Synthesizing Understanding from Data with yt

Matthew Turk
University of Illinois
@powersoffour

Driven by an Ansatz

Software is getting better.

Hardware is getting cheaper.

People cost the same.

Generic	Specific

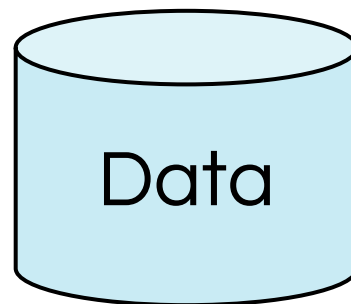# Driven by an Ansatz

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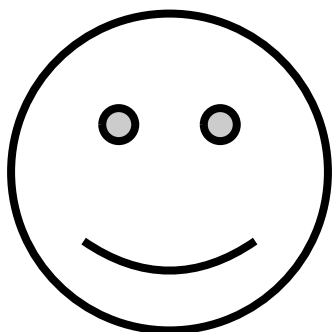
| Generic | Specific |

Driven by an Ansatz

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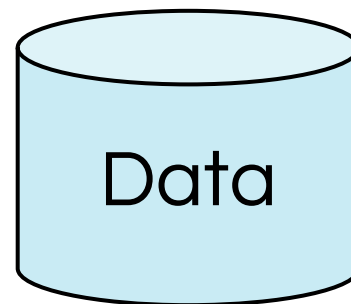| Generic	Specific

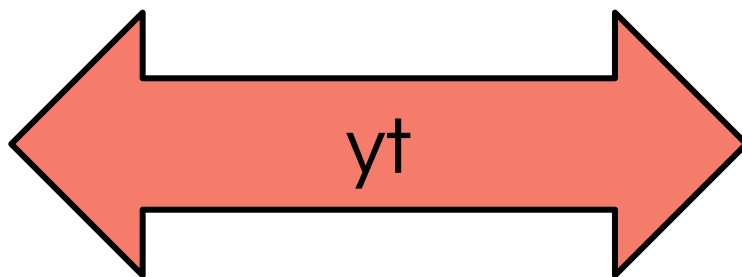# Driven by an Ansatz
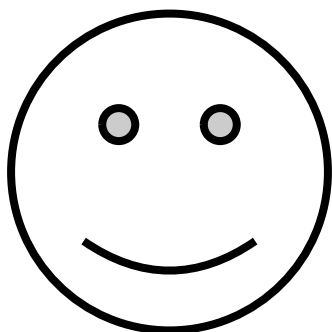
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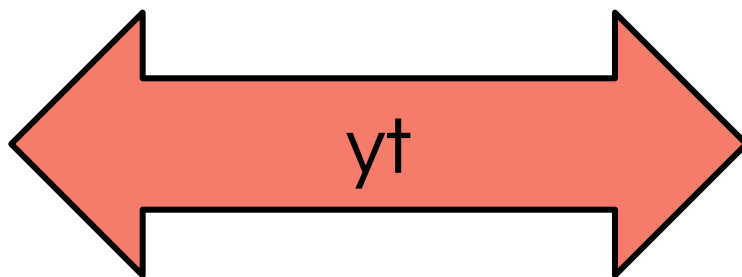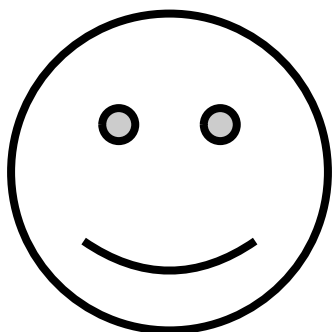
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| Facilitation | Inquiry |

