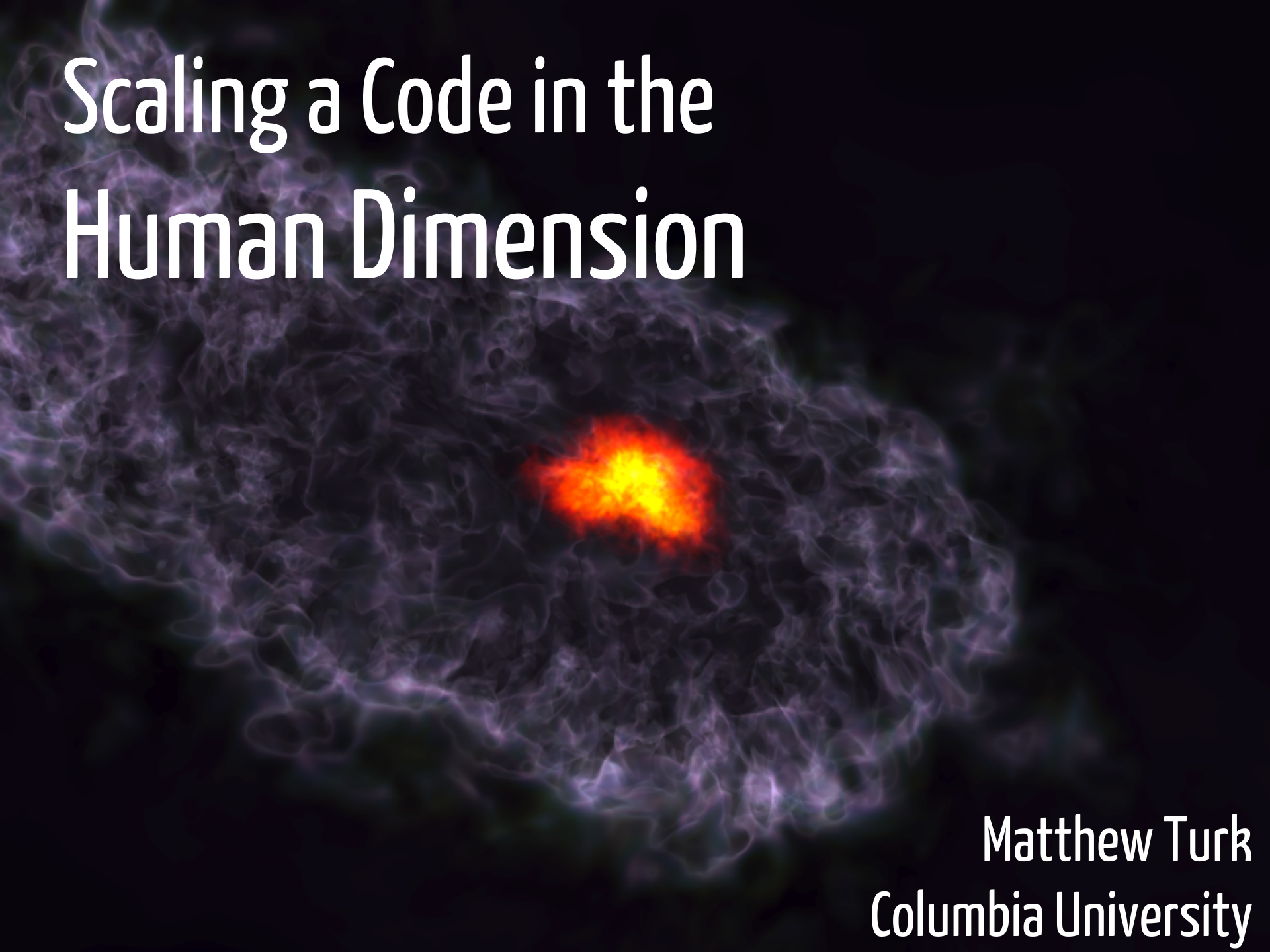
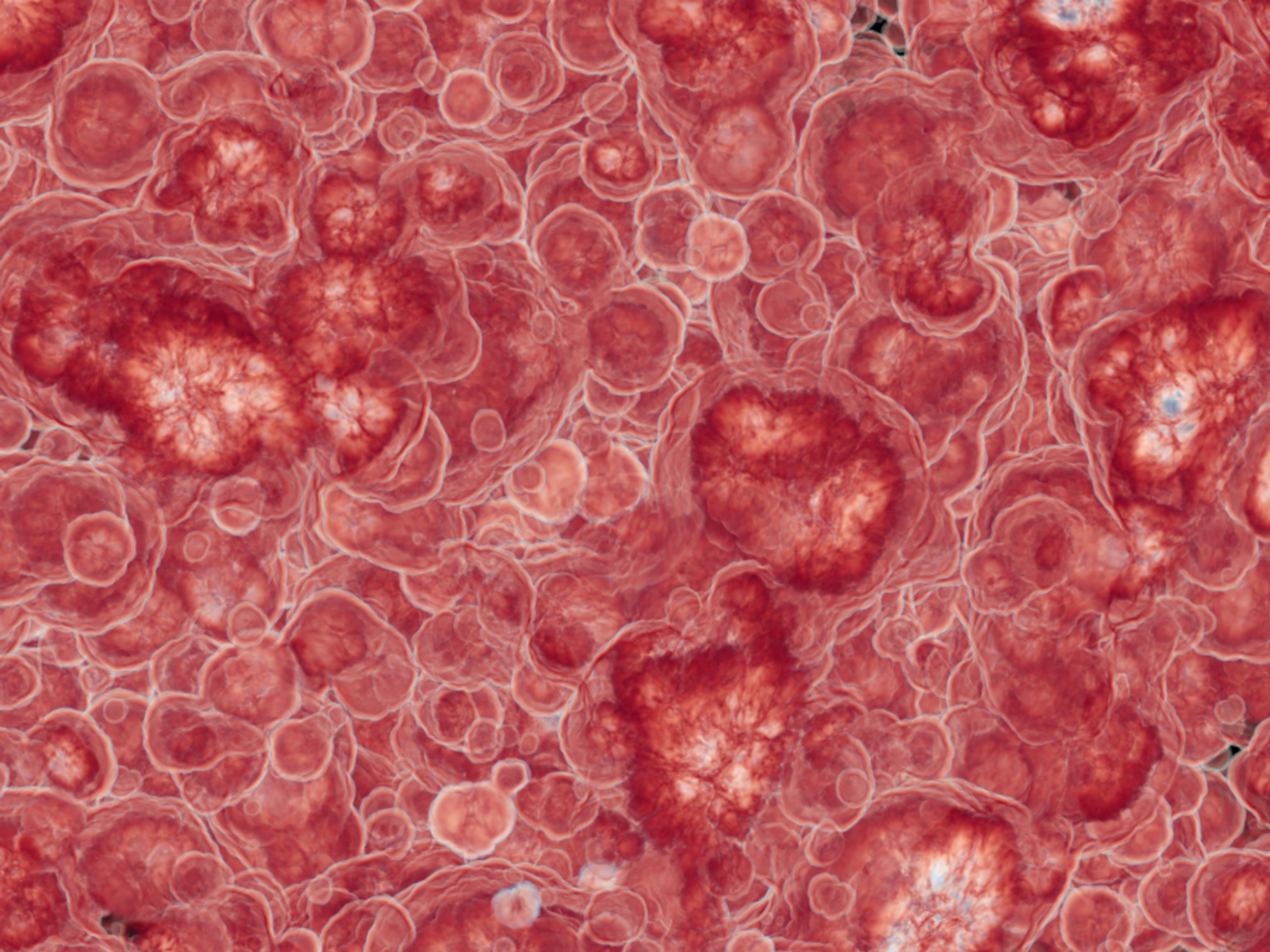
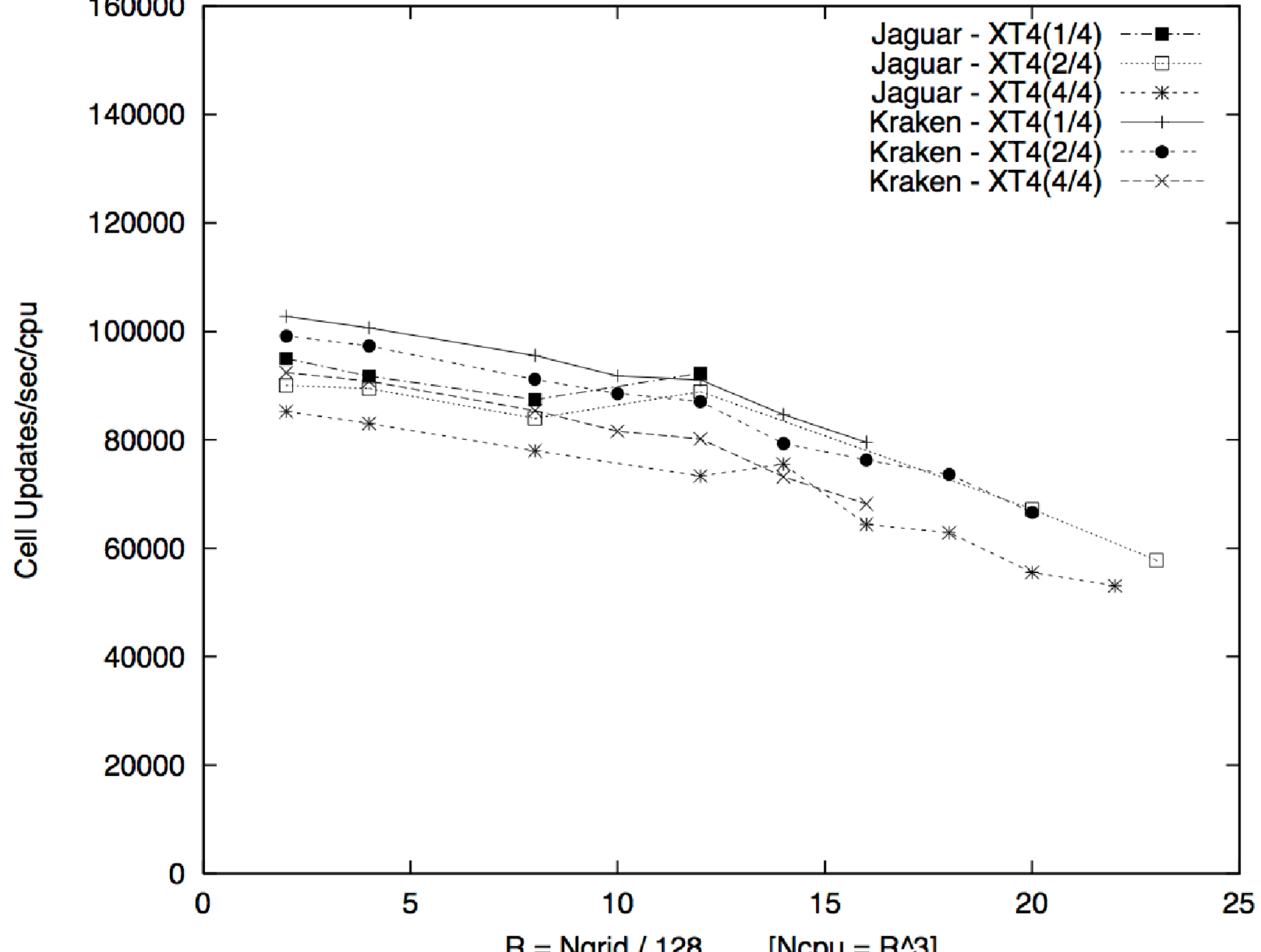


