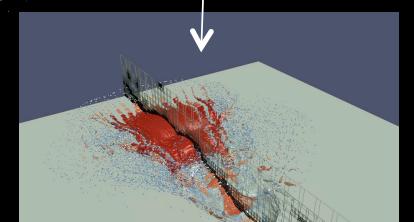
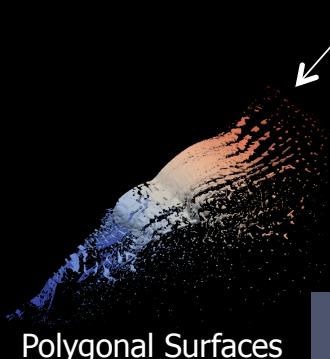


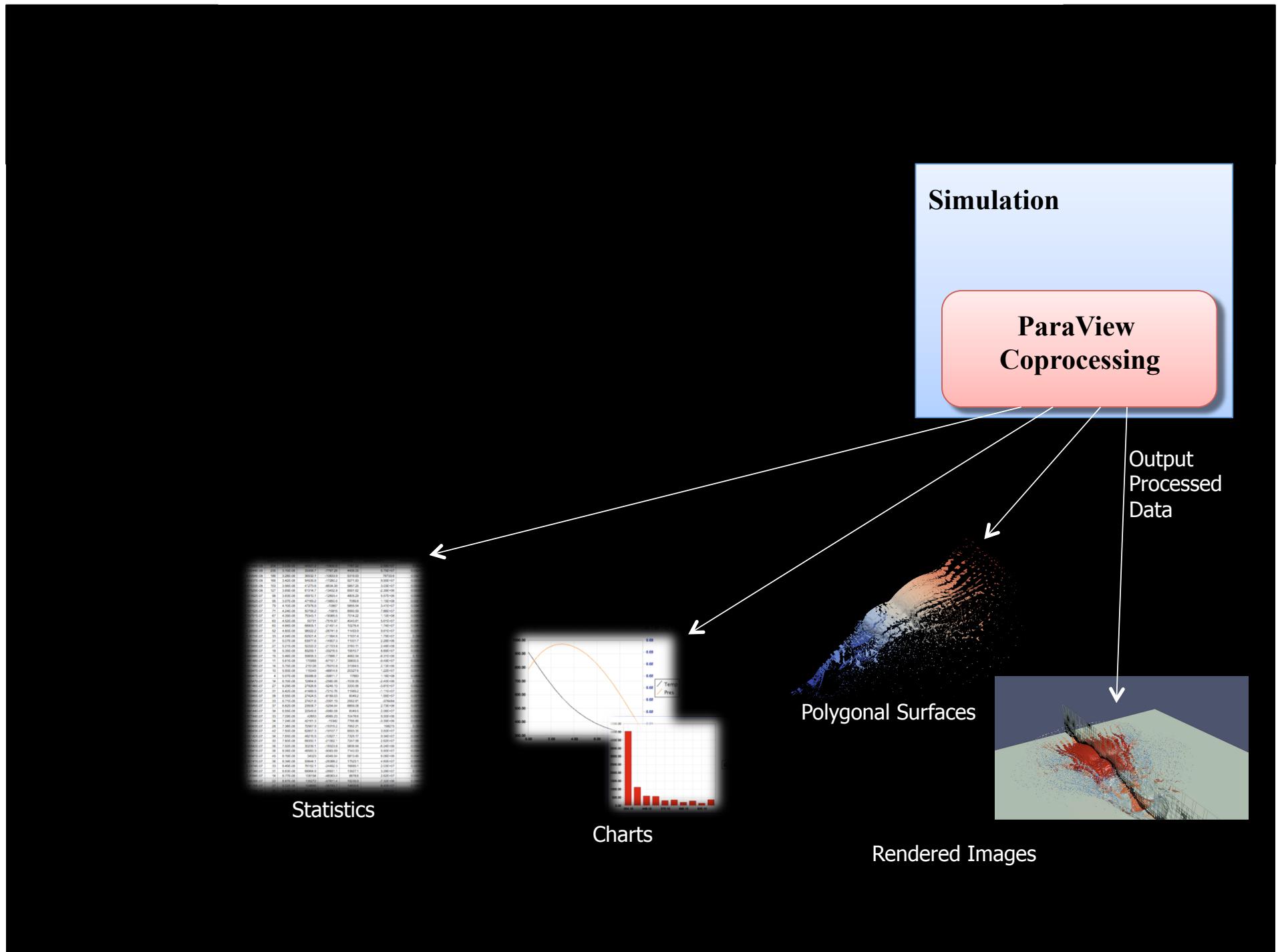
Rendered Images

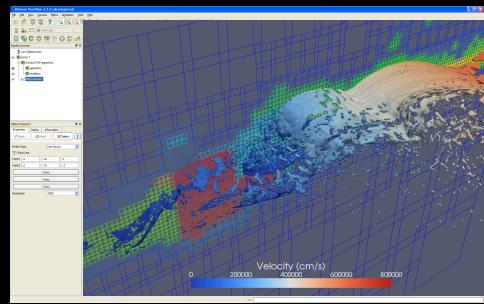
## Simulation

ParaView  
Coprocessing

Output  
Processed  
Data







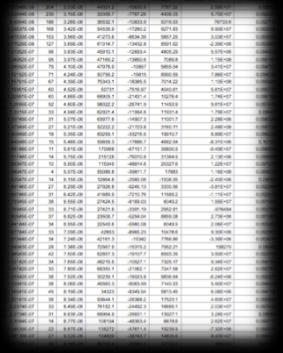
Script Export

```
# Create the reader and set the filename.
reader = servermanager.sources.Reader(FileNames=path)
view = servermanager.CreateRenderView()
repr = servermanager.CreateRepresentation(reader, view)
reader.UpdatePipeline()
dataInfo = reader.GetInformation()
pDInfo = dataInfo.GetPointDataInformation()
arrayInfo = pDInfo.GetArrayInformation("displacement9")
if arrayInfo:
    # get the range for the magnitude of displacement9
    range = arrayInfo.GetComponentRange(-1)
    lut = servermanager.rendering.PVLookupTable()
    lut.RGBPoints = [range[0], 0.0, 0.0, 1.0,
                     range[1], 1.0, 0.0, 0.0]
    lut.VectorMode = "Magnitude"
    repr.LookupTable = lut
    repr.ColorArrayName = "displacement9"
    repr.ColorAttributeType = "POINT_DATA"
```

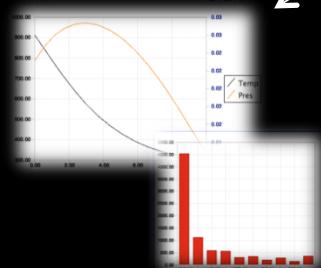
## Simulation

### ParaView Coprocessing

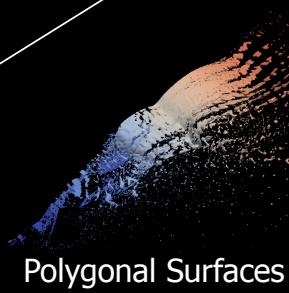
Augmented  
script in input  
deck.



