

# VO Theory Use Cases – Intermediate Scale

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# VO Theory Use Cases – Intermediate Scale

- Two Principal Areas Explored to Date
- N Body Simulations of Globular Cluster Evolution
- 2 D and 3 D MHD Simulations of Collimated Outflows from AGN

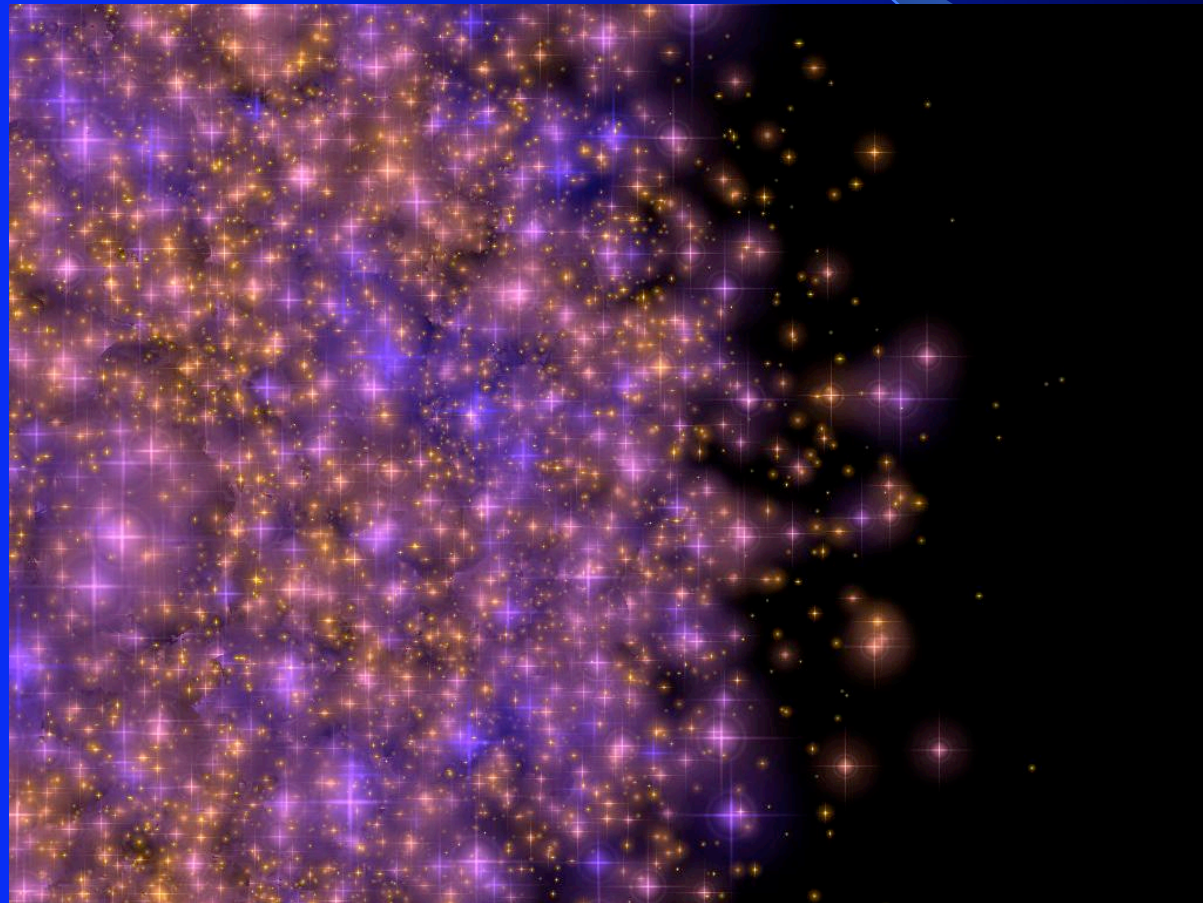
# N Body Simulations of Globular Cluster Evolution

- P. Hut, P. Teuben et al.
- Follows Dynamical and Chemical Evolution of 100,000 Individual Stars
- Tracks Individual Orbits, Binary Capture, etc.