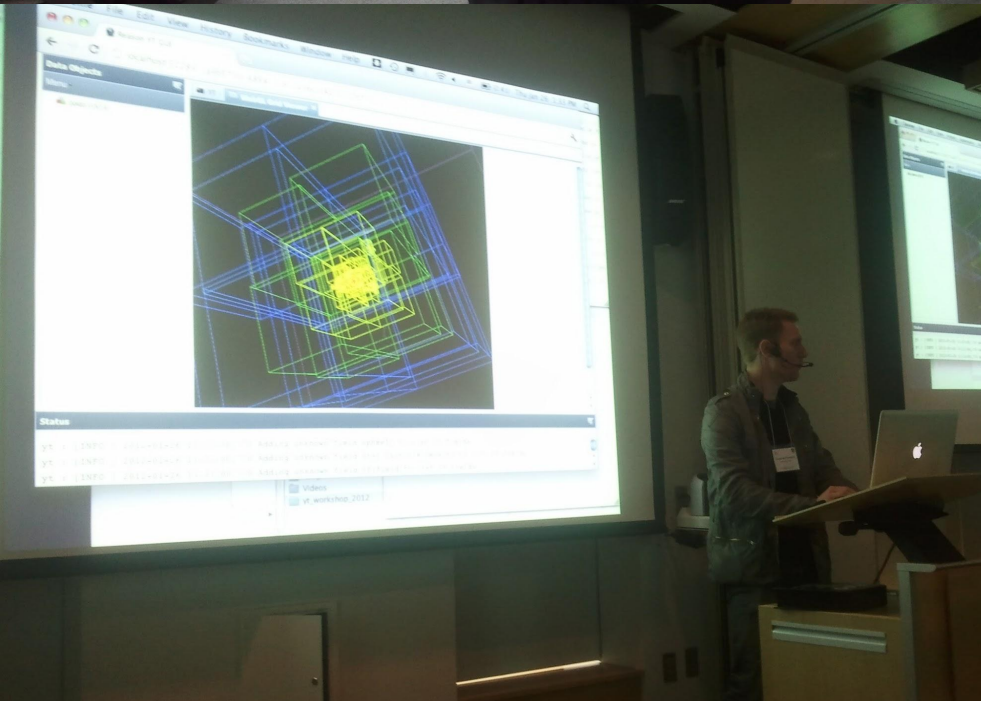
Scaling a Code in the Human Dimension



Matthew Turk
Columbia University







What is yt?

The logo for yt, consisting of the lowercase letters 'y' and 't' in a white, serif font. The 'y' has a decorative swirl at the bottom. The logo is centered within an oval frame that contains a colorful, abstract background of red, yellow, and green.

[astro-ph/1011.3514](#)

[astro-ph/1112.4482](#)

yt-project.org

HOME
COMMUNITY
GET YT
EXAMPLES
DEVELOP

HELP!

DOCS
BLOG
HUB

THE YT PROJECT

ASTROPHYSICAL SIMULATION ANALYSIS AND VIZ



VISUALIZATION OF COMPLEX STRUCTURE

Opaque contour rendering of a cloud-crushing simulation by [Silvia, Smith & Shull](#).

DETAILED DATA ANALYSIS AND VISUALIZATIONS, WRITTEN BY **WORKING ASTROPHYSICISTS** AND DESIGNED FOR PRAGMATIC ANALYSIS NEEDS.



DATA-DRIVEN

Inspect your data

yt is designed to provide a consistent, cross-code interface to analyzing and visualizing



COMMUNITY

Participants welcome!

yt is composed of a friendly community of users and developers. We want to make it



FREE SOFTWARE

Open Source, Open Science

yt is developed completely in the open, released under the GPL license. The developers are

yt Overview

yt is a community-developed analysis and visualization toolkit for astrophysical simulation data. yt provides full support for the [Enzo](#), Orion, [Nyx](#), and [FLASH codes](#), with preliminary support for [RAMSES](#), ART, and Maestro. It runs both interactively and non-interactively, and has been designed to support as many operations as possible in parallel. For more detailed information, see our [ApJS paper](#).

To install `yt`, see [Quickstart Guide](#) or [Installing yt](#). To see what's new since the last version, check out [ChangeLog](#).

If you use `yt` in a paper, you are highly encouraged to submit the repository containing the scripts you used to analyze and visualize your data to the [yt Hub](#), and we ask that you consider citing our [method paper](#), as well. If you are looking to use `yt`, then check out the [yt Hub](#) for ideas of how other people used `yt` to generate worthwhile analysis. We encourage you to explore the source code and even consider [contributing](#) your enhancements and scripts.

For more information, please visit [our homepage](#) and for help, please see [Asking for Help](#).

Getting Started

[Welcome to yt!](#)

What's yt all about?

[yt Orientation](#)

Quickly get up and running with yt: zero to sixty.

[How to Ask for Help](#)

Some guidelines on how and where to ask for help with yt

[Workshop Tutorials](#)

Videos, slides and scripts from the 2012 workshop covering many aspects of yt, from beginning to advanced.

[The Cookbook](#)

A bunch of illustrated examples of how to do things

[FAQ](#)

Frequently Asked Questions: answered for you!

User Guide

TABLE OF CONTENTS

[Welcome to](#)[Quickstart](#)[yt Worksho](#)[Asking for](#)[Ways of In](#)[Configurat](#)[Example S](#)[Analyzing](#)[Visualizing](#)[Analysis M](#)[Advanced y](#)[Getting Inv](#)[API Refere](#)[Field List](#)[Frequently](#)[ChangeLog](#)

SEARCH

There are many simulation codes.

There are many simulation codes,
but there is only one sky.

Fully-Supported

Enzo
FLASH
Orion
Nyx
Raw Data
Piernik

Semi-Supported

Chombo
Athena
ART
RAMSES
GDF

In-Progress

Cactus
Gadget
GAMER
PENCIL

yt is designed to address physical,
not computational,
entities and questions.

yt is supposed to get out of the way.

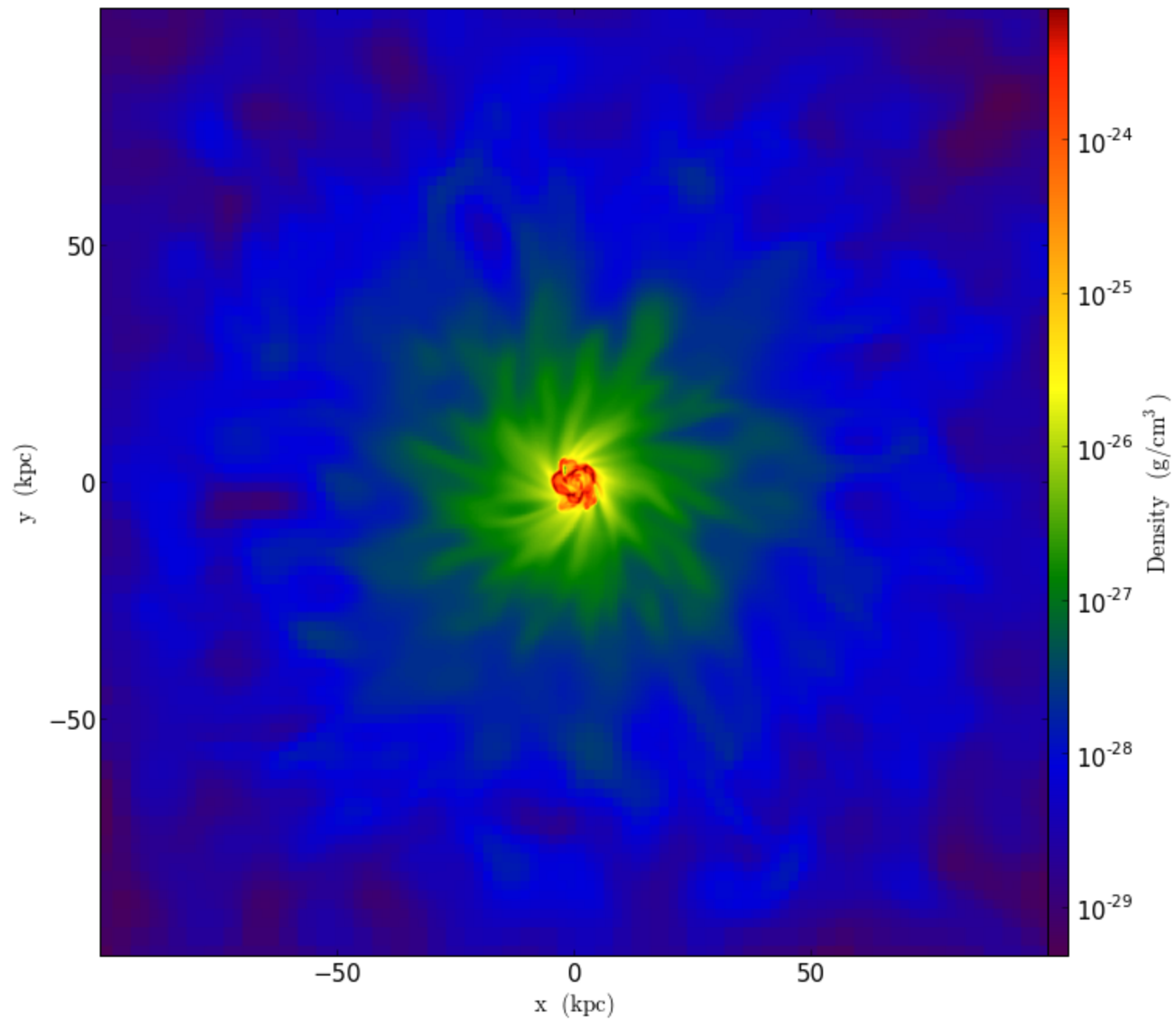
```
from yt.mods import *  
pf = load("galaxy0030/galaxy0030")  
p = SlicePlot(pf, 2, "Density", "c", (200, "kpc"))  
p.show()
```

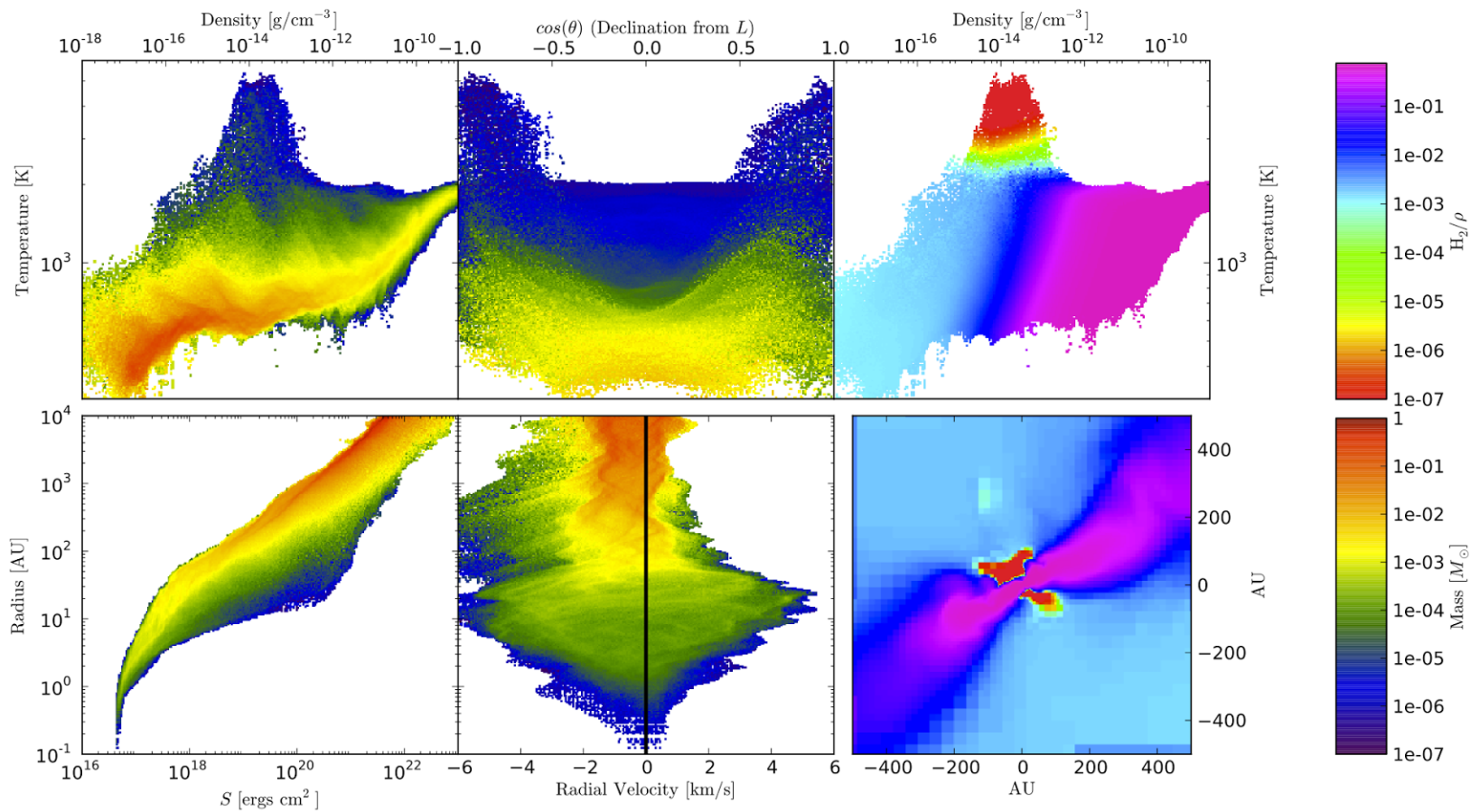
```
from yt.mods import *  
pf = load("galaxy0030/galaxy0030")  
p = SlicePlot(pf, 2, "Density", "c", (200, "kpc"))  
p.show()
```