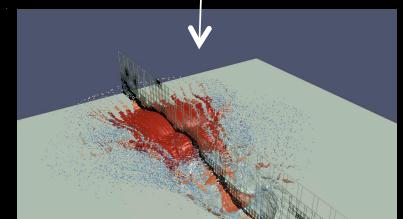
Statistics



Charts

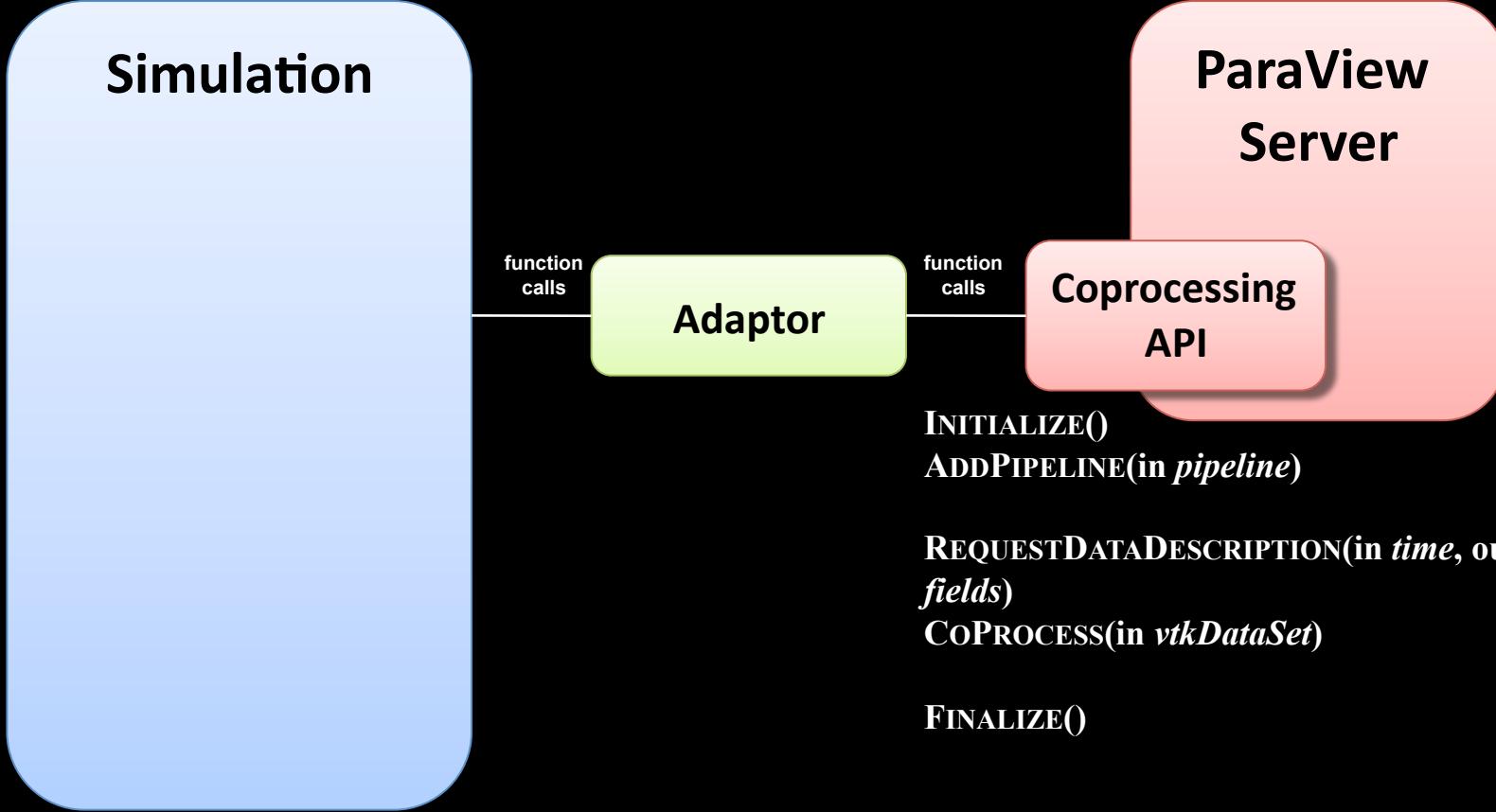


Polygonal Surfaces



Rendered Images

Output  
Processed  
Data





# Example Problem Sets



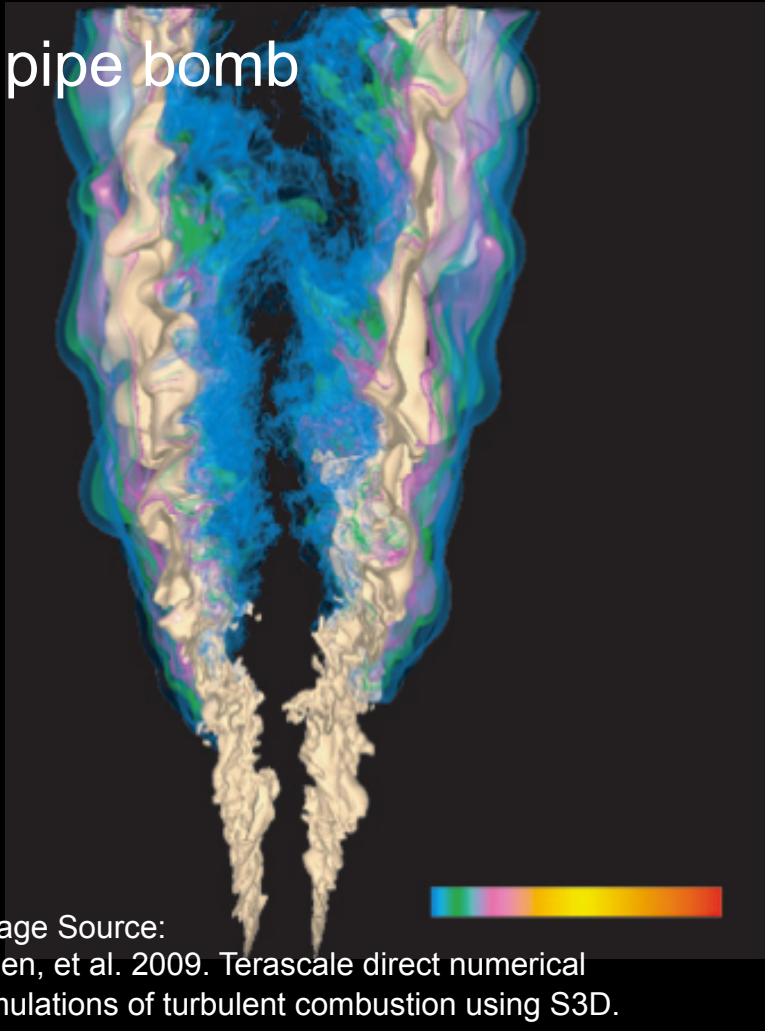
- Ignition/extinction events in burning fuel
- Fragment detection of exploding pipe bomb
- Jet flow over full wing



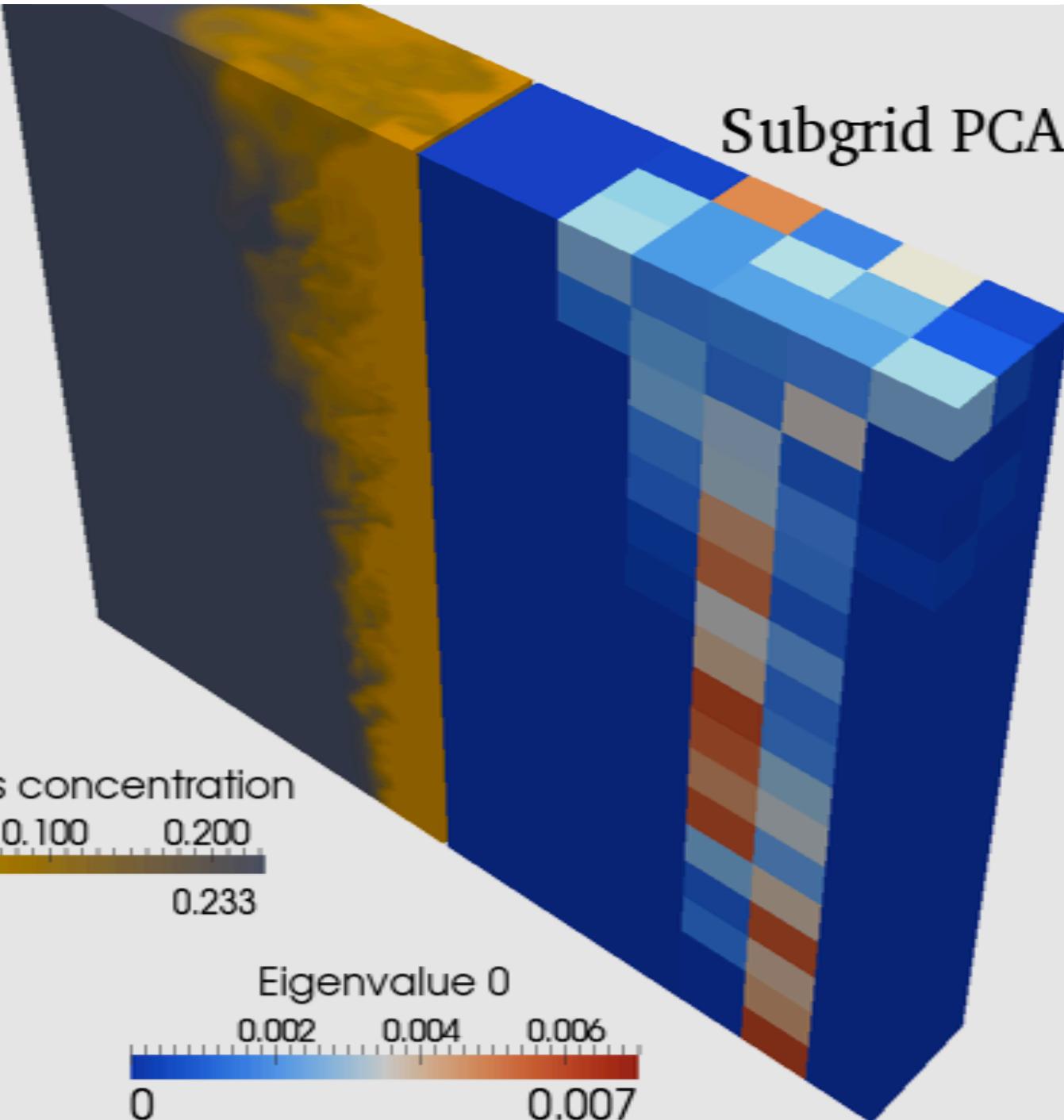
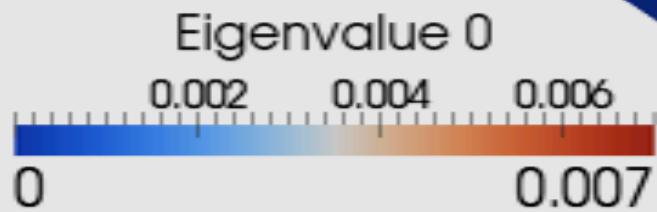
# Example Problem Sets

