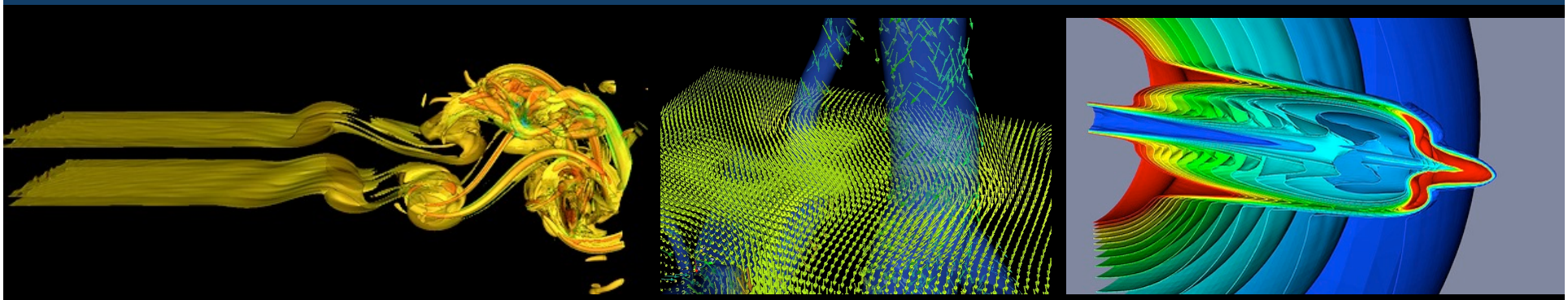
Exceptional service in the national interest

Sandia National Laboratories



ParaView

An End User Tool for Large-Scale Visualization

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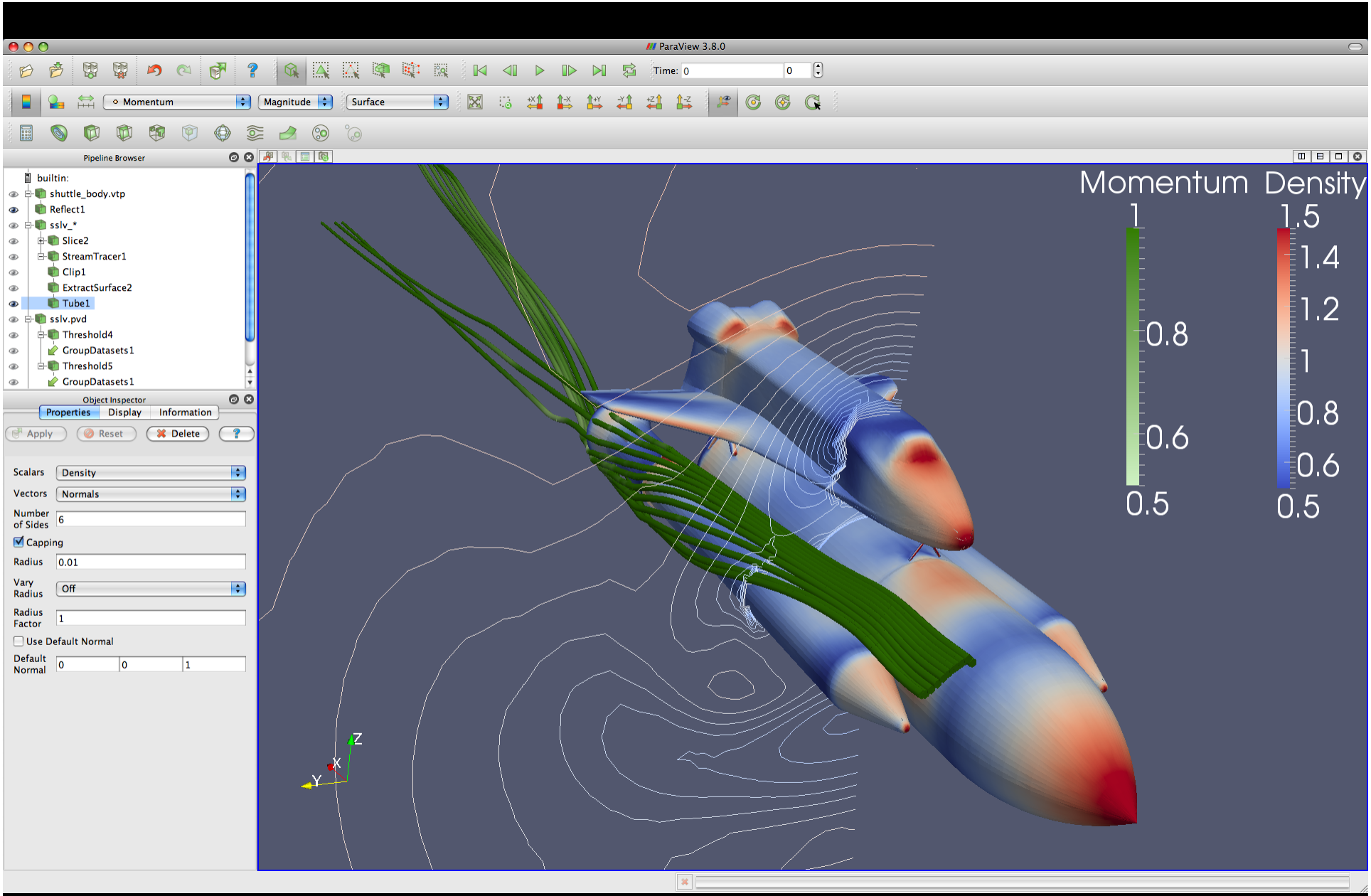
SAND NO. 2011-8972P/2012-5994P/2012-0754P

U.S. DEPARTMENT OF ENERGY

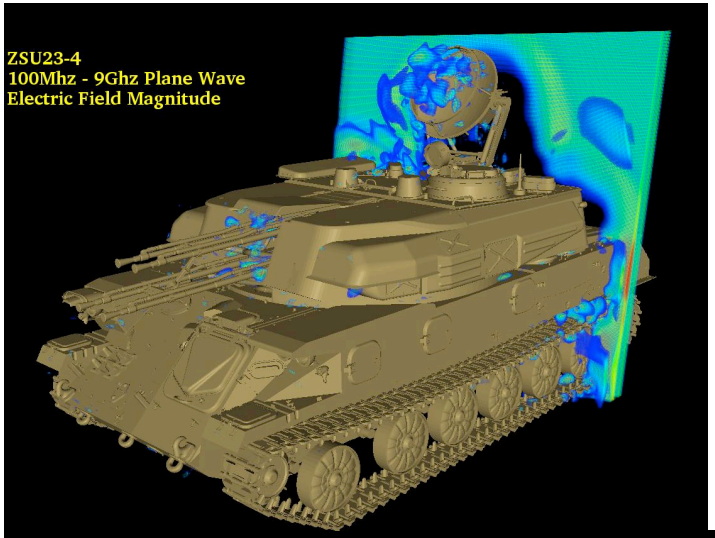
NNSA National Nuclear Security Administration