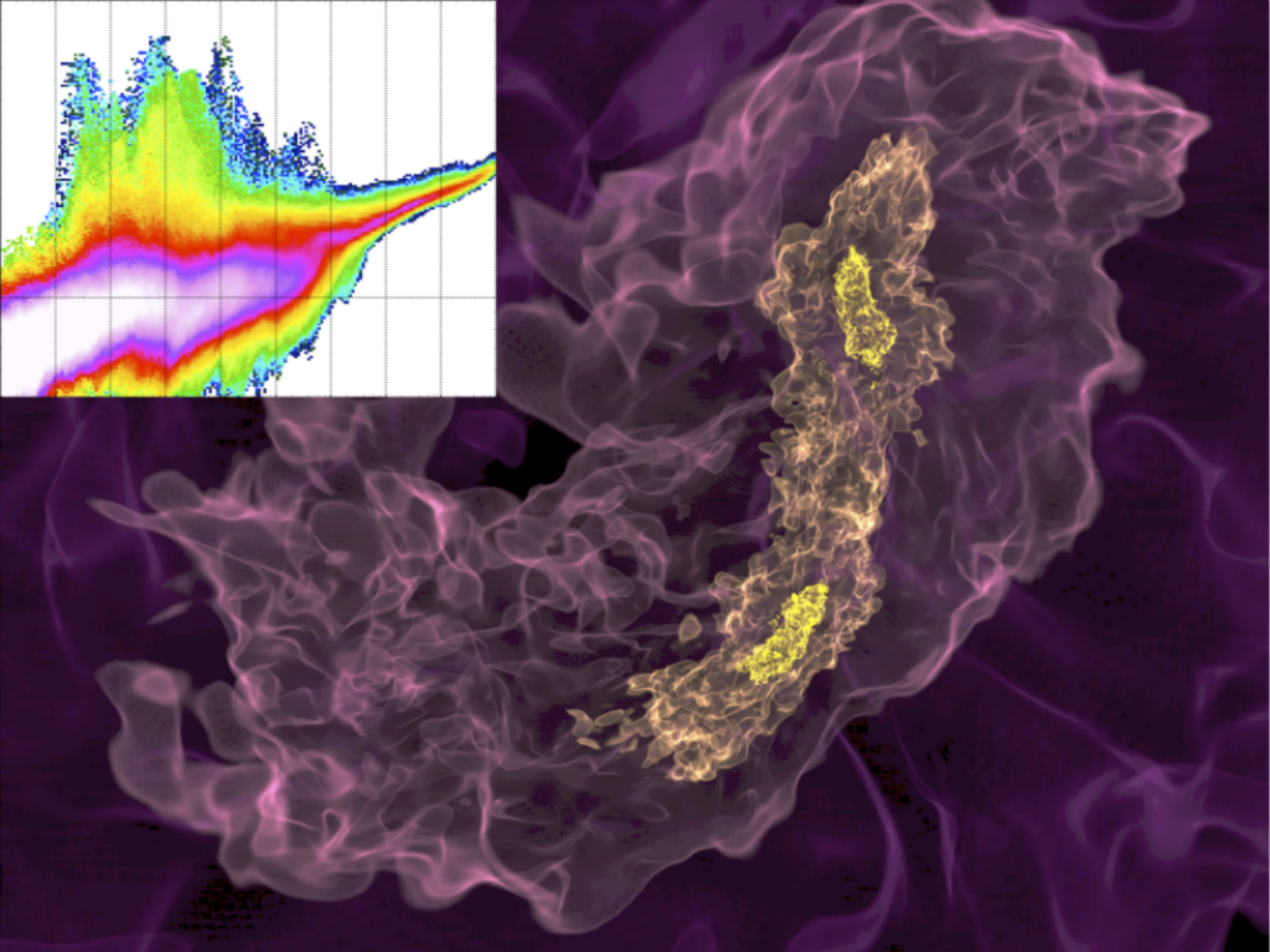
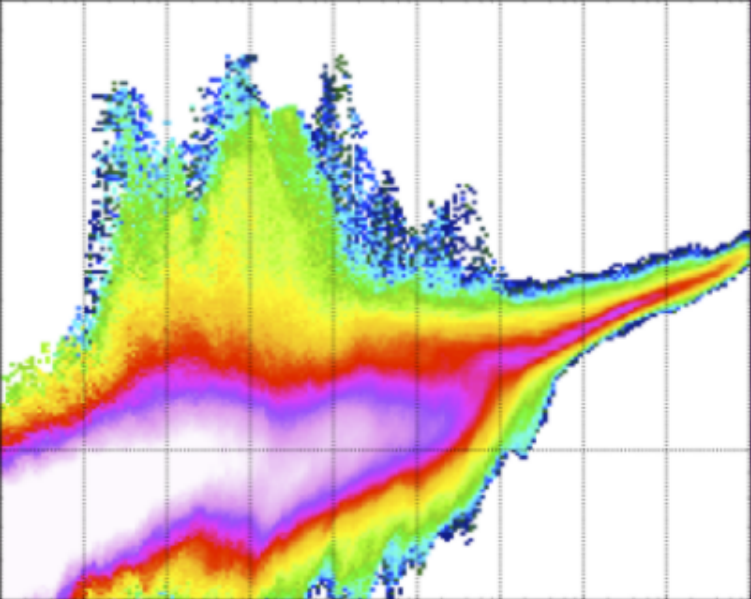
Load from disk, determine IO format, parse
parameters, set up mesh, initialize IO, and create
geometric objects.

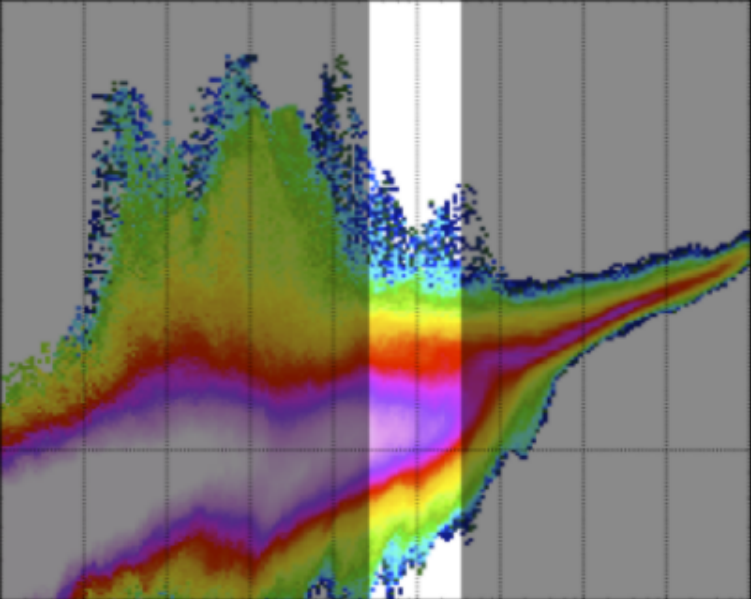

```
from yt.mods import *  
pf = load("galaxy0030/galaxy0030")  
p = SlicePlot(pf, 2, "Density", "c", (200, "kpc"))  
p.show()
```

Identify appropriate subregions of data, mask
out overlapping data, convert to CGS,
concatenate, pixelize, and return plot.

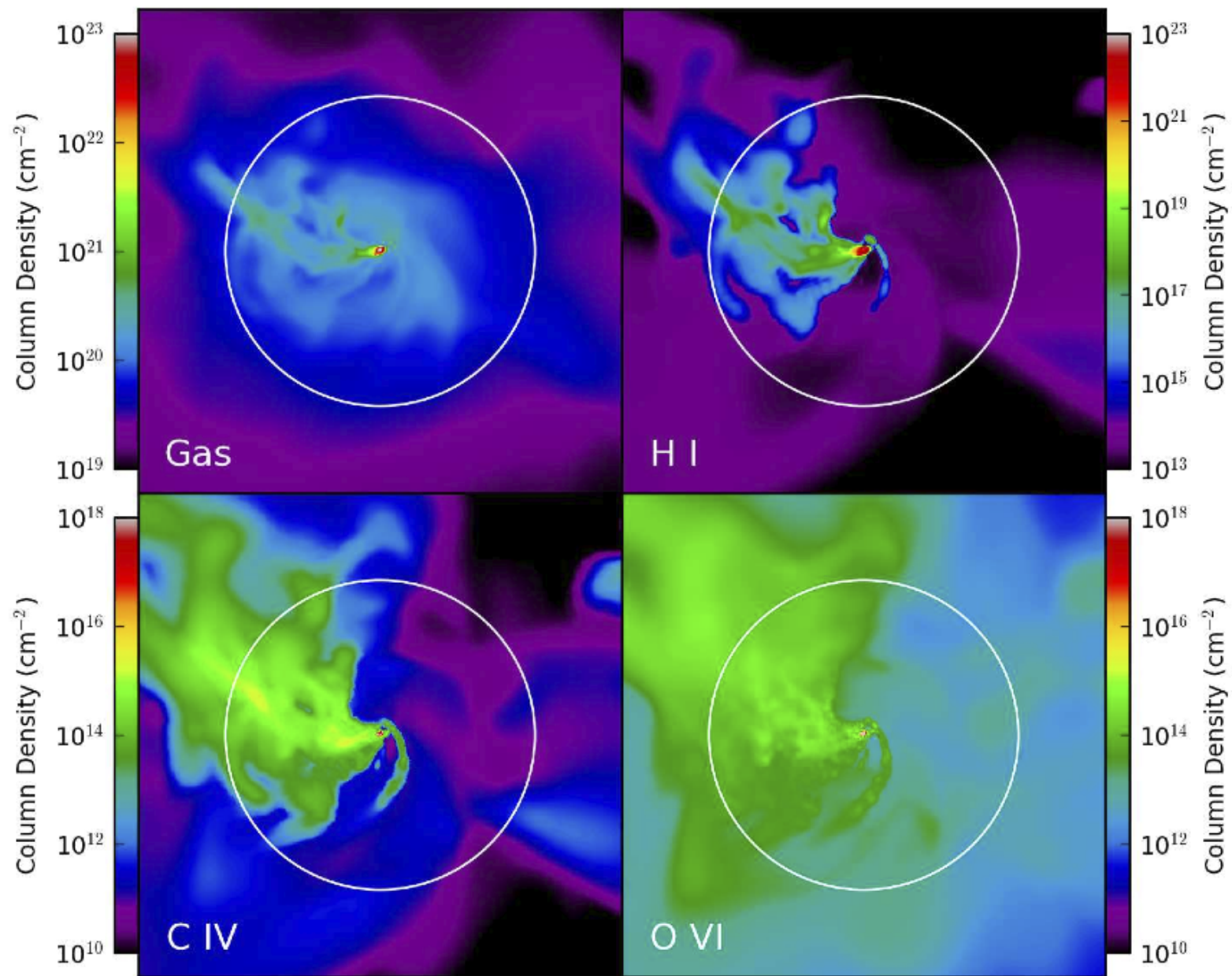








10^{-12} g/cc





XSTARS

The Extreme Science and
Discovery Environment
2011-2012 Annual Highlight

Low-Level Data Handling

Objects and Physical Quantities

Canned Analysis Tasks

(advanced)

Low-Level Data Handling

(intermediate)

Objects and Physical Quantities

(beginner)

Canned Analysis Tasks

"Community"?

