

Teaser Trailer

<https://skfb.ly/QHwx>

A Week of Astrophysical Visualizations

www.astroblend.com/ba2016

A Week of Astrophysical Visualizations

... again, beginning with some motivation
(aka super cool movies and pictures)

(1) Who am I?

(2) What are we doing?

(3) How are we gonna do it?

~~(1) Who am I?~~

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- 
- Movies - in physical space, analysis plots
 - 3D “stuff”
 - Some VR

~~(1) Who am I?~~

(2) What are we doing?

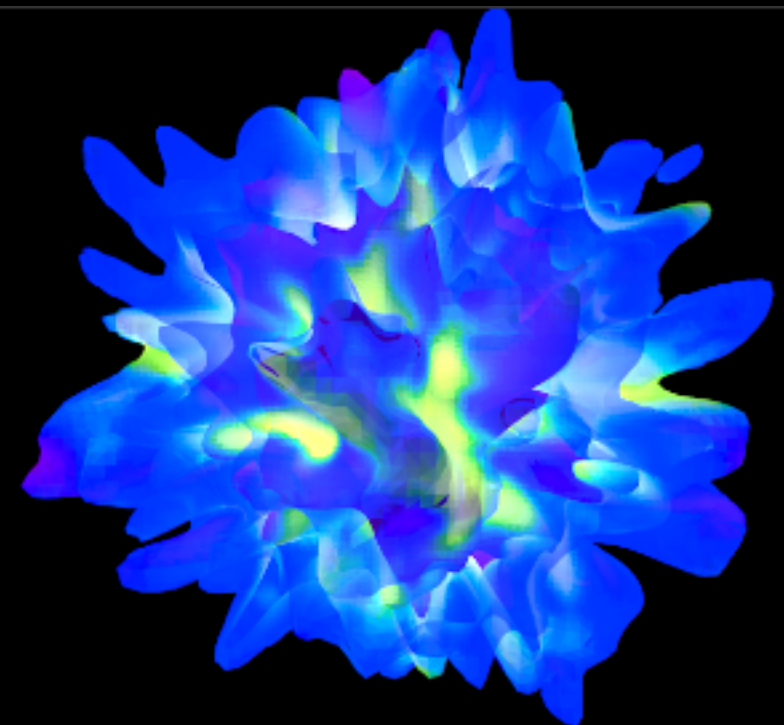
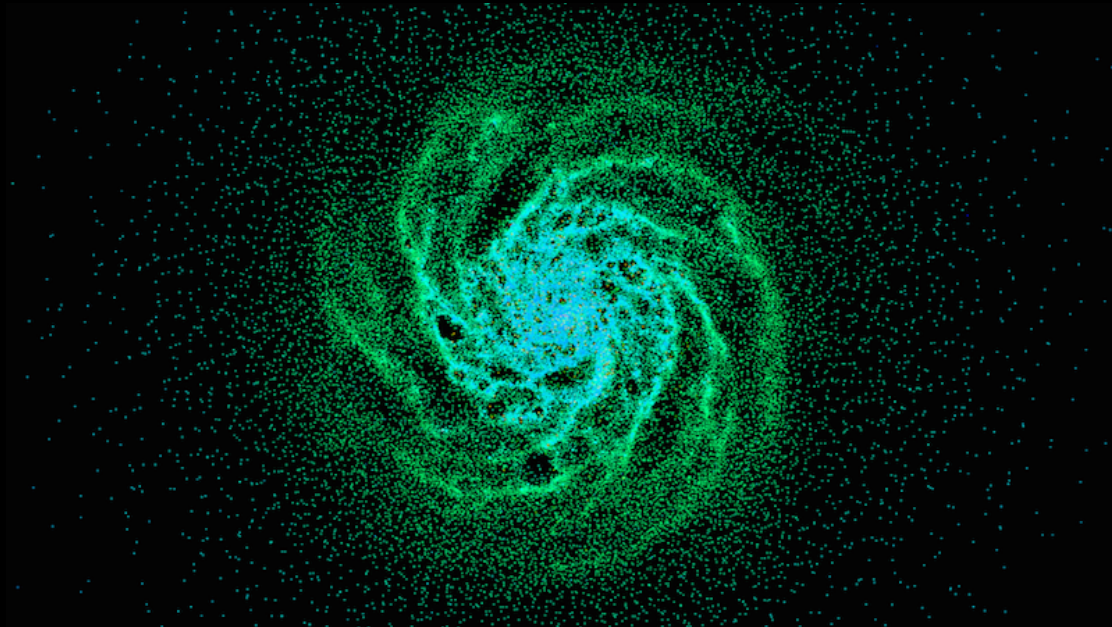
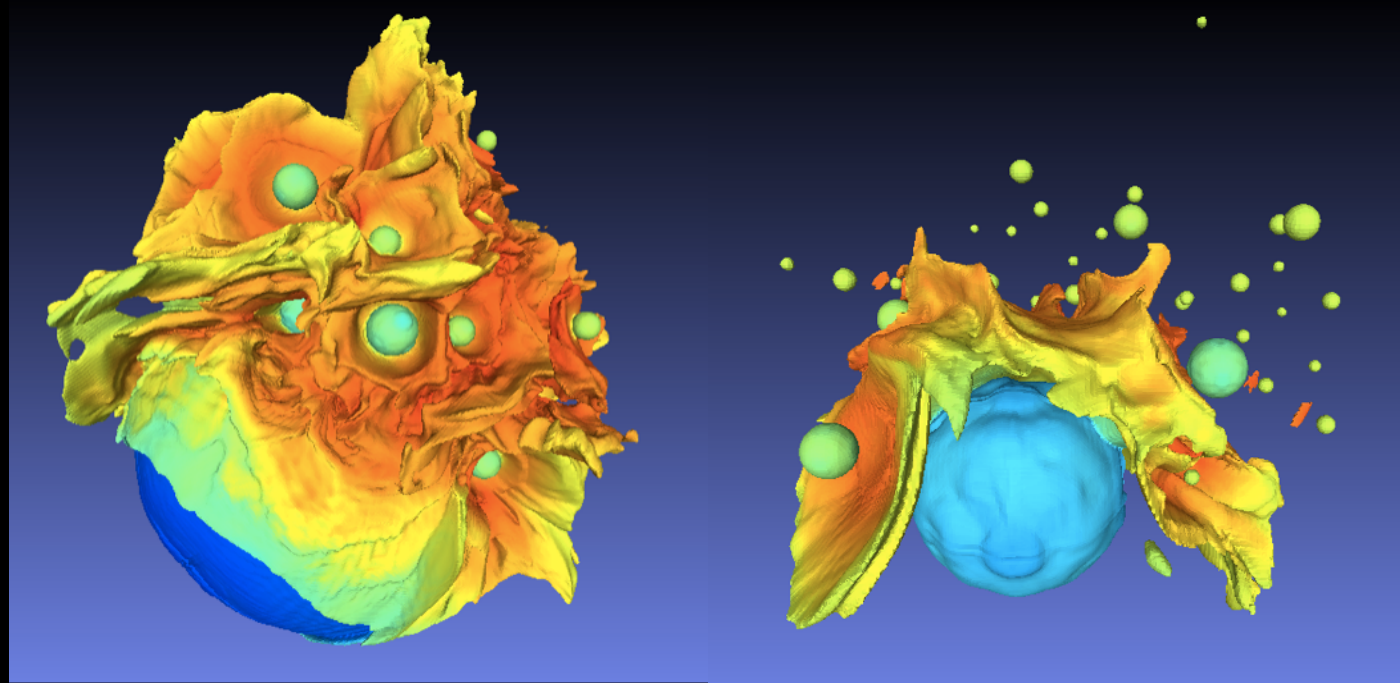
(3) How are we gonna do it?