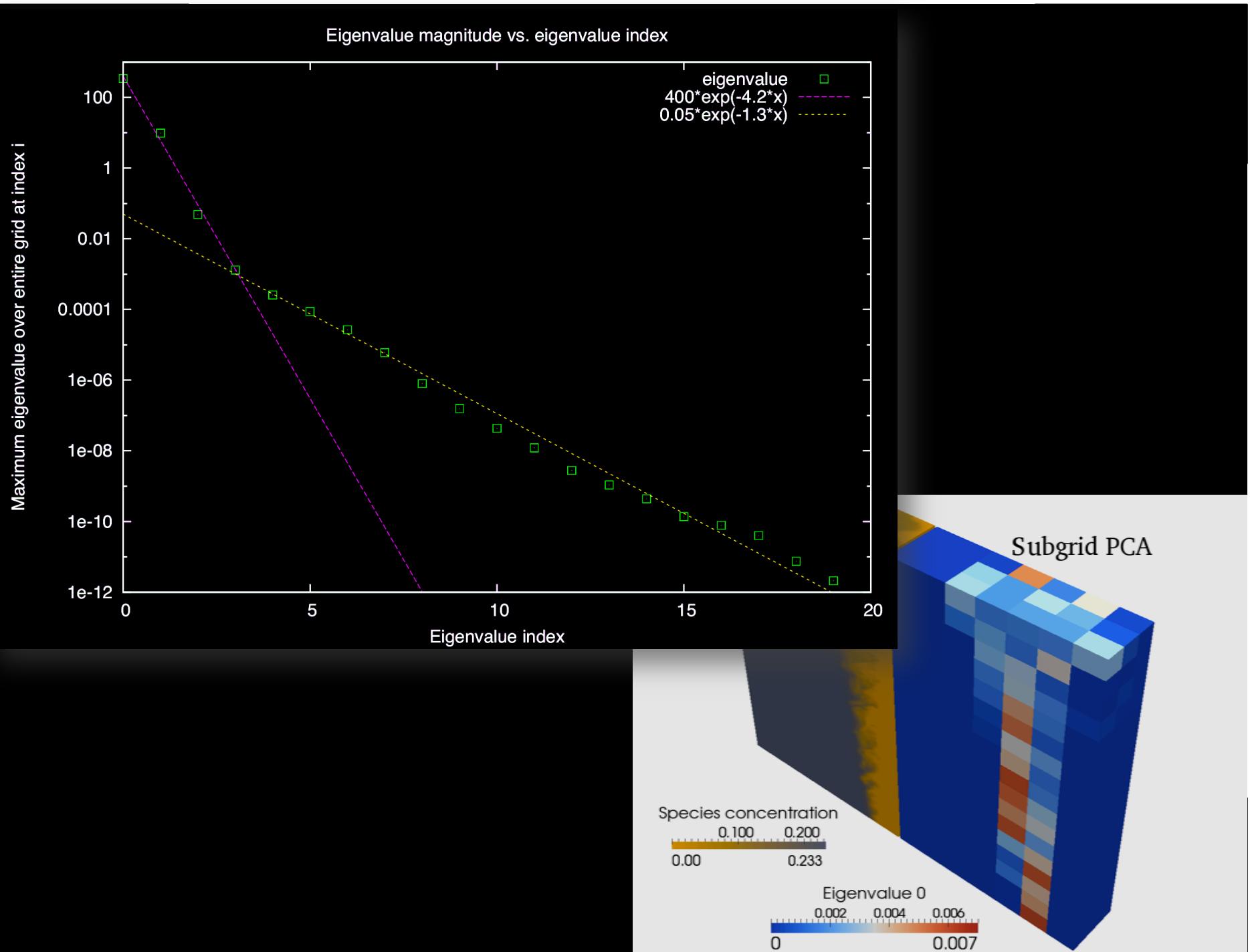


- **Ignition/extinction events in burning fuel**
  - S3D, Sandia California
- Fragment detection of exploding pipe bomb
- Jet flow over full wing



