Visualizing Einstein Toolkit Data with yt

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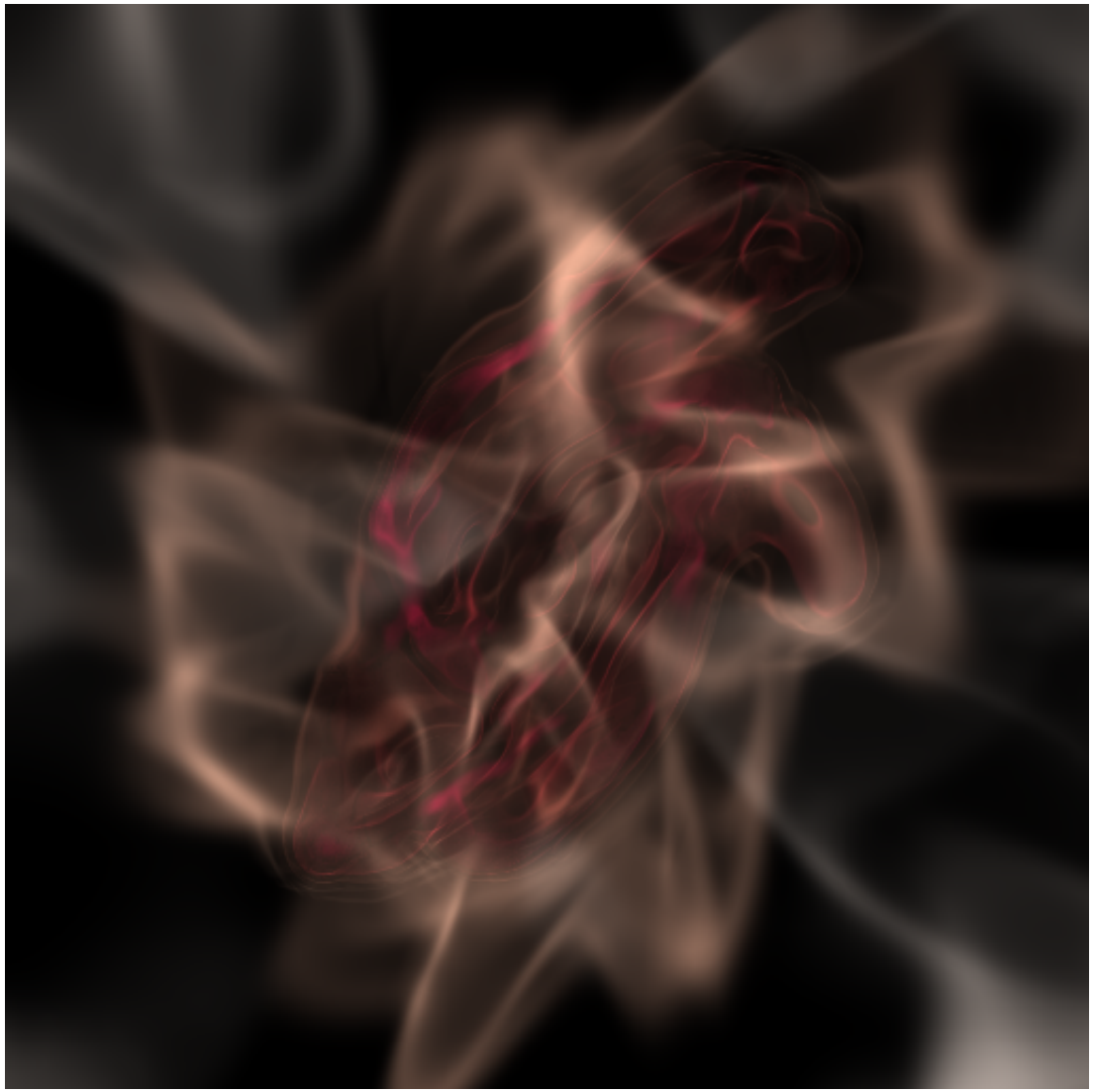
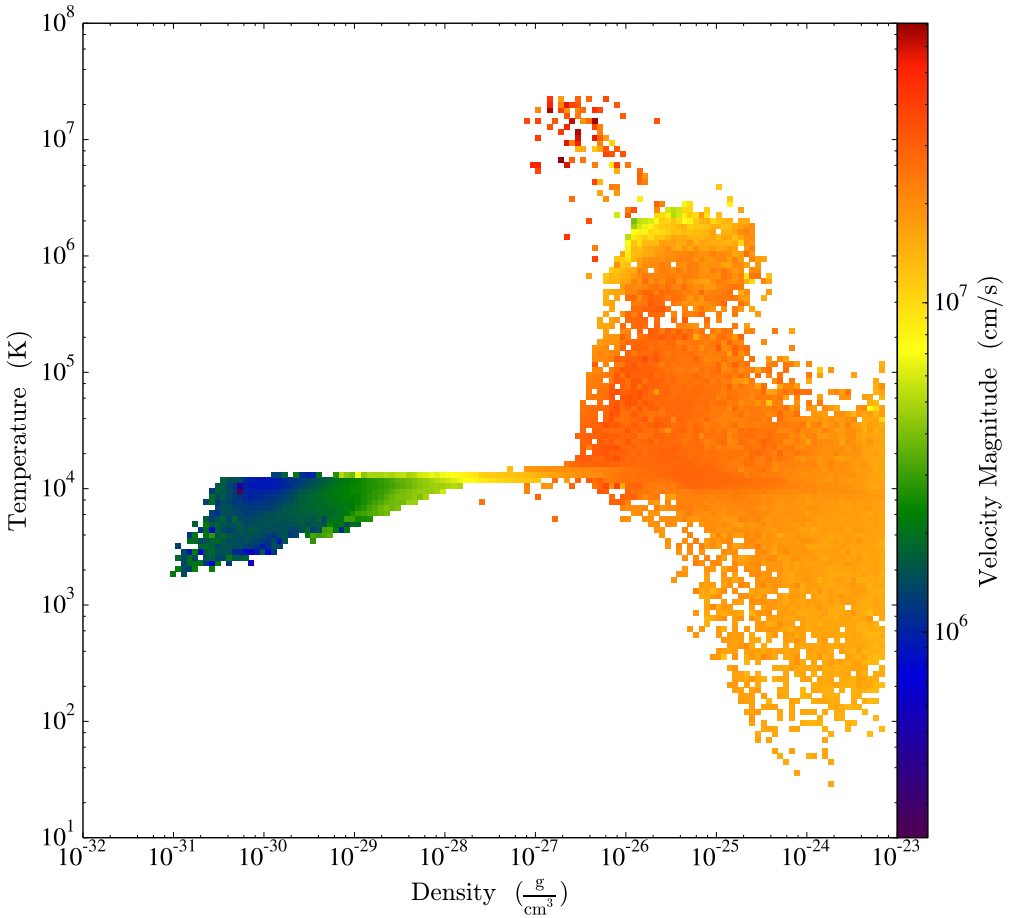
Volume Rendering