- Movies - in physical space, analysis plots
- 3D “stuff”
- Some VR

- Python! (+ FFmpeg)
- Sketchfab!
- Google Cardboard/Vive/Hololense!

Intro - Day 1, Viz

Everything for today is posted under day 1 of Viz of:
www.astroblend.com/ba2016



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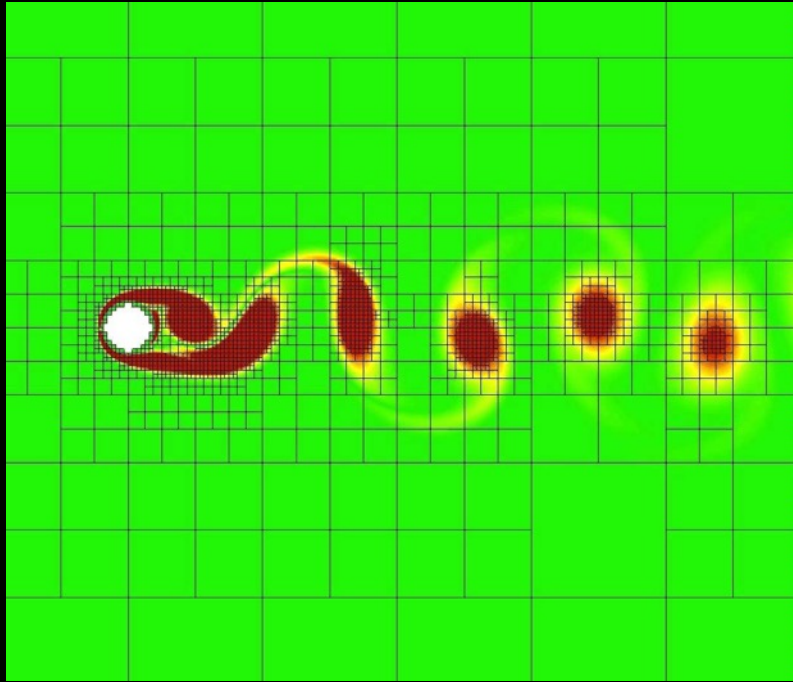
- * So far we have done the 2-Body problem:
 - * analytical vs. numerical
 - * importance of timestep
 - * how to check the accuracy of our simulations (conservation of E, L)
 - * order of solvers (Euler vs. Hermite)
 - * thought about how to deal with code that is getting more and more complex
- * Started doing some multi-body problems! (N-Body) - saw how hard it is to make a stable system, got some hints that Kepler systems are pretty stable and finally figured out ways to make our systems more stable! ... but then tried to DESTROY THEM... in 3D!
- * Some folks looked at Kepler systems, some folks started playing with merging galaxies
- * Also played with a smashing planets visualization: Super Planet Crash!