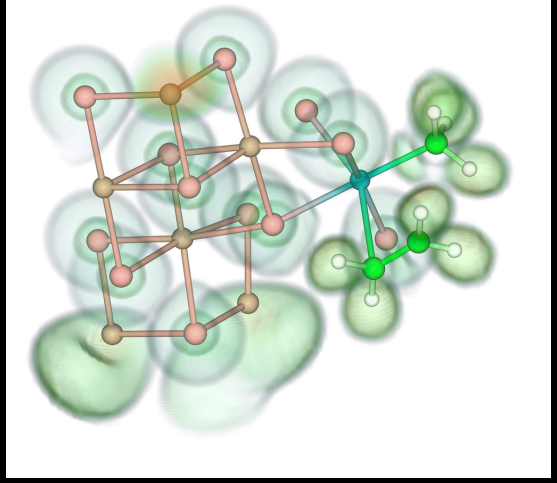
http://paraview.org

HPC wire Editors' Choice Awards 2010

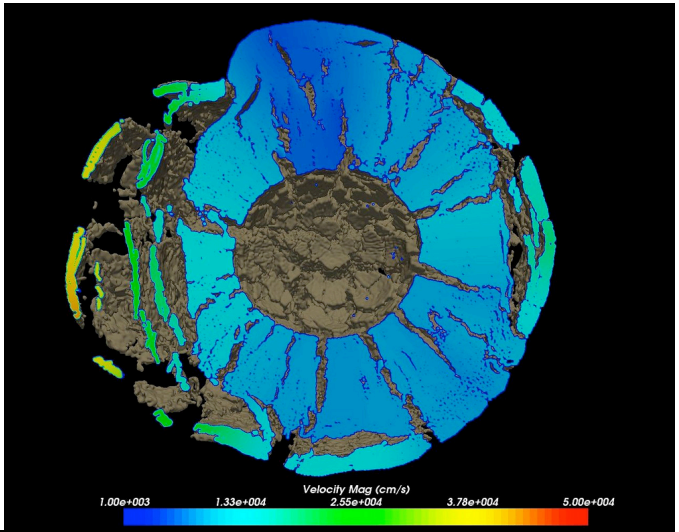
HPC wire Readers' Choice Awards 2010

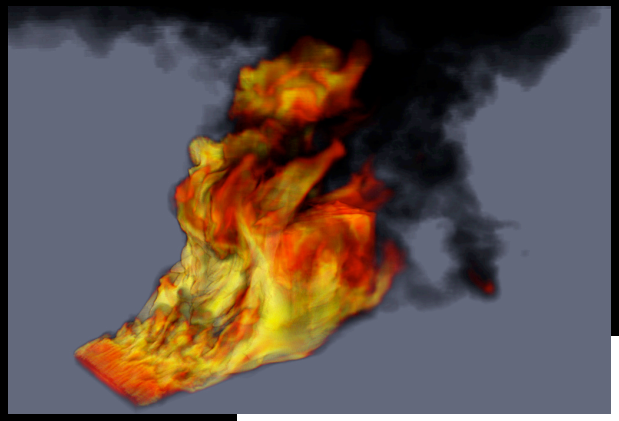


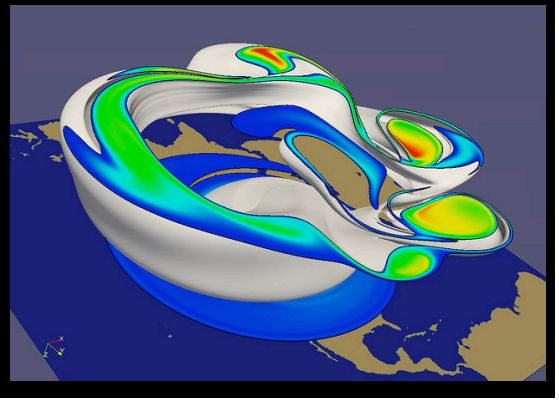
Jerry Clarke, US Army Research Laboratory