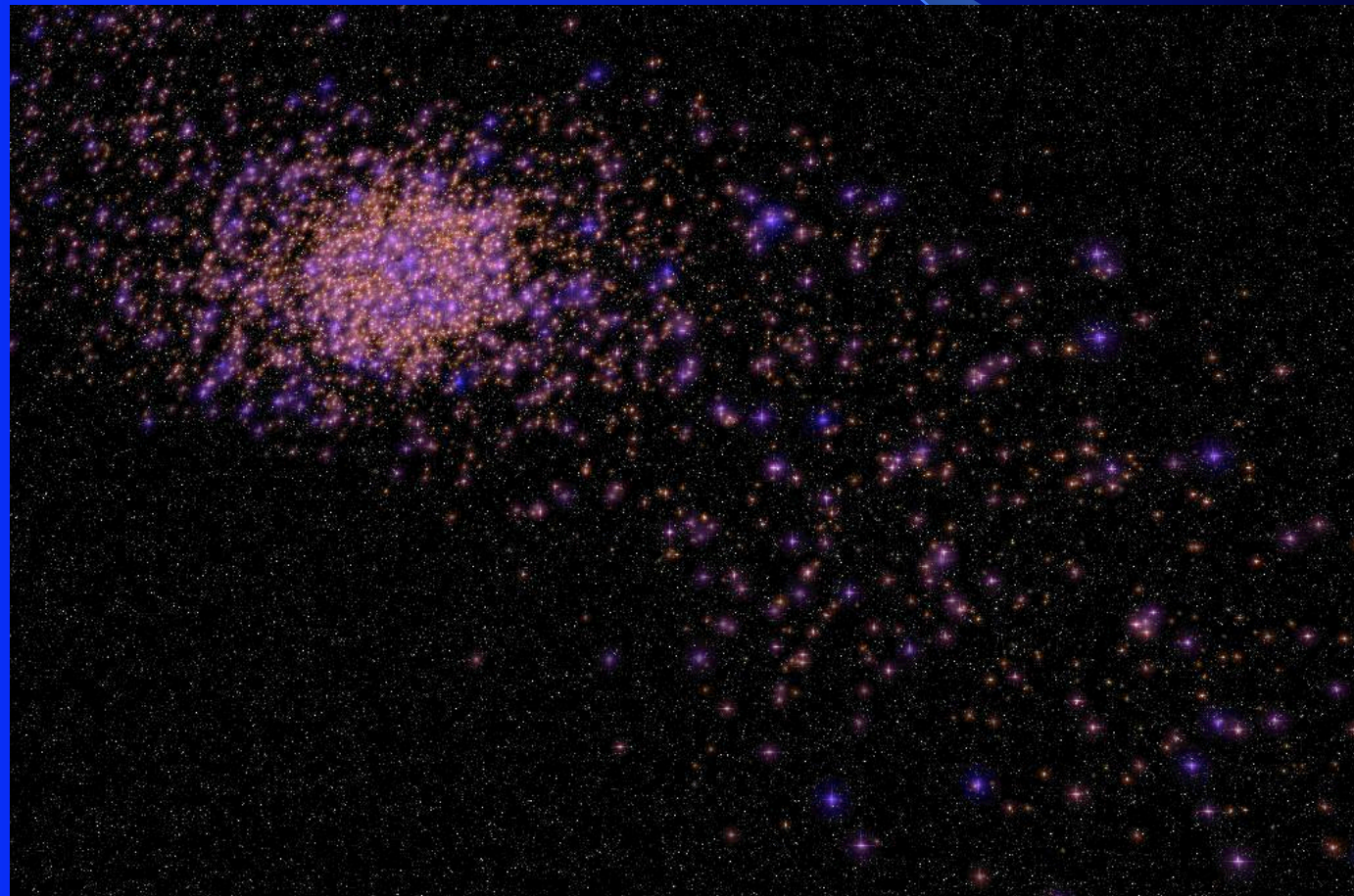
# N Body Simulations of Globular Cluster Evolution

- Some Astrophysics Addressed:
  - Overall Cluster Evolution
  - Core Collapse
  - Binary Fraction; X-Ray Luminosity
  - Evolution of HR Diagram
  - Late Stages of Stellar Evolution and Mass Loss
- Allows Direct Comparison with Observations