Intro - Day 1, Viz

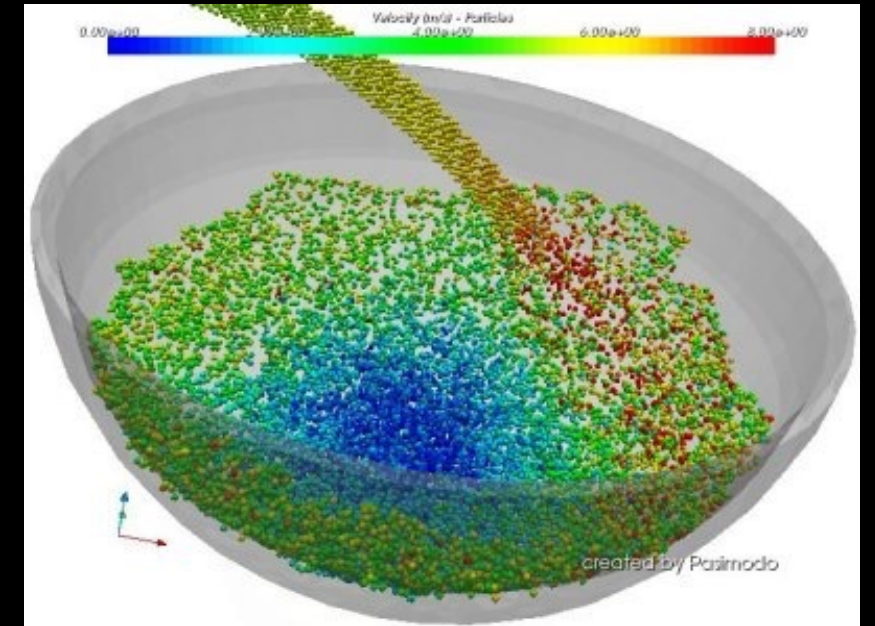
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Workflow of a Typical Computational Astrophysicist

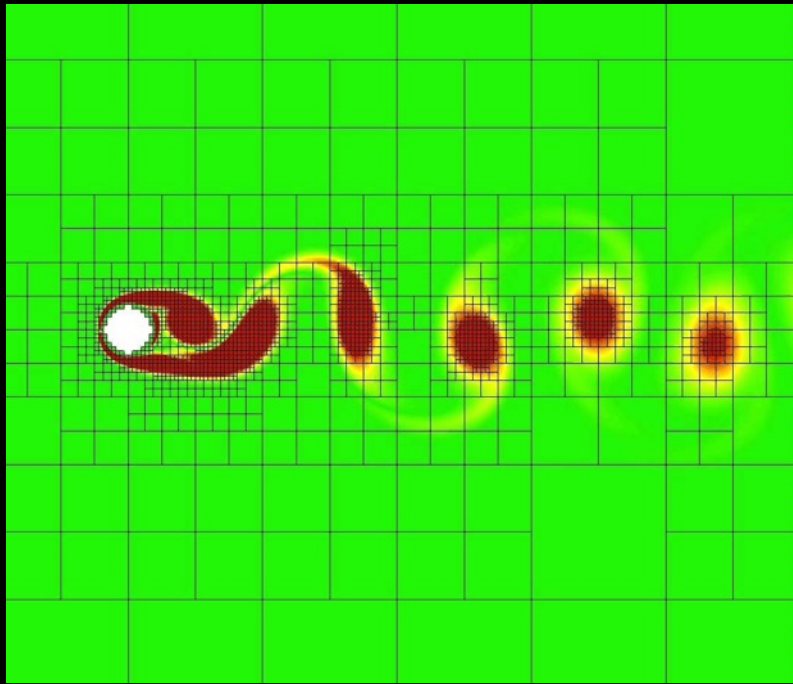


Pick a code for your physics problem.



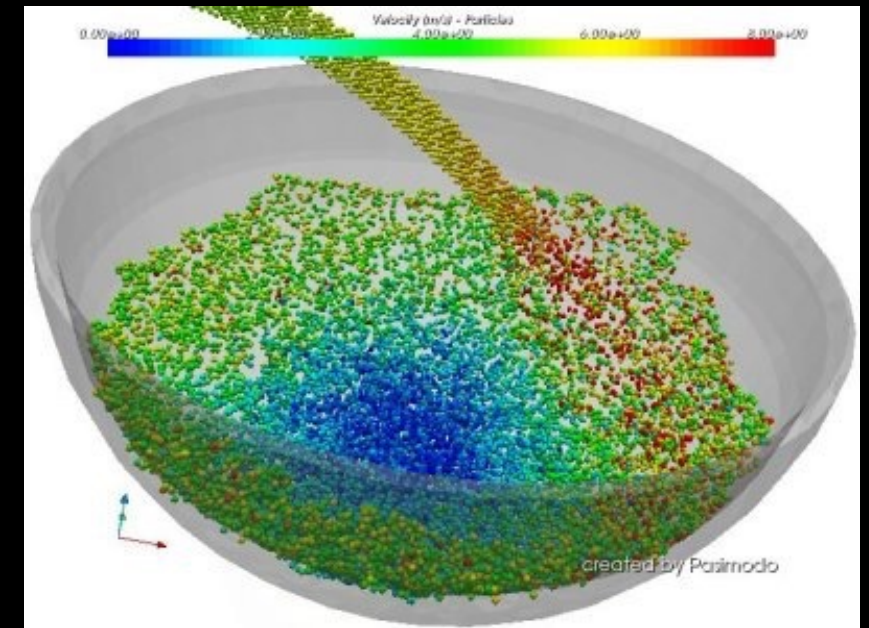
Workflow of a Typical Computational Astrophysicist

Adaptive Mesh Refinement
(AMR)



Follows flows across
mesh boundaries

Smooth Particle Hydrodynamics
(SPH)