Traditional View of Scientific Development

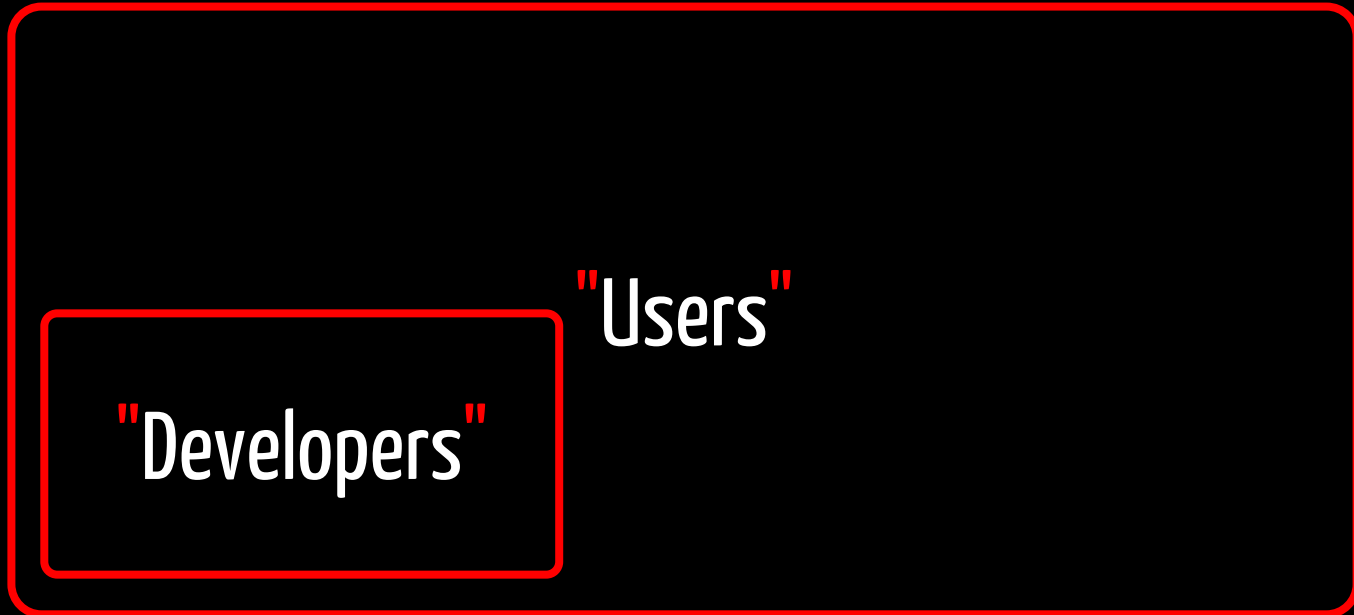


"Users"

The diagram illustrates a top-down model of scientific development. It features a large, light blue rounded rectangle at the top containing the text "Users". Below this, centered, is a smaller, light blue rounded rectangle containing the text "Developers". A thick, dark blue arrow points from the "Users" box down to the "Developers" box, indicating a flow of direction or influence from the users to the developers.

"Developers"

Most Scientific Development



Community of Practice

"Devusers"

"Developers"

Inspection and verification

Tracking modifications

Sharing information

Doing new and interesting things

"Users"

Uncritical acceptance of code?

"Users"

"These are the people we give the code
to that don't care how it works."



Challenges

Academic Reward Structure

Academic Reward Structure

de facto & de jure

de facto & de jure

Utilization of developed tools

Respect from community

Project involvements

Invitations and opportunities to speak

de facto & de jure

Funding

Publications

Citation count

Influence

Traditional astrophysics does not
favor tool builders.

Chores

Documentation,

testing,

outreach,

infrastructure development.

Chores

Tasks not fully-aligned with reward structure present great motivational challenges.

Co-opetition



Funding

Publications

Citation count

Influence



The "citation economy" for community codes is broken, and this disproportionately impacts new and junior contributors.

The "citation economy" for community codes is broken, and this disproportionately impacts new and junior contributors.

(It's bad for us, but even worse for infrastructure.)

How developer community
engagement, cohesion, excitement
and energy is affected by funded
improvements remains unclear.

How do the relationships between
distributed software developers
interact with academic relationships?

Strategies

Design the community you want.

Design the community you want.

Diversity. Tone. Enthusiasm. Congeniality.

Design the community you want.

This is an investment.

Design the community you want.

Diversity. Tone. Enthusiasm. Congeniality.

Growing diversity in scientific
software development is a key
challenge.

Technical & Social

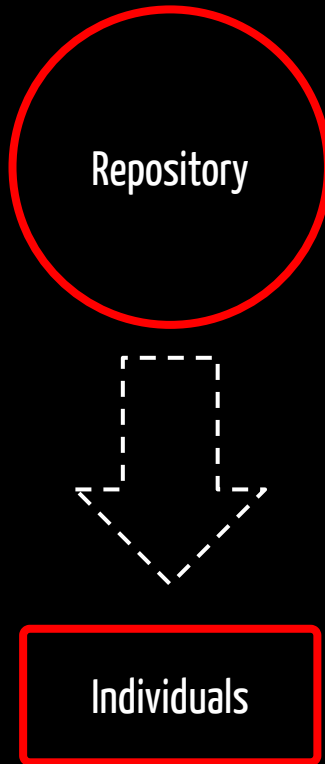
Technical & Social

Reduce barrier to entry
Test on every push
Review every changeset

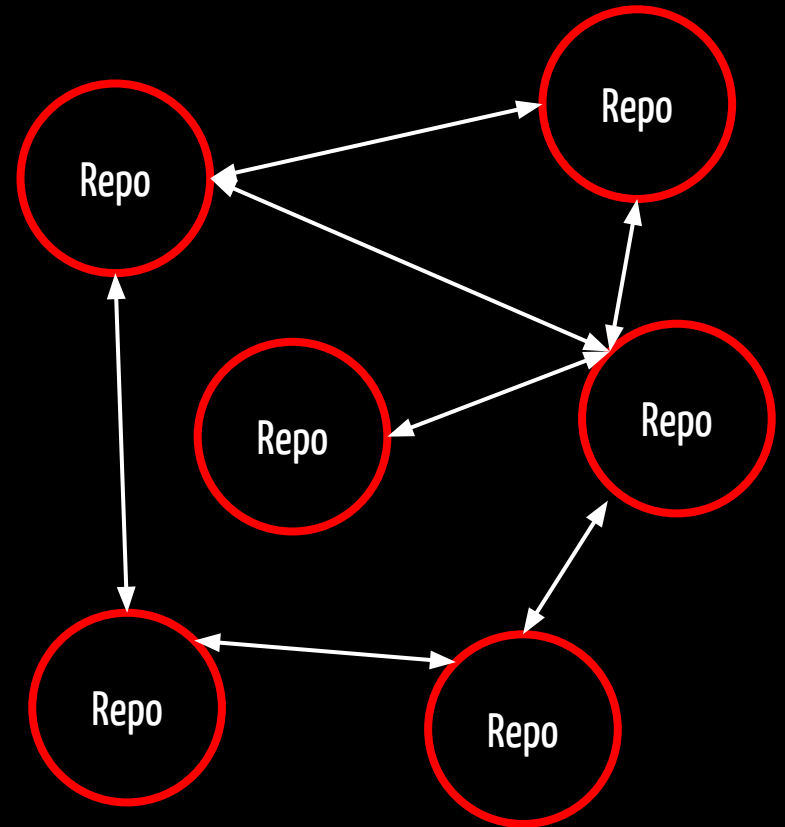
Reduce barrier to entry
Test on every push
Review every changeset

Everything comes in the box: version control, extensions,
sample data, dependencies, and tutorials.

CVCS



DVCS



Reduce barrier to entry
Test on every push
Review every changeset

Shining Panda for unit tests & small data answer tests,
ReadTheDocs.org, and an auto-deployed ReST blog.

Reduce barrier to entry
Test on every push
Review every changeset

Pull requests and mentoring of new developers, through
IRC, mailing list, and code comments.



An upstream path...

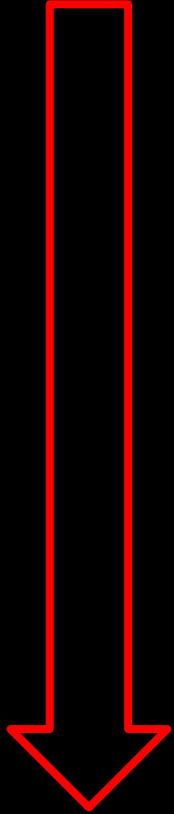
Happy Application

Itch-Scratching

Pull Request Submission

Code Review & Mentoring

Participation



Happy Application

Itch-Scratching

Pull Request Submission

Code Review & Mentoring

Participation

Accept contributions of data,
scripts, images, projects

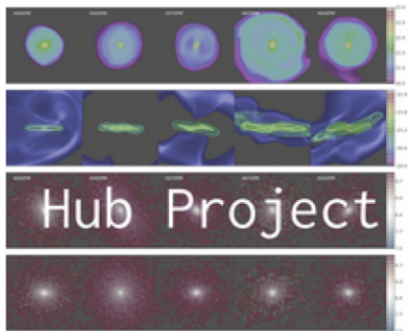
The yt Data Hub

This is the yt Data Hub, a place to upload and share data and images generated by and from [yt](#).

Right now we have widgets for variable maps (projections, slices), 3D vertex exploration, simulation parameter display, and collections of images.

To get started, [register a user](#) and follow the [quickstart](#) to upload data.

Recent Projects

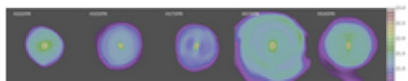


rprof2d: Simple radial profiles of 2D images

By [Matthew Turk](#) in Analysis and Visualization.

[Project Home](#) / [Hub Page](#)

This is just a simple tool that uses numpy to create a radial profile of a 2d image, optionally weighted by a second image. Takes as input the image, central x and y pixel locations, and a few keyword arguments. Requires numpy. Needs to be placed in your PYTHONPATH to be used.



Using Rockstar & consistent-trees with yt

By [Christopher Moody](#) in Astrophysical Utilities.

Communication

All project business is conducted openly.