http://yt-project.org/data/

Data Analysis

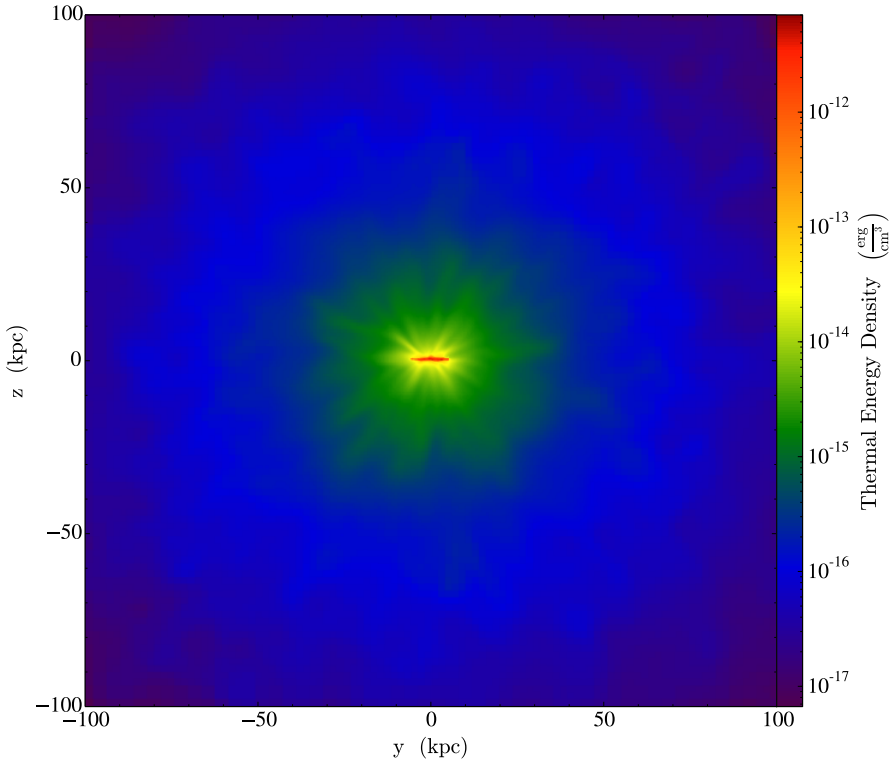
```
import yt
source = "./galaxy0030"
d = "density"
t = "temperature"
vm = "velocty_magnitude"
ds = yt.load(source)
ad = ds.all_data()
yt.PhasePlot(ad,d,t,vm)
```



