an analysis platform

Matthew Turk (UCSD)

an analysis platform

(...that works on multiple types of data)

Matthew Turk (UCSD)

The Problem:

The Problem:

In your dataset you have Things.
Things you want to study.
But you have to find these Things.

The Problem:

But the way you find a Thing isn't necessarily the same way I'd find a Thing.

The Problem:

So how do we really know we're making fair comparisons?

The Problem:

And more to the point, if I get a postdoc somewhere else, should I really have to re-learn how to make a slice through a simulation?

yt is an astrophysical simulation analysis package.

yt is an astrophysical simulation analysis package.

It helps you ask questions of your data.

yt is an astrophysical simulation analysis package.

It helps you ask questions of your data.

I'd like for it to work with lots of types of data.

yt 1.0	yt 1.5	yt 1.7
Enzo	Enzo Orion	Enzo Orion Chombo

	yt 1.8	yt 1.9
	Enzo Orion Chombo Flash Ramses	Enzo Orion Chombo Flash Ramses Gadget ART ZEUS-MP

So how does one add
support for a new code?

Simulation Output

MetaData

Data

Internal yt structures

Most importantly, grids!

Simulation Output

MetaData

Data

Internal yt structures

requires

- Understanding parameters and units
- Understanding spatial relationships of data
- Understanding disk IO for data
- Understanding data locality on disk

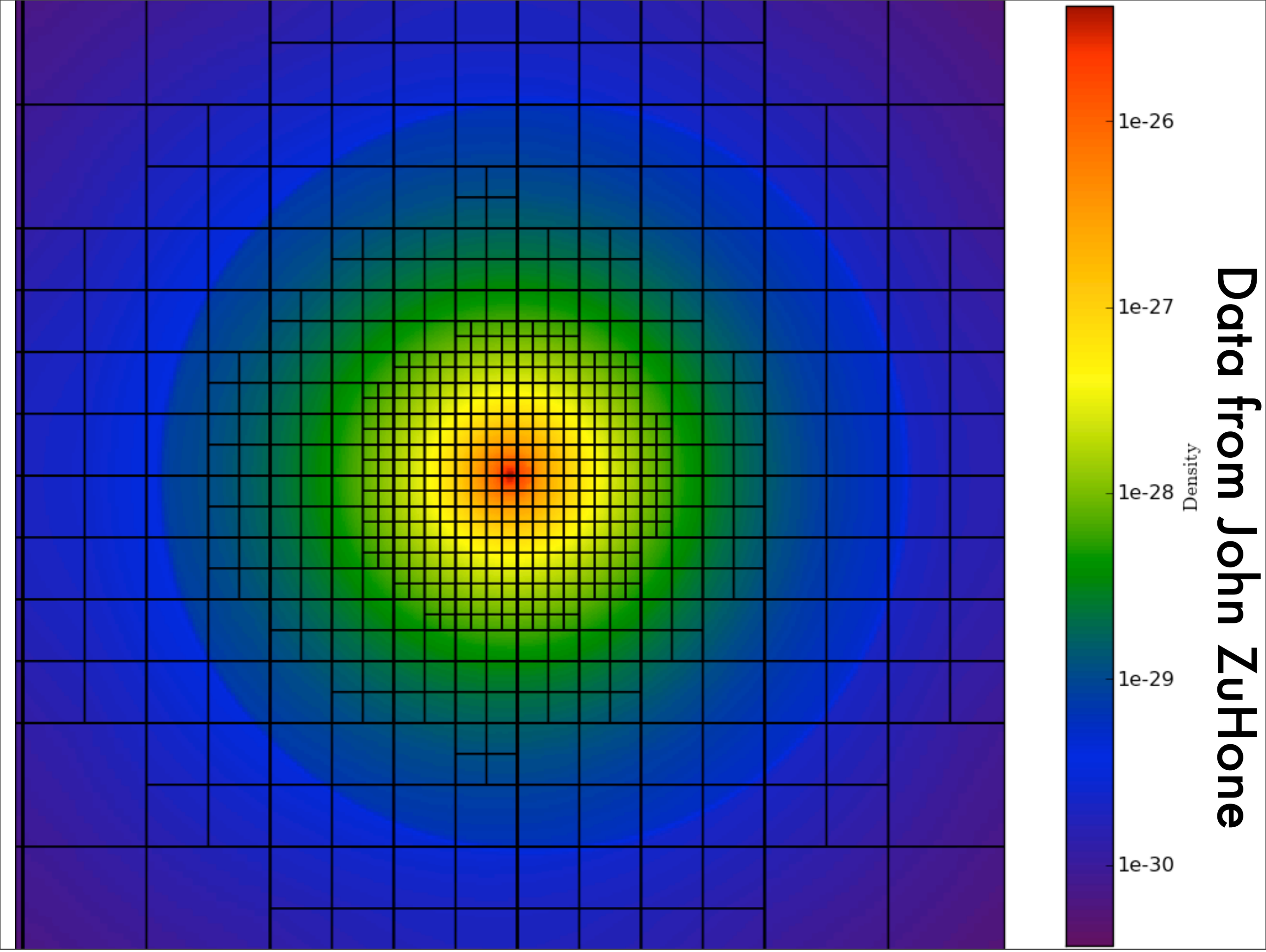
FLASH

FLASH is a code developed by the ASC FLASH center to study supernovae.
Lately it has been put to good use for cosmology.

Block structured AMR.

HDF5 output.

FLASH is an ideal code to put into yt.