Immediate

106492963191448855651946952650 - Hangouts with extras - Google Chrome

<https://talk.gdget.google.com/hangouts/extras/talk.google.com/106492963191448855651946952650?authuser=66&w=66&h=66>

Hangouts with extras

Documents

- Notes
- Sketchpad
- ytworkshop10BUTIS
- yt2012-workshop-rst...
- ytworkshop10BUTIS...
- Add document

Group Chat

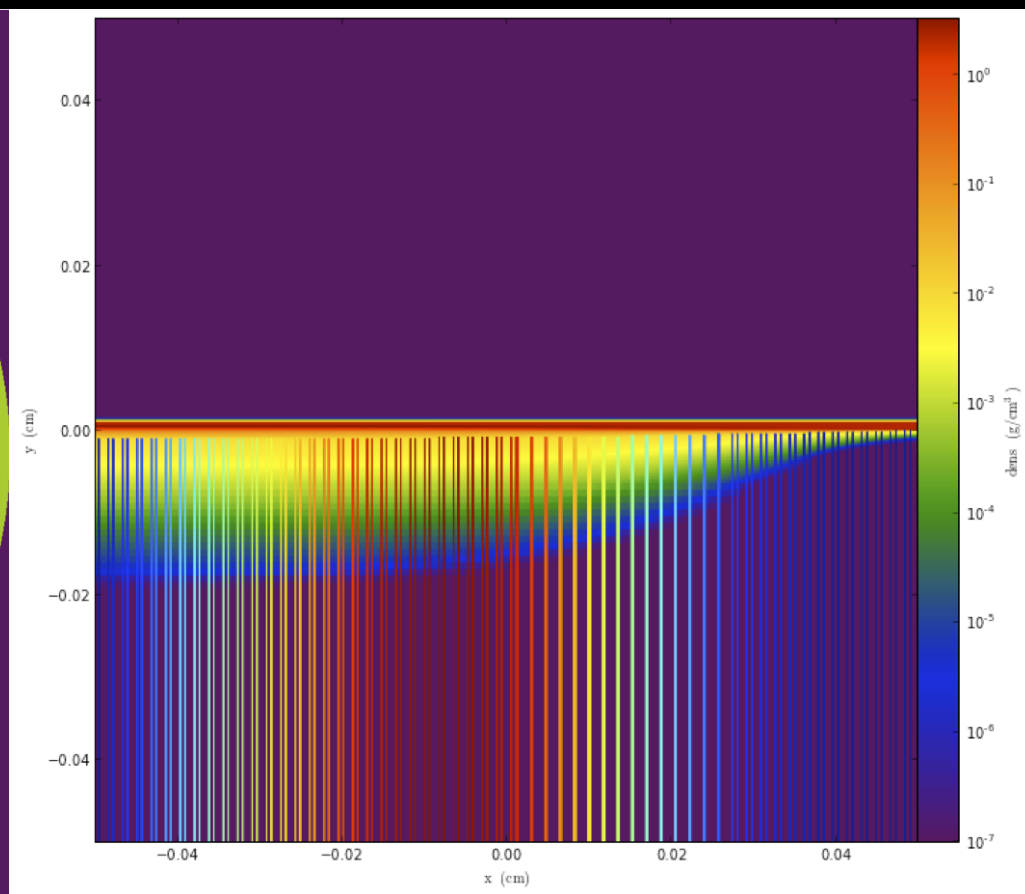
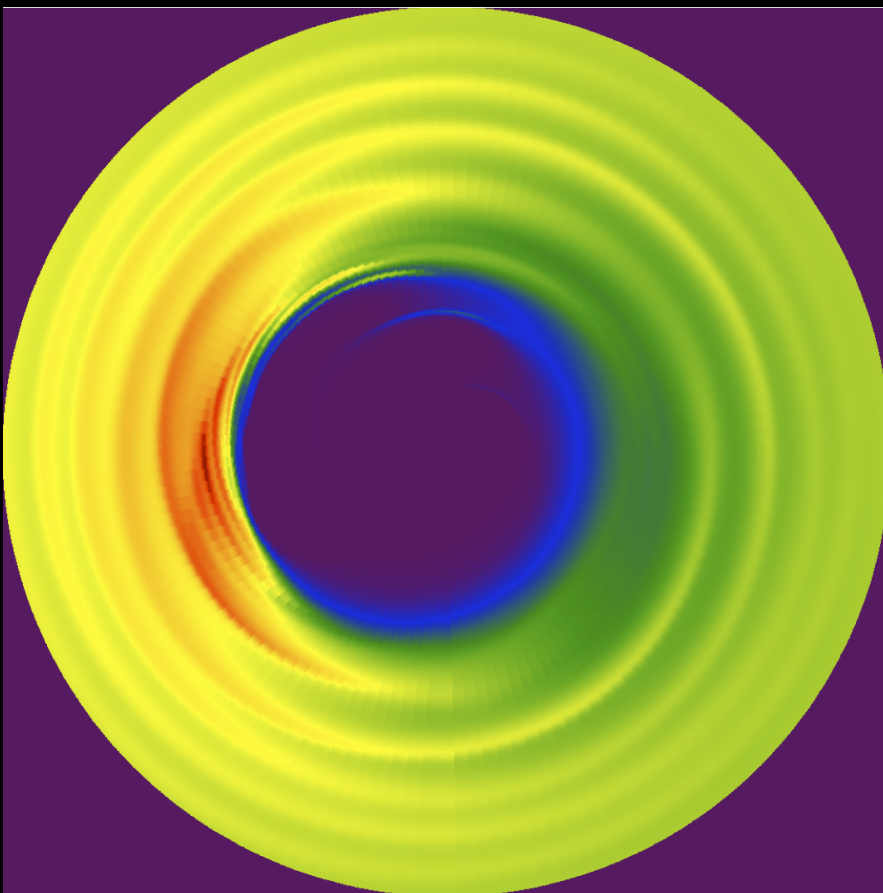
You are now off the record
[Leave group chat](#)
 Extras direct joined group chat
[View details](#)
[Join group chat](#)

Fx	Dates	A	B	O	Description	C	E
1	Title	Day	Presenter	Description	Length (minutes)	URL	
2	Welcome		Don	Welcome to the FLASCH center!	15		
3	Introduction (paper, scripting, documentation (how to use it))		Matt	Welcome to the workshop, and a brief introduction of terms. What are the implicit properties we construct in yf? What does it mean when it talks about an object?	30	https://bluscher.org/MatthewTurkly/workshop2012/rt-edu-ec/	
4	Nature of objects		Brian	Show, projections, and phase plots, hands-on with provided or insight datasets. Line-by-line, description of what goes on in the background. Wander around like searching assistants.	30		
5	Simple visualization and hands-on		Johnd or Stephen	Simple, non-technology stuff: relativistic averages, post value, angular momentum, and so on. Mostly derived quantities and their motion.	30		
6	Vary general analysis		Sara		30		
7	Analysis: Hands-on		All	Show off the Hub, along with the cookbook, and talk about the availability of those scripts. Show how to upload to the hub.	30		
8	Showcase of scripts		Conson	Google homework assignments: come up with angular momentum, circular velocity, slices, etc. General cosmological analysis.	30		
9	Late		All		30		
10	Parallelism		Sam or Stephen	What are the different types of parallelism? What can run in parallel? How do you know what kind of task size to use? What's a feed, how do we define a new field, how do you access parameters and spatial information. Derived quantities: how do you make one, what is available, how do you use them in analysis.	30		
11	Fields and Derived Quantities		Brian	Show how easy it is to construct complex data objects and to manipulate their data. Includes derived fields as well as accessing and ingesting data. Show broken data objects and time series, decoupling, fluxes, and connected sets. Show how to do time series analysis, and what to do with it when you're done. Cover both TimeSeries and Transmutation, as well as manual plotting and handling.	30		
12	Advanced Data Objects and hands-on		Matt or Stephen	Using the basic off-axis projection tool and color-magnitude function, show how to users render.	30		
13	Time Series Analysis		Brian	How to take a plot and make it ready for a paper. How do you access or create plot data? What's a callback? Fastest. Show script.	30		
14	Regression Volume Rendering		Conson	What does it come with for canned analysis processes? Star analysis, connected sets / clusters, halo-finding. (Use this as an intro to the challenging lab).	15		
15	Advanced Visualization and hands-on		Jeff and (?) Sam		30		
16	Control analysis and hands-on		Stephen or Brian		30		
17	Challenging info				30		
18	Adios?				30		

Immediate



Immediate



Low-Latency

```
yt: analysis and viz. home: http://yt-project.org/ (and still not in any app stores!)
23:49:55 < CIA-62> yt: Nathan Goldbaum <goldbaum@ucolick.org> * 358092443a92 r5992
      /yt/visualization/plot_modifications.py:
23:49:55 < CIA-62> yt: Fixing a bug in convert_to_pixel, which I've renamed to
23:50:12 < CIA-62> yt: convert_to_plot since it should convert to plot coordinates (not
23:50:12 < CIA-62> yt: necessarily the same as pixel coordinates).
23:50:12 < CIA-62> yt: Nathan Goldbaum <goldbaum@ucolick.org> * 5c7b2095ee5a r5993
      /yt/visualization/plot_window.py: Need to cast this to a string
23:50:12 < CIA-62> yt: Matthew Turk <matthewturk@gmail.com> * 148b51ad39af r5994 /yt/ (3 files in 2 dirs):
      Merged in ngoldbaum/yt-ngoldbaum (pull request #194)
23:50:19 < ngoldbaum> awesome, thanks matt
Day changed to 11 Jul 2012
00:22:00 < mjturk> np
00:22:03 < mjturk> thank you for the changes
00:22:52 < xarthisius> mjturk: is this a typo or there's some magic behind that I don't understand?
      http://paste.lugons.org/show/2824/
00:24:00 < xarthisius> without that patch I get weird axis labels for non-square domains
00:27:06 < xarthisius> oh, ngoldbaum that ^^ should be directed to you :)
00:27:33 < ngoldbaum> it's a type
00:27:41 < ngoldbaum> thanks for testing on non-square domains
00:27:55 < ngoldbaum> if anything doesn't work it's a bug (and probably a typo)
00:28:06 < ngoldbaum> thanks xarthisius
[08:00] [mjturk(+Zi)] [2:#yt(+cnt)]
```

High-Latency

August 2012 Archives by thread

- Messages sorted by: [\[subject \]](#) [\[author \]](#) [\[date \]](#)
- [More info on this list...](#)

Starting: *Wed Aug 1 06:33:13 PDT 2012*

Ending: *Fri Aug 31 12:30:40 PDT 2012*

Messages: 99

- [\[yt-users\] error in light_ray periodic ray creation](#) *Britton Smith*
- [\[yt-users\] Quiver normalization](#) *Massimo Gaspari*
 - [\[yt-users\] Quiver normalization](#) *Jean-Claude Passy*
 - [\[yt-users\] Quiver normalization](#) *Massimo Gaspari*
 - [\[yt-users\] Quiver normalization](#) *Jean-Claude Passy*
- [\[yt-users\] yt 2.4 release announcement](#) *Nathan Goldbaum*
- [\[yt-users\] YT installation](#) *Sherwood Richers*
 - [\[yt-users\] YT installation](#) *Matthew Turk*
 - [\[yt-users\] YT installation](#) *Sherwood Richers*
 - [\[yt-users\] YT installation](#) *j s oishi*
 - [\[yt-users\] YT installation](#) *j s oishi*
 - [\[yt-users\] YT installation](#) *Sherwood Richers*
 - [\[yt-users\] YT installation](#) *Nathan Goldbaum*
 - [\[yt-users\] YT installation](#) *Sherwood Richers*
 - [\[yt-users\] YT installation](#) *Matthew Turk*
- [\[yt-users\] yt update error](#) *Latif*
 - [\[yt-users\] yt update error](#) *Matthew Turk*
 - [\[yt-users\] yt update error](#) *Latif*
 - [\[yt-users\] yt update error](#) *Matthew Turk*

Technical
& Social

Culture self-propagates.
So, it must be seeded directly.

The traditional "Open Source" community is
not always the right role model.

The traditional "Open Source" community is
not always the right role model.

Diversity. Tone. Enthusiasm. Congeniality.

Foster a community of peers,
not a community of elites.

H

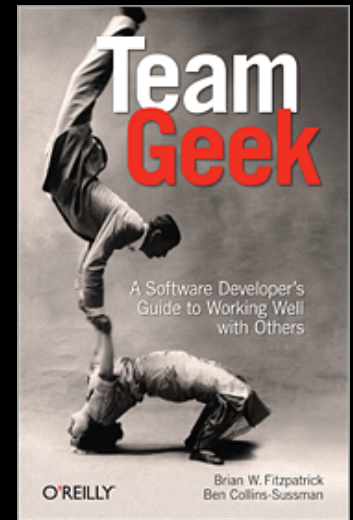
R

T

H

R

T



Fitzpatrick & Collins-Sussman

Humility

R

T

Humility

Respect

T

Humility

Respect

Trust

Humility

I think there might be a bug in ...