http://yt-project.org/data/

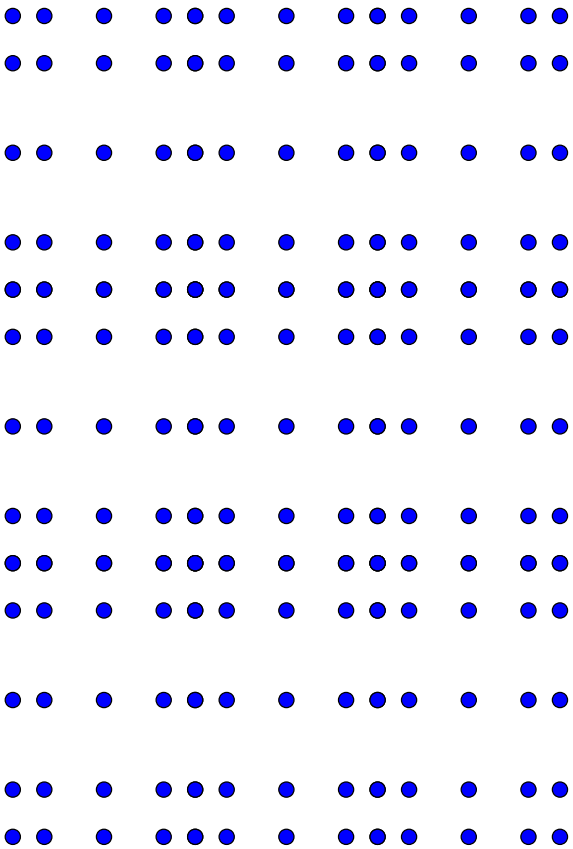
With Python, yt is Easily Extendable

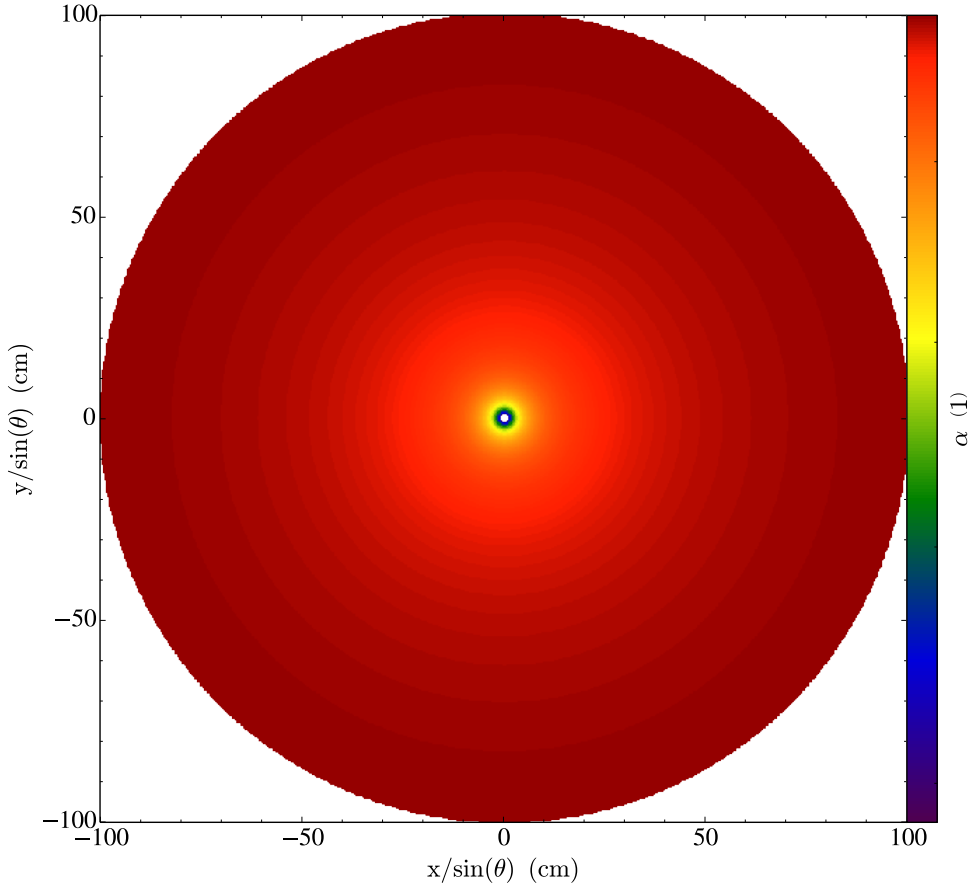
```
# function defining
# new quantity
fname = "thermal_energy_density"
def therm_en_dens(field,data):
    n = data['gas',
             'number_density']
    kT = data['gas', 'kT']
    return (3/2)*n*kT

# add it to the dataset
ds.add_field(("gas",fname),
             units="erg/cm**3",
         function=therm_en_dens)

# plot
ad = ds.all_data()
yt.ProjectionPlot(...)
```