Thursday, August 12, 2010

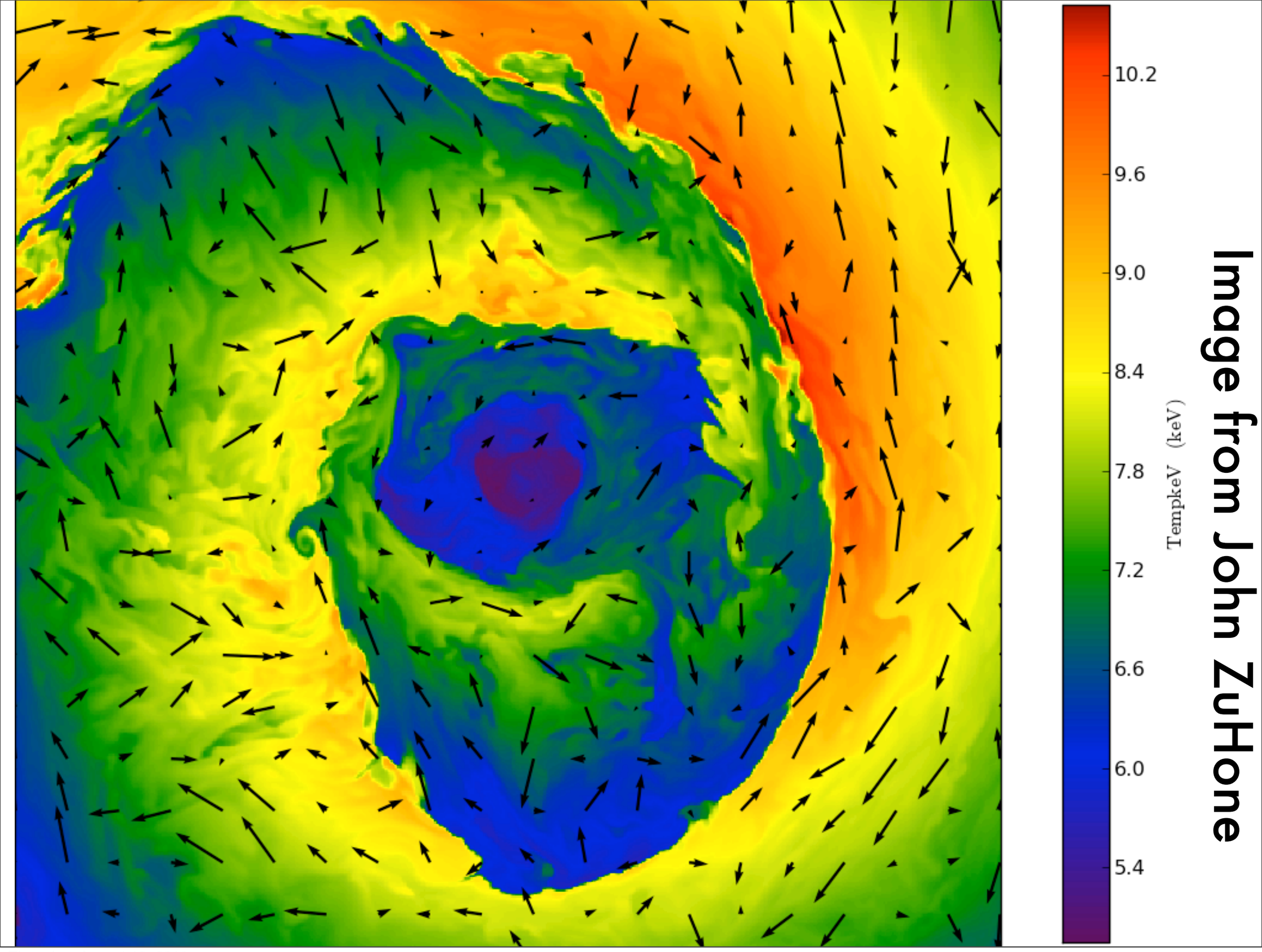
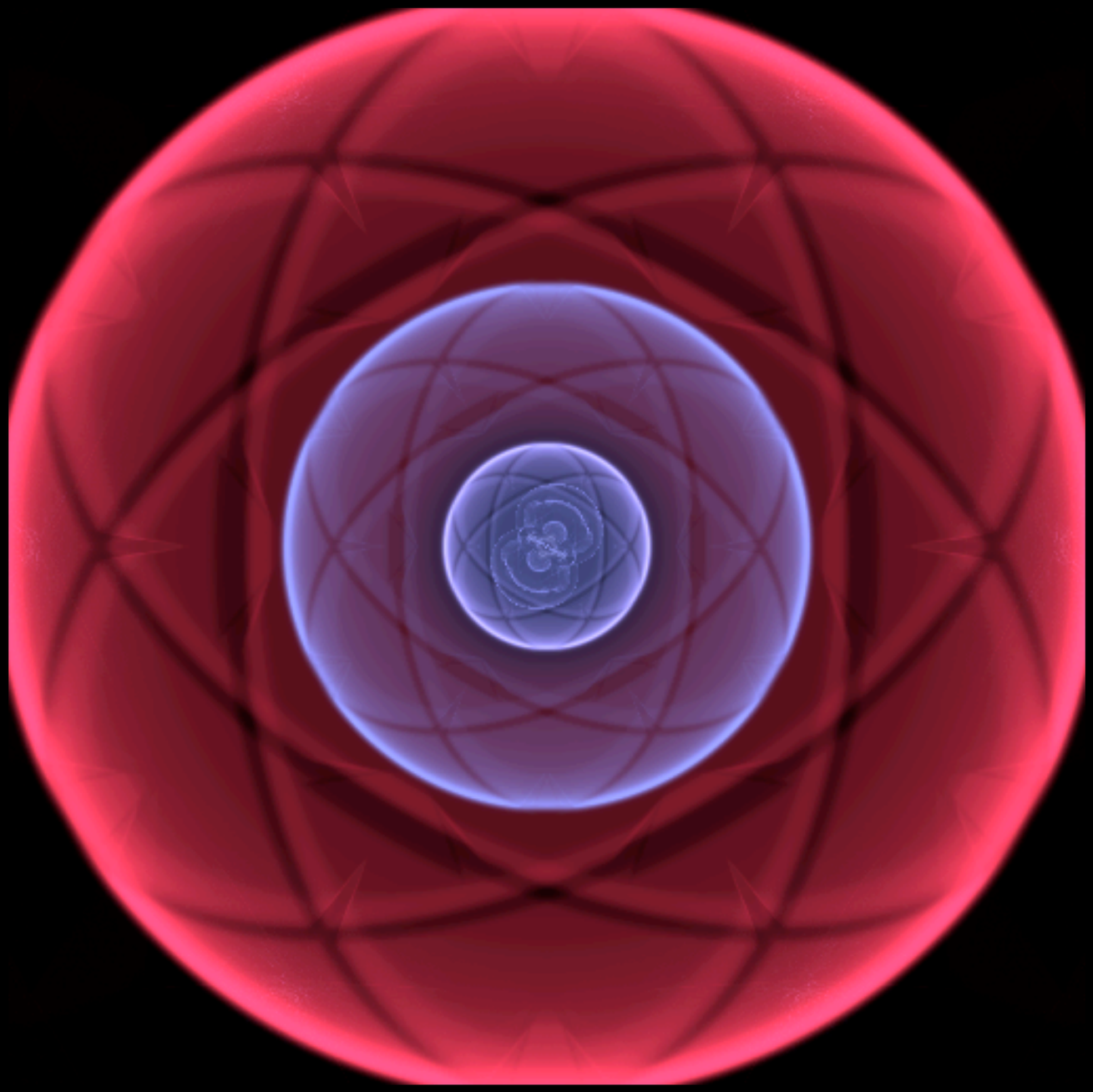


Image from John ZuHone

Thursday, August 12, 2010



Movie from Sean Couch.
(Please forgive the artifacts, yt doesn't handle
FLASH boundary conditions very well just yet.)

RAMSES

RAMSES is an octree, cell-based code.

Because yt was designed to operate on patches, it's optimized for few operations on large chunks of data.

process

Phase One:

using Oliver Hahn's RamsesRead++ !

Read in the data, very flatly.

Each oct grid was a yt grid.