yt

the yt project

- Python-based (C, Cython, etc)
- Community developed
  - Code of Conduct
  - Governance structure
  - 100+ contributors
  - Volumetric and non-spatial data
- Used in over 200 papers
- Grids, particles, octrees, and unstructured meshes
- Arbitrary geometric representations
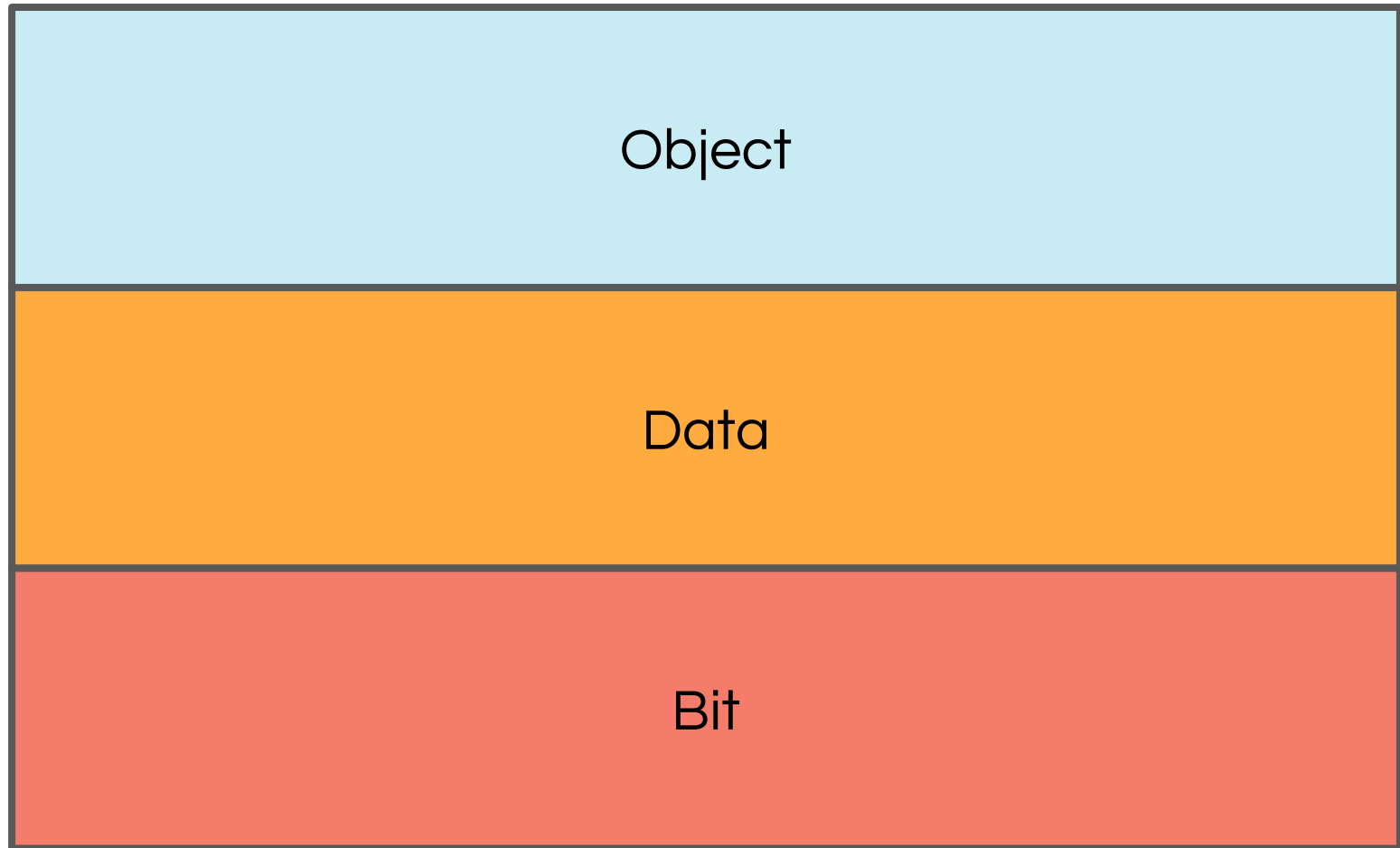- Minimize time to inquiry

Project "Members"