http://yt-project.org/data/

yt Extended for Discontinuous Galerkin Methods

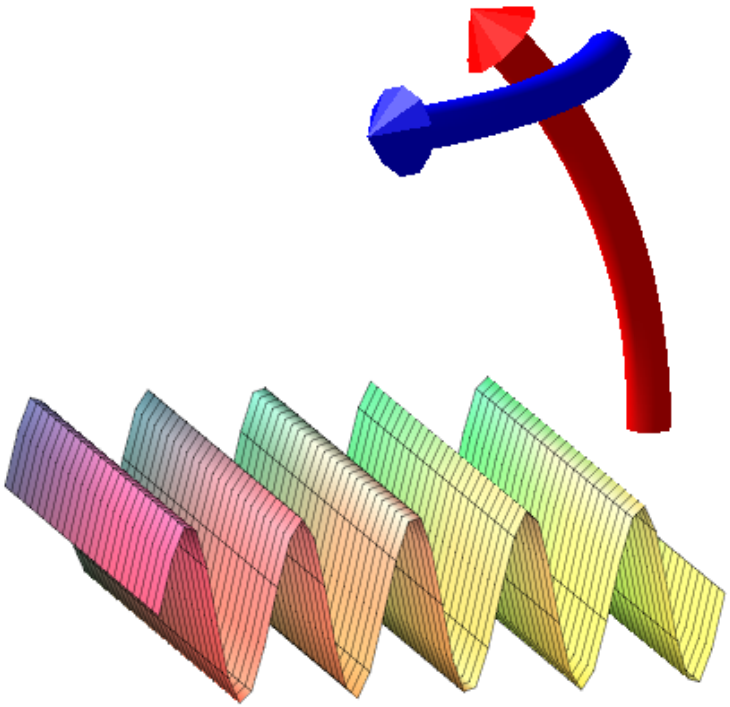


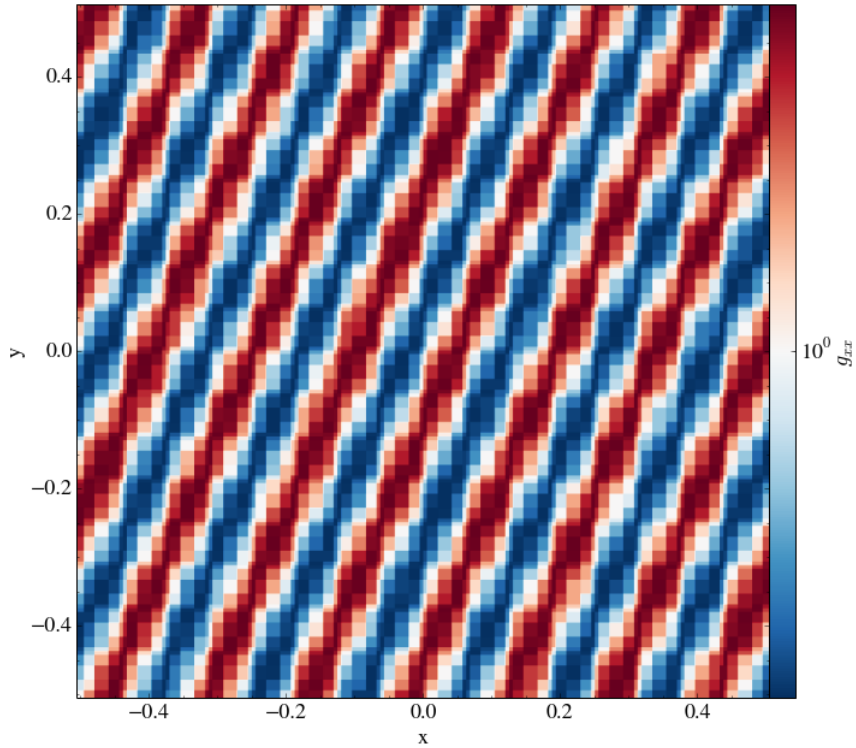


Miller and Schnetter. In Prep.