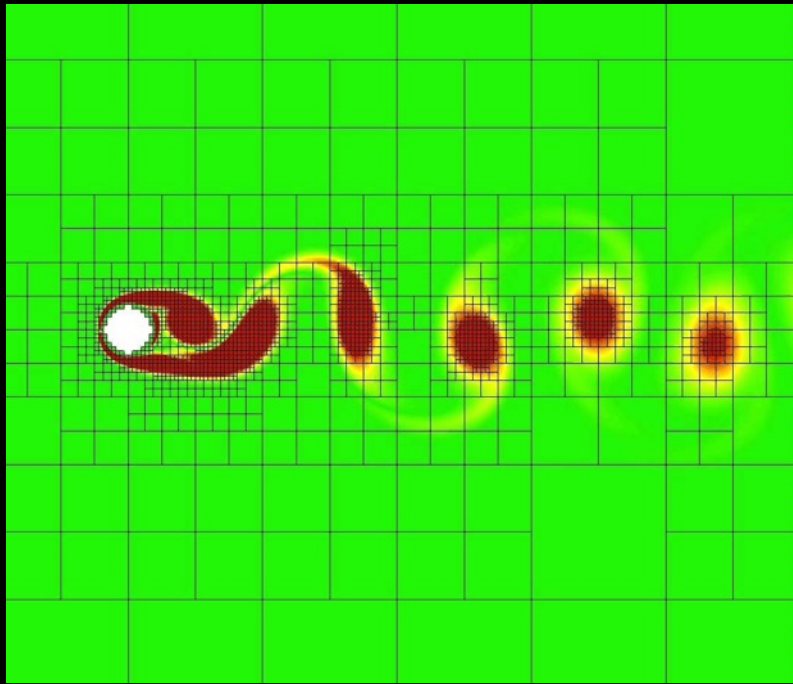


Follows particle
interactions

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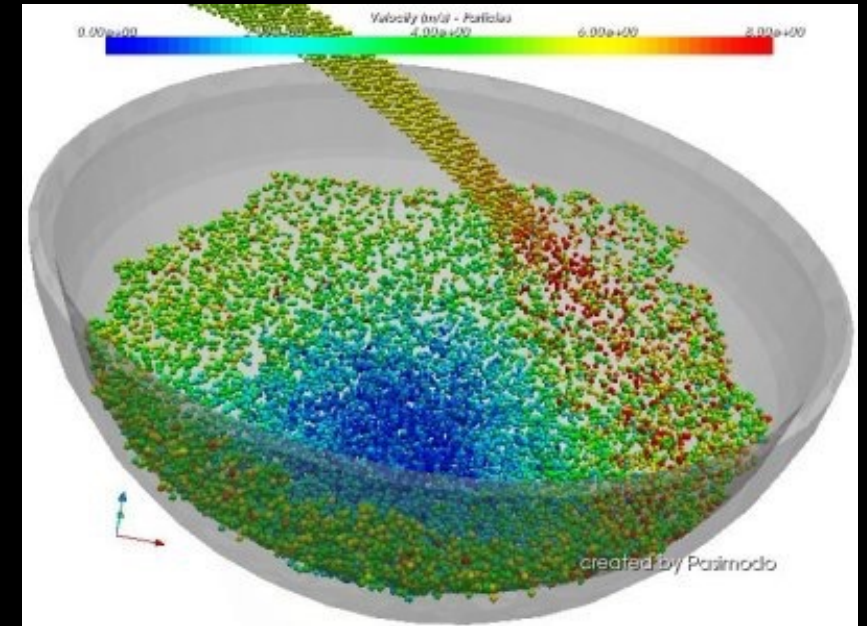
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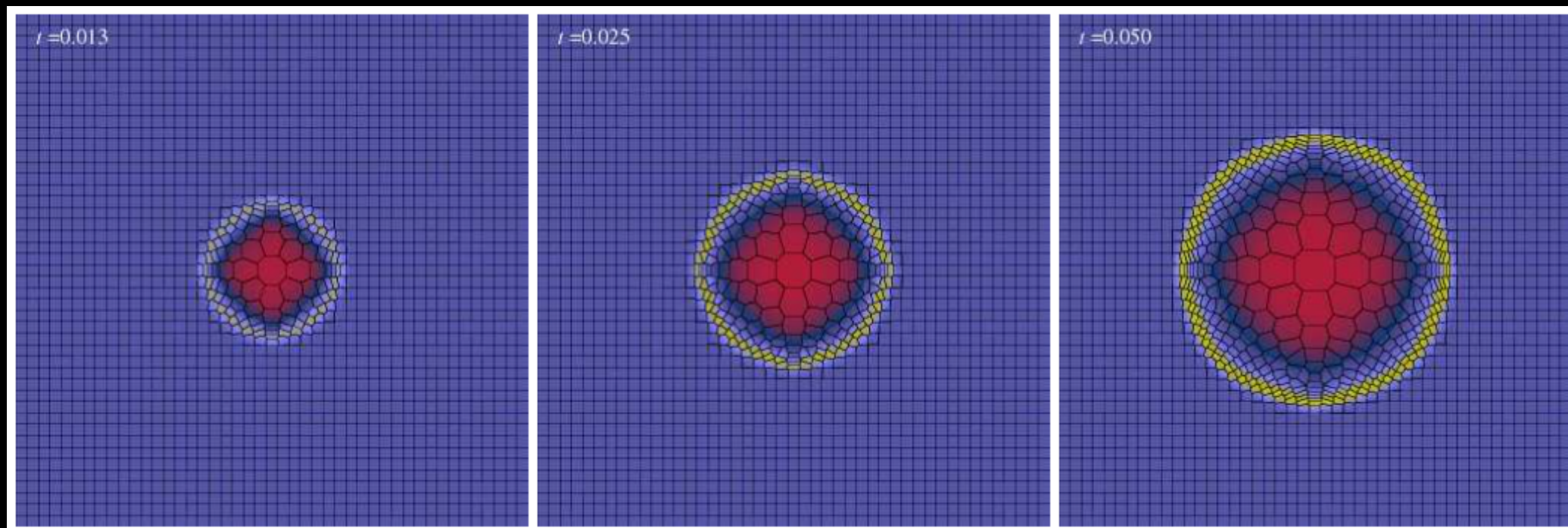