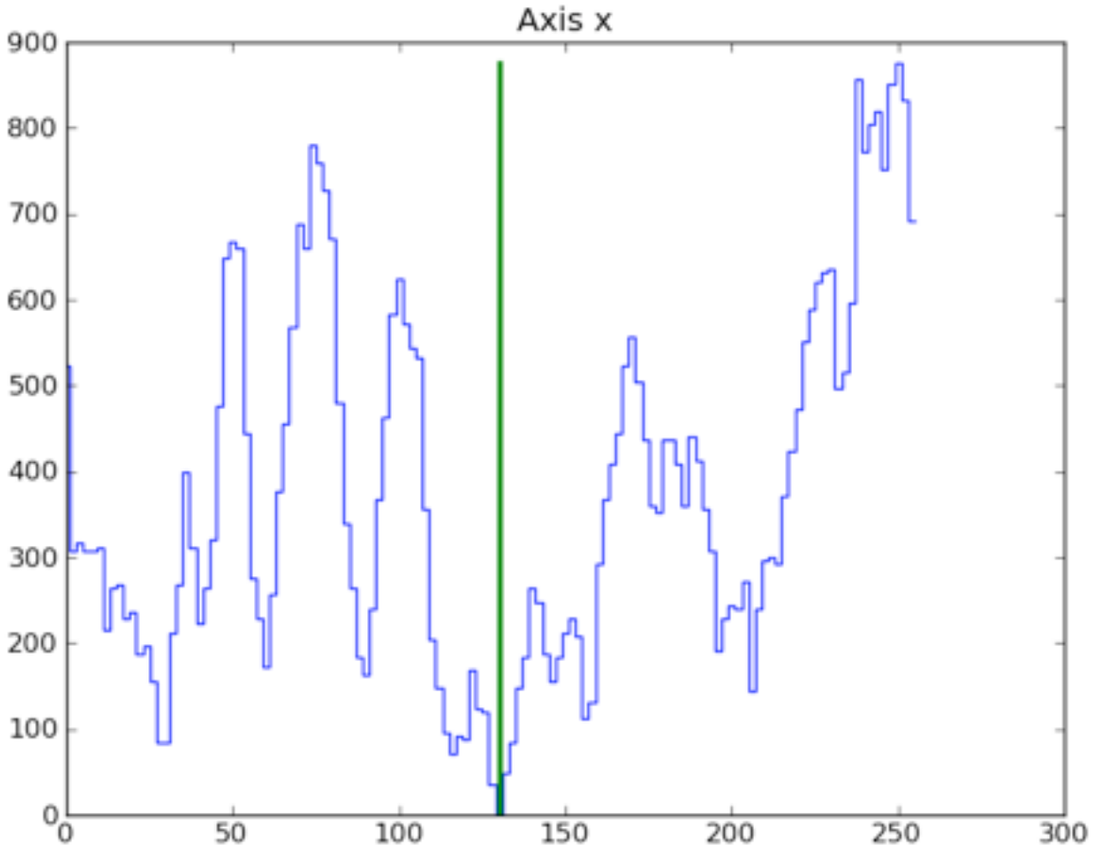
This was prohibitively slow.

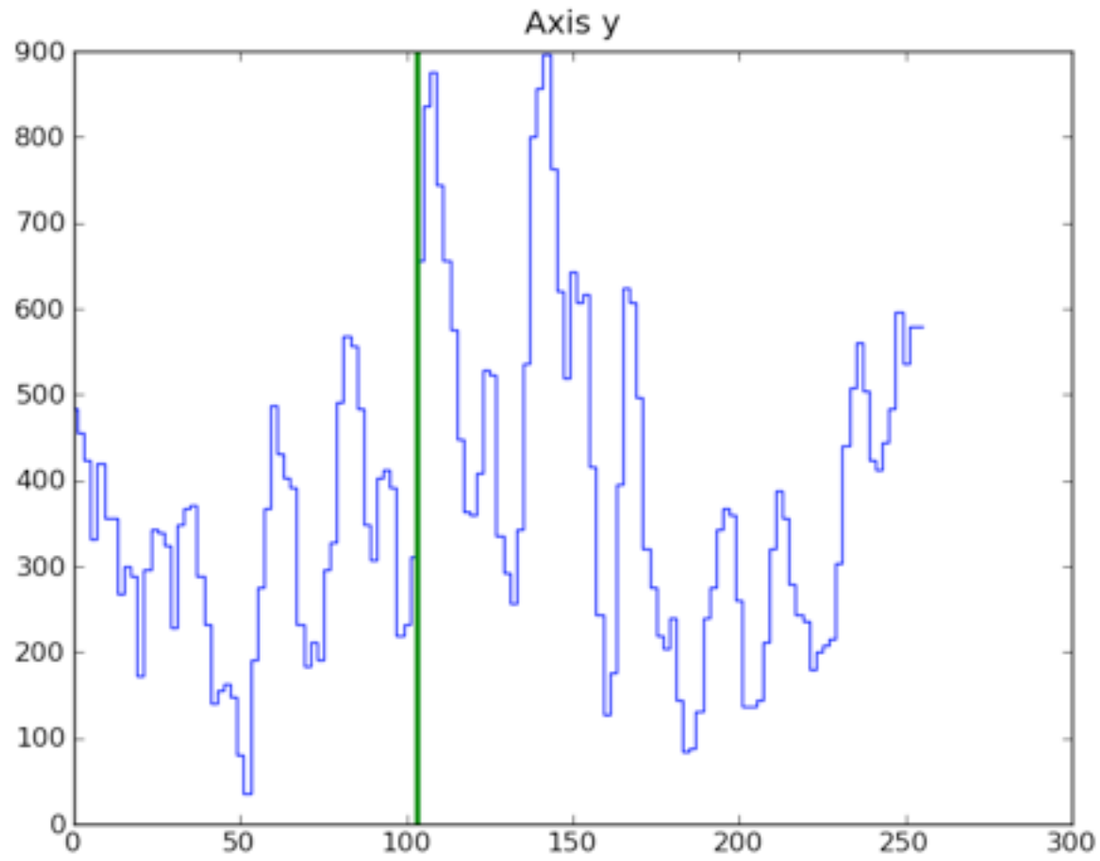
Phase Two:

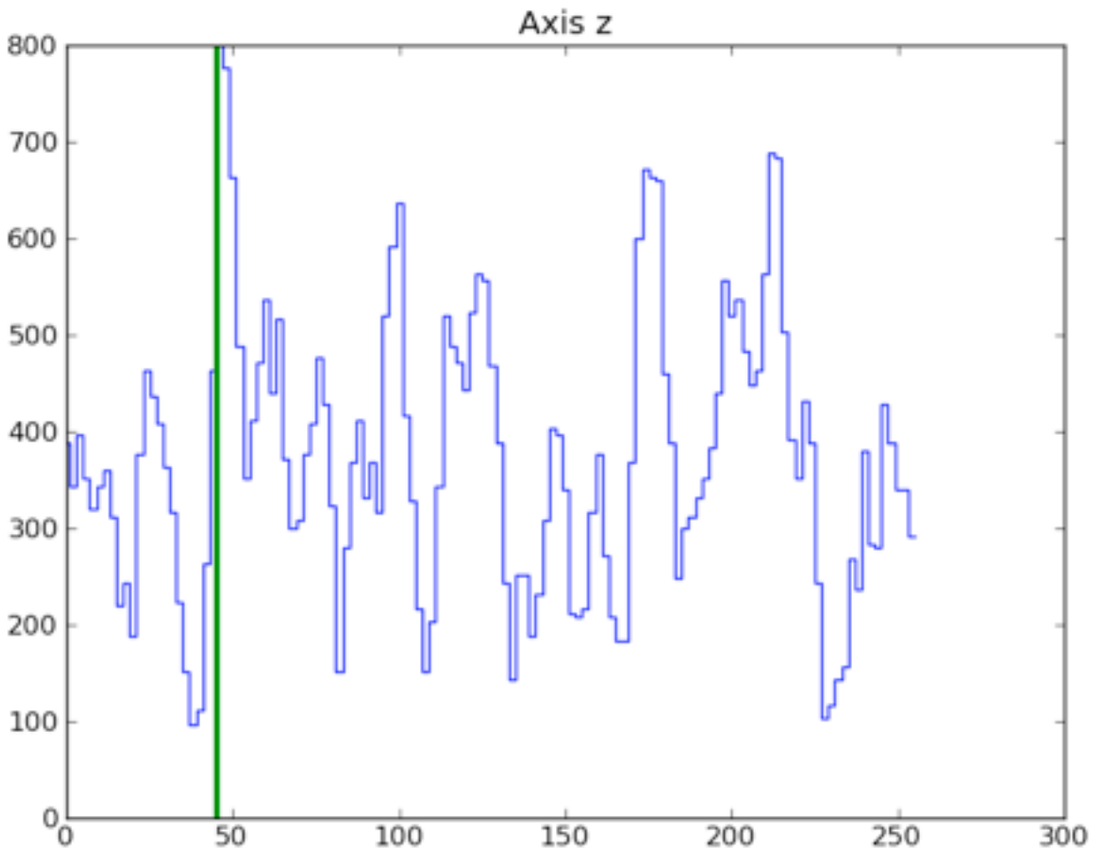
Read in the data, very flatly.

Each oct grid was a proto grid.

Identify clusters.