yt Extended for Discontinuous Galerkin Methods

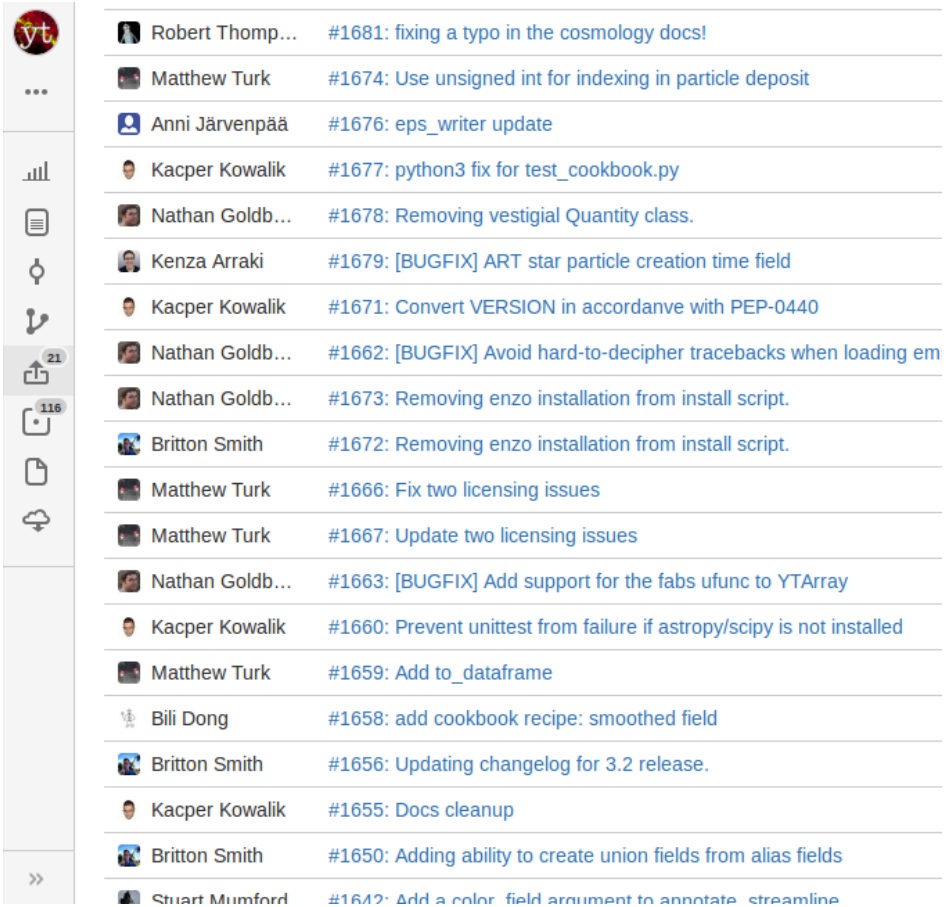
$$ds^2 = -H dt^2 + H dx^2 + dy^2 dz^2, \; H = 1 - A \sin\left(\frac{2\pi(x-t)}{d}\right)$$





Miller and Schnetter. In Prep.

Extensions are Encouraged!



Robert Thomp…	#1681: fixing a typo in the cosmology docs!
Matthew Turk	#1674: Use unsigned int for indexing in particle deposit
Anni Järvenpää	#1676: eps_writer update
Kacper Kowalik	#1677: python3 fix for test_cookbook.py
Nathan Goldb…	#1678: Removing vestigial Quantity class.
Kenza Arraki	#1679: [BUGFIX] ART star particle creation time field
Kacper Kowalik	#1671: Convert VERSION in accordanve with PEP-0440
Nathan Goldb…	#1662: [BUGFIX] Avoid hard-to-decipher tracebacks when loading em
Nathan Goldb…	#1673: Removing enzo installation from install script.
Britton Smith	#1672: Removing enzo installation from install script.
Matthew Turk	#1666: Fix two licensing issues
Matthew Turk	#1667: Update two licensing issues
Nathan Goldb…	#1663: [BUGFIX] Add support for the fabs ufunc to YTArray
Kacper Kowalik	#1660: Prevent unittest from failure if astropy/scipy is not installed
Matthew Turk	#1659: Add to_dataframe
Bili Dong	#1658: add cookbook recipe: smoothed field
Britton Smith	#1656: Updating changelog for 3.2 release.
Kacper Kowalik	#1655: Docs cleanup
Britton Smith	#1650: Adding ability to create union fields from alias fields
Stuart Mumford	#1642: Add a color_field argument to annotate_streamline

How To Read The Source Code

If you just want to *look* at the source code, you may already have it on your computer. If you build yt using the install script, the source is available at `$YT_DEST/src/yt-hg`. See *Installing yt Using pip or from Source* for more details about to obtain the yt source code if you did not build yt using the install script.

The root directory of the yt mercurial repository contains a number of subdirectories with different components of the code. Most of the yt source code is contained in the yt subdirectory. This directory its self contains the following subdirectories:

`frontends`

This is where interfaces to codes are created. Within each subdirectory of yt/frontends/ there must exist the following files, even if empty:

- `data_structures.py`, where subclasses of AMRGridPatch, Dataset and AMRHierarchy are defined.
- `io.py`, where a subclass of IOHandler is defined.
- `fields.py`, where fields we expect to find in datasets are defined
- `misc.py`, where any miscellaneous functions or classes are defined.
- `definitions.py`, where any definitions specific to the frontend are defined. (i.e., header formats, etc.)