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Smooth Particle Hydrodynamics
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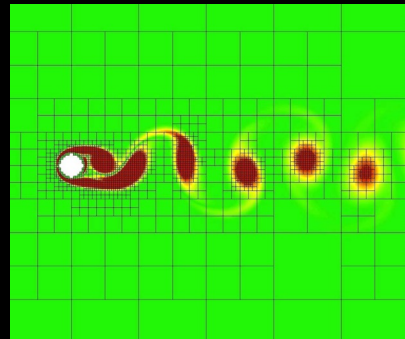


... or both

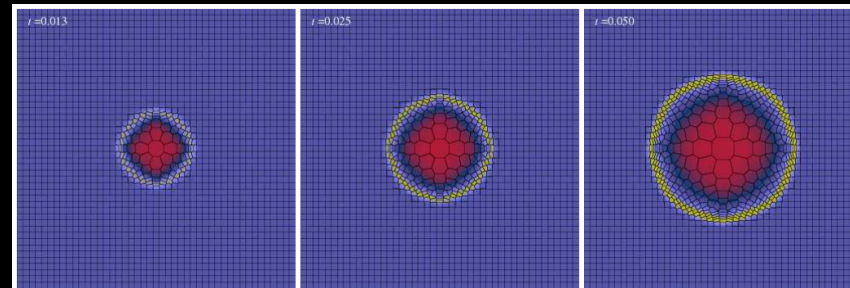


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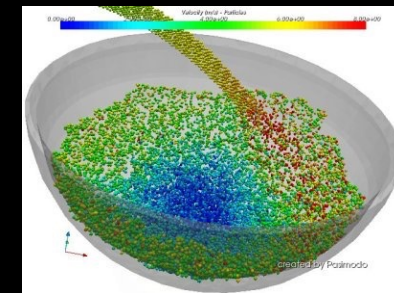
(AMR)



(Moving Mesh)



(SPH)



We only wanted to deal with gravitating objects - so we chose an N-Body code.

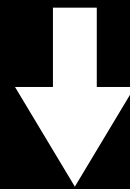


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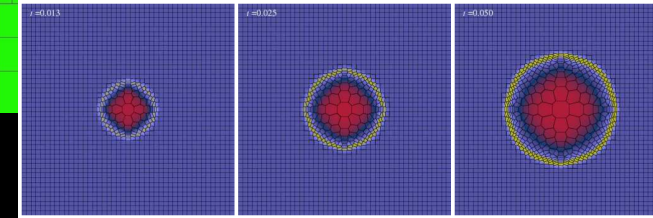
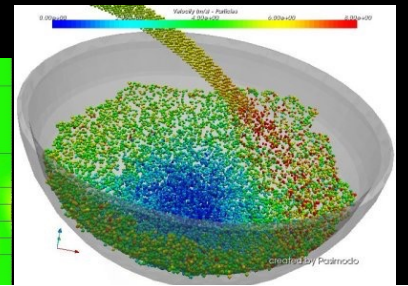
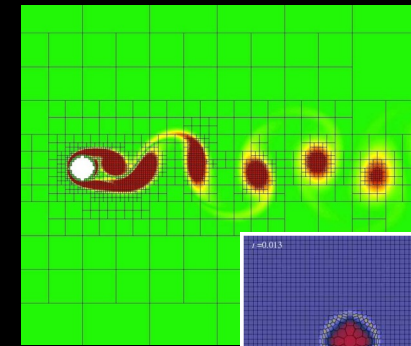
(N-Body)



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(Hydro)



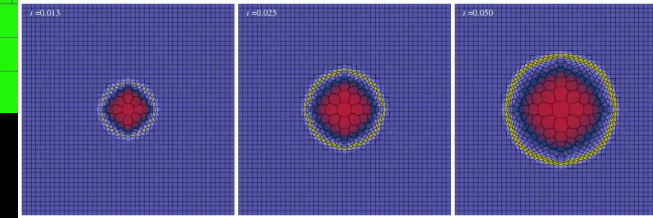
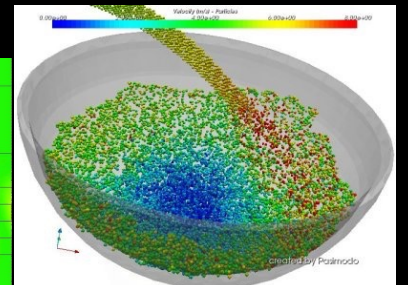
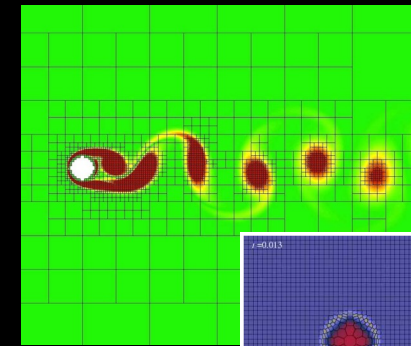
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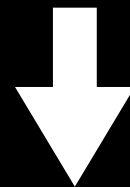
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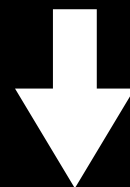
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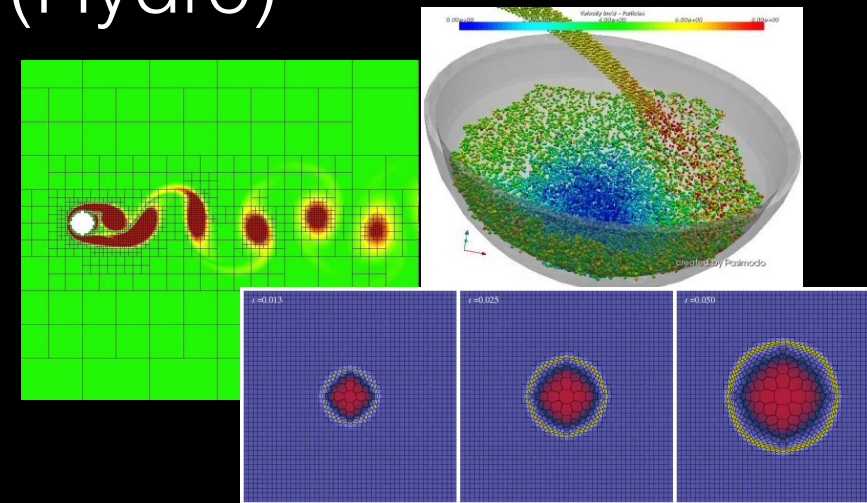
Send to supercomputer... and wait