Kenza Arraki	Jeff Oishi
Hilary Egan	Brian O'Shea
Nathan Goldbaum	Doug Rudd
Cameron Hummels	Anthony Scopatz
Suoqing Ji	Sam Skillman
Allyson Julian	Stephen Skory
Ben Keller	Britton Smith
Kacper Kowalik	Casey Stark
Sam Leitner	Matthew Turk
Chris Malone	John Wise
Andrew Myers	Michael Zingale
Jill Naiman	John ZuHone

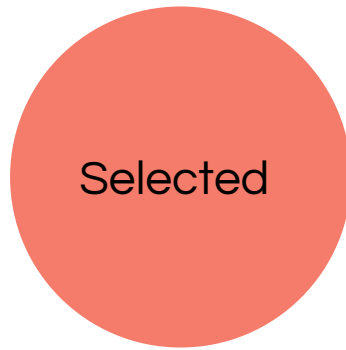Dozens of contributors...
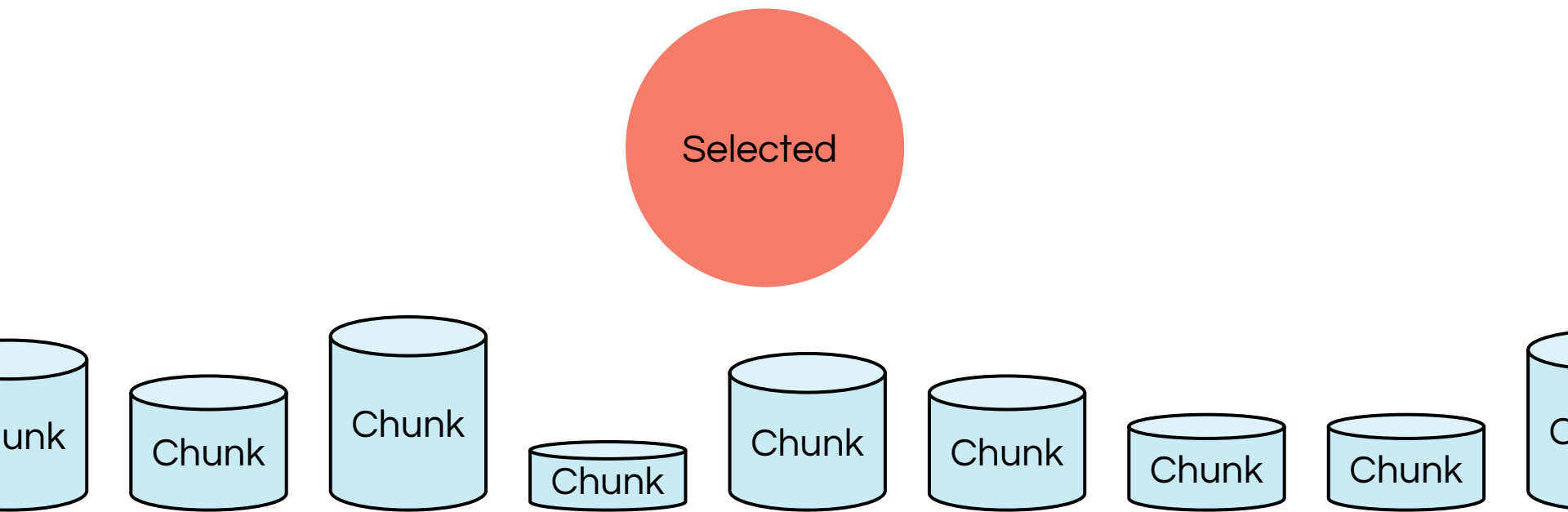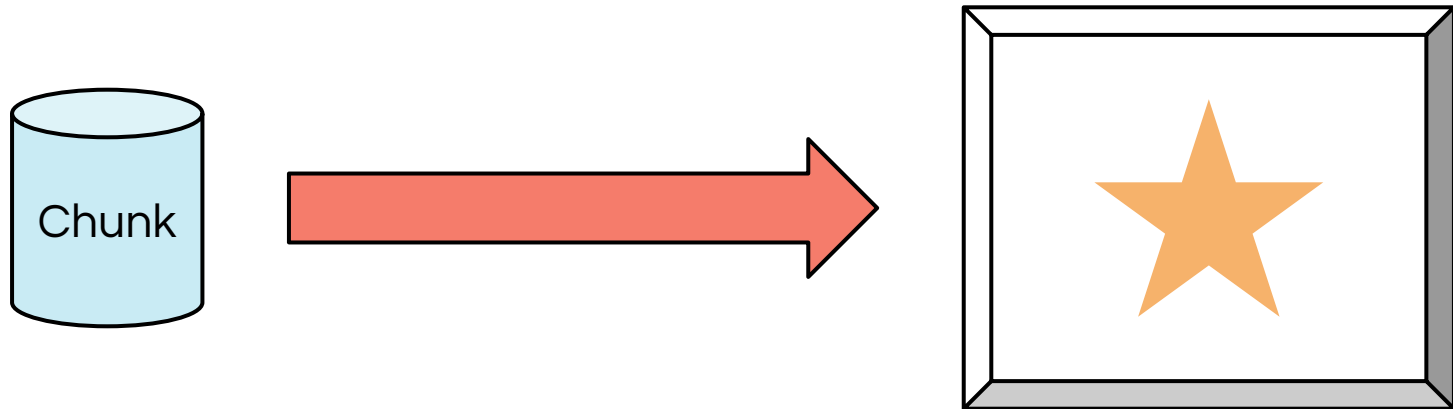
Some
Simulation