`fields`

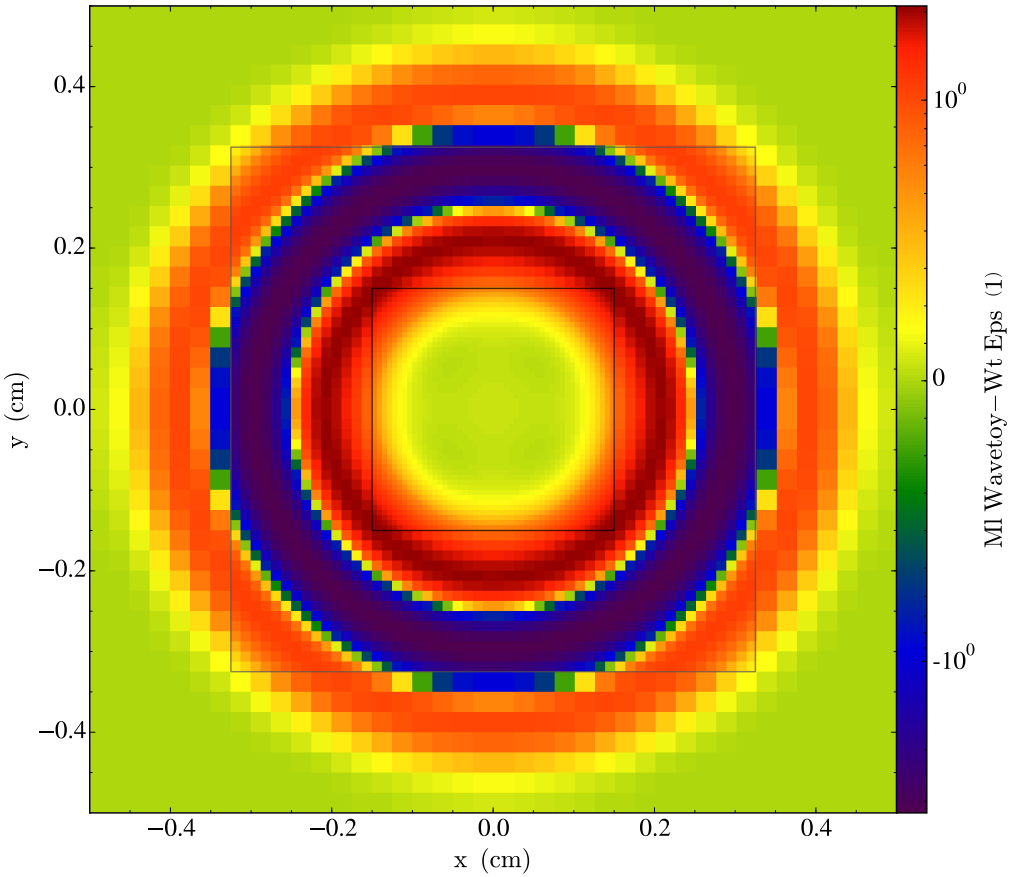
This is where all of the derived fields that ship with yt are defined.

`geometry`

This is where geometric helpler routines are defined. Handlers for grid and oct data, as well as

