einstein toolkit

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einstein toolkit

- Goal: have state-of-the-art set of tools for NR available as open source
- Organised by Einstein Consortium, open to everyone
- See http://einsteintoolkit.org

Guiding Principles

- Open, community-driven software development
- Separation of physics software from computational science infrastructure
- Well thought out and stable interfaces
- Provide complete working production codes

Current State

- Official release on June 17, 2010
- 3D spacetime (BSSN) and GR Hydro (Valencia formulation) evolution code, puncture initial data, horizon finders, wave extraction, etc.
- Cactus (framework), Carpet (AMR)
- Production quality features (Ninja, NRAR)
- Not all new – you may be using it already

Core Einstein Toolkit
svn.einsteintoolkit.org

Cactus Flesh
and CCTK
svn.cactuscode.org

Einstein Toolkit
svn.partnersite.org

Carpet AMR
git.carpetcode.org

Tools, Parameter Files,
& Data
svn.einsteintoolkit.org

GetComponents

Assemble Simulation

GetComponents

Research Group

Group Modules
cvs.groupthorns.org

Individual Modules
cvs.mythorns.org

People

- 49 contributors over the past decade, both from physics and CS; many left the field by now
- currently 50 members from 14 sites in 7 countries
- 9 maintainers from 5 sites
- >200 publications, >30 theses building on these components

Science Capabilities

- BSSN
  (phi, W; 1+log, Gamma driver; up to 8th order)
- GR Hydro
  (based on Whisky; Valencia formulation)
- BH / NS initial data
  (TwoPunctures, Lorene)
- Excision / Turduckening
- Runge-Kutta a.o.
- AMR
- Horizon finder
- Wave extraction
- MPI, OpenMP
- HDF5 output, visualisation

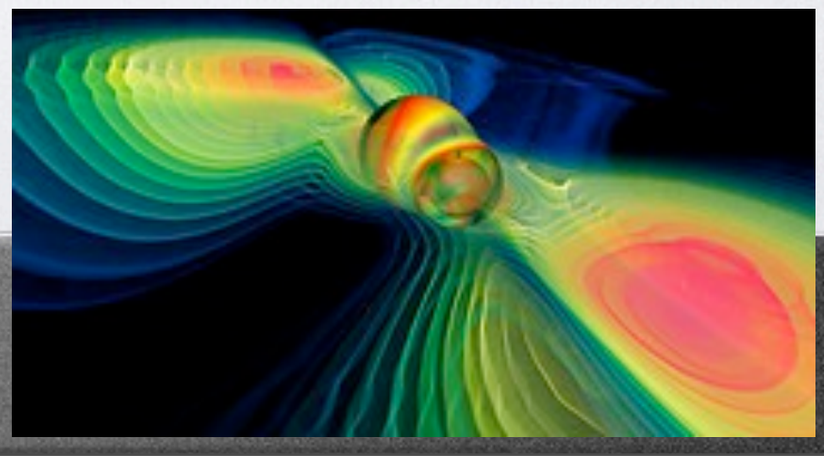
Quality Control

- Open source ≠ offer download
- Requirements for ET components:
  – sufficient quality (actually being used)
  – documentation (e.g. publication)
  – community interest (have maintainer)
- Also provide easy step-by-step instructions for first-time users

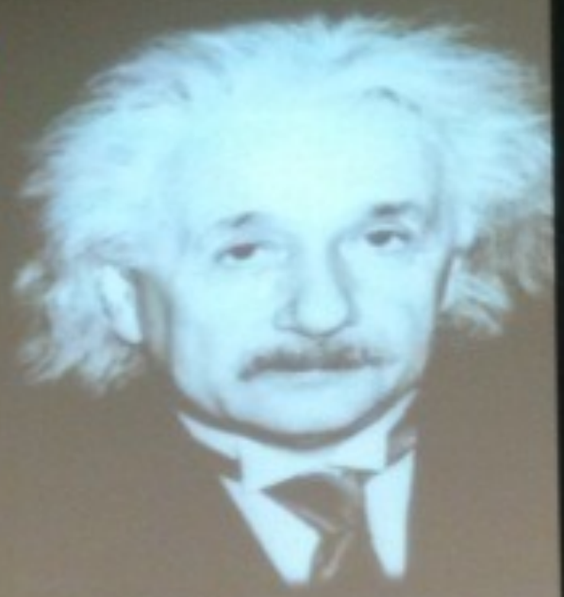
Tutorial for New Users

http://docs.einsteintoolkit.org/et-docs/Tutorial_for_New_Users

1. Get account on Queen Bee (fill in web form)
2. Download (4 shell commands)
3. Configure (3 commands) [need user name, email address, allocation]
4. Build (1 command)
5. Run simulation (1 command)