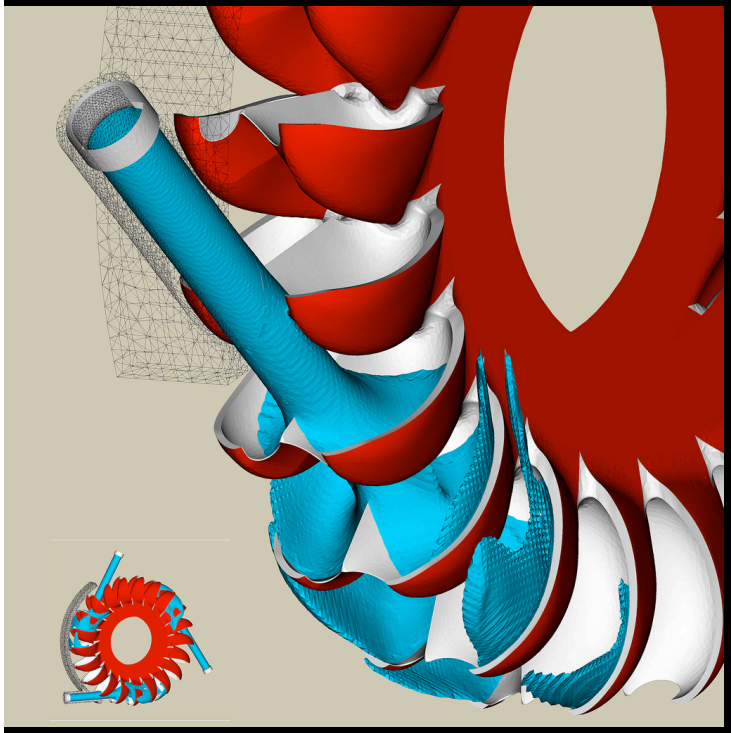


Swiss National Supercomputing Centre

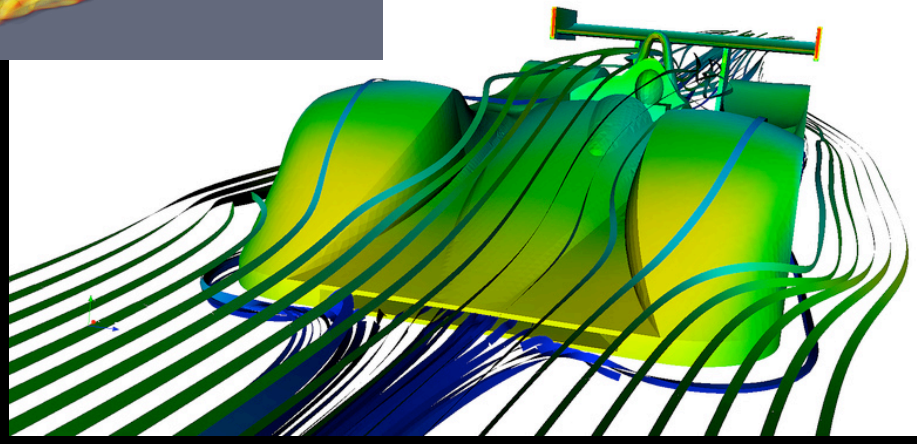








Swiss National Supercomputing Centre



Renato N. Elias, NACAD/COPPE/UFRJ, Rio de Janerio, Brazil

Important Stuff I Won't Talk About

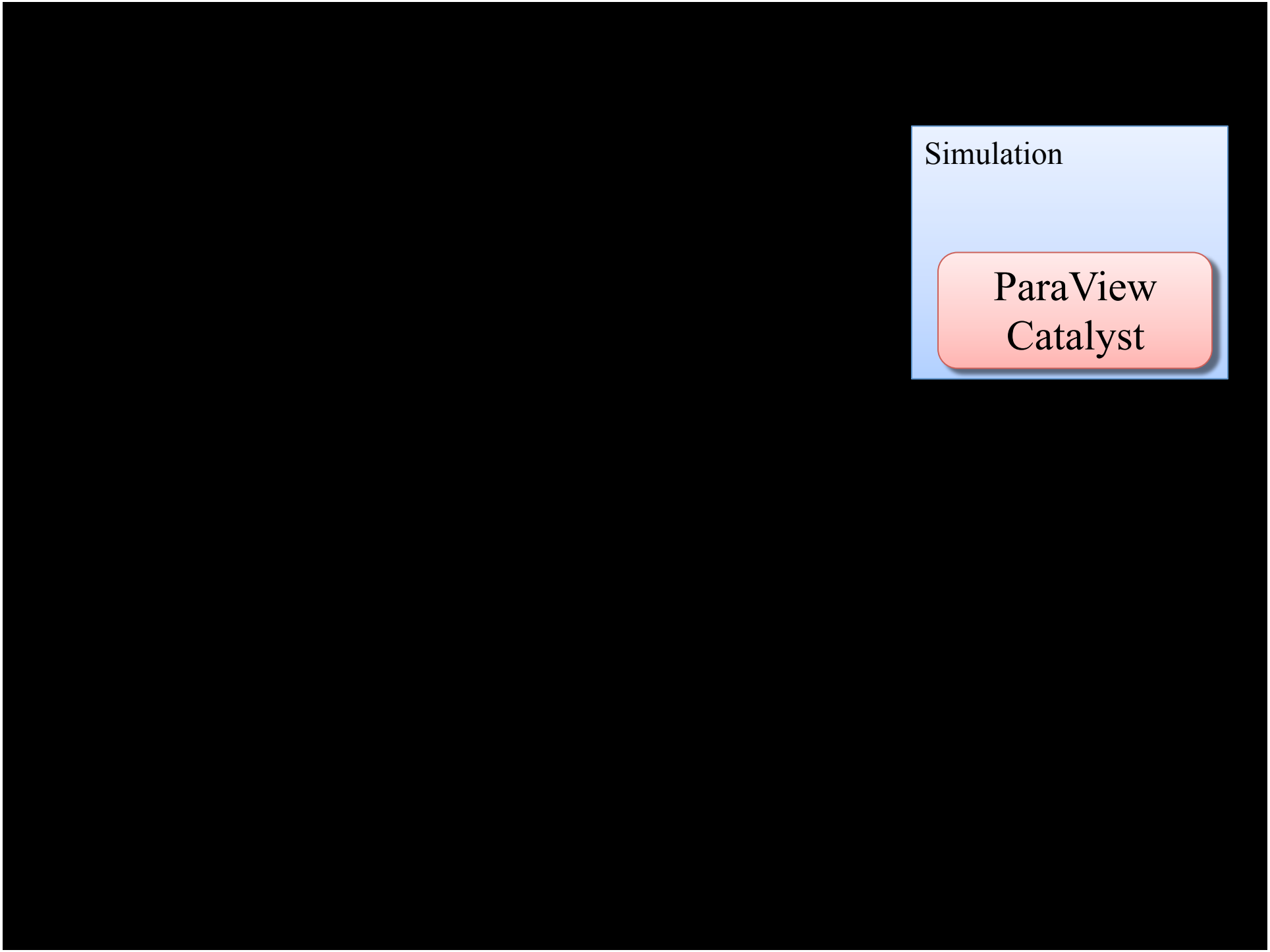
Sandia National Laboratories

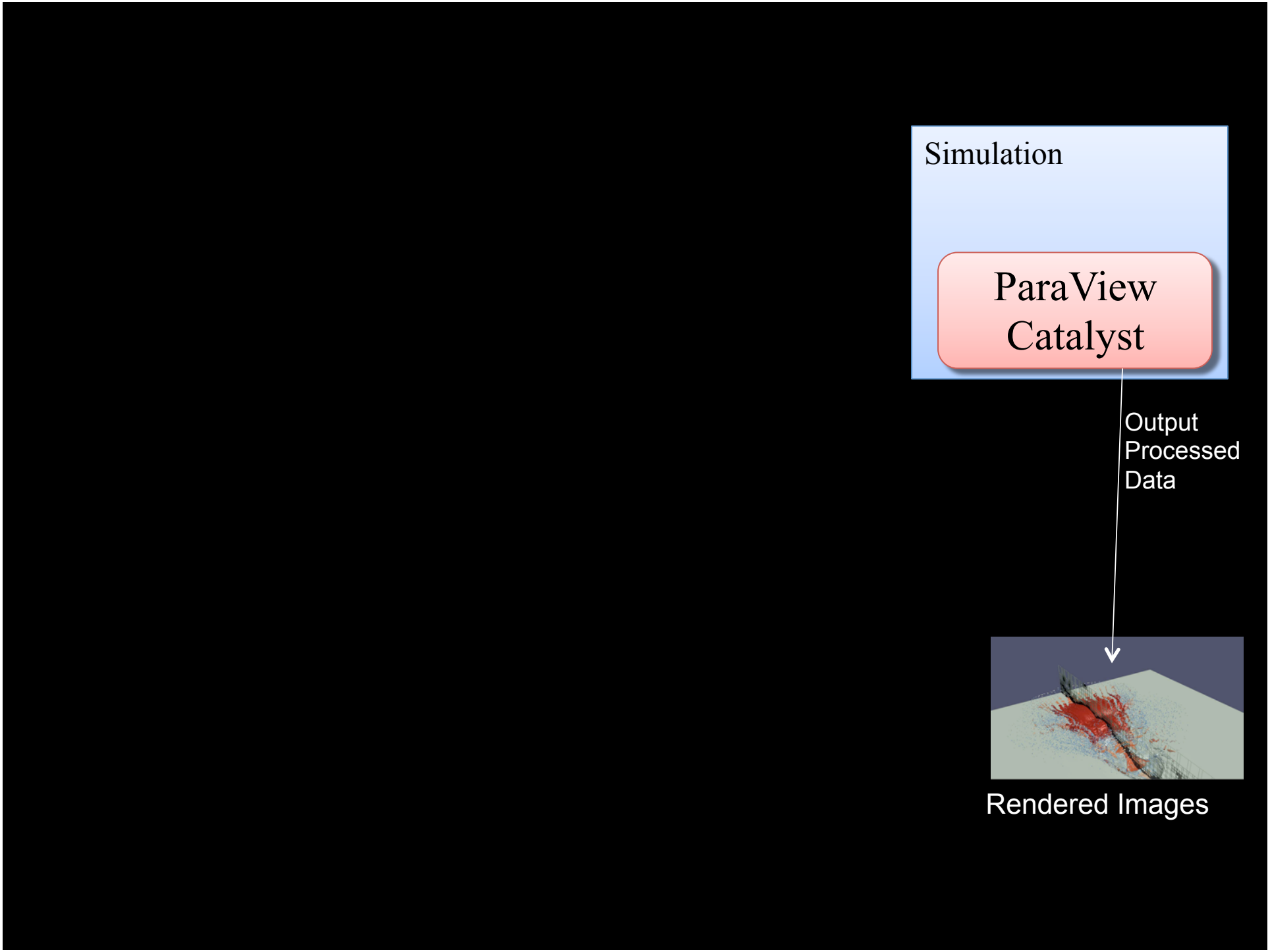
- Large Scale
  - Parallel client/server architecture
  - Demonstrated 100's of thousands processes, trillions of cells
- Next Generation Architectures
  - Multi-core, many-core
- Alternate Solutions
  - VisIt: DOE Funded, SciDAC supported, large scale, similar capabilities
  - EnSight: Commercially sold, parallel service
  - Others (Visus, VisTrails, MayaVi)
- Google "ParaView Tutorial"
  - Or come to Supercomputing