Layers of Representation

Object

Data

Bit

Some
Simulation

Selector

Selected

Selected

D

High-Level Operations

High-Level Operations

High-Level Operations

High-Level Operations
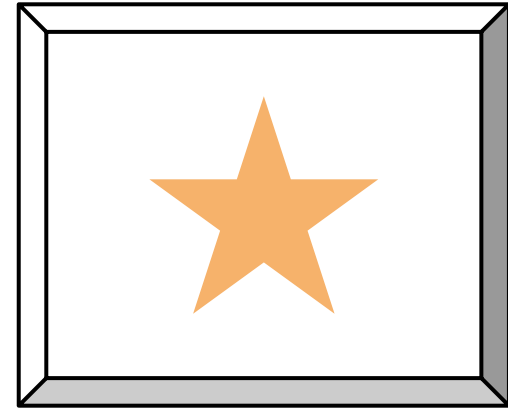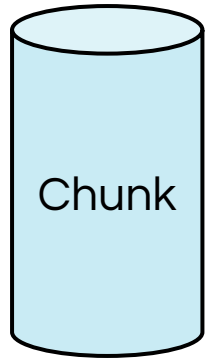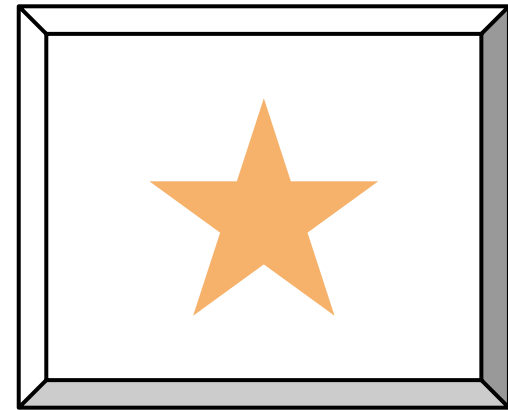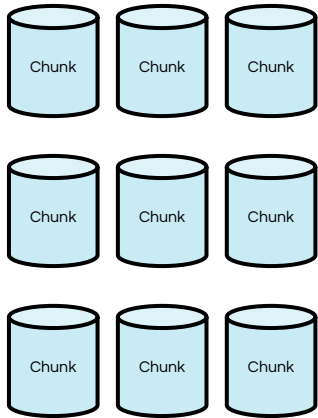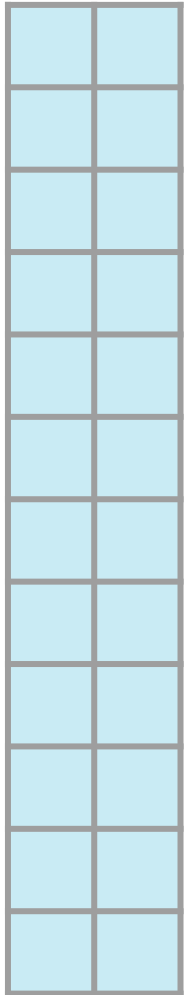
Mid-Level Operations