General Relativity

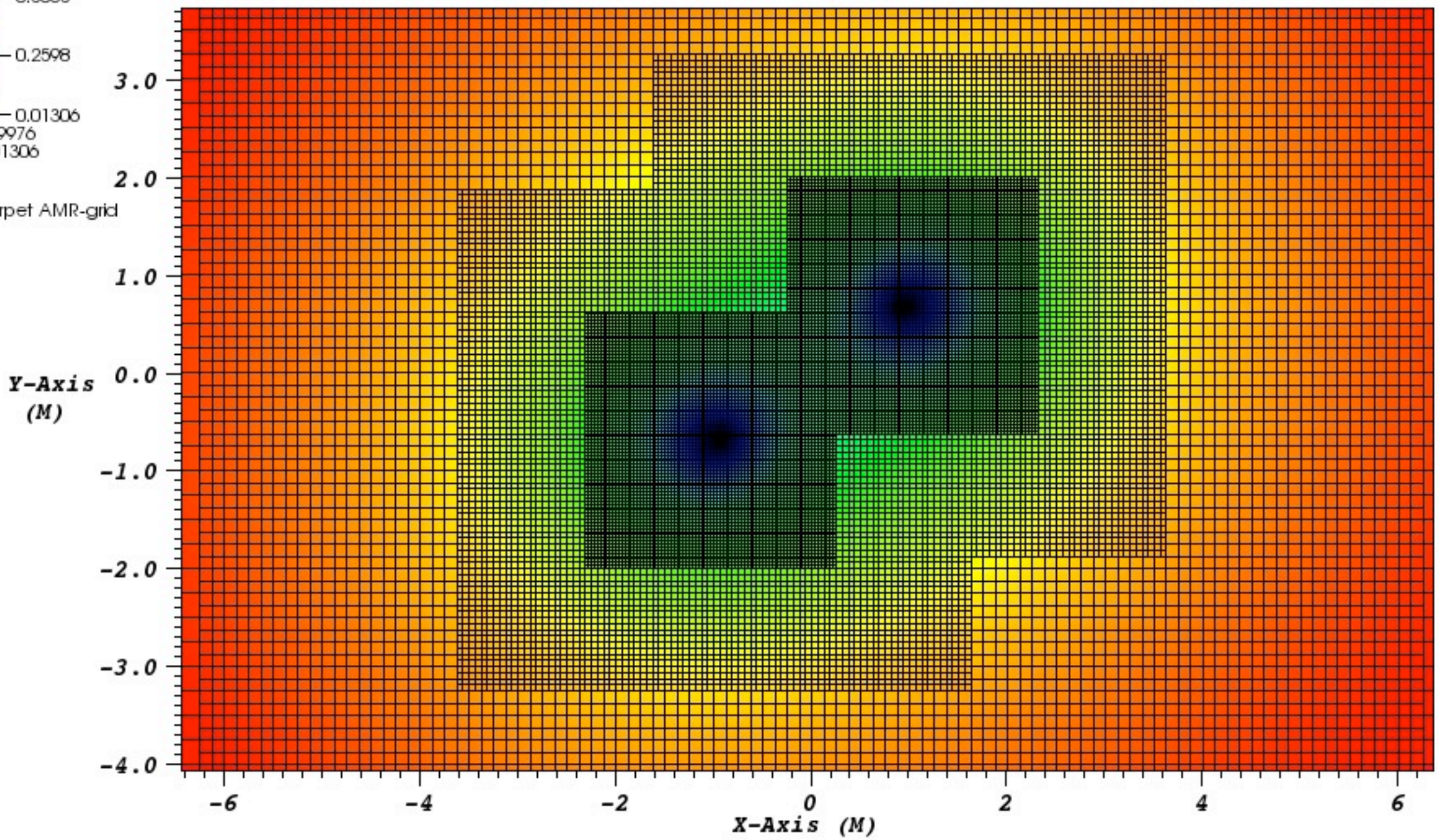


- Why we need to consider it?
- Curvature of Space-time
- Einstein Toolkit / Cactus

DB: alp.file_0.h5
Cycle: 7680 Time:15

Pseudocolor
Var: ADMBASE--alp
1.000
0.7533
0.5065
0.2598
0.01306
Max: 0.9976
Min: 0.01306