# Subgrid PCA





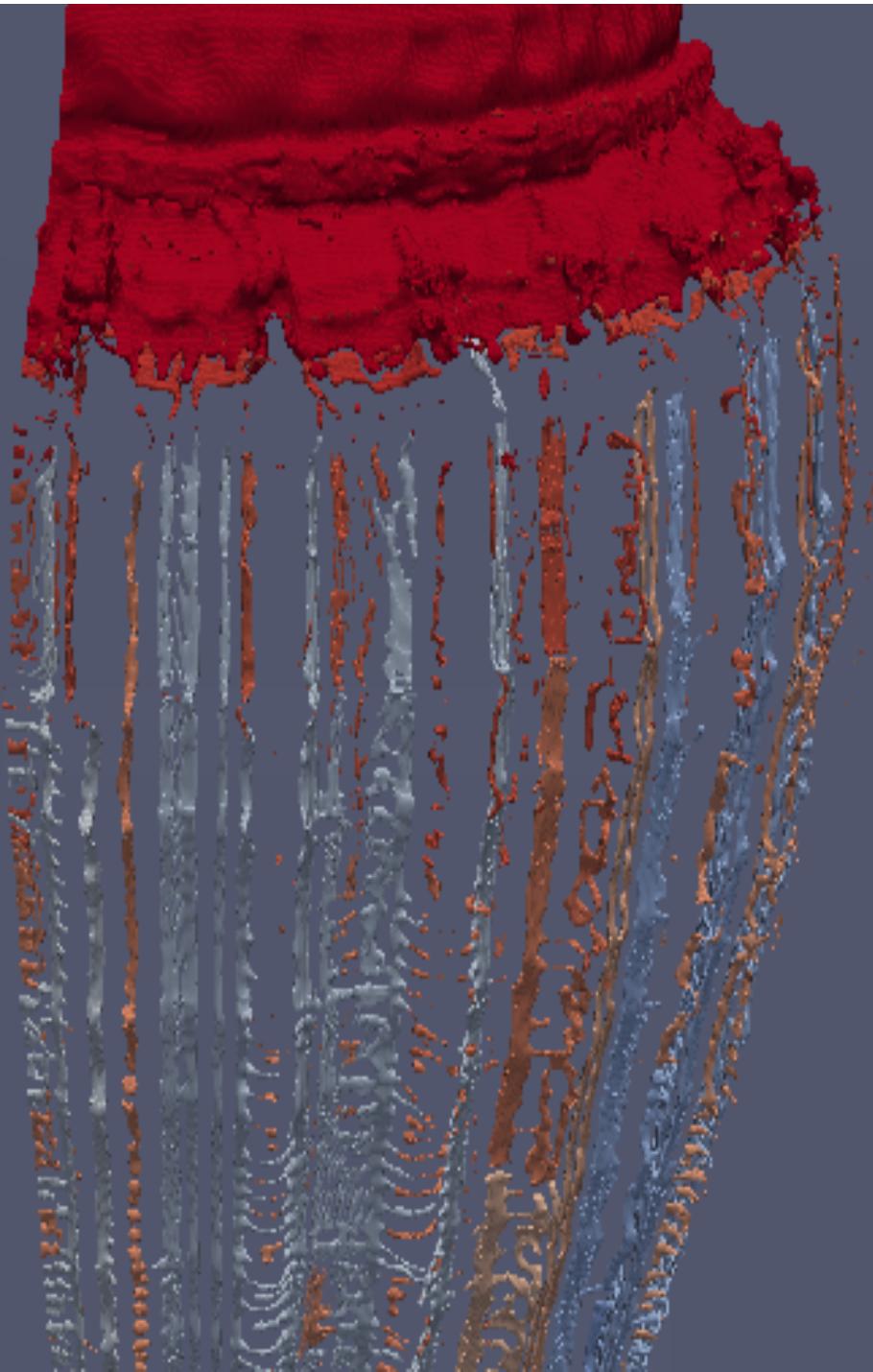


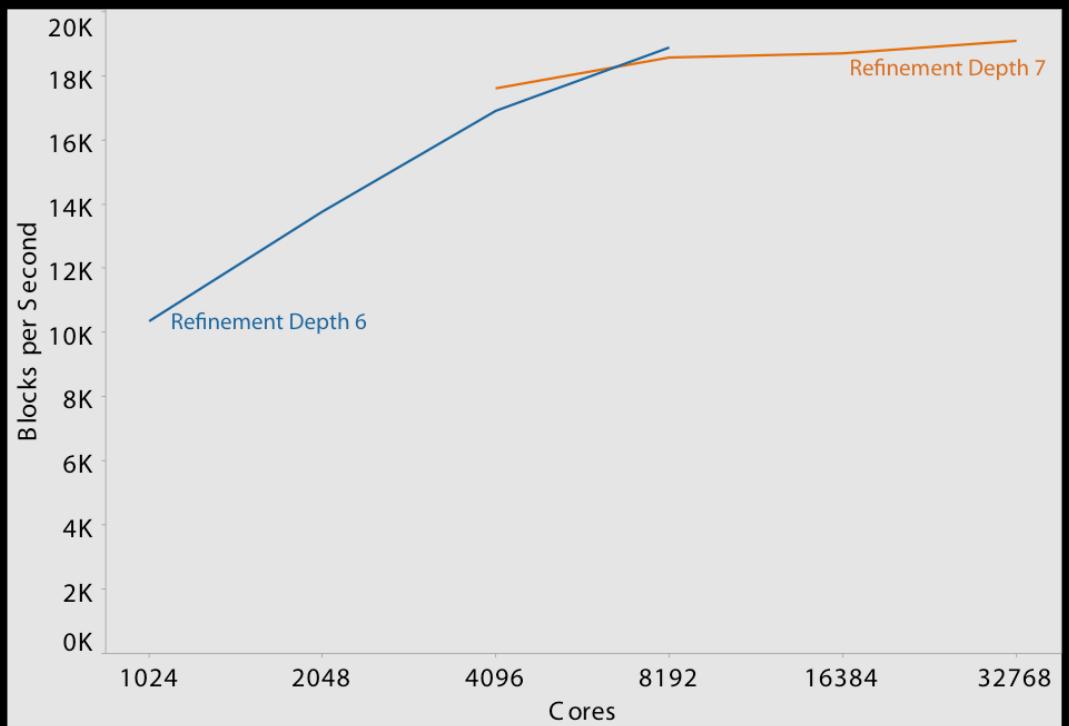
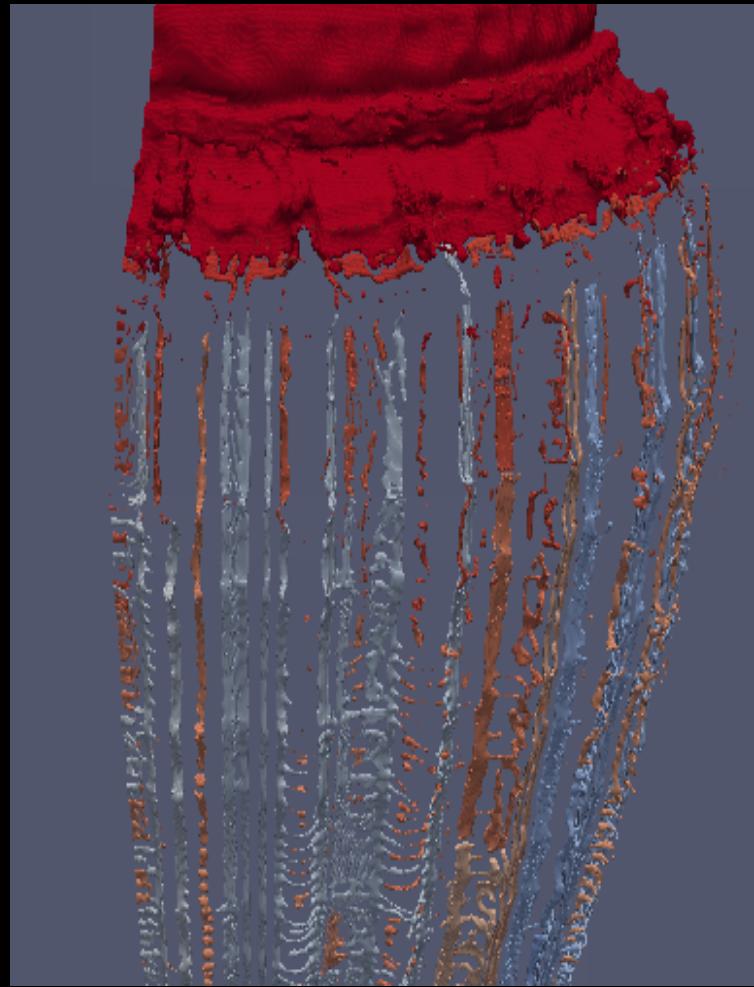
# Example Problem Sets

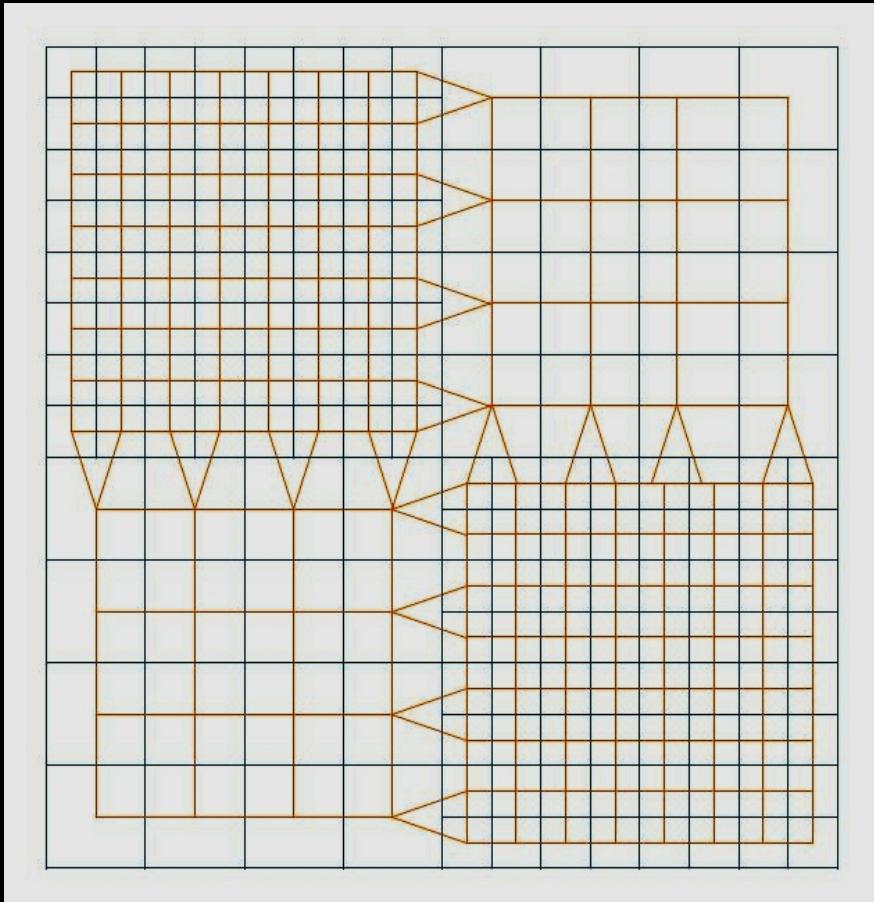
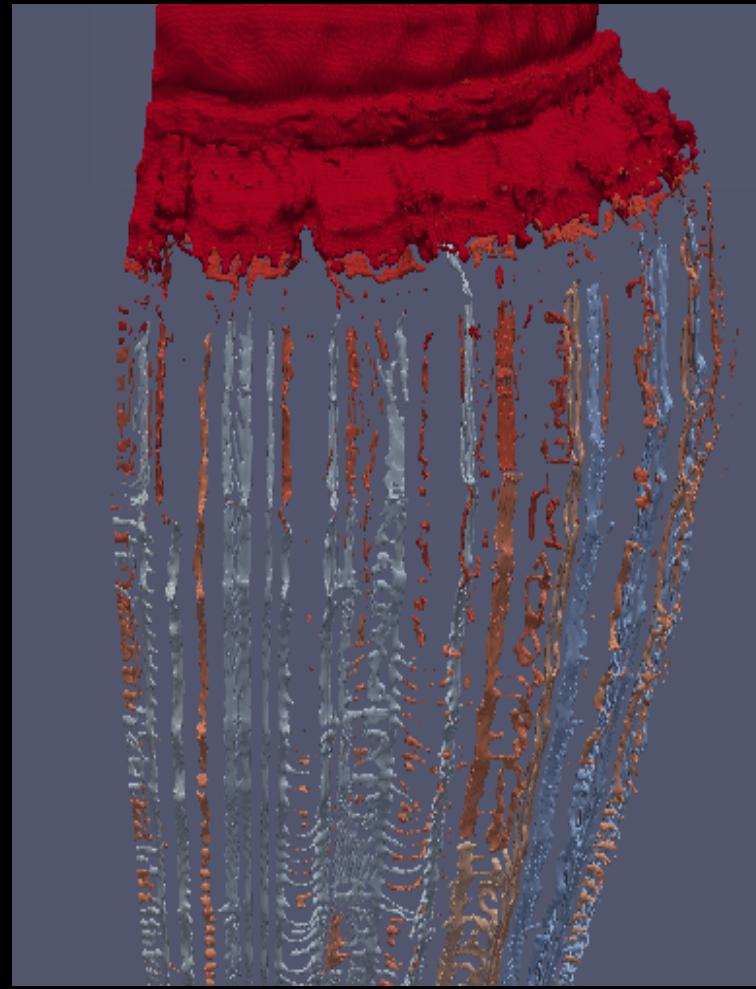