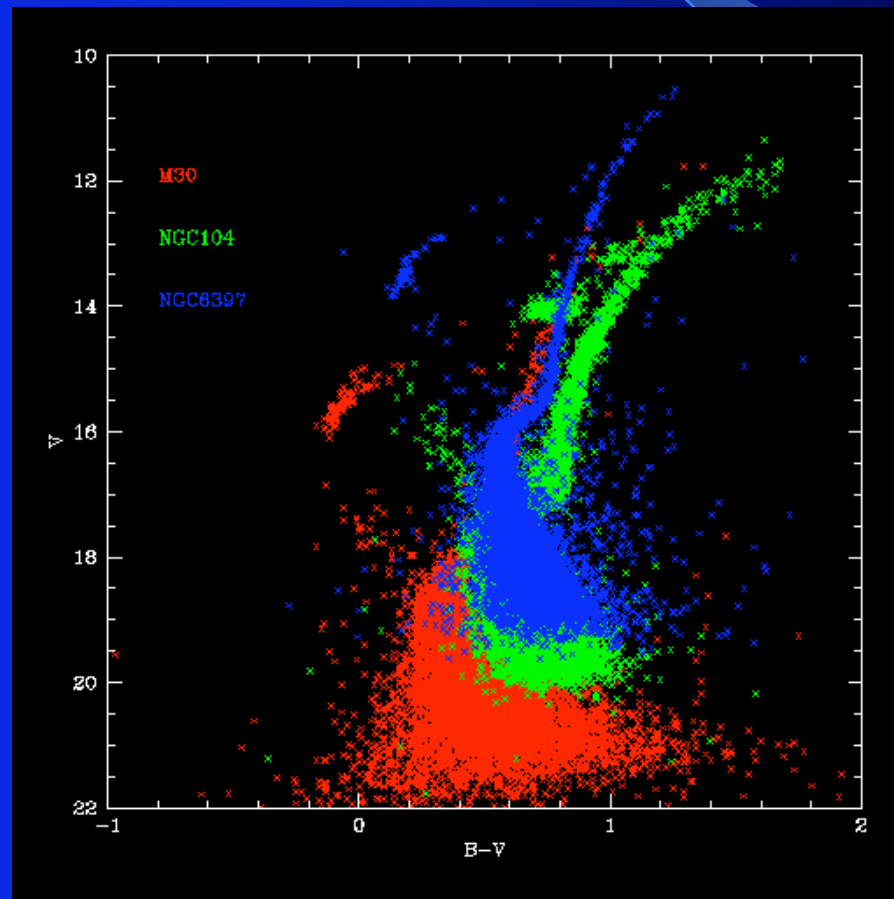
# N Body Simulations of Globular Cluster Evolution



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# N Body Simulations of Globular Cluster Evolution

- Data Requirements:
  - Does Not Use Arrays for Most Data
  - Follows Time Intervals of Individual Orbits
  - Stores Orbital Data with Differing Timelines
  - Requires Fly Through Capability
    - Uses AMNH Rose Planetarium
  - Size of Data Sets: ~ TB



# N Body Simulations of Globular Cluster Evolution

- Requires Definition of Theory MetaData Standards Before Further Progress Can Be Made

# MHD Simulations of Collimated Outflows from AGN

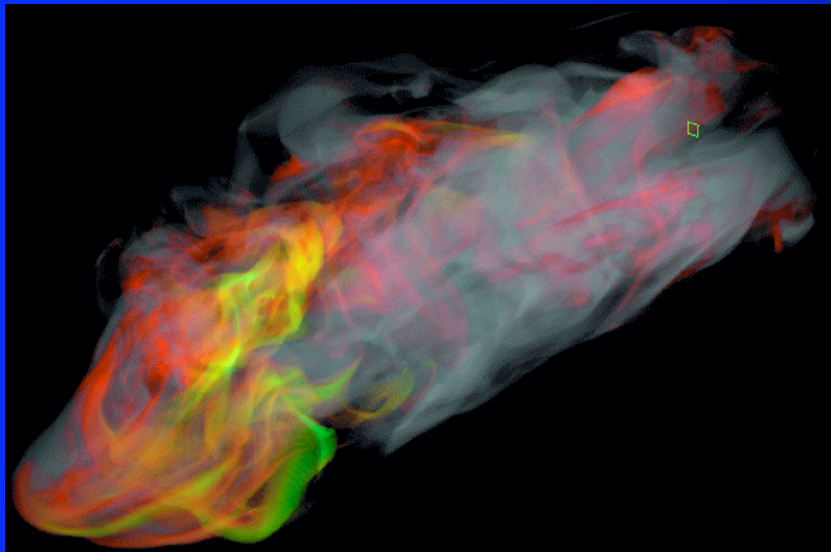
- T. Jones, D. De Young, I. Tregillis, S. O'Neal et al.
- Self Consistent MHD Simulations of Large Scale Outflows to  $\sim 100$  kpc
- Follows Evolution of Relativistic Particle Population Including Shock Acceleration