Mesh
Var: Carpet AMR-grid



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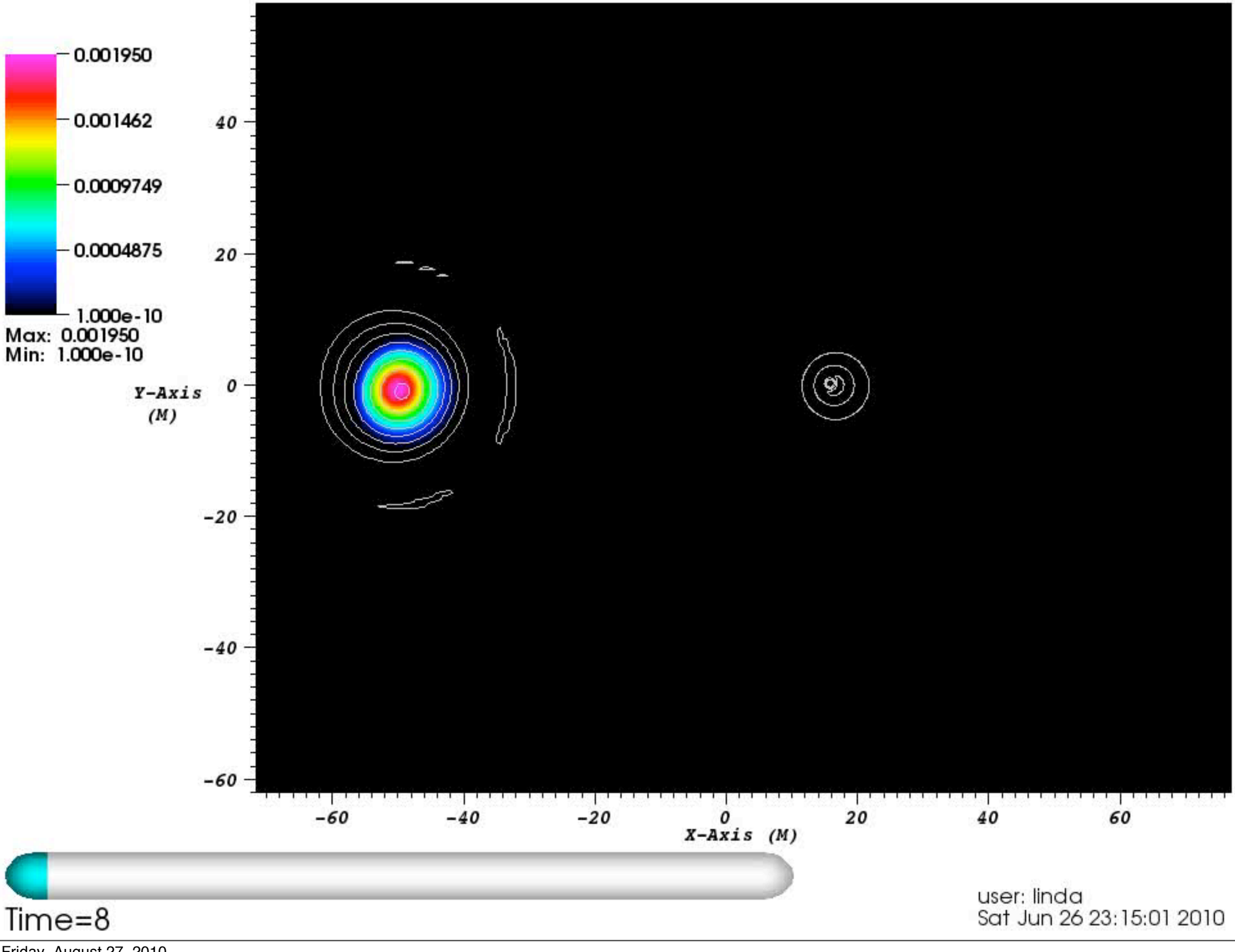
Wed Jun 23 20:38:55 2010