- Ignition/extinction events in burning fuel
- **Fragment detection of exploding pipe bomb**
  - CTH, Sandia New Mexico
- Jet flow over full wing







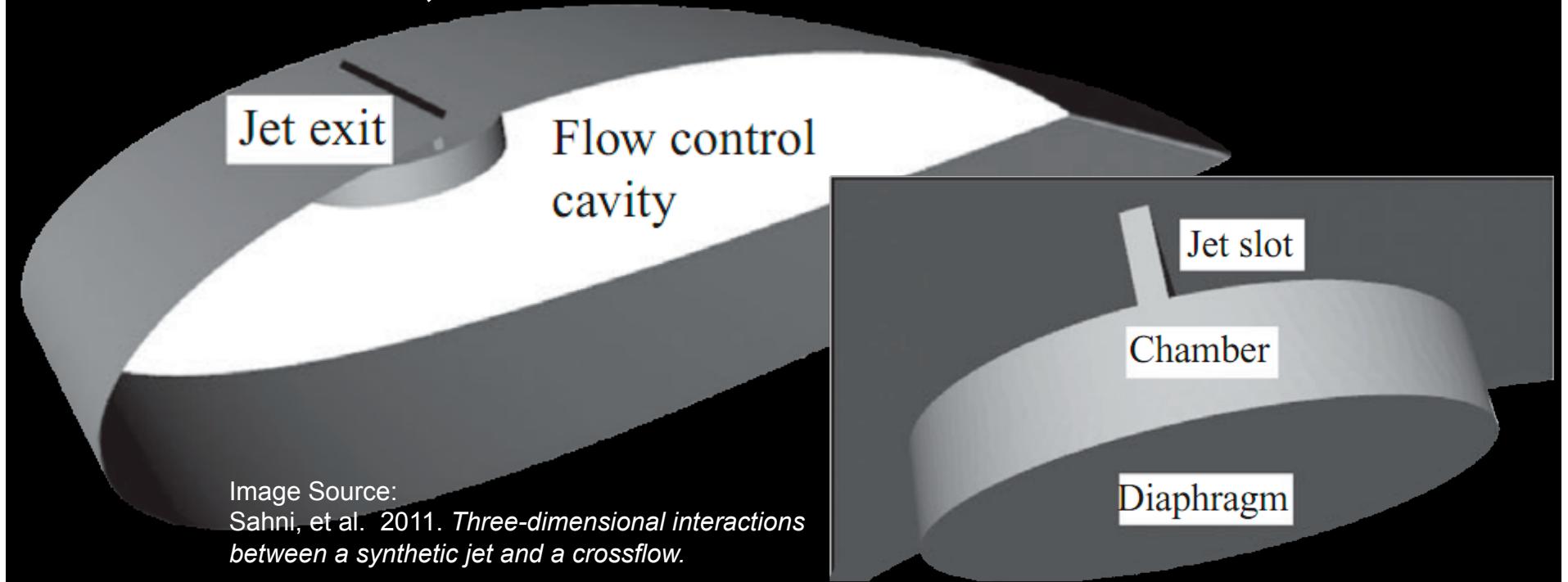


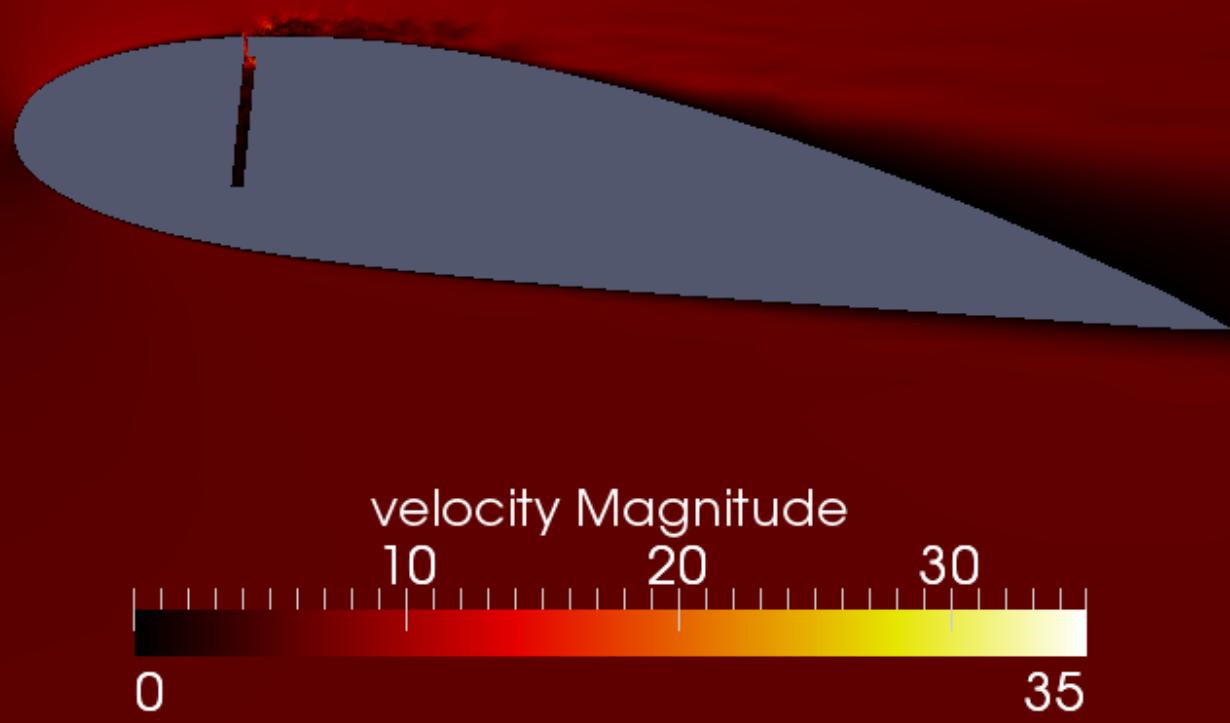


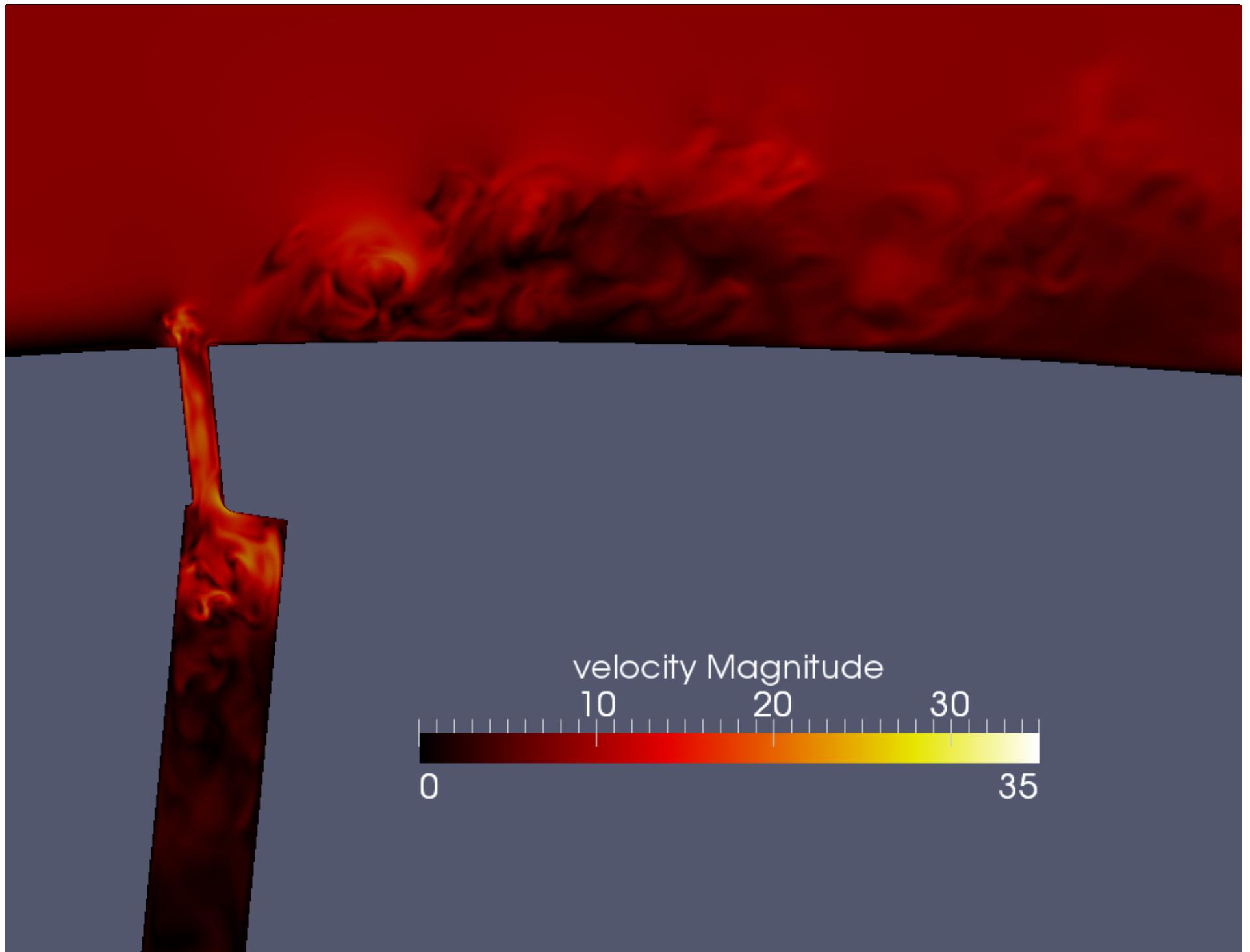