# MHD Simulations of Collimated Outflows from AGN

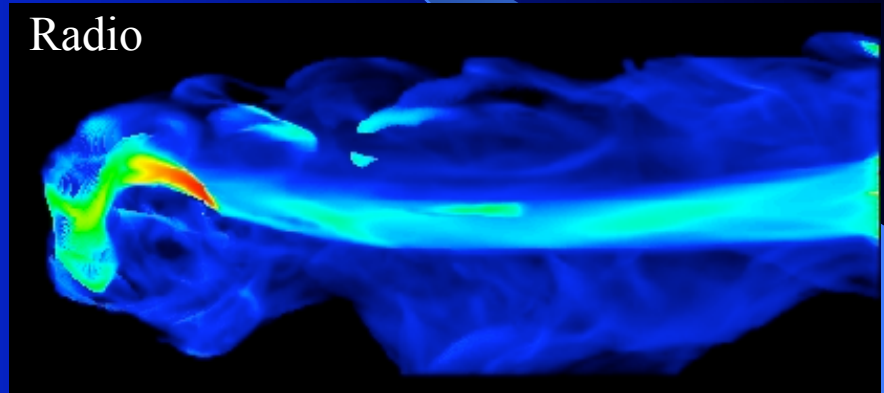
- Some Astrophysics Addressed
  - Global Evolution of Large Scale Jets
  - Role of Interaction with Ambient Medium –  
Entrainment and Jet Deceleration
  - Evolution of Magnetic Amplification
  - Evolution of Particle Spectrum
  - Distribution of Synchrotron Radiation as a  
Function of Space and Time