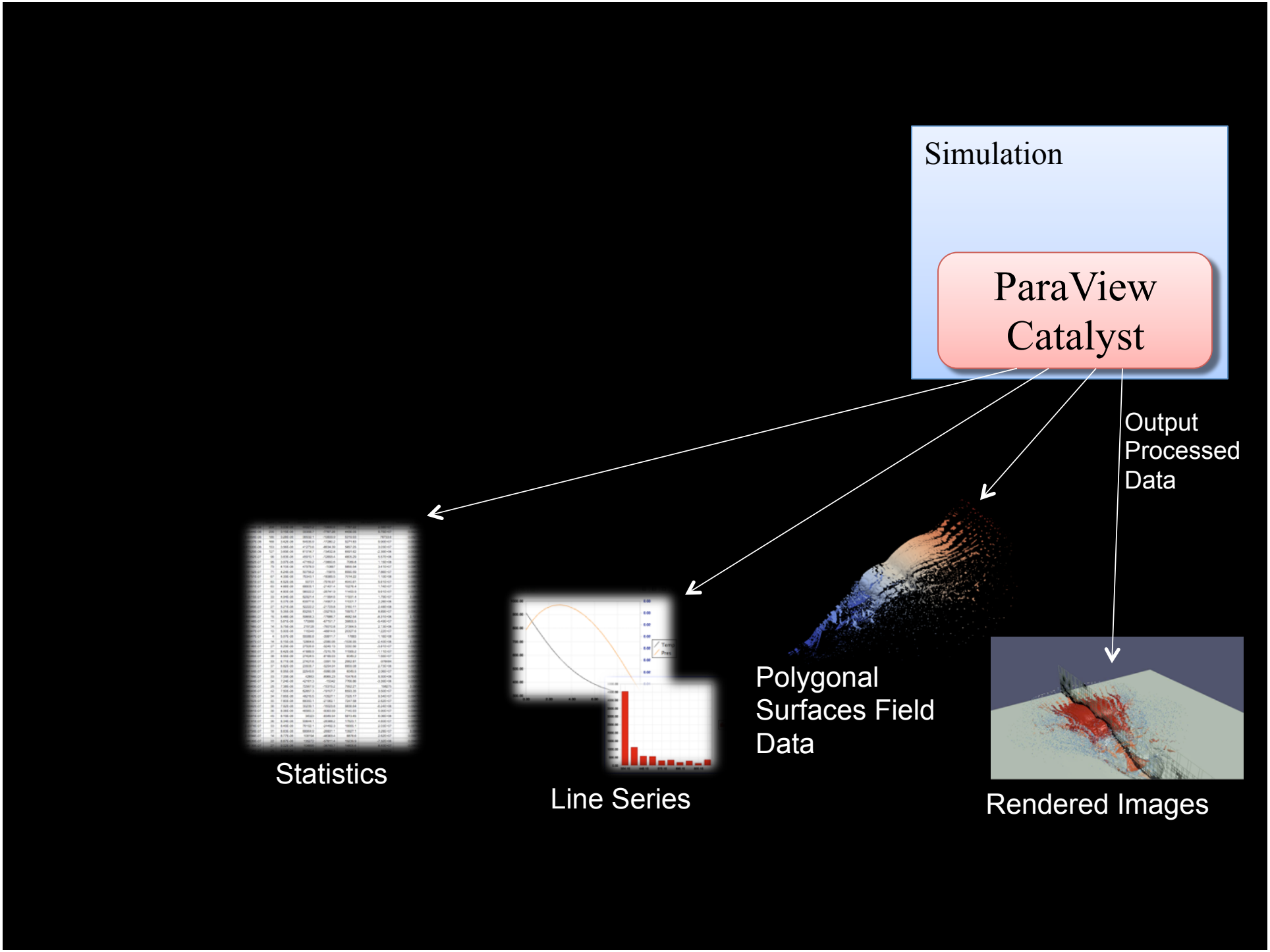
Space of "In Situ" Solutions

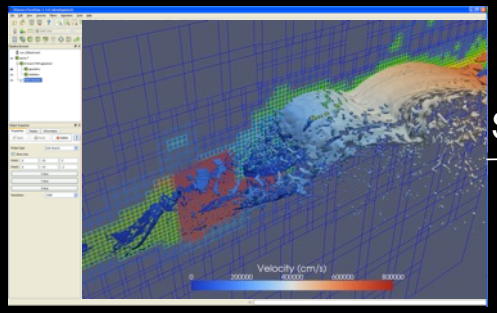
Sandia National Laboratories

	Capability	Coupling	Footprint	Transfer	Interactive
Tightly Integrated	Low	Tight	**Low**	**None**	No
Embedded	**High**	Tight	High	Possible memcpy	No
Hybrid	**High**	Tight	Medium	Subset Hi Speed Transfer	**Yes**
Co-Scheduled	**High**	**Loose**	~5% Extra Nodes	Hi Speed Transfer	**Yes**
Off-Line	**High**	**Loose**	**None**	Slow Persistent Storage Cost	**Yes**


Simulation
ParaView
Catalyst


Simulation
ParaView
Catalyst
Output
Processed
Data
Rendered Images


Simulation
ParaView Catalyst
Output Processed Data
Statistics
Line Series
Polygonal Surfaces Field Data
Rendered Images



Script Export

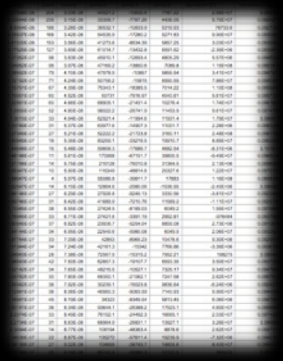
```
# Create the reader and set the filename.
reader = servermanager.sources.Reader(FileNames=path)
view = servermanager.CreateRenderView()
repr = servermanager.CreateRepresentation(reader, view)
reader.UpdatePipeline()
dataInfo = reader.GetDataInformation()
pDinfo = dataInfo.GetPointDataInformation()
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"
```

Augmented script in input deck.