# Example Problem Sets

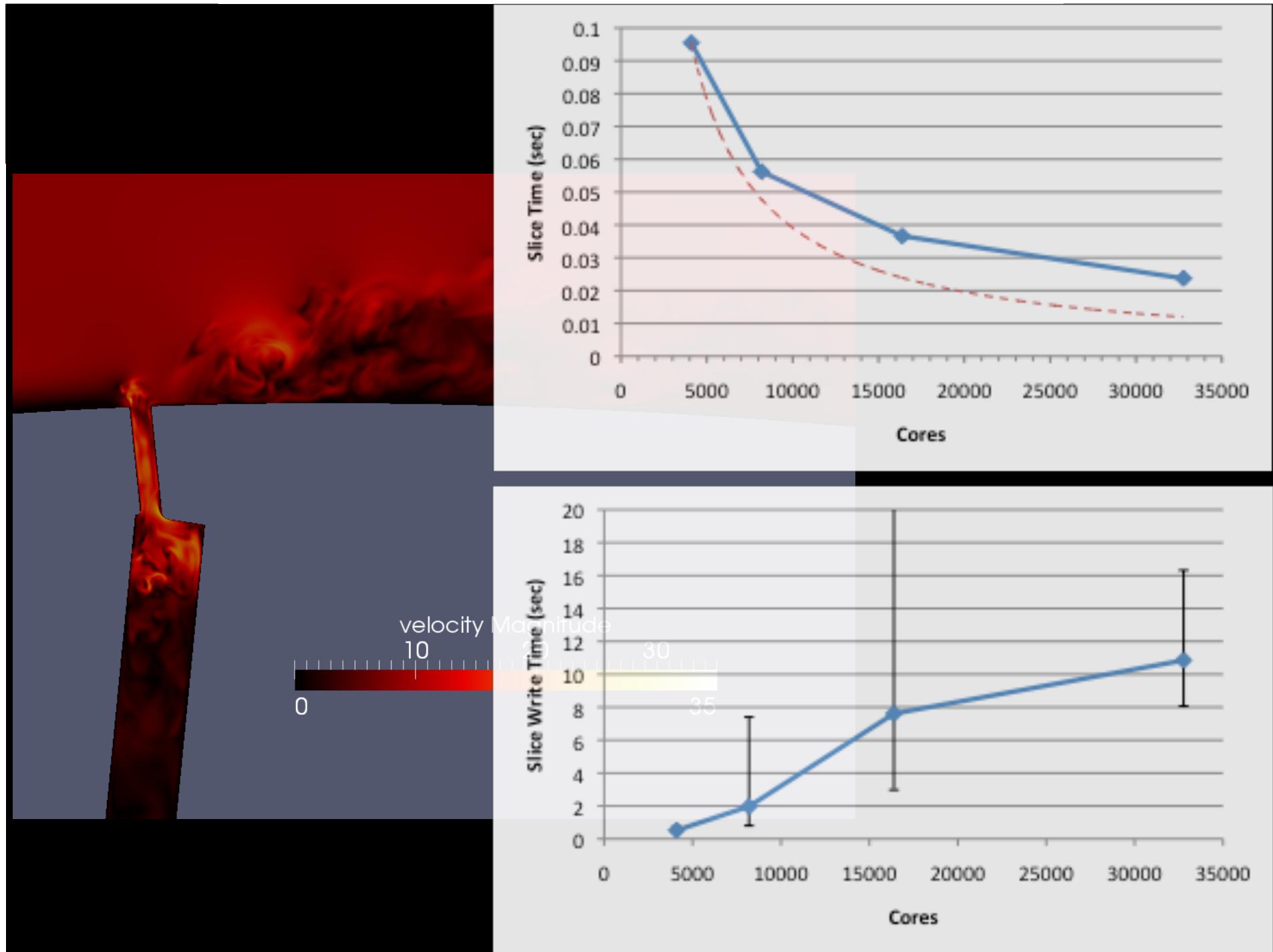


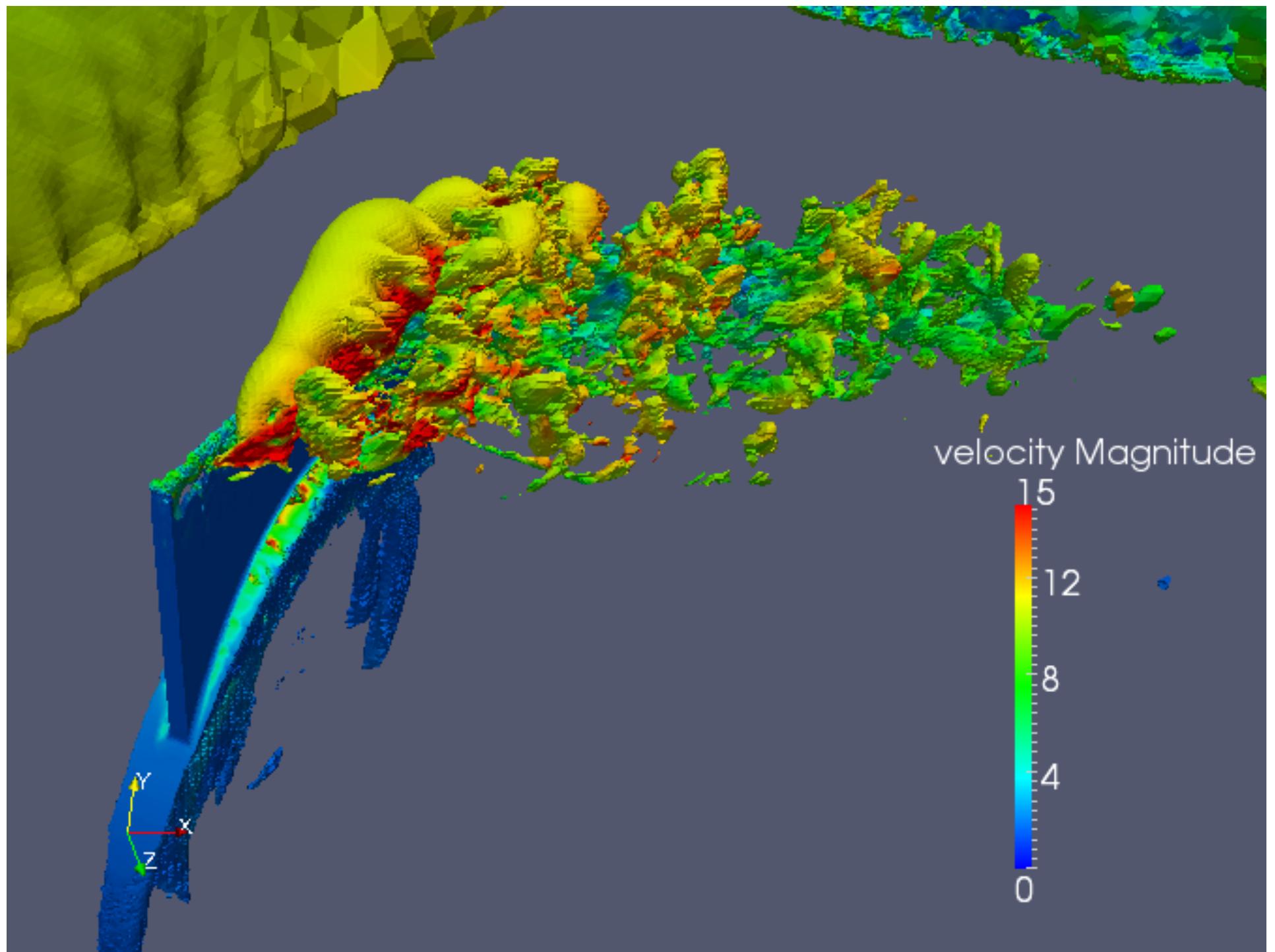
- Ignition/extinction events in burning fuel
- Fragment detection of exploding pipe bomb
- **Jet flow over full wing**
  - Phasta, UC Boulder and Kitware