# MHD Simulations of Collimated Outflows from AGN

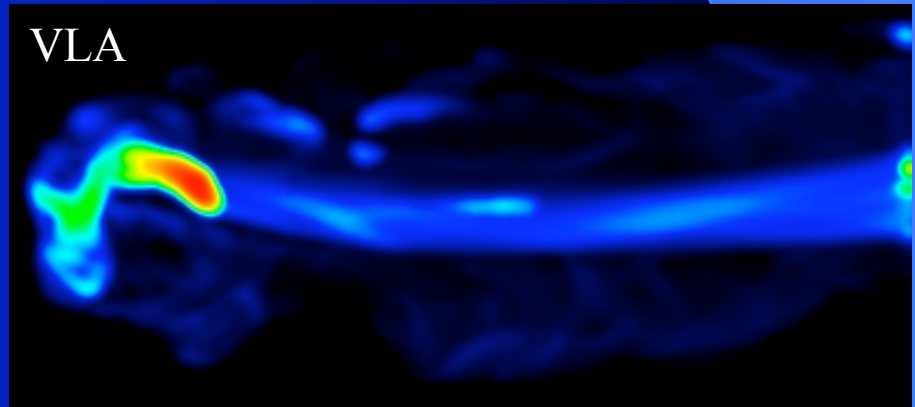
Electrons



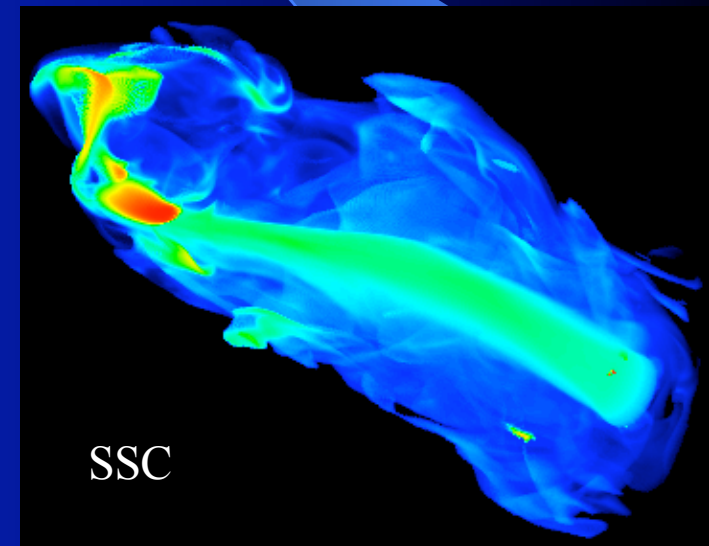
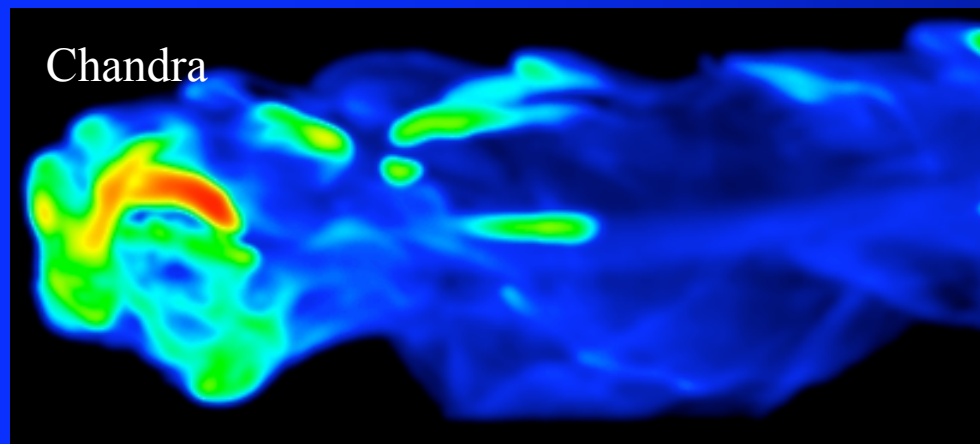
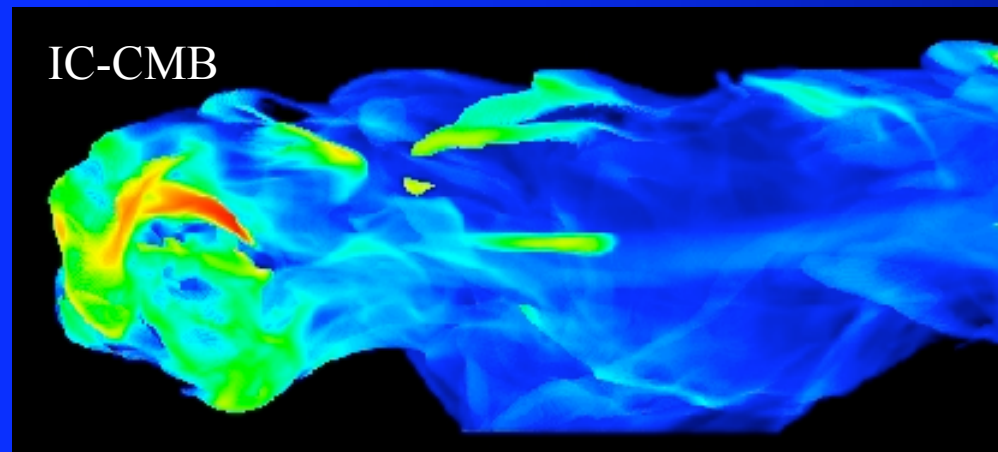
Radio