Mid-Level Operations

Mid-Level Operations

$$m \times s^{-1} = m/s$$

Symbolic manipulation and pragmatic ontologies

Low-Level Operations

a

Low-Level Operations

Low-Level Operations

Chunk Chunk Chunk

Chunk Chunk Chunk

Chunk Chunk Chunk

Low-Level Operations

Chunk

Low-Level Operations

Chunk
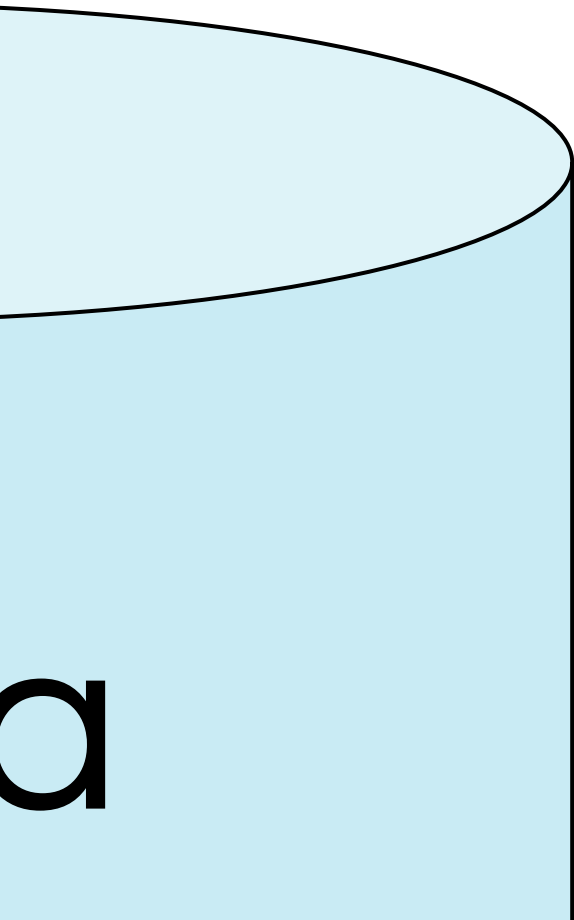
Low-Level Operations

Low-Level Operations

Internal yt

Chunk Chunk Chunk

Chunk Chunk Chunk

Chunk Chunk Chunk

Low-Level Operations

ART	Maestro
ARTIO	MOAB
Athena	Nyx
Carpet	OWLS
Castro	OWLS-Subfind
Chombo	PKDGrav
Eagle	PLUTO
Enzo	RAMSES
ExodusII	Rockstar
FITS	SDF
FLASH	Stream HTTP
Gadget	Stream Grids
Gadget-FOF	Stream Octree
Gasoline	Stream Particles
GDF	Stream Unstructured