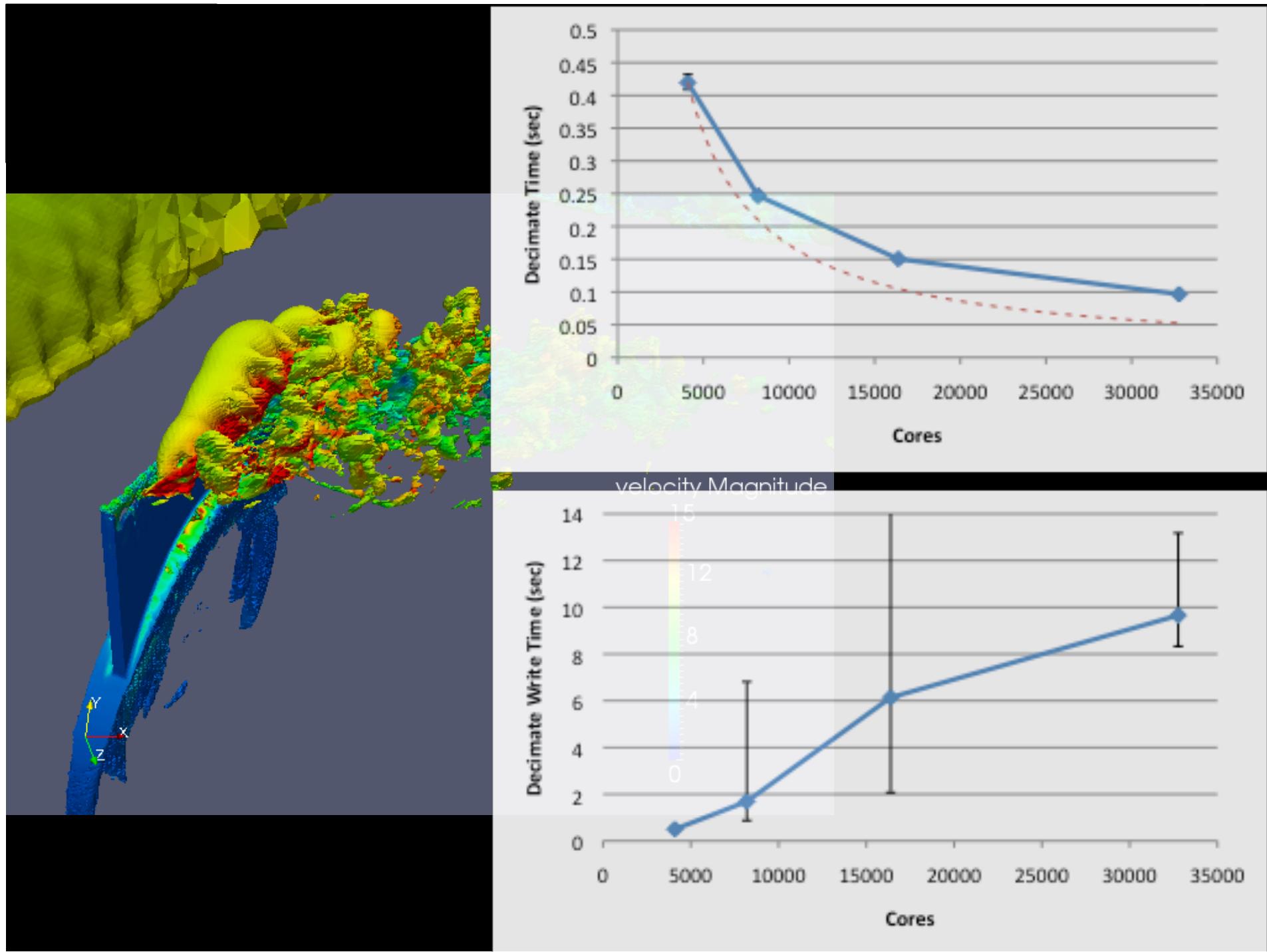






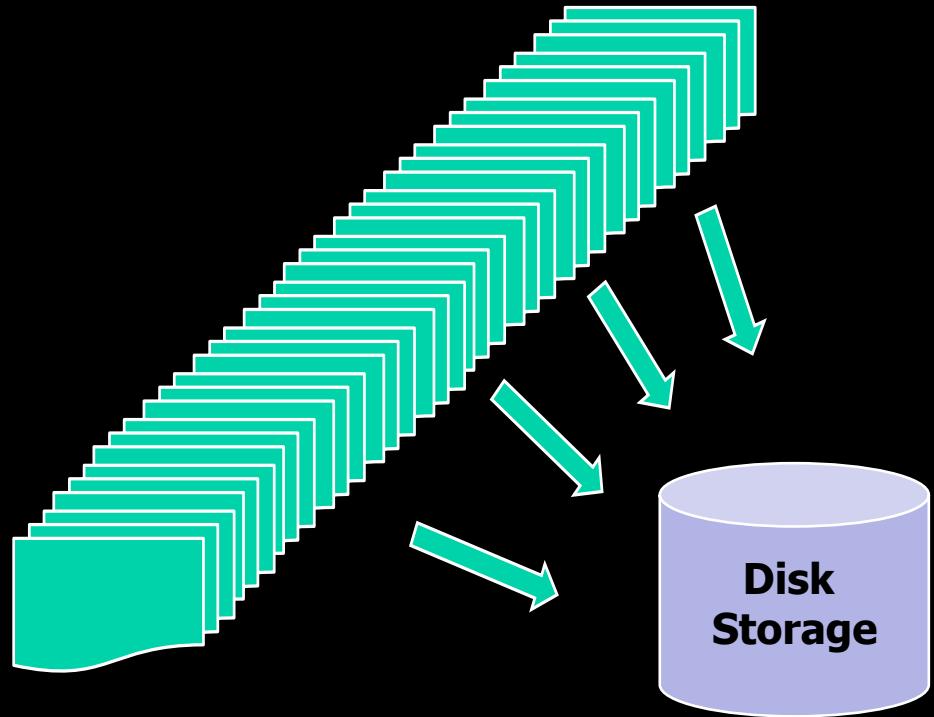
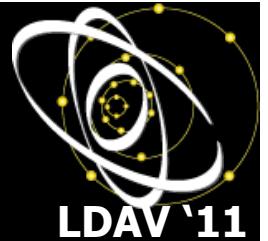








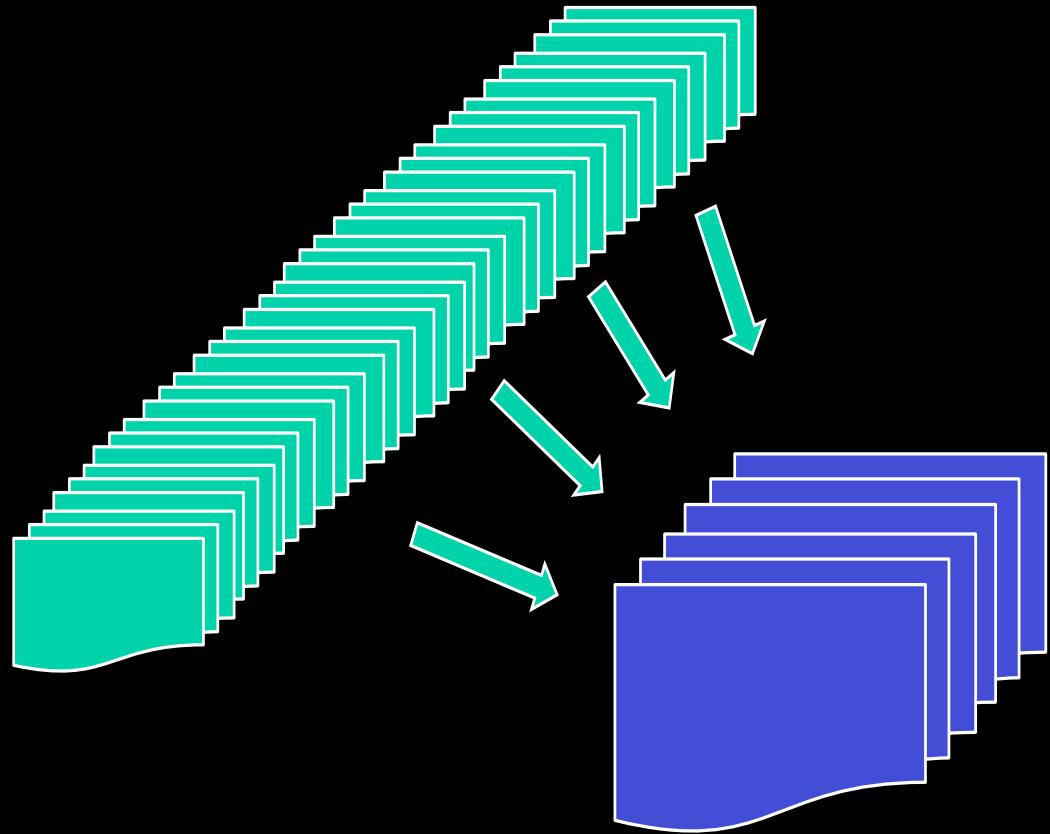
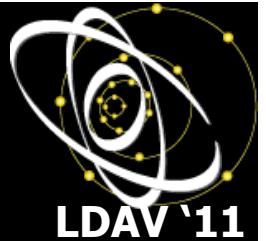
# In Transit Visualization