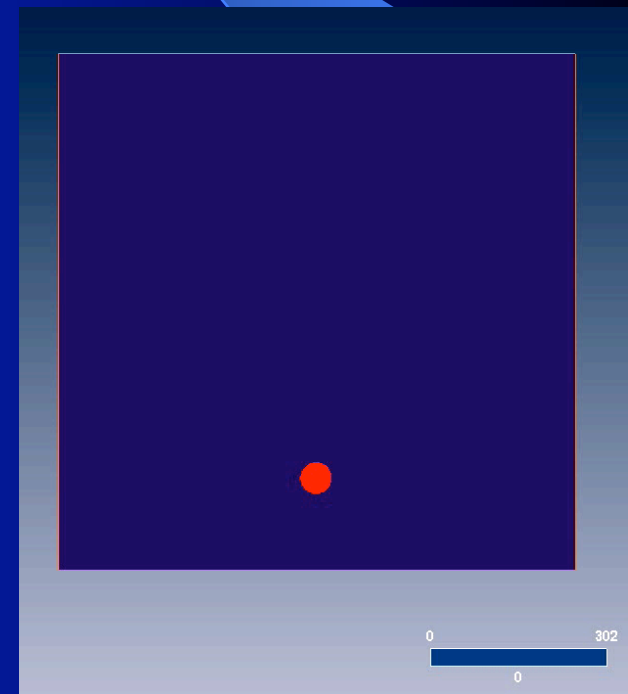
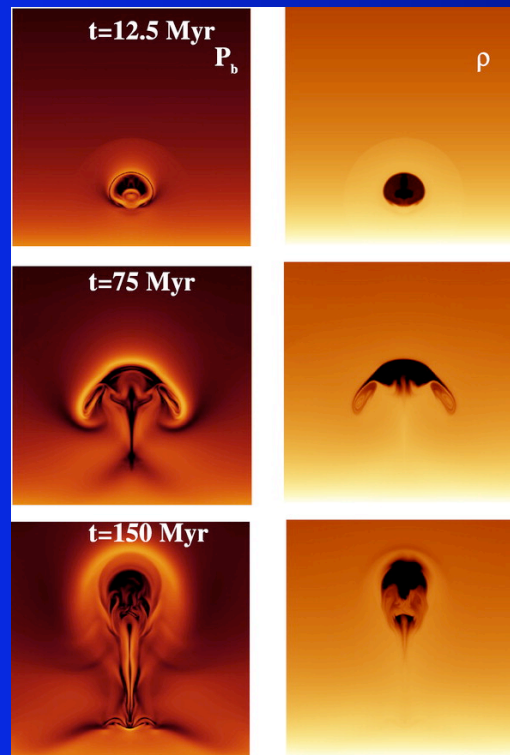
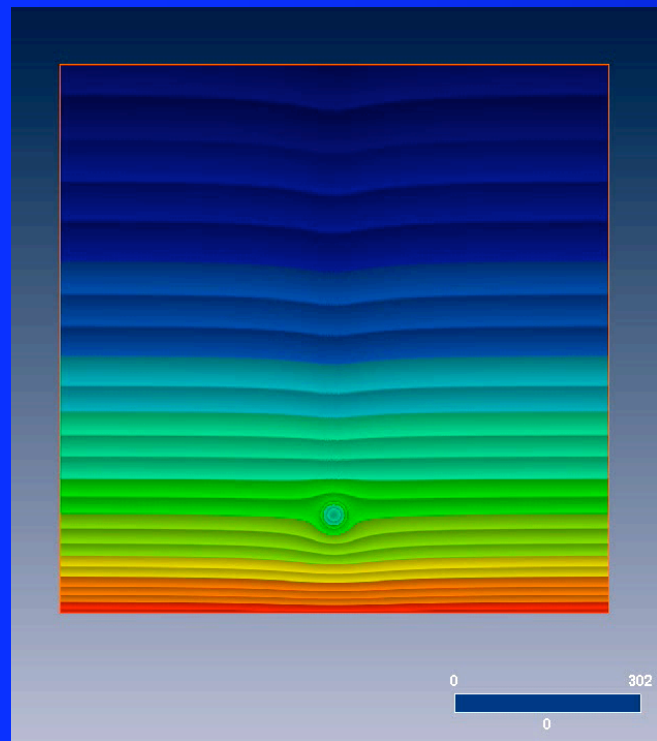
VLA



# MHD Simulations of Collimated Outflows from AGN



# MHD Simulations of Collimated Outflows from AGN



# MHD Simulations of Collimated Outflows from AGN

- Code is Fully Parallel
- Now Running at San Diego Supercomputer Ctr.
- Data Format Highly Specialized, Non Std.
- Subsequent Complex Post Processing Required
- Size of Raw Data Sets: Up to Tb per Run

# MHD Simulations of Collimated Outflows from AGN

- Requires Definition of Theory MetaData Standards Before Further Progress Can Be Made