Workflow of a Typical Computational Astrophysicist

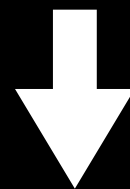
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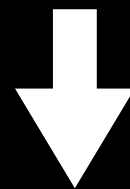
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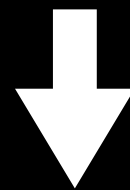
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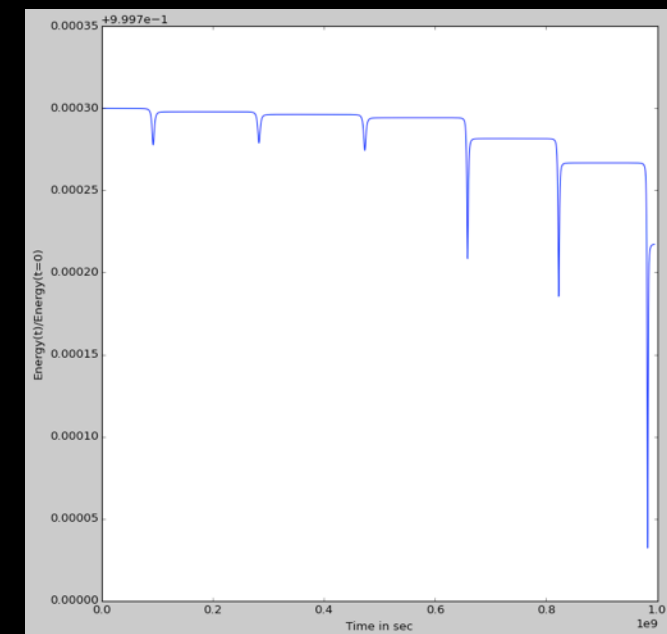
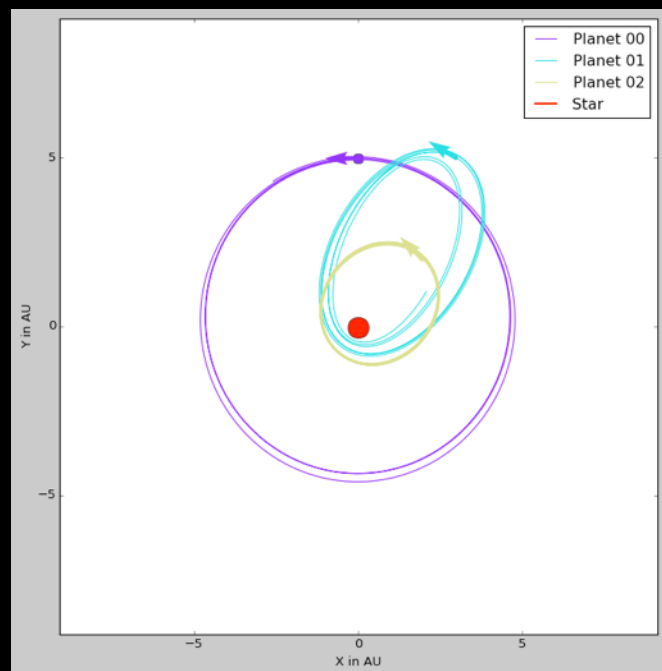
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Visualize and Analyze