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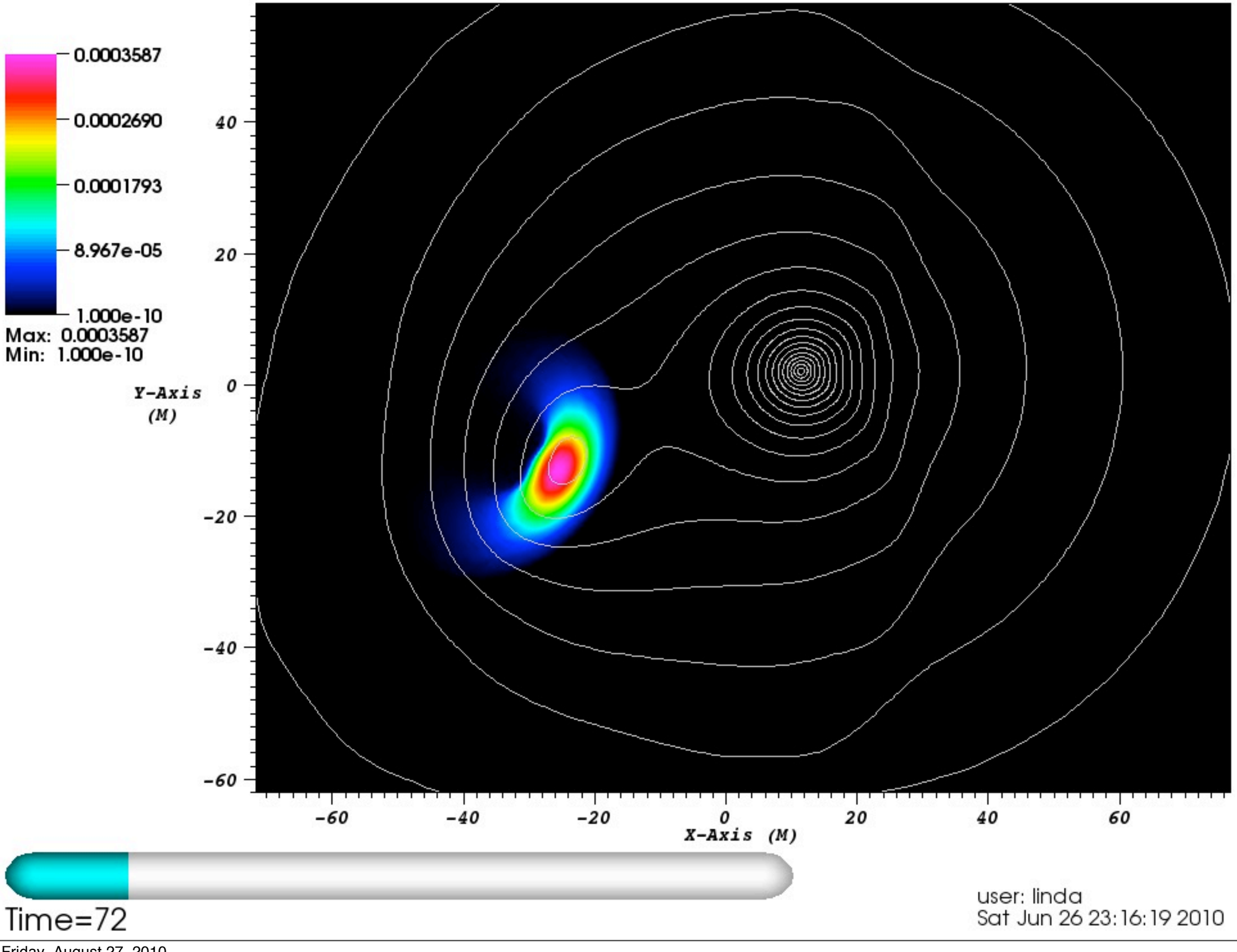
Sat Jun 26 23:15:01 2010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0.0002690
0.0001793
8.967e-05
1.000e-10
Max: 0.0003587
Min: 1.000e-10
Y-Axis (M)
40
20
0
-20
-40
-60
-60
-40
-20
0
20
40
60
X-Axis (M)
Time=72
user: linda
Sat Jun 26 23:16:19 2010

Simulation vs. Science

- Running a simulation << doing science
- Need to know about meaningful initial conditions, numerical stability, accuracy/resolution, have patience, have curiosity, have a "gut feeling" for what is "right"...
- But, with open codes that are easy to use, can concentrate on these things!

Tools: GetComponents

- Task: Collect software from various repositories at different sites
- Make Einstein Toolkit easy to download without requiring centralised repository
- Supports cvs, svn, git, http, ...

Tools: Simulation Factory

- Access remote systems, synchronise source code trees
- Configure and build on different systems semi-automatically
- Manage simulations (follow “best practices”, avoid human errors)

Tools: Formaline

- Task: Ensure that simulations are and remain repeatable, remember exactly how they were performed
- Take snapshots of source code, system configuration; store it in executable and/or repository (does not need much space)
- Tag all output files (and images/movies?)

General Guidelines

- Don't want to provide "best code"; rather want to offer pieces from which people can choose
- Should be very high quality, but not cutting edge
- Providing open-source software means real work; comparable to writing a paper: should be citable, should count on CV

Support

- Web site http://einsteintoolkit.org
- Mailing list users@einsteintoolkit.org
- Weekly public phone calls
- IRC chat channel #cactus
- Also blog, wiki, code repositories, (bug tracker), ...

Acknowledgements

- More than 4 dozen contributors (over past years)

- NSF projects: CIGR, XiRel, Alpaca, PetaCactus (LSU, GA Tech, RIT, AEI, Caltech)

- LONI "loni_cactus" allocation

Plan

- Looking for users and contributions
- Don't want to take over software; rather want to point to good software
- Currently Cactus-centric, want to expand this
- Looking in particular for pre-3D and post-3D and insteadof-3D tools
- Working on GRMHD, better EOS