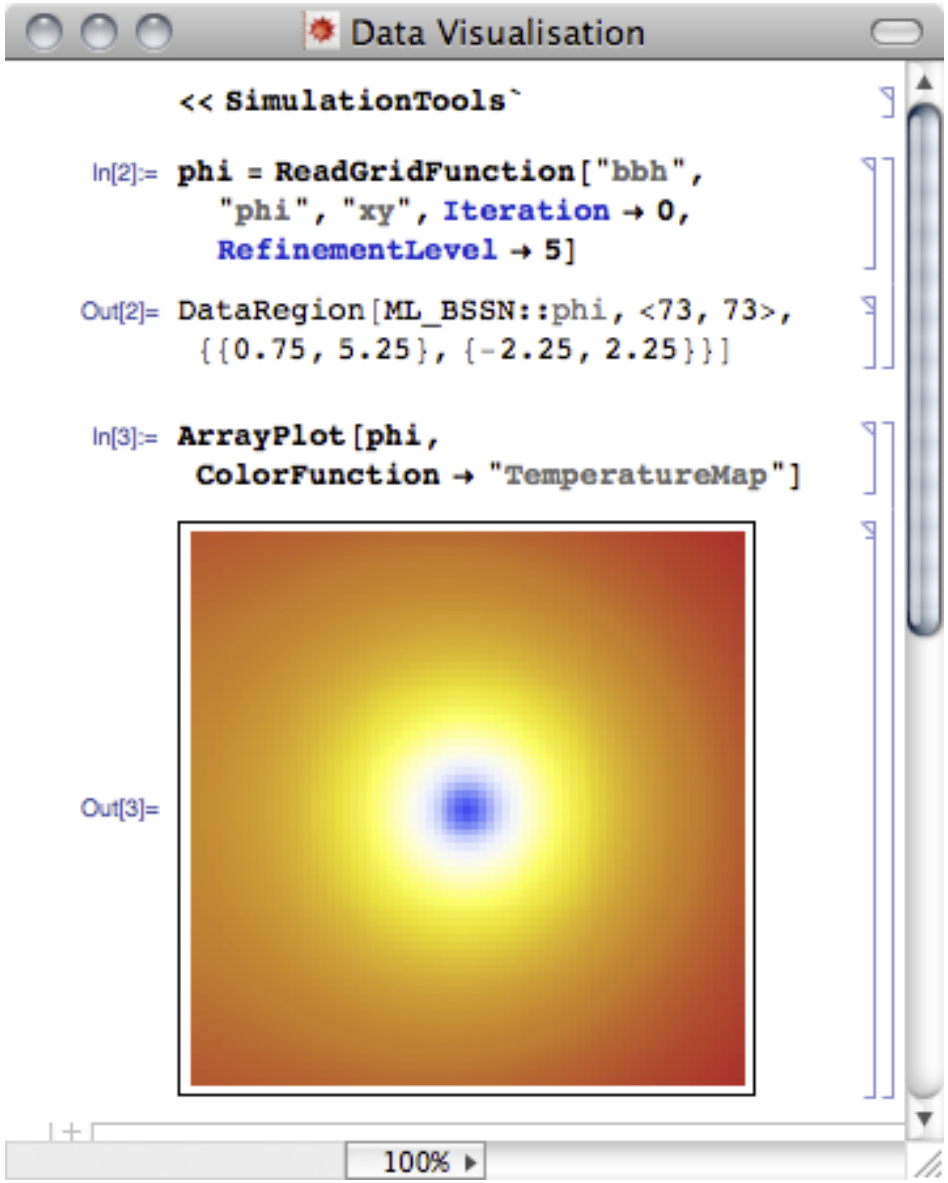
Preliminary Einstein Toolkit Visualizations

$$\ddot{u} = c^2 \nabla^2 u$$



Alternative Tools

- Visit and Paraview
- See Wolfgang Kastaun's talk
- See Roland Haas's talk:
  - Simulation Tools (Ian Hinder): `http://simulationtools.org`
  - scivis/scidata (David Radice): `https://bitbucket.org/dradice/`
  - Cactus reader thorns
  - Replay Thorn (Roland Haas)



Advantages

- Python module:
  - Scripting interface
  - Easily extendable
  - Full power of Python available
  - Trivial installation
- Community developed
  - Inclusive and Accessible

Disadvantages

- No GUI to speak of
- Infrastructure
  - Inflexible
  - (Currently) not ready for numerical relativity
- Reading Einstein Toolkit data in its preliminary stages