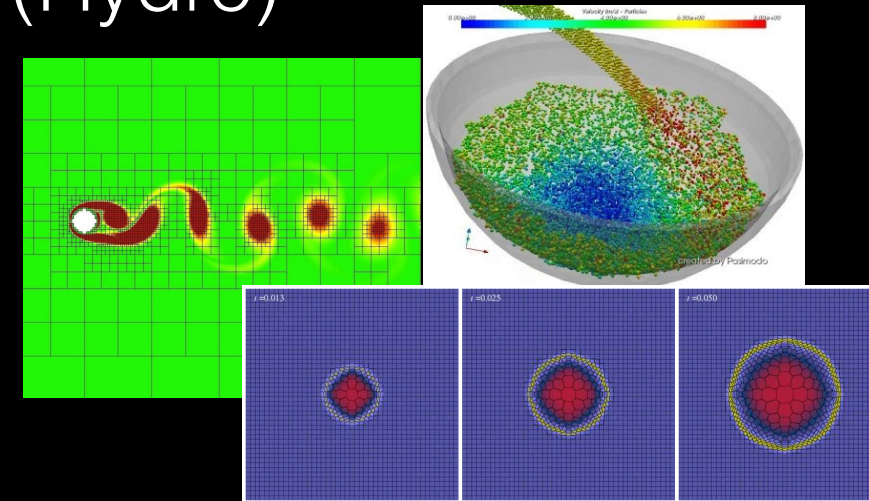


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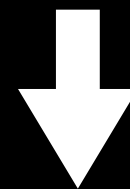
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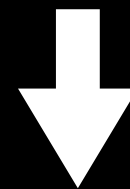
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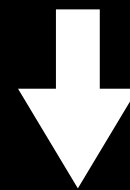
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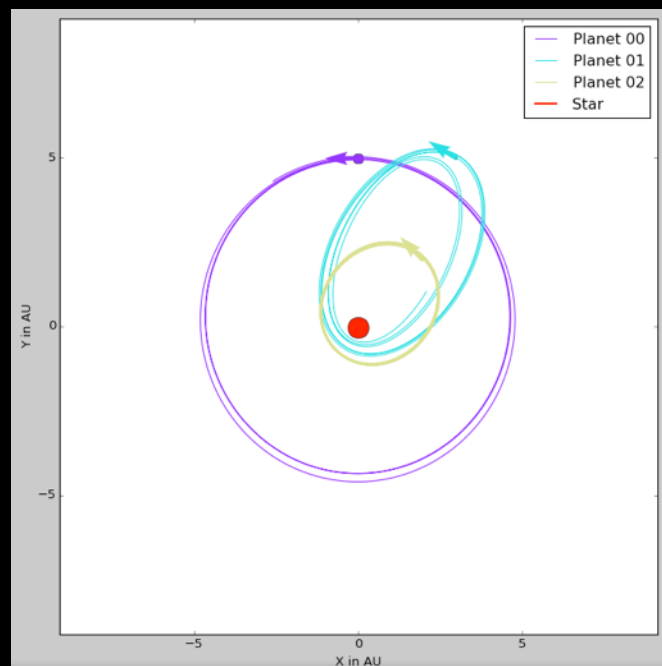
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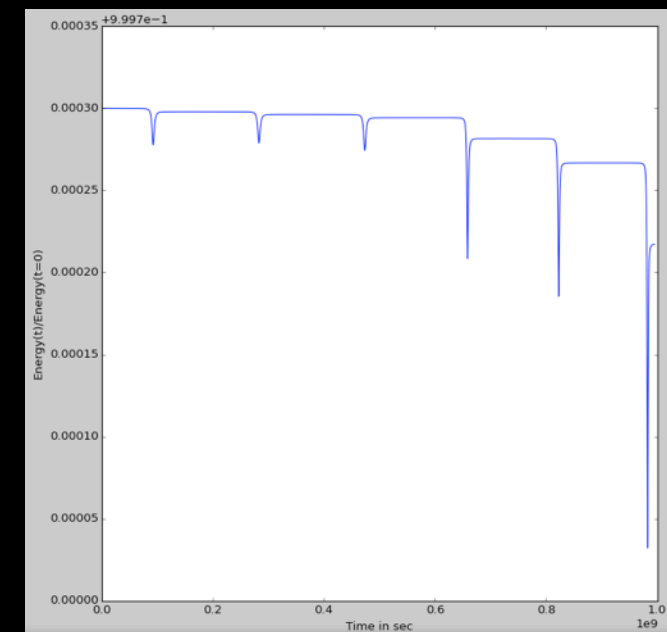
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Visualize and Analyze



What does my simulation physically look like?



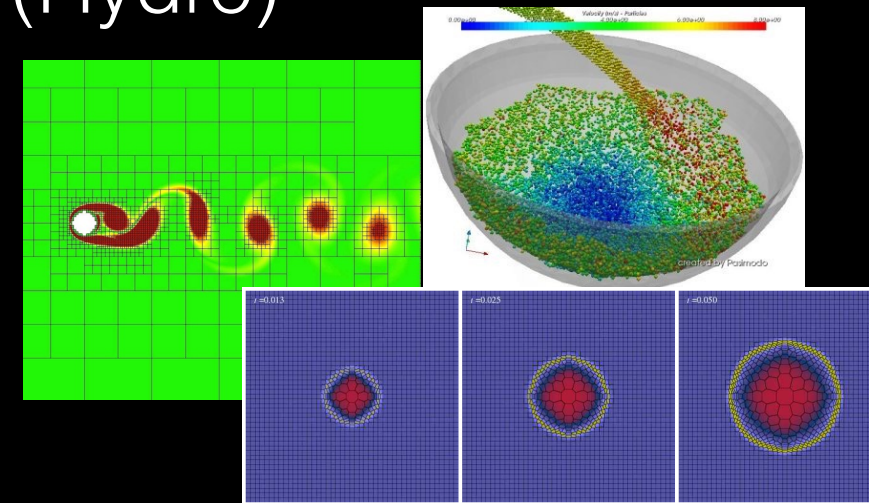
How close am I to simulating reality? What physics can I learn from my sim?