Full scale  
Simulation  
w/ In situ



# In Transit Visualization

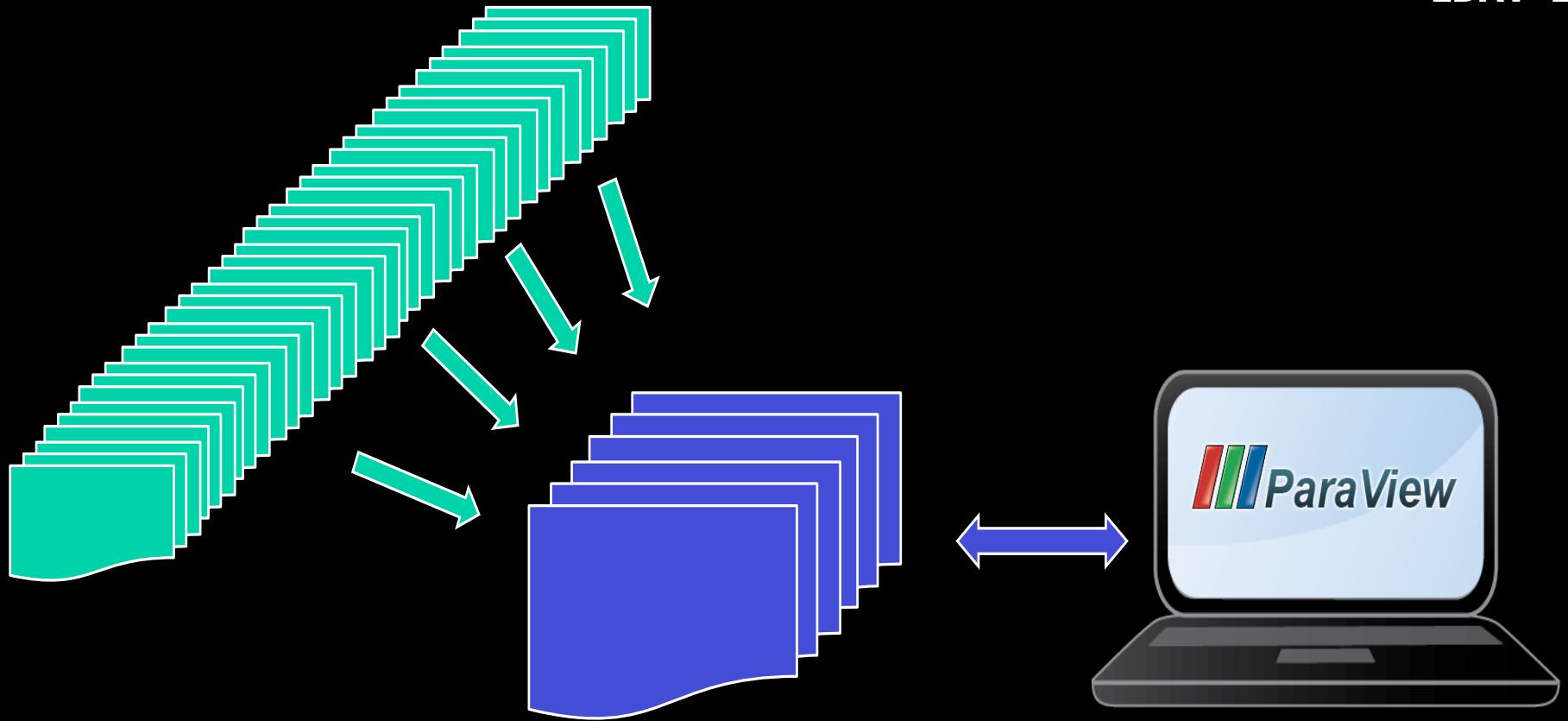


Full scale  
Simulation  
w/ In situ

Smaller scale  
Covisualization



# In Transit Visualization



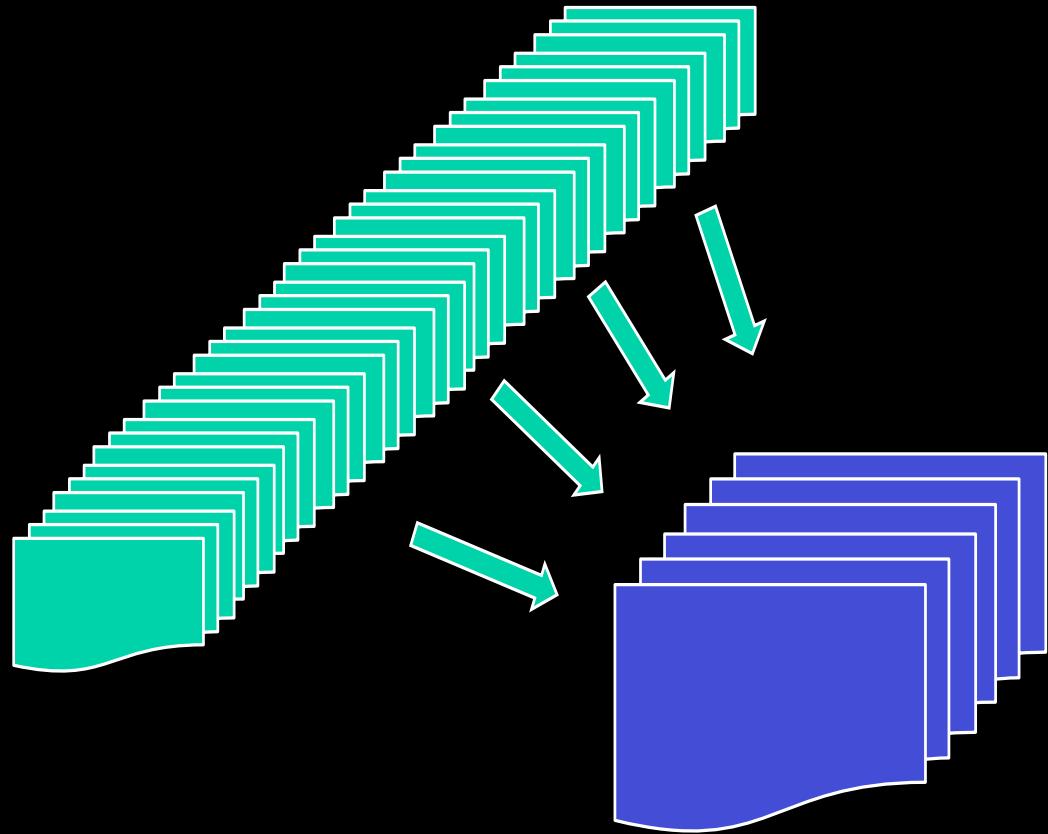
Full scale  
Simulation  
w/ In situ

Smaller scale  
Covisualization

Interactive Client



# In Transit Visualization



16k cores  
IBM BG/P

10 Viz Nodes

~1 Step/Sec  
80% simulation  
20% visualization



# Thanks for your attention



**Nathan Fabian, ndfabia@sandia.gov**

- <http://paraview.org/paraview/resources/software.html>
  - Latest version: 3.12.0-RC2
- “Large Scale Visualization with ParaView”
  - Date: Sun Nov 13
  - Time: 8:30am – 12:00pm
- “In-Situ Visualization with ParaView”
  - Date: Sun Nov 13
  - Time: 1:30pm – 5:00pm