It's like that for a good reason. Don't touch it.

I think there might be a bug in ...



It behaves that way because ...

Respect

I've noticed something is acting
strangely with ...

You're probably doing it wrong.

I've noticed something is acting
strangely with ...

Can you tell us how you'd expect it to
act?

Trust



Letting go...

By emphasizing pride over ownership, we've found projects can move between people without smothering through control.



Successes

In a Nutshell, yt...

...has had 7,345 commits made by 42 contributors representing 113,588 lines of code

...is mostly written in Python with an average number of source code comments

...has a well established, mature codebase maintained by a large development team with stable year-over-year commits

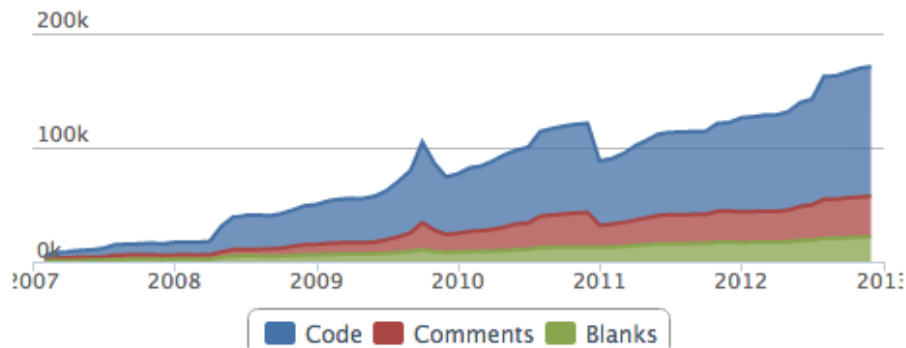
...took an estimated 29 years of effort (COCOMO model) starting with its first commit in February, 2007 ending with its most recent commit about 17 hours ago