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A Few Recent Projects
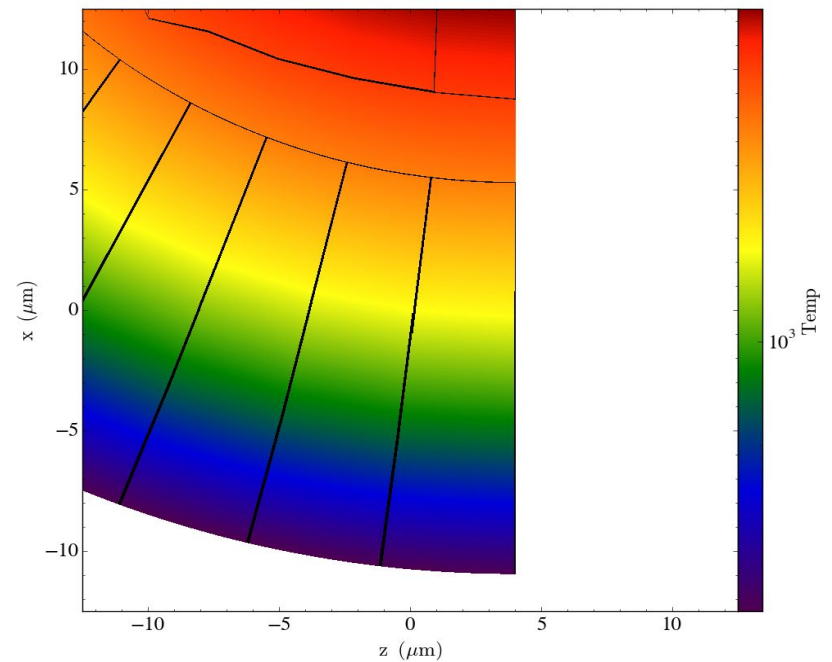
A Few Recent Projects

Higher-Order FEM

Courtesy Andrew Myers

A Few Recent Projects

Higher-Order FEM

t = 0.366 Myr

Density (g cm^{-3})

-15

-16

-17

-18

-19

-20

Courtesy Stella Offner

Courtesy Max Katz

Convection in a Mixed H/He Layer on a Neutron Star (with rotation)

0.0133 s

Courtesy Mike Zingale

Chandra/ACIS-S XMM-Newton/EPN NuSTAR/FPD

Astro-H/SXS Athena+/WFI

27 54 82 109 137 164 191 219 246

Courtesy John ZuHone

A Few Recent Projects

Compressed bitmap indices

A Few Recent Projects

Compressed bitmap indices

A Few Recent Projects

Compressed bitmap indices

Spatial Tree

exploring published data

```
hub.yt/data/goldbaum2015a/
hub.yt/data/goldbaum2015b/
arxiv.org/abs/1510.08458
```