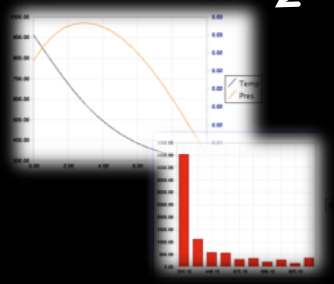
Simulation

ParaView Catalyst

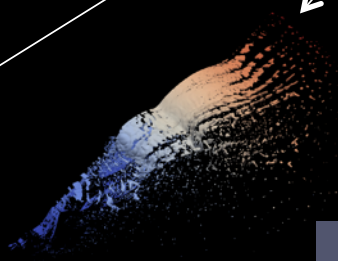
Output Processed Data



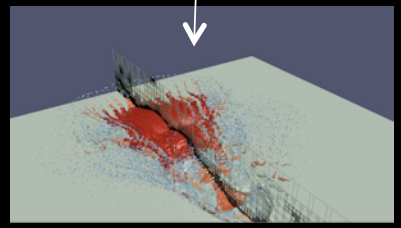
Statistics



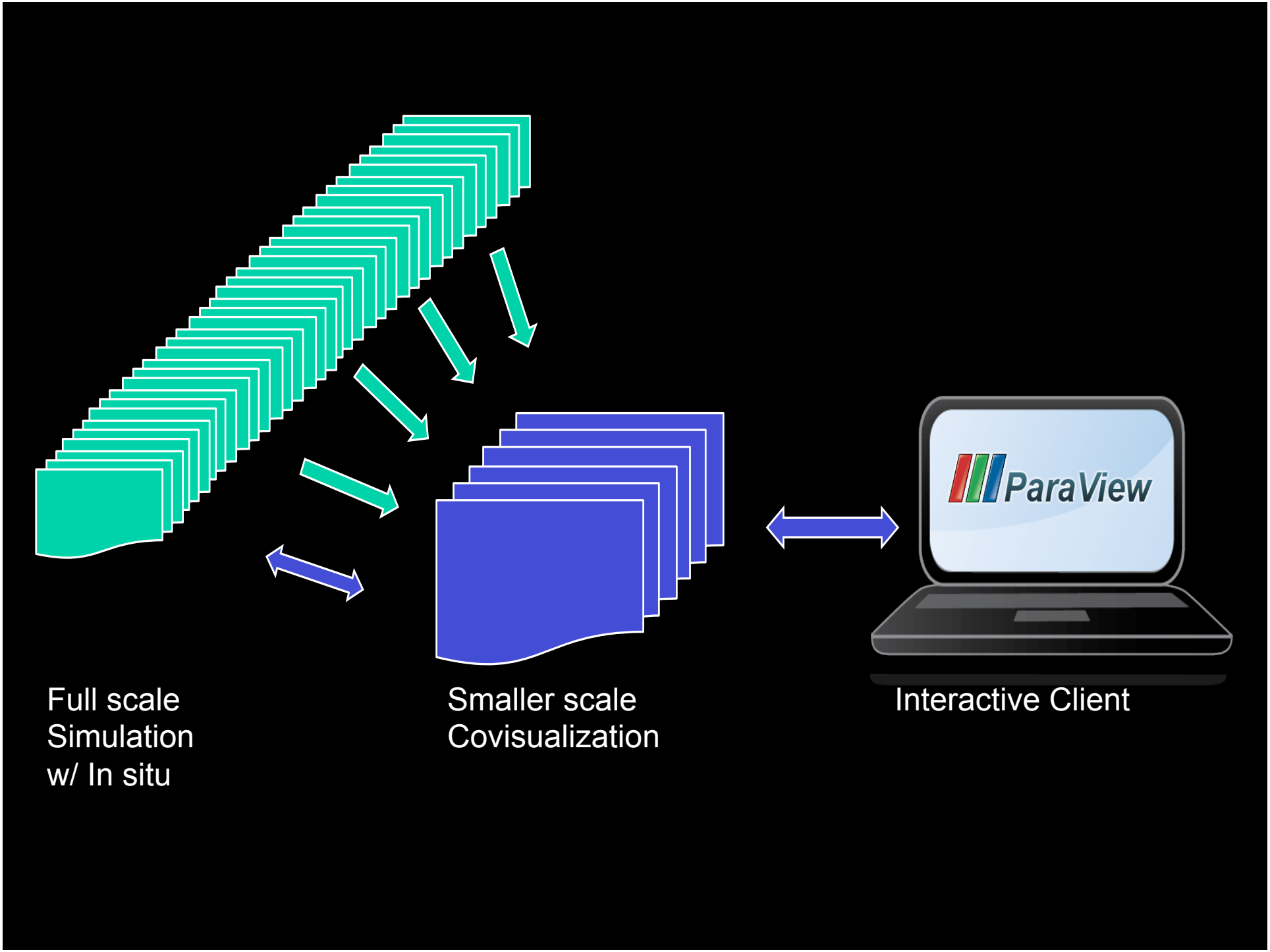
Line Series

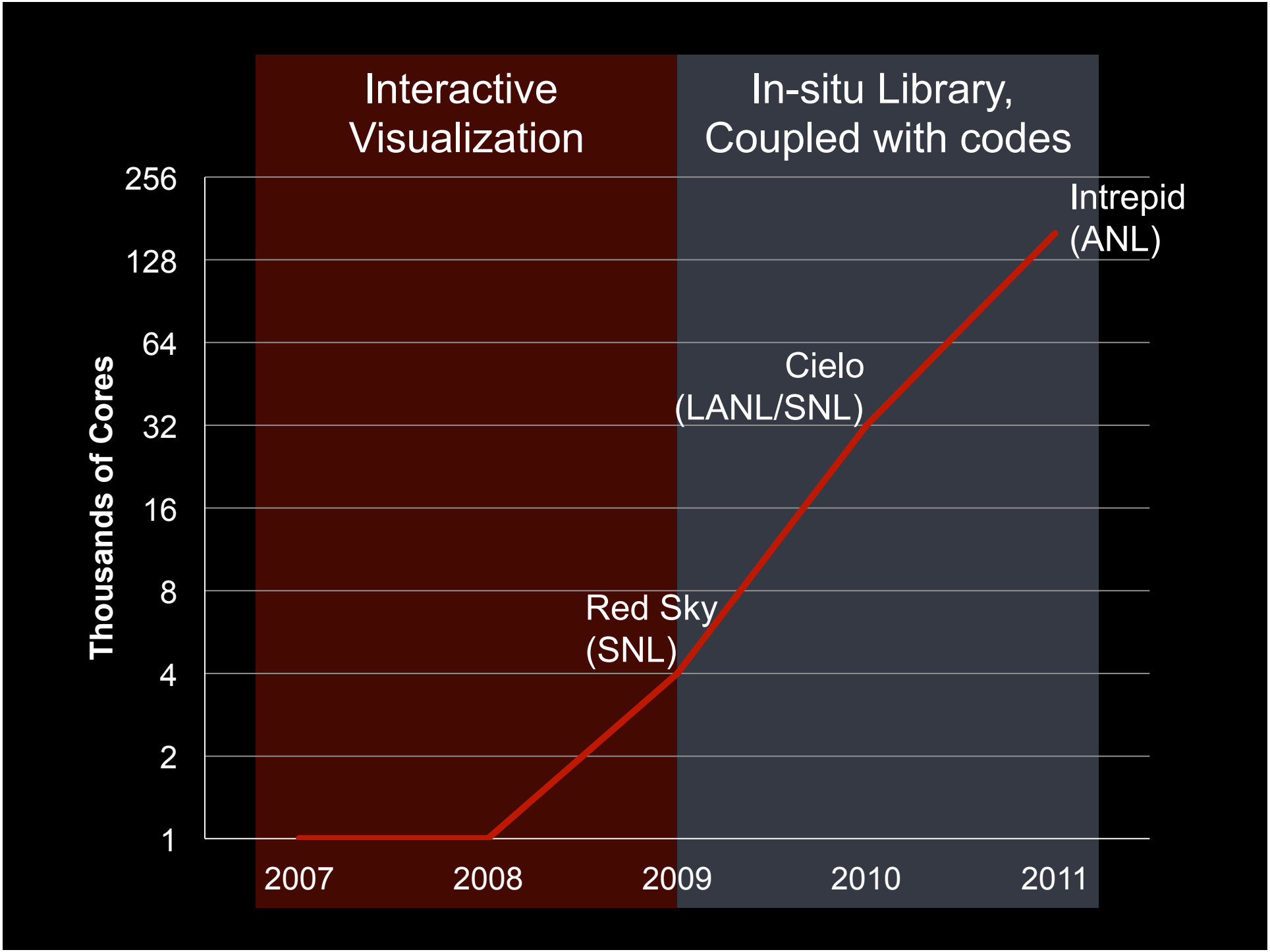