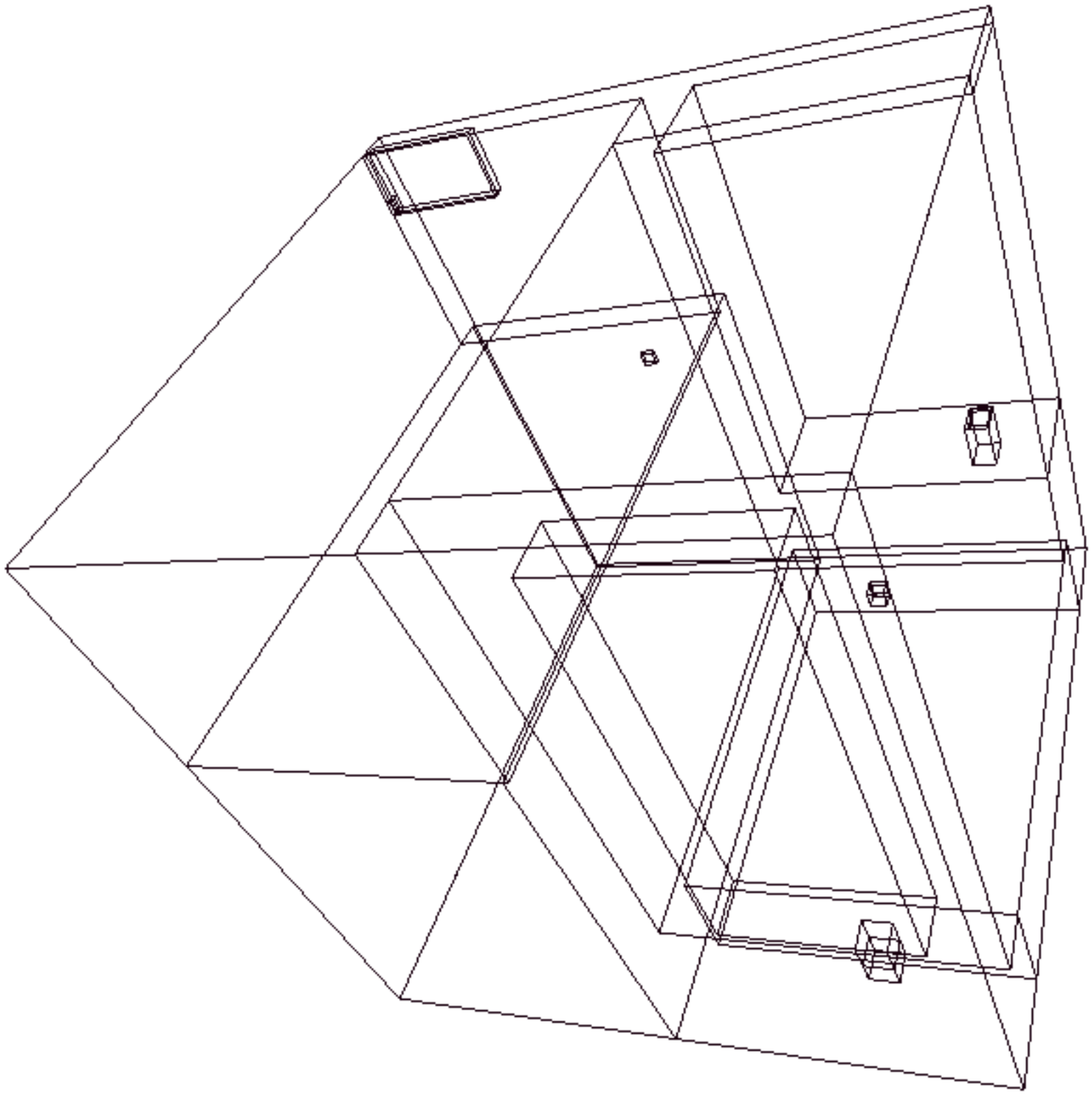




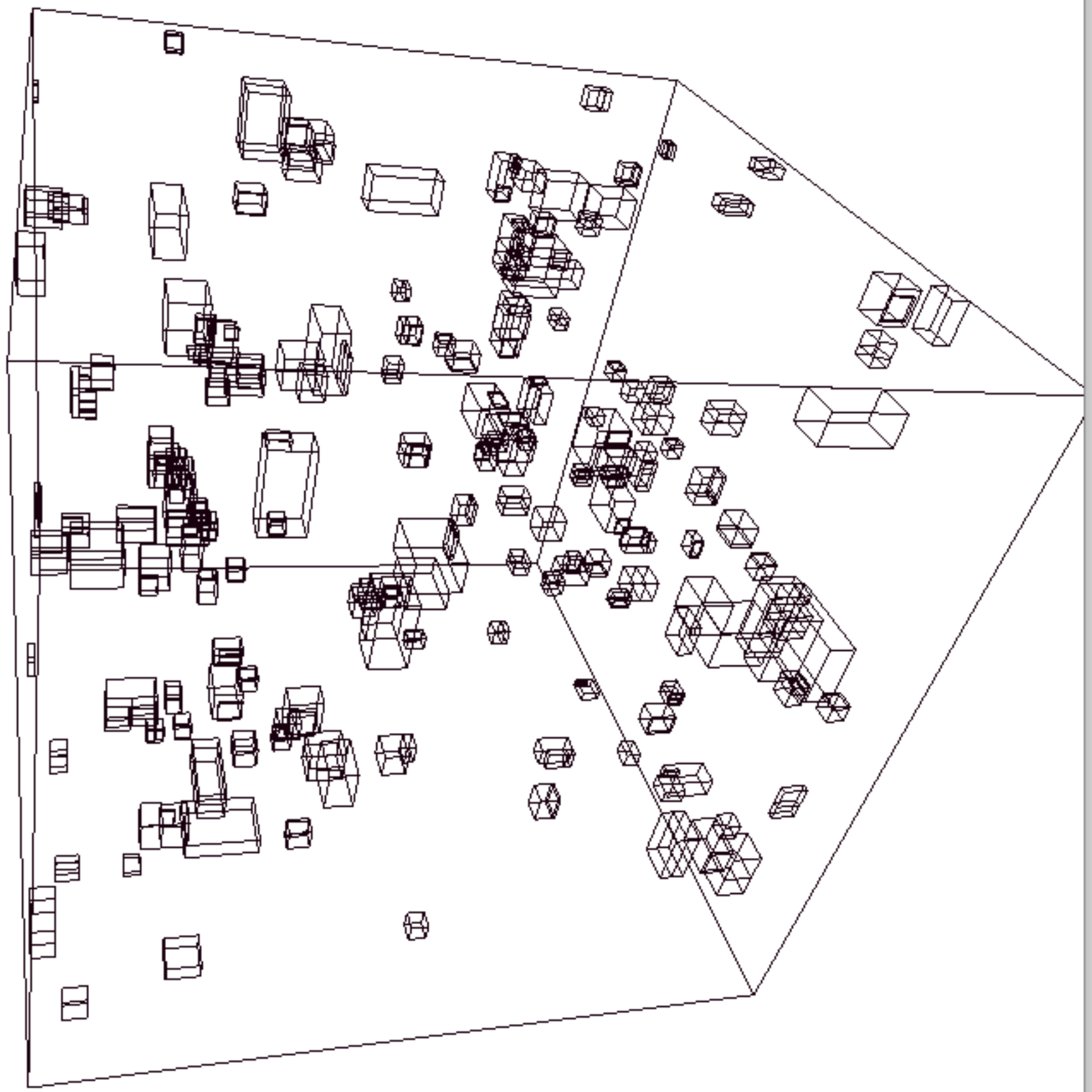


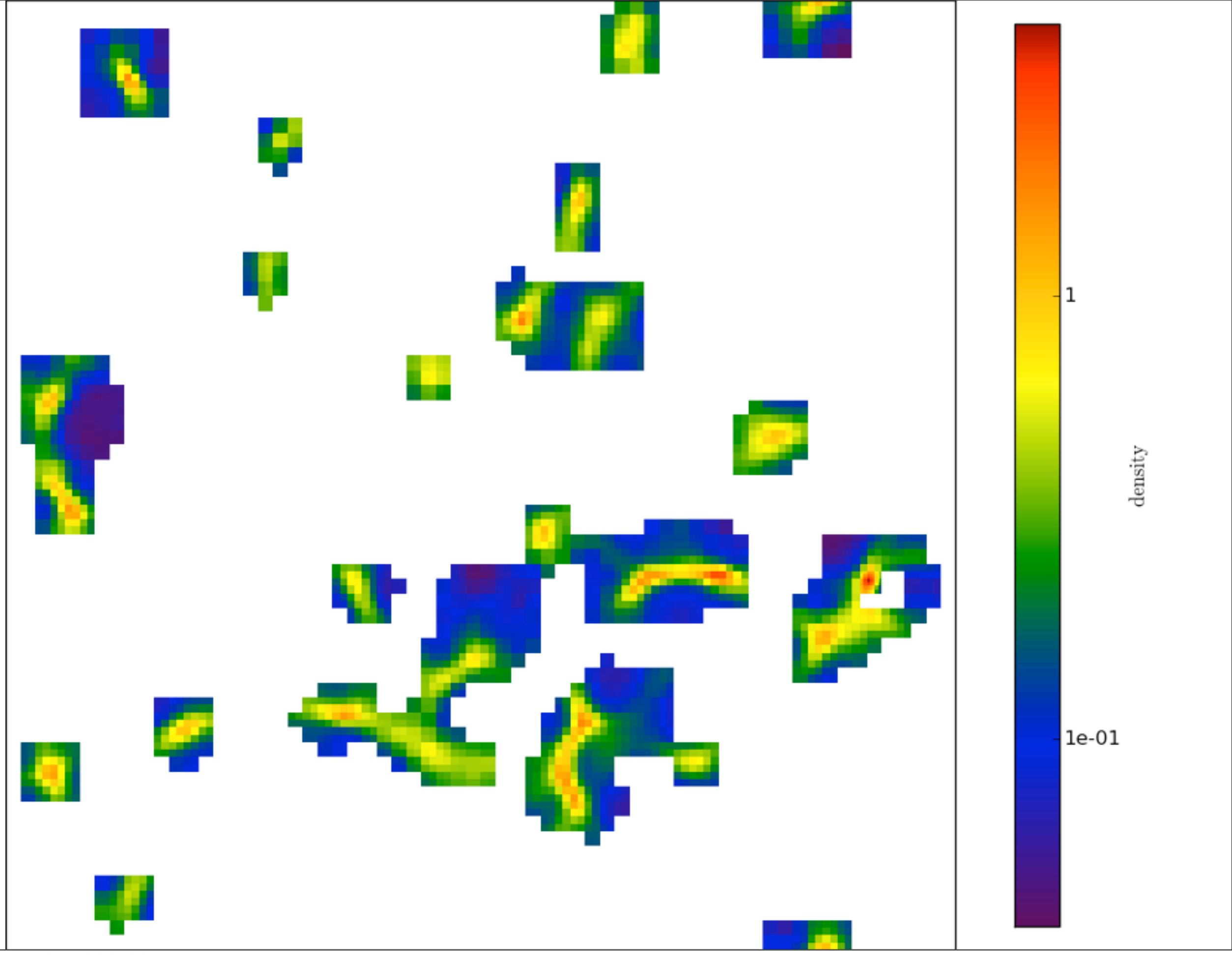
Recursively split until efficiency requirement is met.