Galaxy Visualization Widget

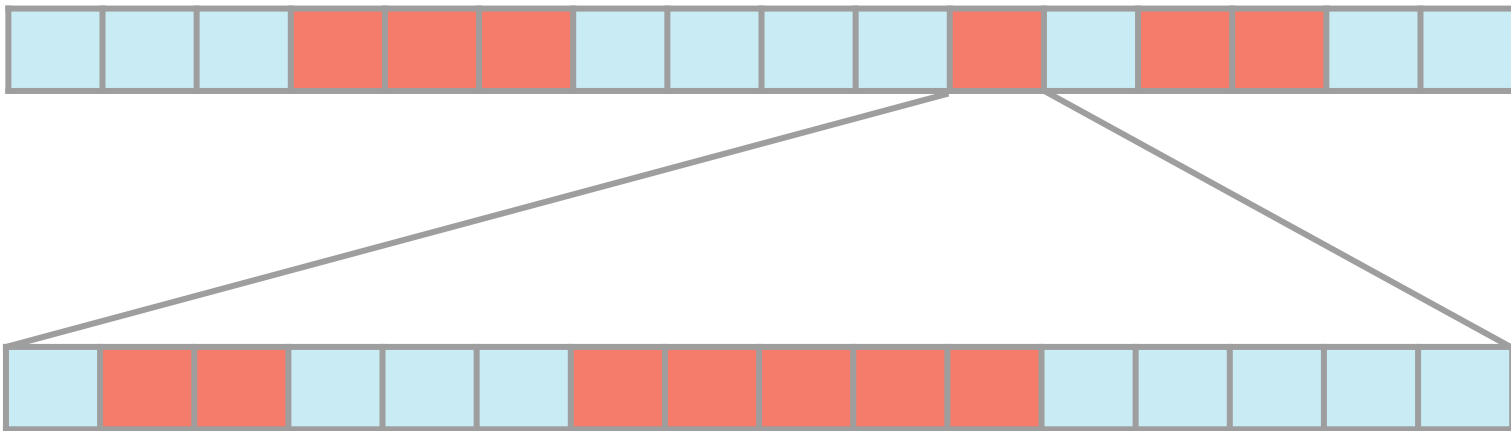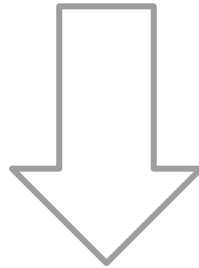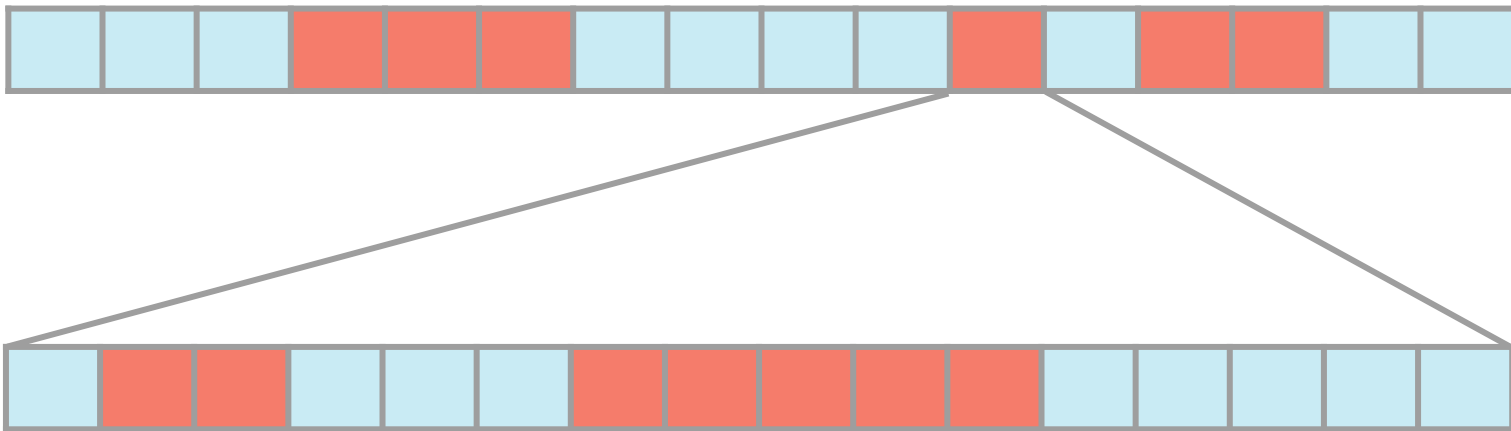This notebook defines a simple widget used to visualize various fields derived from a set of 3D AMR hydrodynamic simulation of an isolated disk galaxy. The full simulation dataset weighs in at around 15 TB, but these sorts of interactive visualizations make it easy to quickly and easily visualize the physically important parts of the data.

The widget should appear after the final notebook cell.

```python
In [1]:  from galanyl.widget import galaxy_widget
         from IPython.display import display

         display(galaxy_widget)
```

the yt data hub

Data Source
(Blue Waters,
observations, cold
storage, etc)

Web UI or CLI for data
reduction, analysis,
visualization

Transparent
data bridging

Publishing & Sharing

Secure websockets,
IAM, HTTP proxying

Spinning Disk
(hot cache)

Fast Network

Compute workers
orchestrated across
elastic cloud
infrastructure

the yt data hub

use.yt

the yt data hub

use.yt

Phase 1: Notebooks & data.

the yt data hub

use.yt

Phase 2: Collaboration & publishing.

the yt data hub

use.yt

Thank you.

matthewturk@gmail.com

@powersoffour

http://yt-project.org/