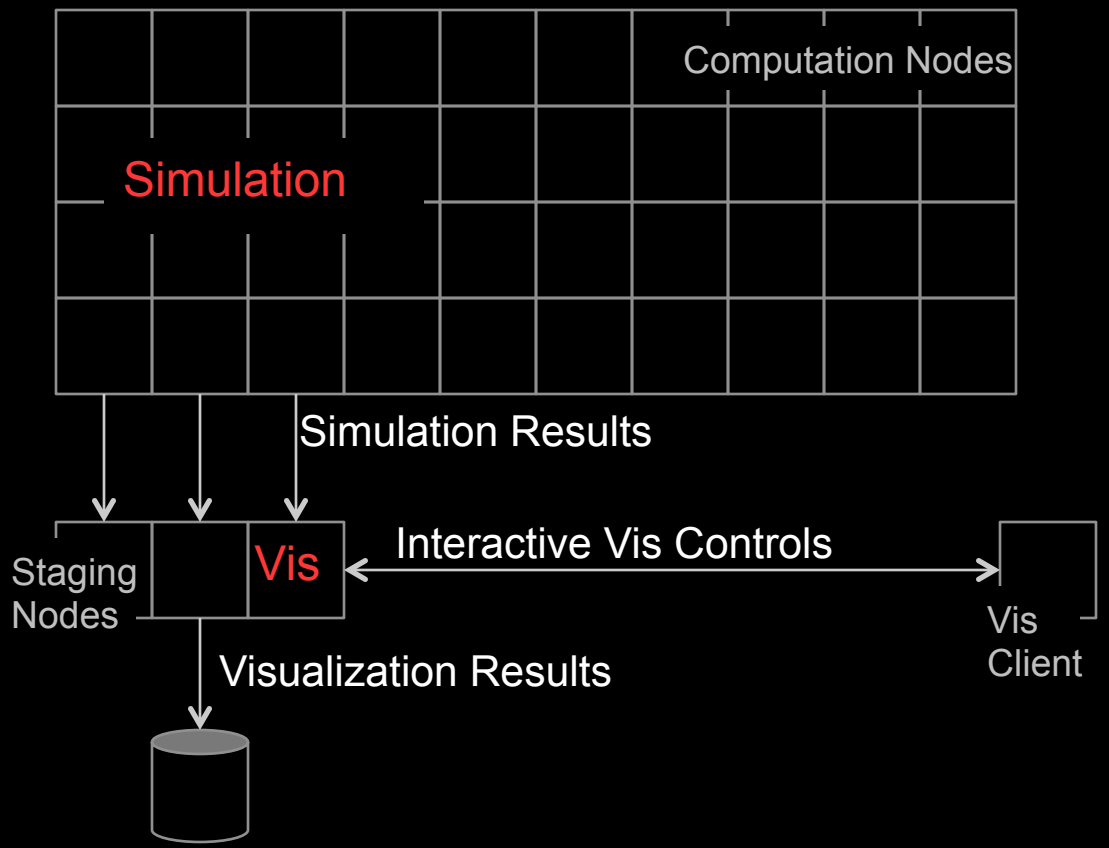
Polygonal Surfaces Field Data

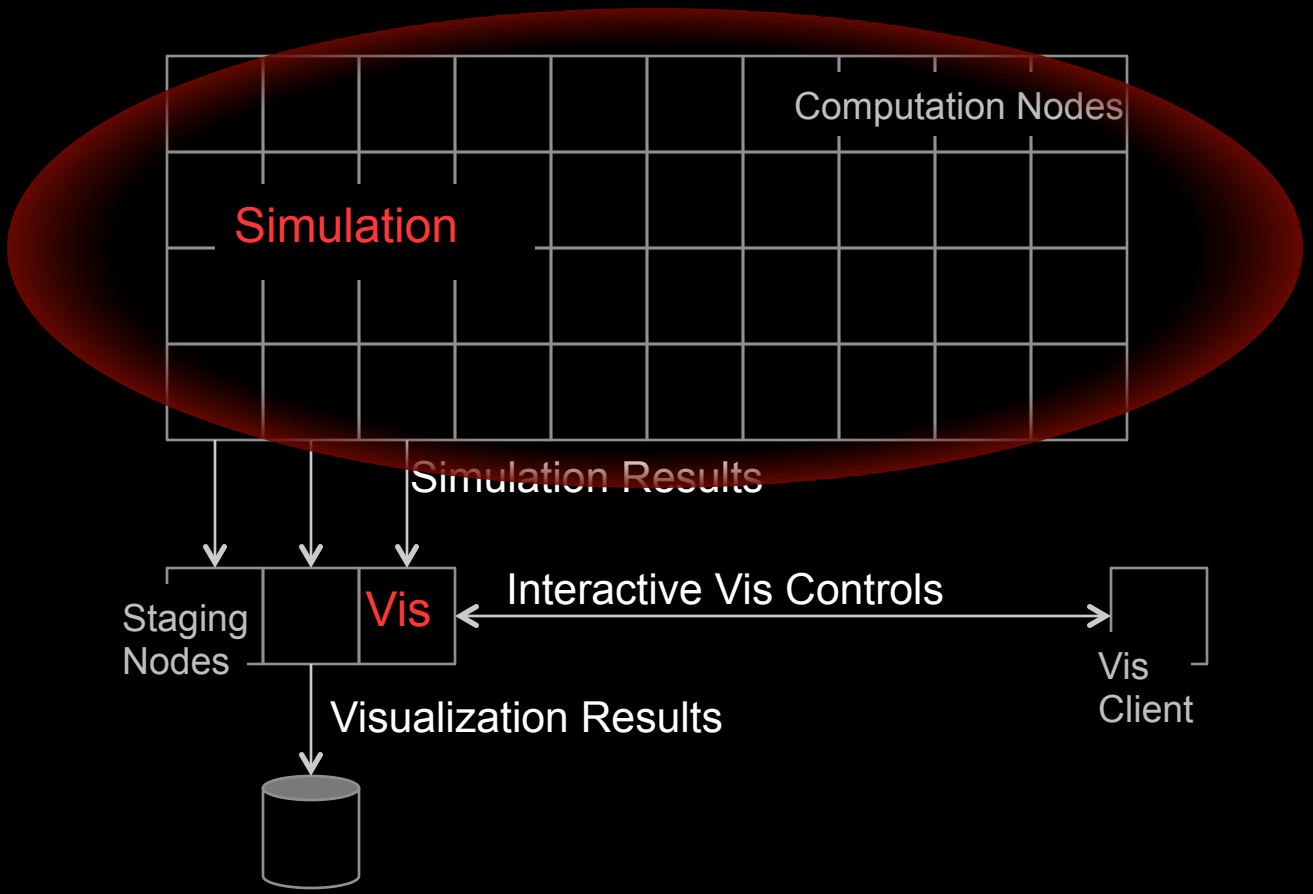


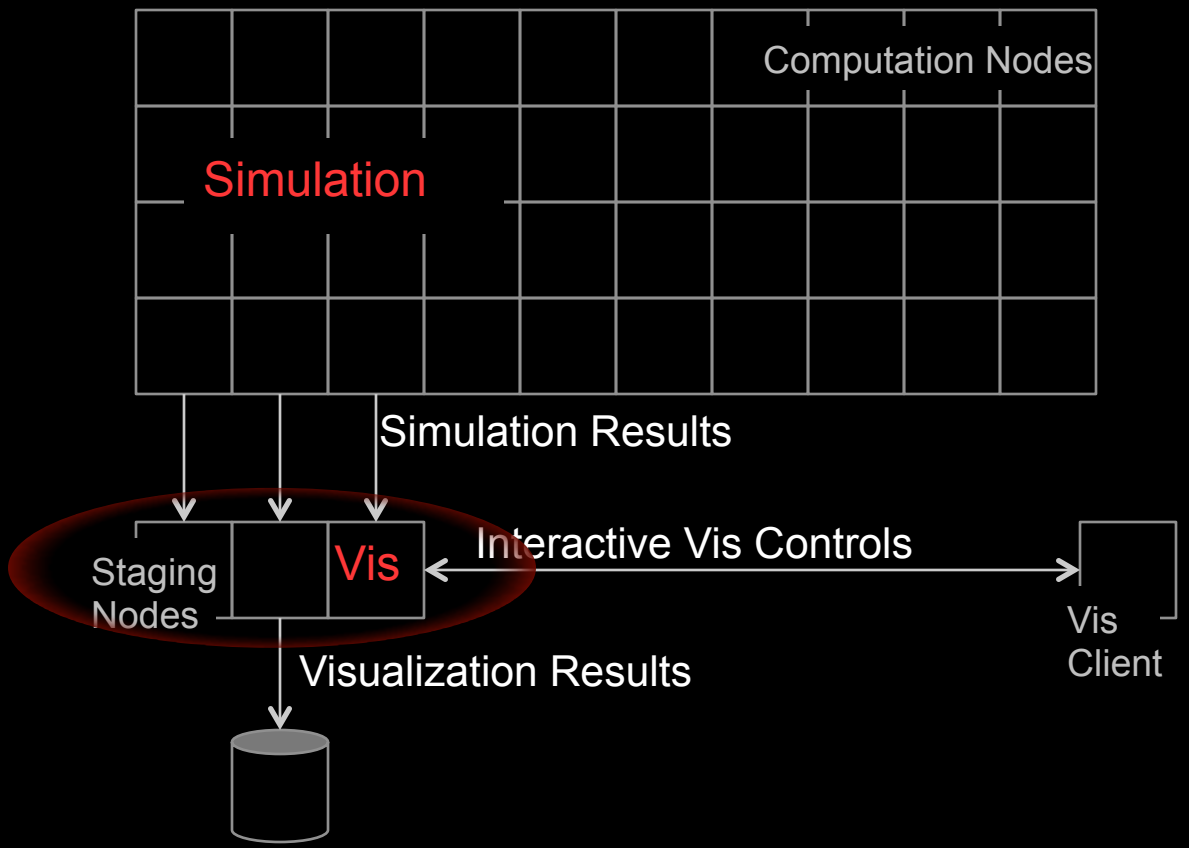
Rendered Images

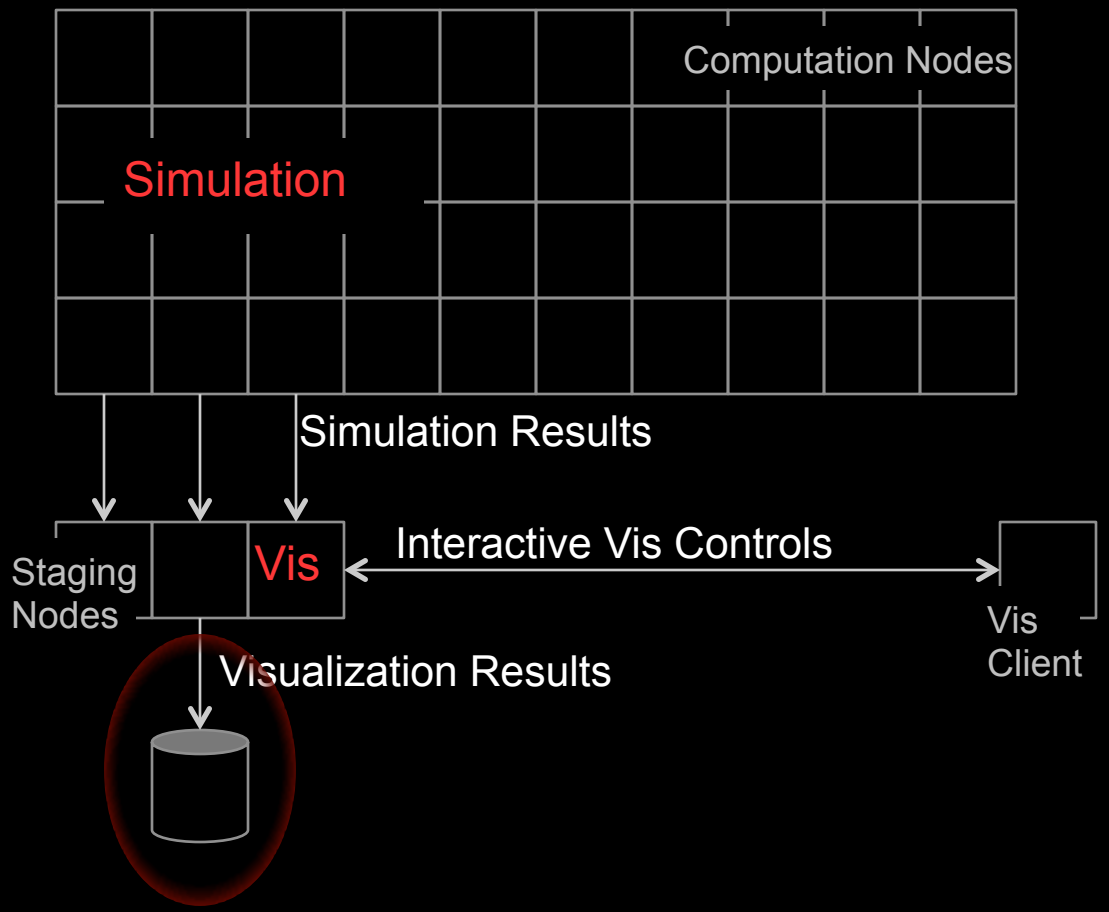

ParaView
Full scale
Simulation
w/ In situ