Languages



Python	77%	C	12%
JavaScript	5%	8 Other	6%

Lines of Code



Activity

30 Day Summary

Nov 14 2012 — Dec 14 2012

219 Commits

12 Contributors

including 1 new contributor

1 New Language :

TeX/LaTeX added Dec 13

12 Month Summary

Dec 14 2011 — Dec 14 2012

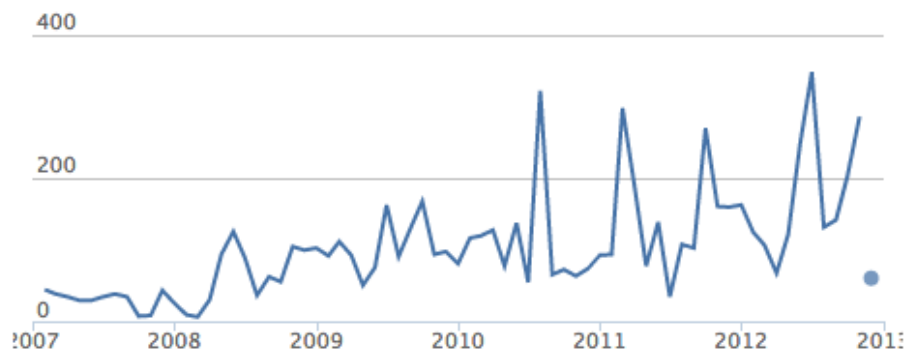
2057 Commits

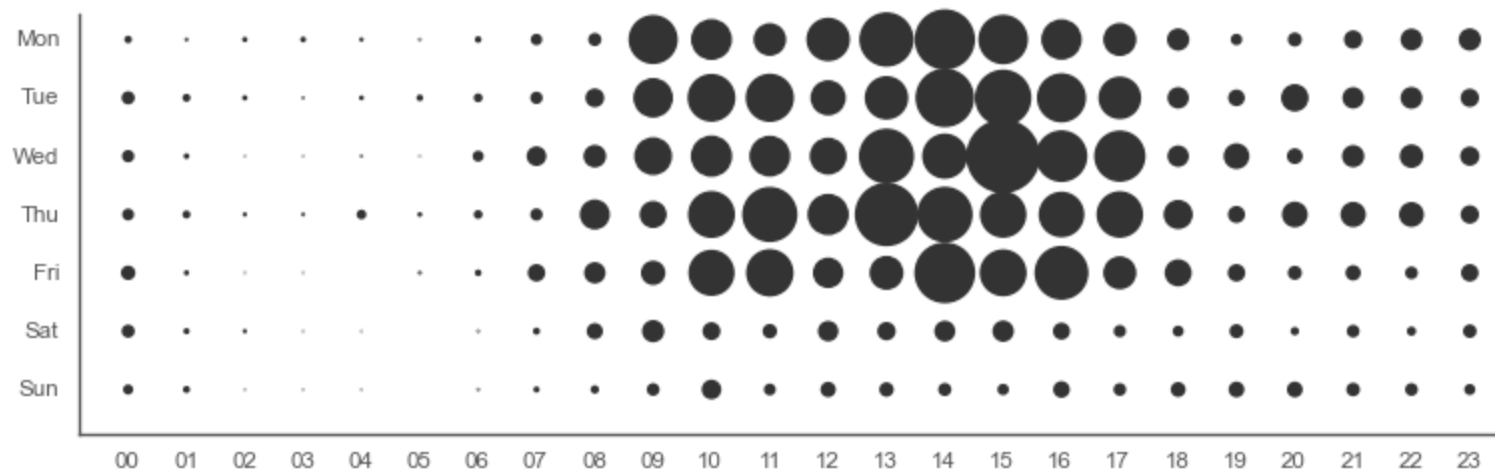
Up +384 (22%) from previous 12 months

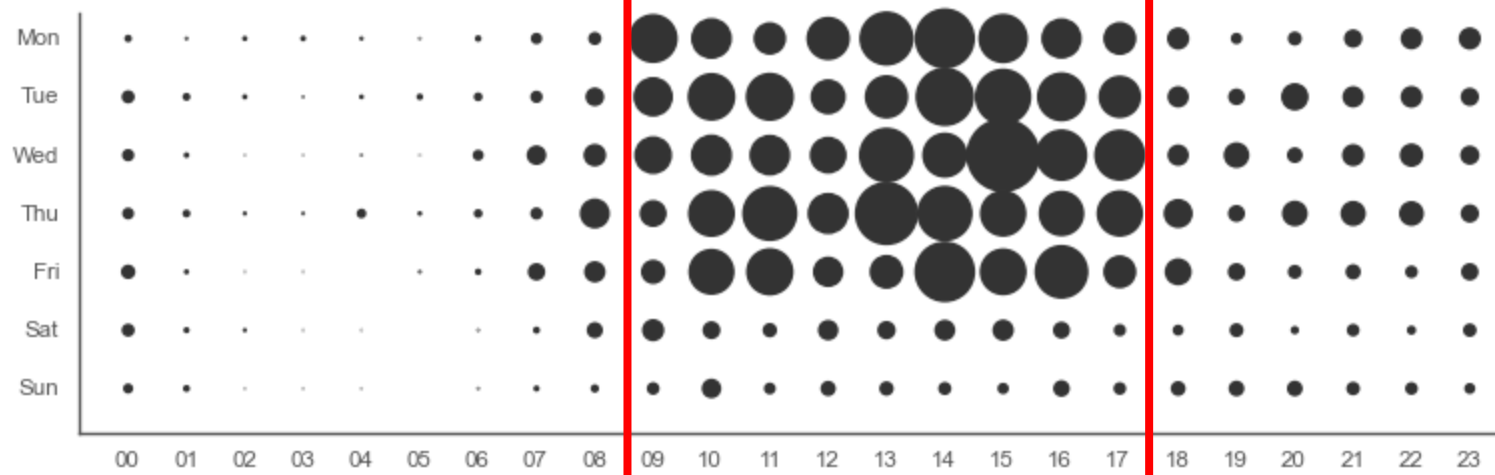
26 Contributors

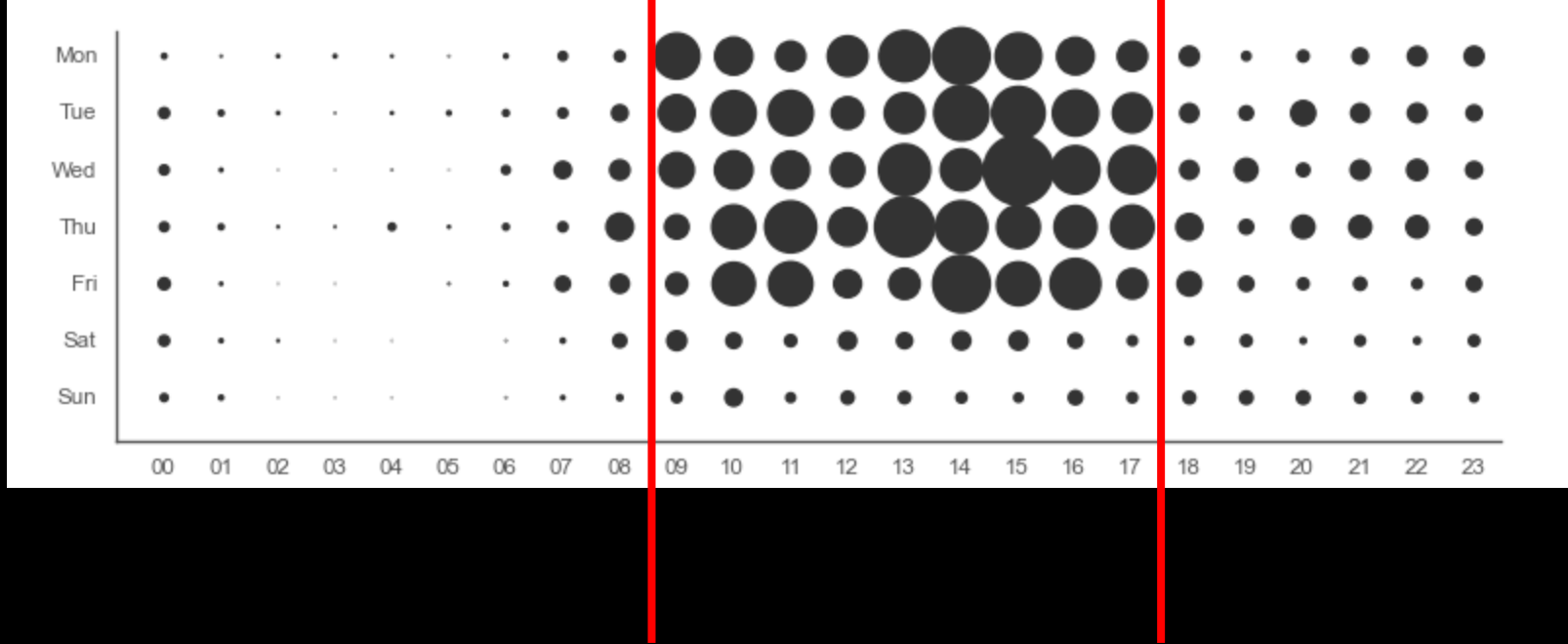
Up +3 (13%) from previous 12 months

Commits per Month

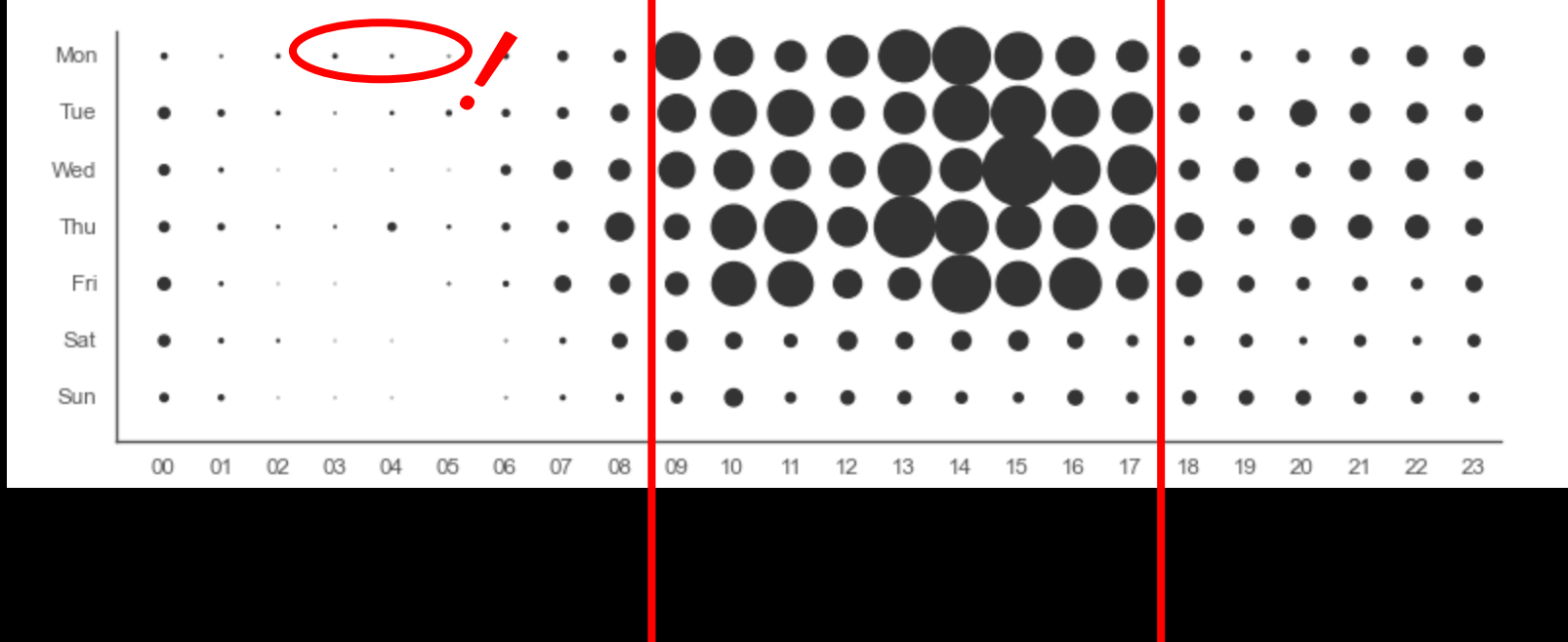




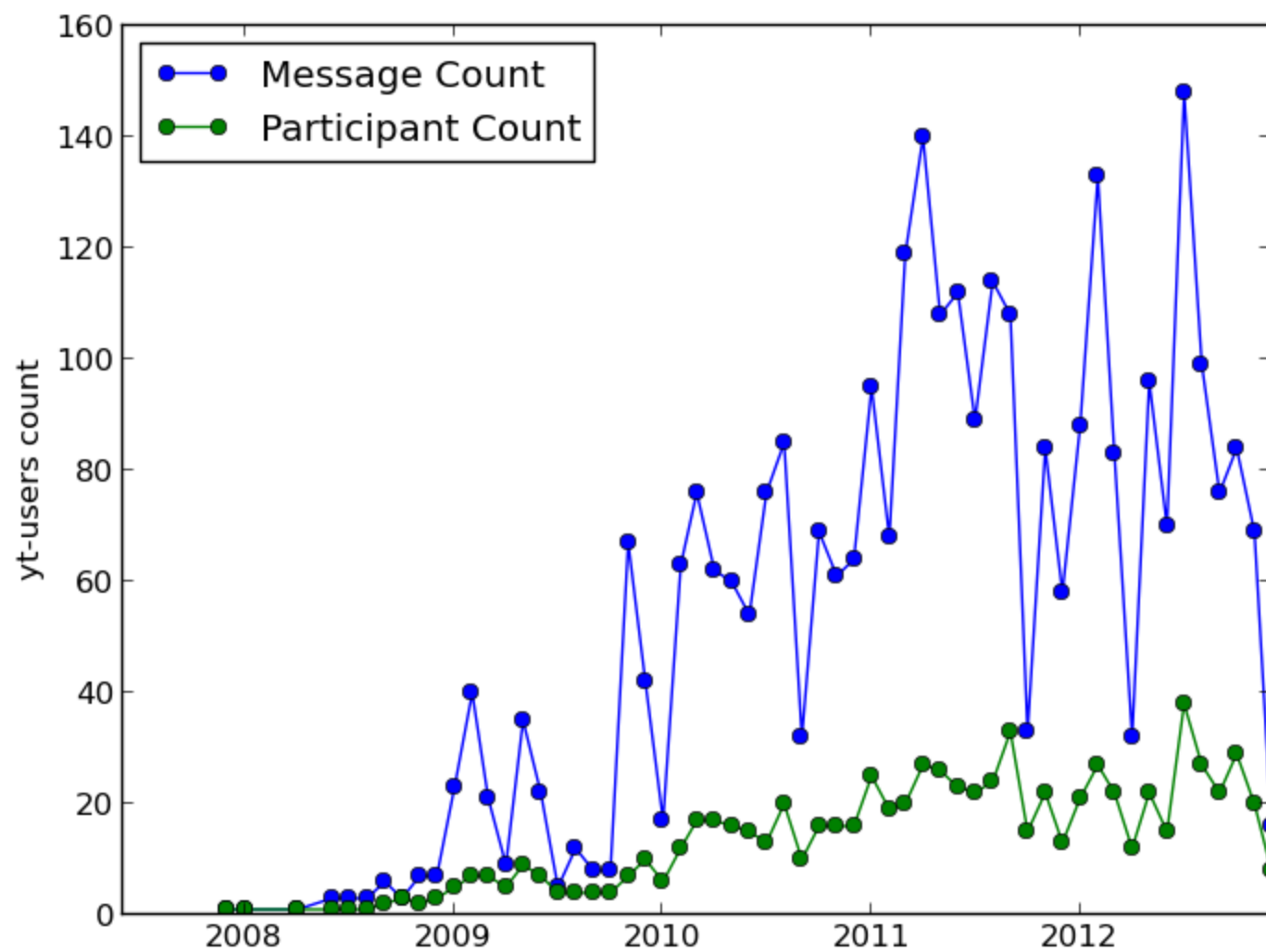


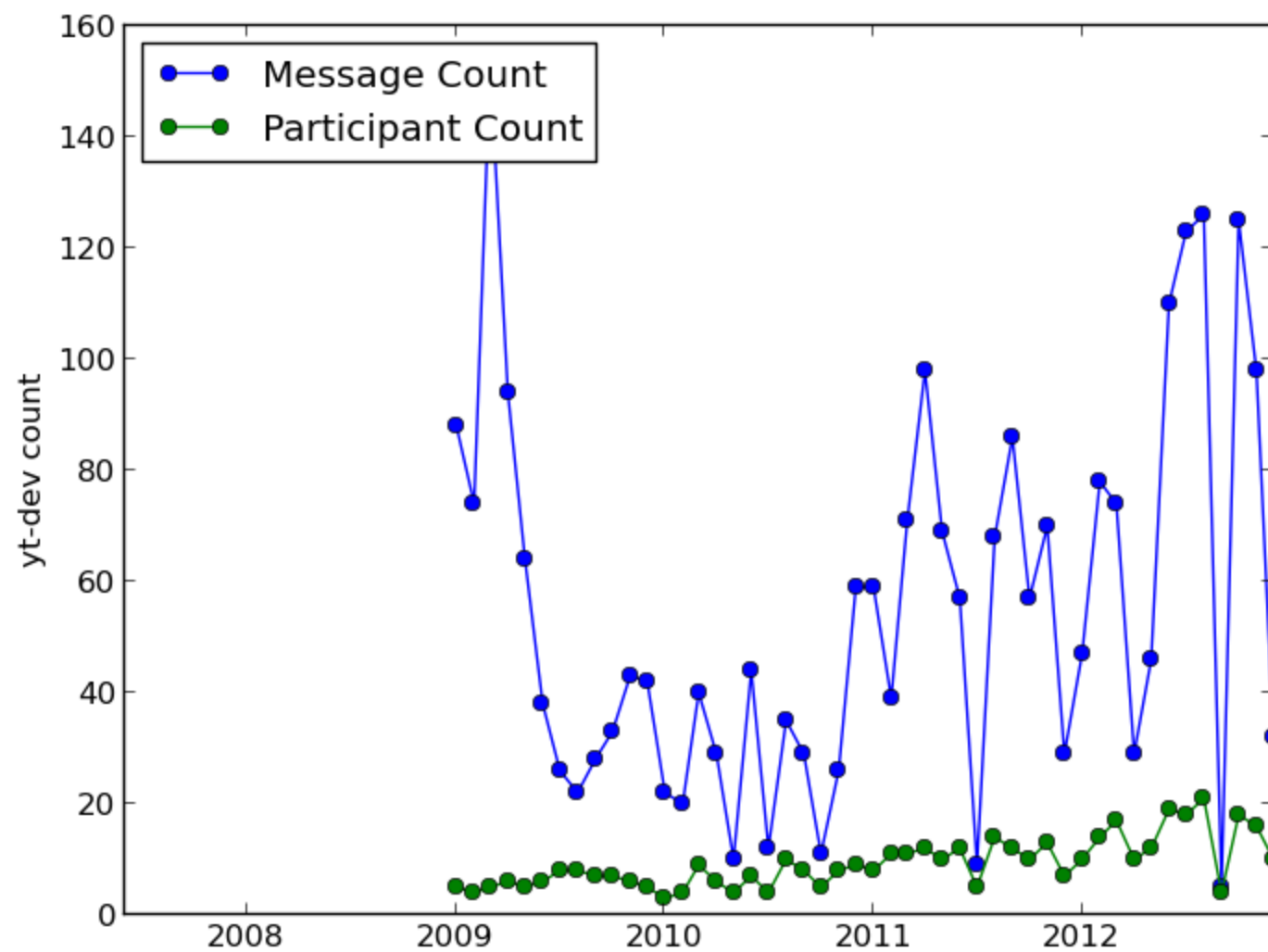


Developed by working astrophysicists.



Developed by working astrophysicists.