This worked pretty well, but for big datasets it didn't converge.

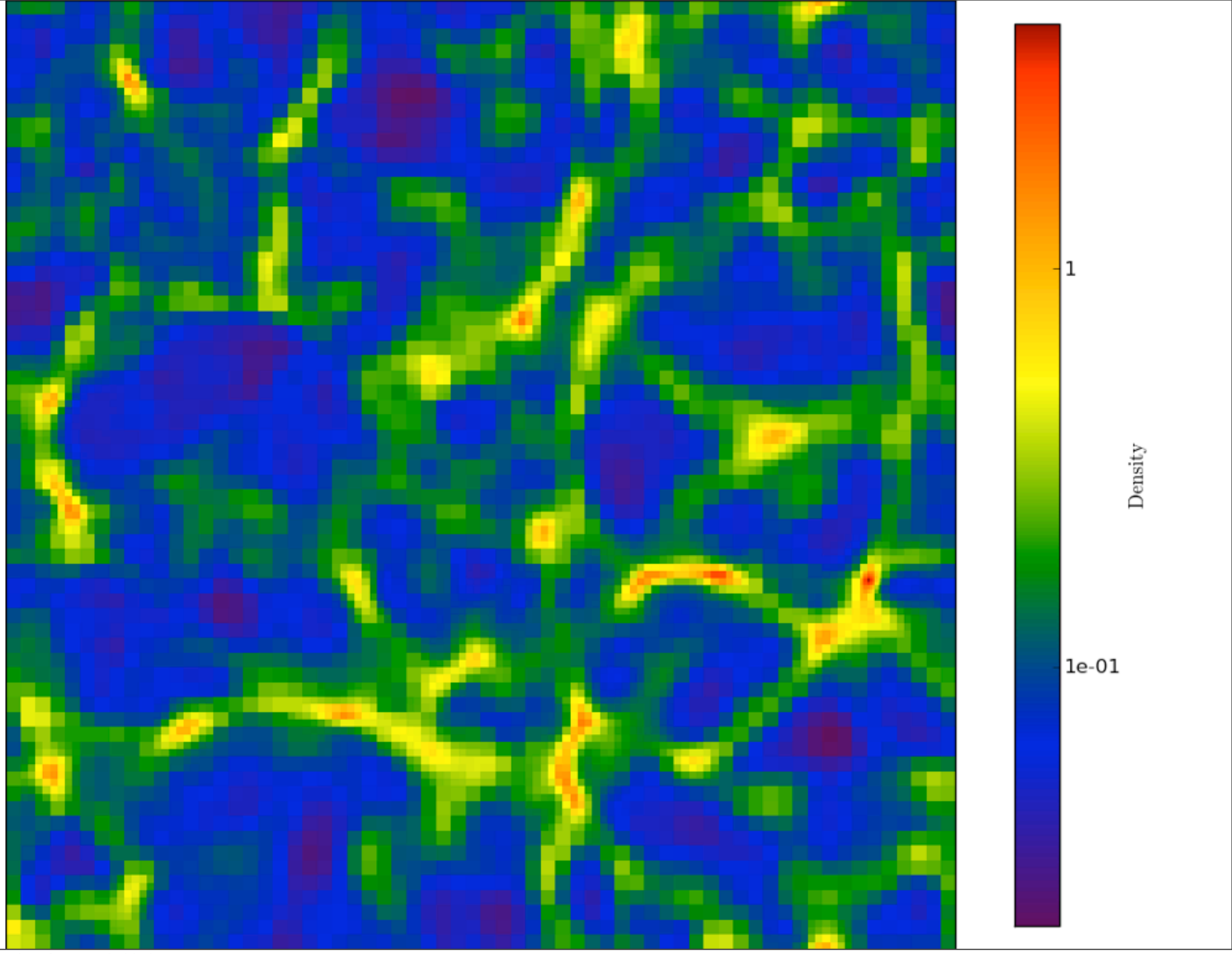


By applying a series of cuts and subdomains, this process became reasonably speedy.