Smaller scale
Covisualization
Interactive Client

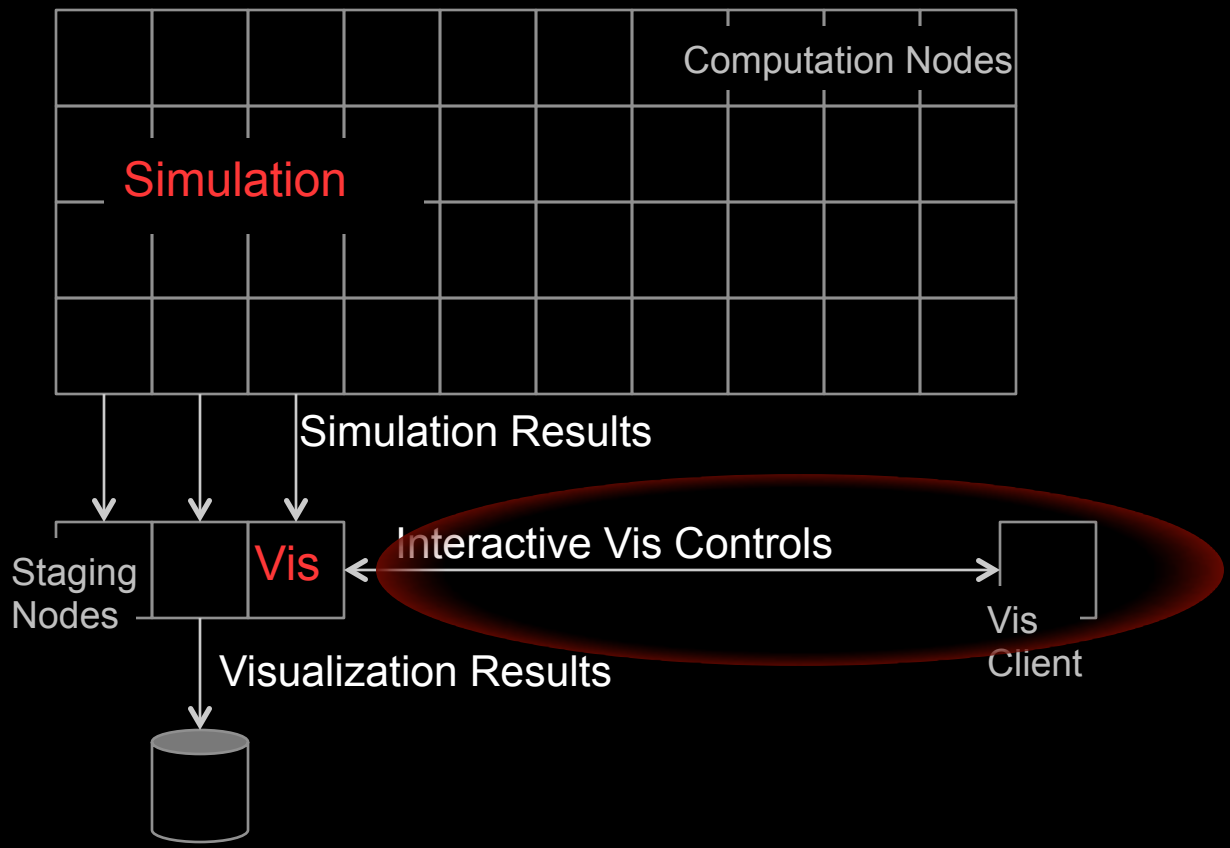

Interactive Visualization
In-situ Library, Coupled with codes
Thousands of Cores
256
128
64
32
16
8
4
2
1
2007
2008
2009
2010
2011
Red Sky (SNL)
Cielo (LANL/SNL)
Intrepid (ANL)