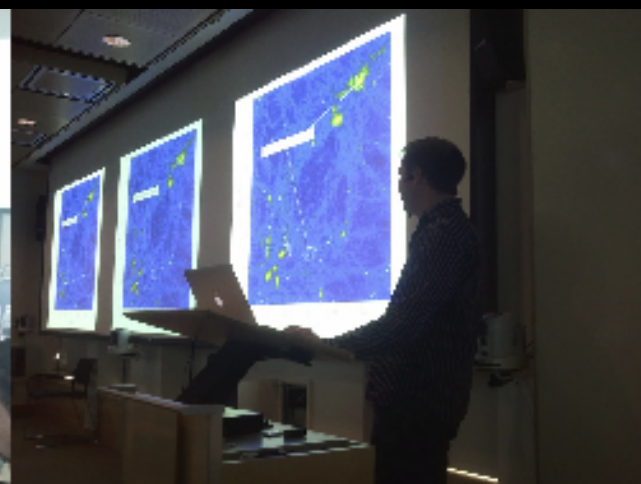




	count	CPU hours	users	projects
matlab	24852	464244.83	14	8
cctm	3577	210446.84	1	2
cdo	1592	101810.32	1	1
gen.v4	1588	391359.18	3	1
cam	1559	45894.90	11	5
yt	1231	121396.69	13	12
sigma	641	24622.21	3	2
grads	541	161510.58	3	1
mm5	400	459.18	4	2
eden	384	42798.52	6	4
grib	346	87726.47	6	2
milc	326	2377.34	3	2
grmhd	303	531167.83	2	3
ncl	259	2675.59	2	2
sses	184	9948.52	1	1
paraview	177	34682.84	8	3
swift	169	2325.34	4	2
visit	101	4869.59	8	8
pop	100	209565.51	3	3
wrf	100	398.94	4	3
enzo	87	24014.62	4	3
tsc	74	105.90	1	1
R	70	24628.78	2	2
partadv	69	2062.75	1	1
a_out	56	158.65	4	4
hsi	48	2716.69	7	5
hmc	45	5.08	2	1
cactus	42	157.10	1	1
ior	42	79503.02	2	2
hy3s	39	53.02	4	3
idl	38	1971.62	6	6
music	29	7032.03	1	1

Usage on XSEDE Nautilus

Szczepanski et al, 2012





ytanalysis's channel

+ Subscribe

12
subscribers

659
video views

Feed

Videos

Search Channel

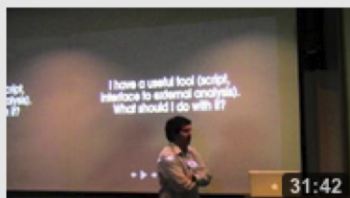


Activity

Comments



ytanalysis uploaded and added to [yt workshop 2012](#) 7 months ago



[yt workshop 2012 - Development Overview](#)

28 views

<http://yt-project.org/works...>

Development Overview by Sam Skillman



ytanalysis uploaded and added to [yt workshop 2012](#) 7 months ago



[yt workshop 2012 - Testing and Documentation](#)

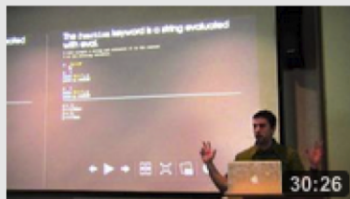
20 views

<http://yt-project.org/works...>

Testing and Documentation by Stephen Skory



ytanalysis uploaded and added to [yt workshop 2012](#) 7 months ago



[yt workshop 2012 - Clump Finding](#)

6 views

<http://yt-project.org/works...>

Clump Finding by Britton Smith

About ytanalysis's channel

by ytanalysis

Latest Activity

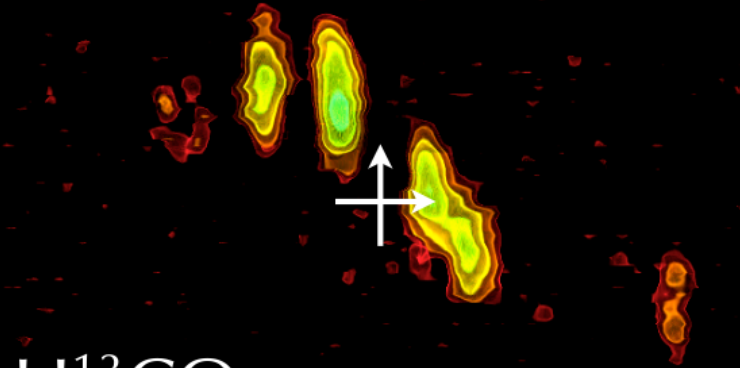
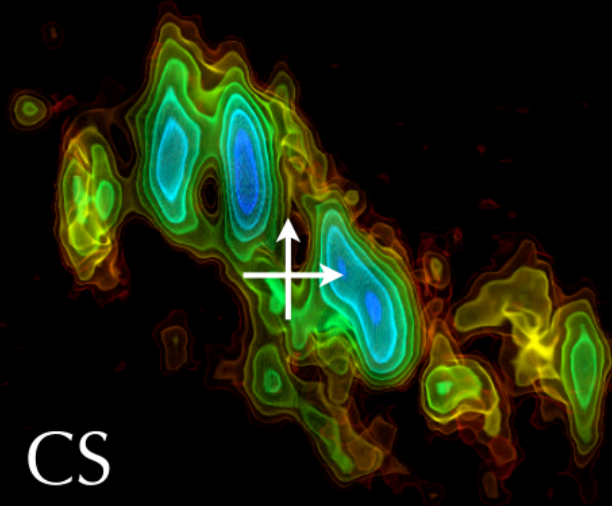
Jan 31, 2012

Date Joined

Sep 27, 2011

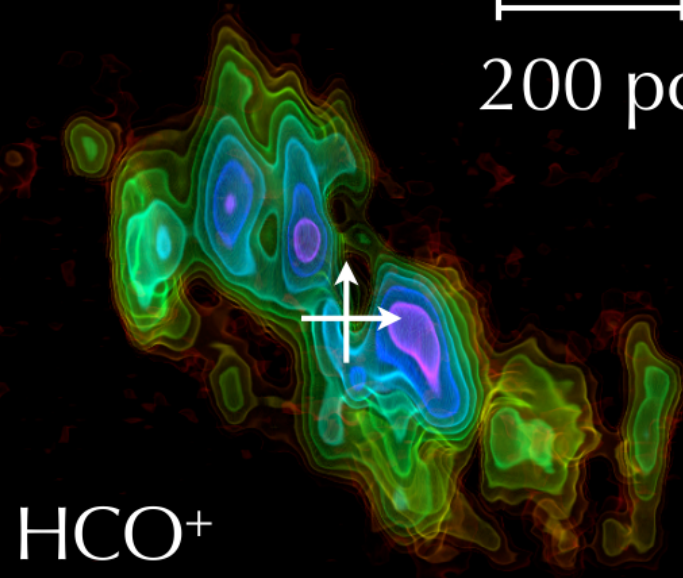
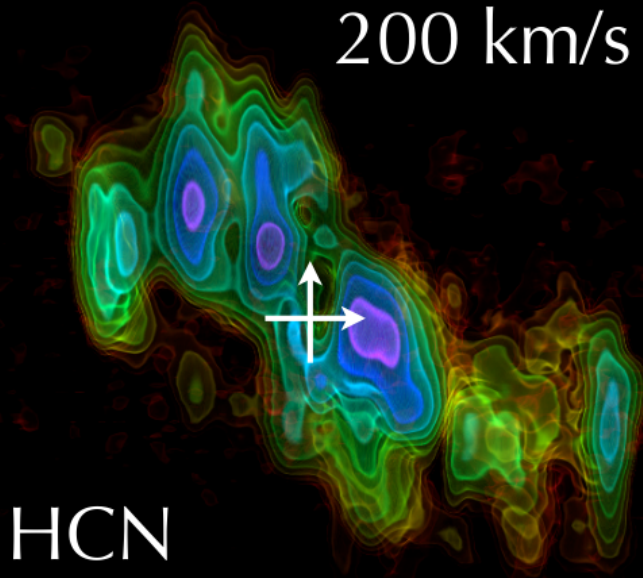
Country

United States

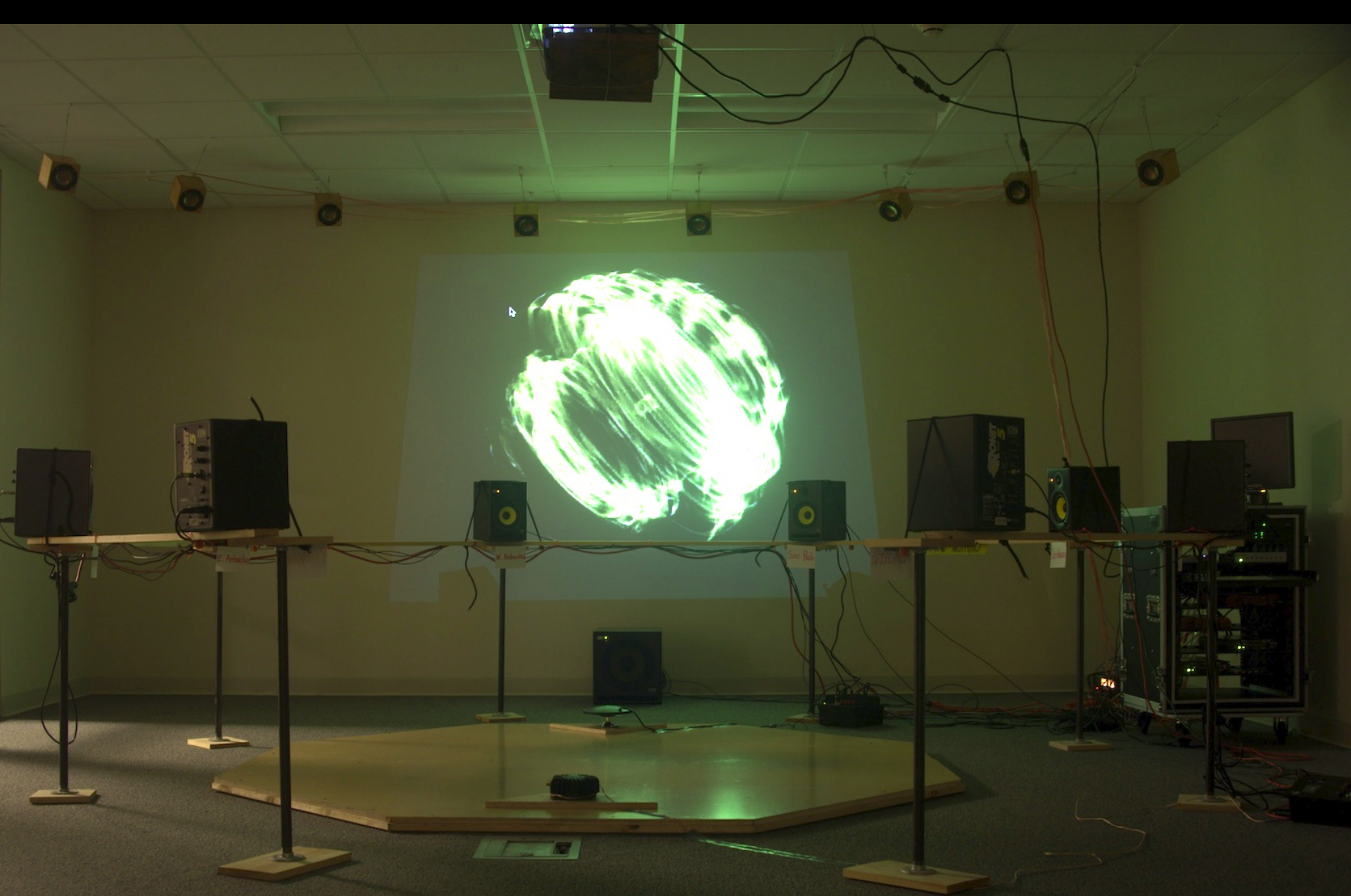


200 km/s

200 pc



Moving beyond computational astrophysics.



Moving beyond astrophysics.

Our first major litmus test, a 3.0
release with major infrastructure
overhauls, is on the horizon.

"... it seems likely that significant software contributions to existing scientific software projects are not likely to be rewarded through the traditional reputation economy of science. Together these factors provide a reason to expect the over-production of independent scientific software packages, and the underproduction of collaborative projects in which later academics build on the work of earlier ones."

Howison & Herbsleb (2011)

First Workshop on Sustainable Software for Science: Practices and Experiences

SC13, November 17, 2013

wssspe.researchcomputing.org.uk

Deadline is September 6!

Thank you.

(Short) Bibliography

"The Art of Community" by Jono Bacon

"Producing Open Source Software" by Karl Fogel

"Team Geek" by Brian Fitzpatrick & Ben Collins-Sussman

"Organizing Simulation Code Collectives" by Mikaela Sundberg

"Scientific Software Production" by James Howison & James Herbsleb

"Your Community is your Best Feature" by Gina Trapani

"The Proof of the Pudding" by John Allsopp

"Standing Out in the Crowd" by Skud

"Why you should write buggy software" by Brian Granger

Tom Abel
Kenza Arraki
David Collins
Brian Crosby
Andrew Cunningham
Nathan Goldbaum
William Grey
Markus Haider
Cameron Hummels
Christian Karch
Steffen Klemer
Kacper Kowalik
Mike Kuhlen
Eve Lee
Sam Leitner
Yuan Li
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