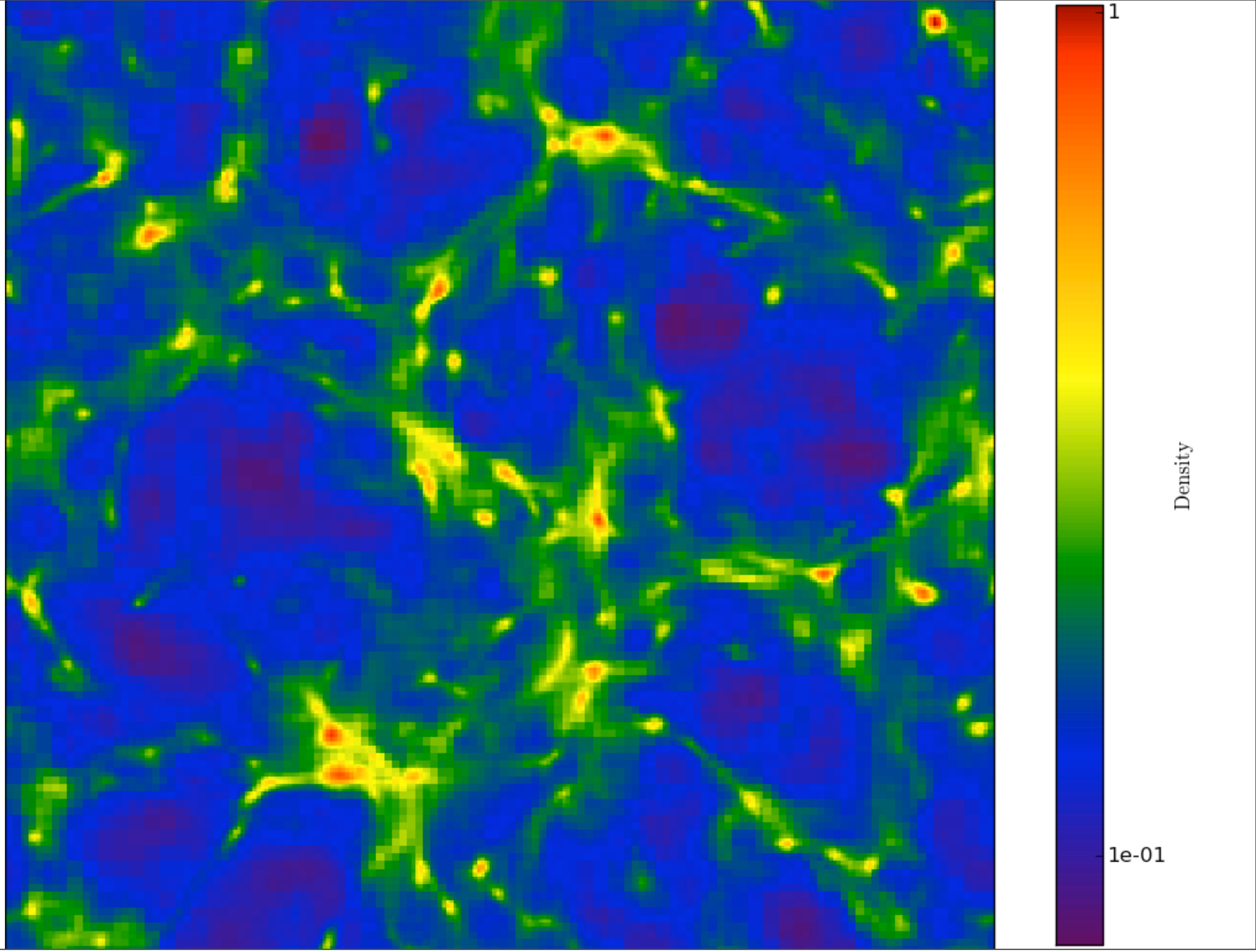




Thursday, August 12, 2010

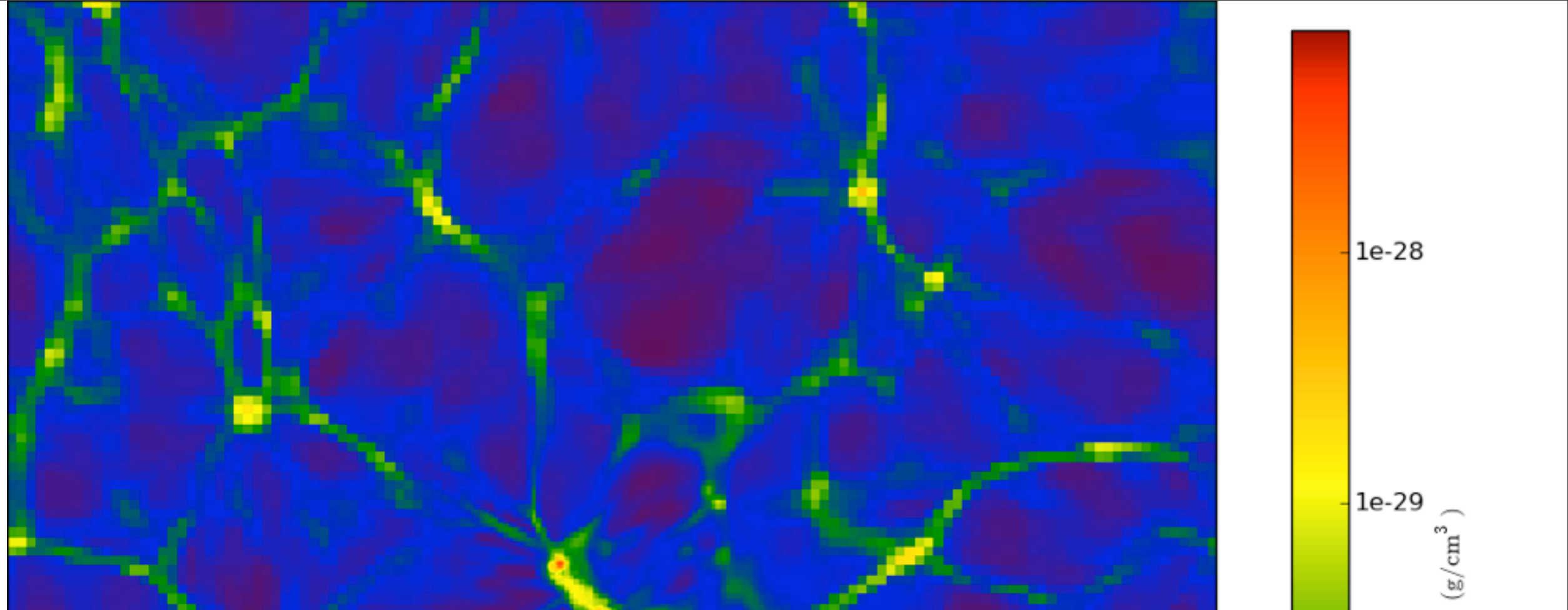


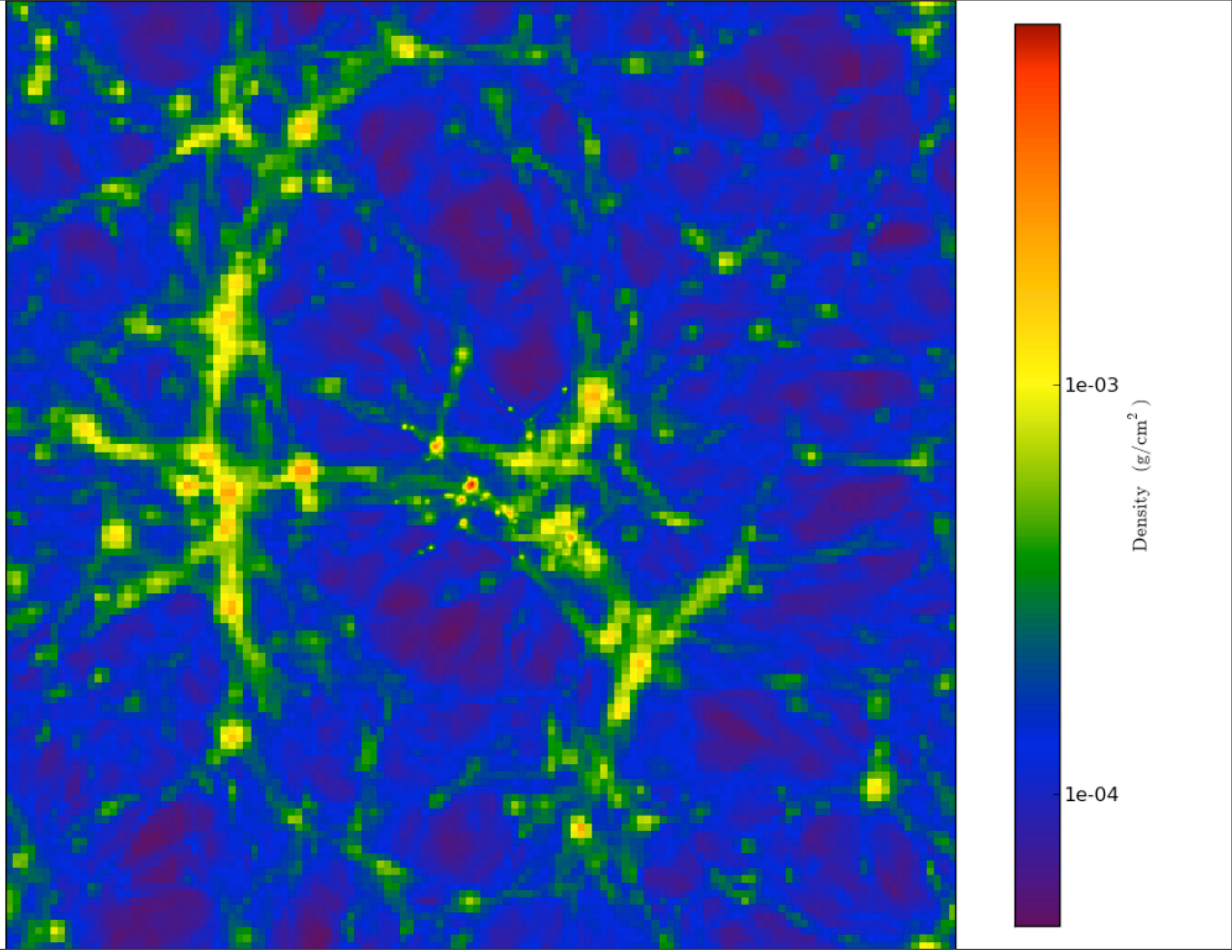
Thursday, August 12, 2010


1
Density
1e-01

yt can now do cross-code comparisons of RAMSES, FLASH and Enzo.