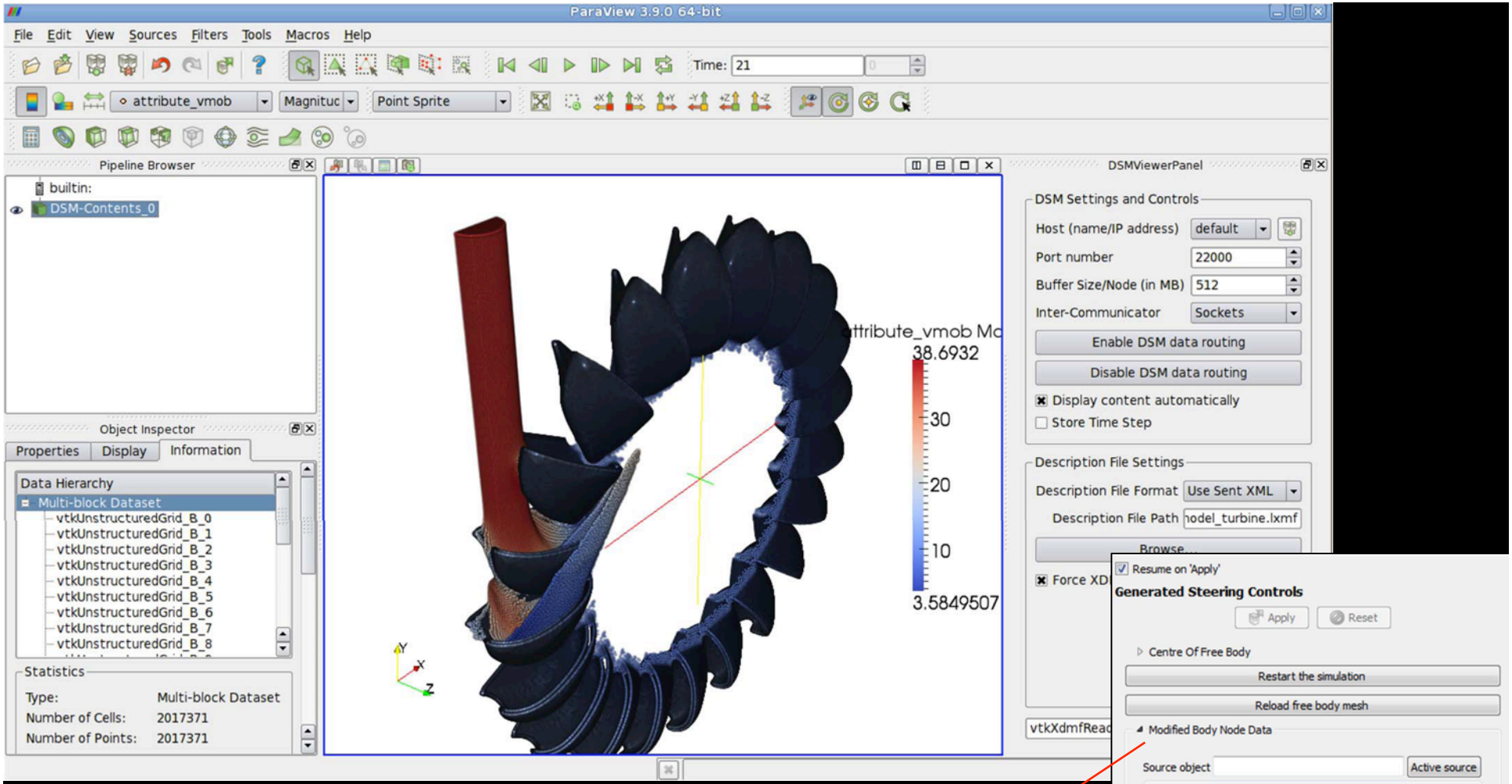

Computation Nodes
Simulation
Simulation Results
Staging
Nodes
Vis
Interactive Vis Controls
Vis
Client
Visualization Results


Computation Nodes
Simulation
Simulation Results
Staging Nodes
Vis
Interactive Vis Controls
Vis Client
Visualization Results


Computation Nodes
Simulation
Simulation Results
Staging Nodes
Vis
Interactive Vis Controls
Vis Client
Visualization Results


Computation Nodes
Simulation
Simulation Results
Staging Nodes
Vis
Interactive Vis Controls
Vis Client
Visualization Results


Computation Nodes
Simulation
Simulation Results
Staging Nodes
Vis
Interactive Vis Controls
Vis Client
Visualization Results




```
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                    label="Modified Body Node Data">
  <DataExportDomain name="data_export"
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                    geometry_path="/Mesh_Nodes#1/NewXYZ"
                    topology_path="/Mesh_Nodes#1/NewCo..."
                    command_property="ReloadFreeBodyMesh" />
</DataExportProperty>
```
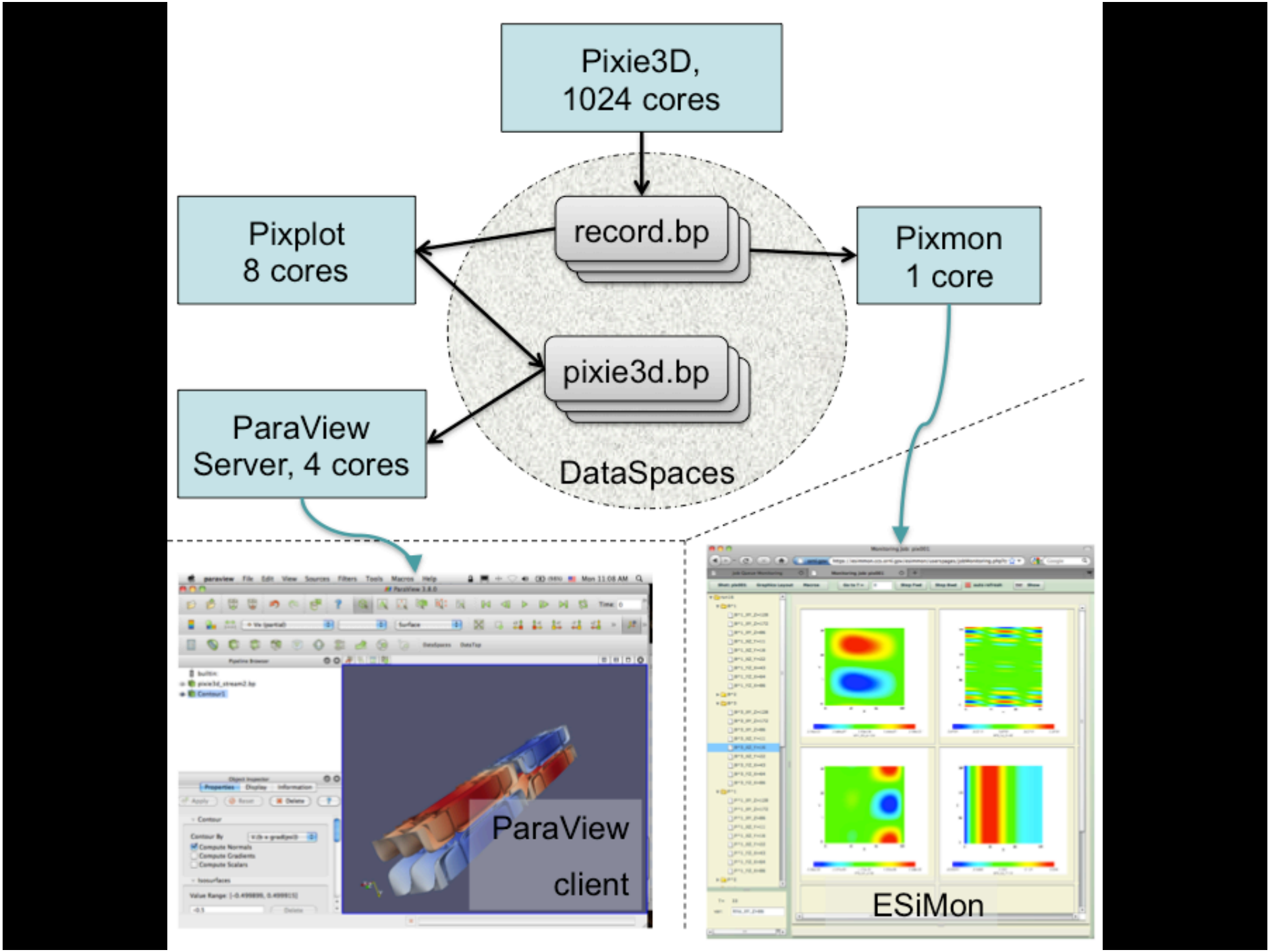

Biddiscombe, et al, “Parallel Computational Steering and Analysis for HPC Applications using a ParaView Interface and the HDF5 DSM Virtual File Driver.”


Pixie3D,
1024 cores
Pixplot
8 cores
record.bp
Pixmon
1 core
pixie3d.bp
ParaView
Server, 4 cores
DataSpaces
ParaView
client
ESiMon