(modulo a few bugs with large datasets.)


1e-28
1e-29
1e-30
1e-31
Density (g/cm^3)


1e-03
1e-04
Density (g/cm^2)

going forward:

A format for grid and gridded astrophysical data.

We will implement and support this in yt 2.0.

Identical scripts,
different data,
reliable cross-code comparisons.

A brief soliloquy about my research efforts!

A brief soliloquy about my research efforts!

(I do more than just yt and enzo development)

My thesis work was on adding a new chemical model to Enzo.

This can be tedious work.

This can be tedious work.

Balancing reactions, coding update steps, testing results,
trying new algorithms, threading reaction rate
coefficients...

This can be tedious work.

Balancing reactions, coding update steps, testing results,
trying new algorithms, threading reaction rate
coefficients...

But in truth, it's pretty fun.

dengo

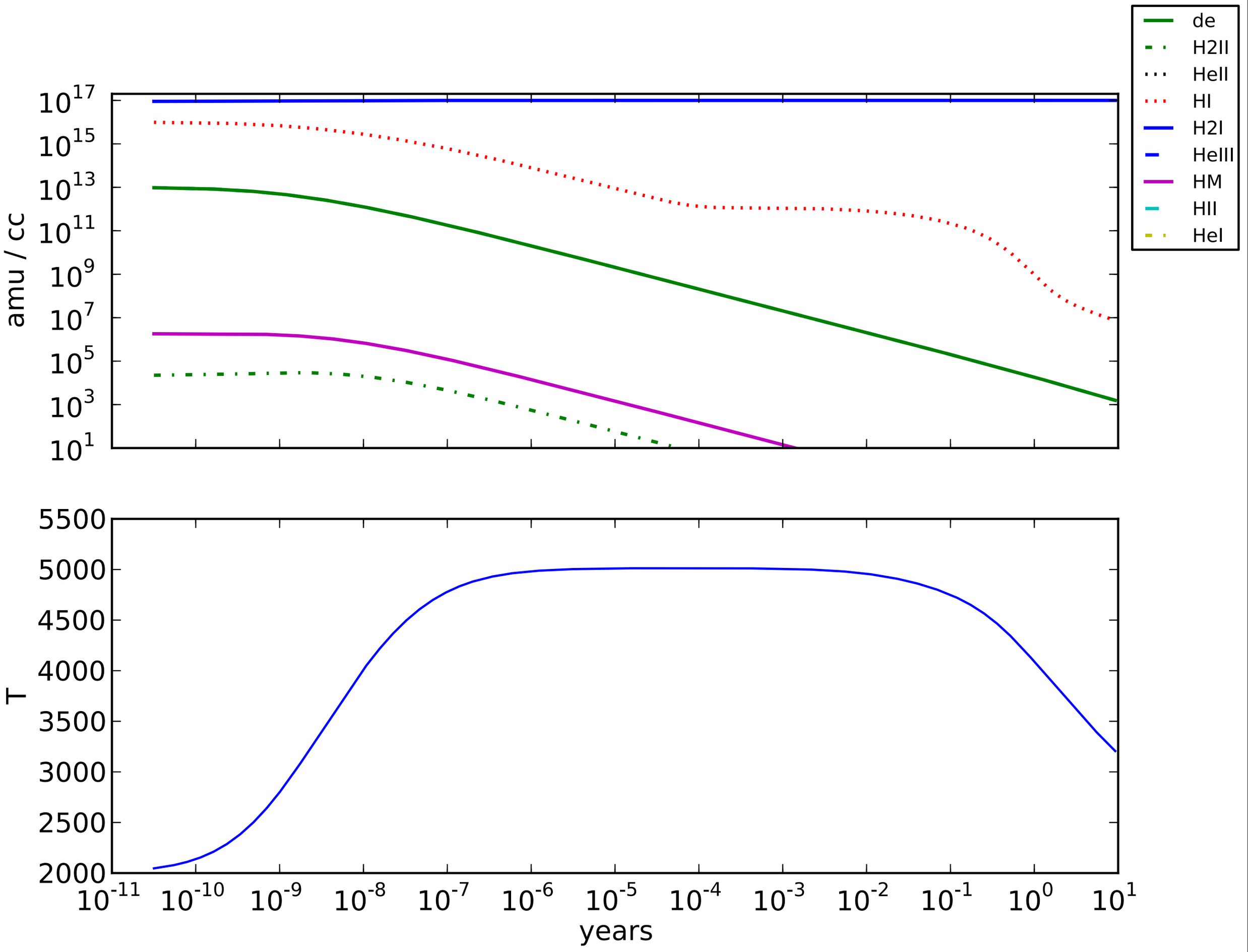
A new package for programmatically describing chemical rate equations and generating solvers to be used in simulation codes.

It's a meta-solver.

```
HI = Species(“HI”, weight=1)
H2I = Species(“H2I”, weight=2)
r13 = Reaction(“r13”, [(1,H2I), (2,HI)], [(3,HI)])
r22 = Reaction(“r22”, [(3,HI)], [(1,H2I), (1,HI)])
```

This is then used to generate a solver for use in a simulation code, including Jacobian calculation, EOS and cooling.

First implementation: CVODE in Enzo.


de
H2II
HeII
HI
H2I
HeIII
HM
HII
HeI
amu / cc
10^{17}
10^{15}
10^{13}
10^{11}
10^{9}
10^{7}
10^{5}
10^{3}
10^{1}
T
5500
5000
4500
4000
3500
3000
2500
2000
10^{-11}
10^{-10}
10^{-9}
10^{-8}
10^{-7}
10^{-6}
10^{-5}
10^{-4}
10^{-3}
10^{-2}
10^{-1}
10^{0}
10^{1}
years

released soon...

Thank you.

http://yt.enzotools.org/
yt-users@lists.spacepope.org
matthewturk@gmail.com

yt team:

Jeff Oishi
Britton Smith
Stephen Skory
Sam Skillman
John Wise
Oliver Hahn
John ZuHone
Chris Moody