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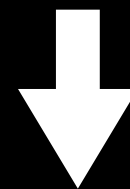
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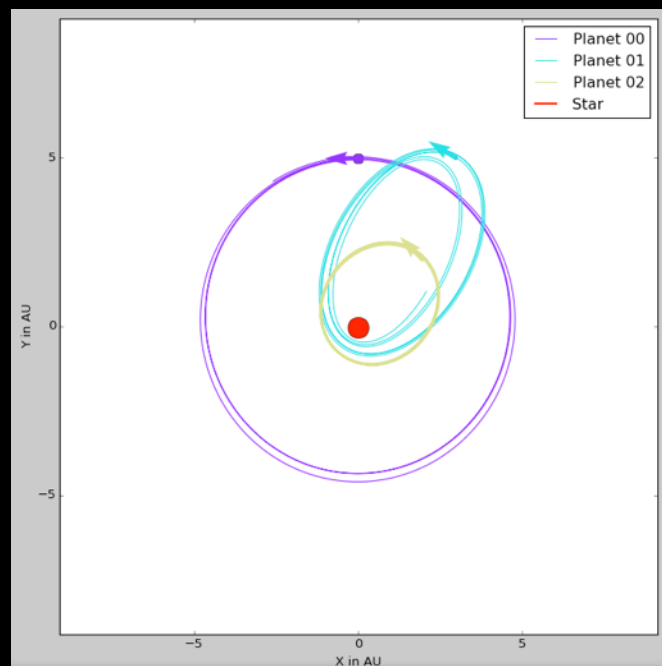
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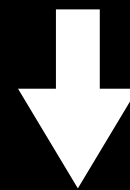
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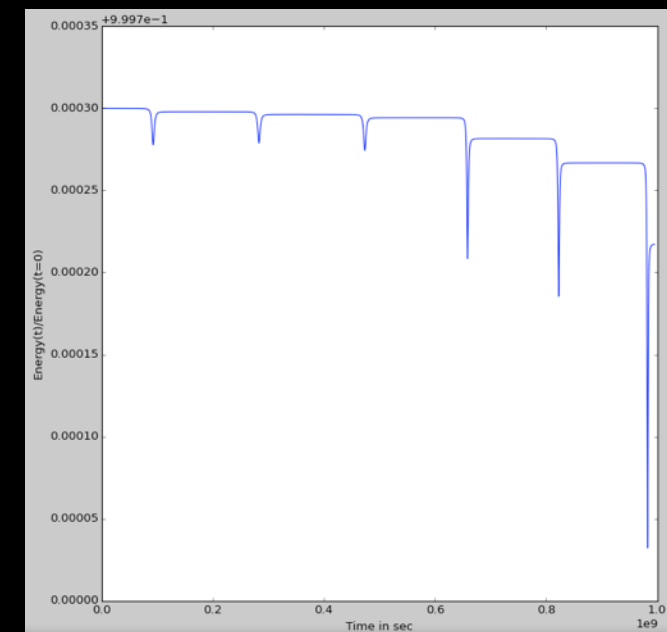
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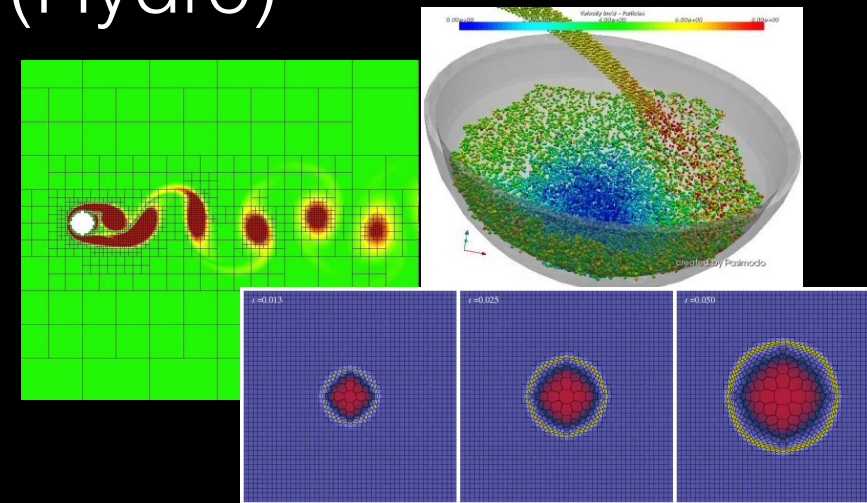
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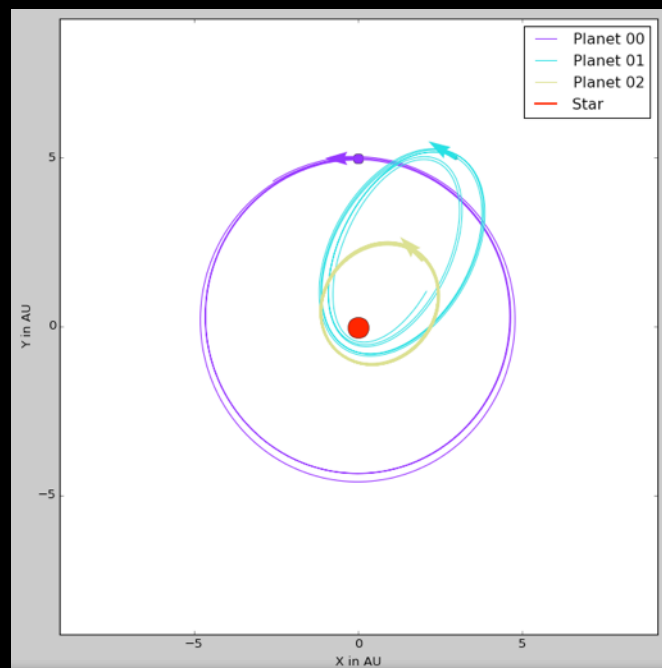


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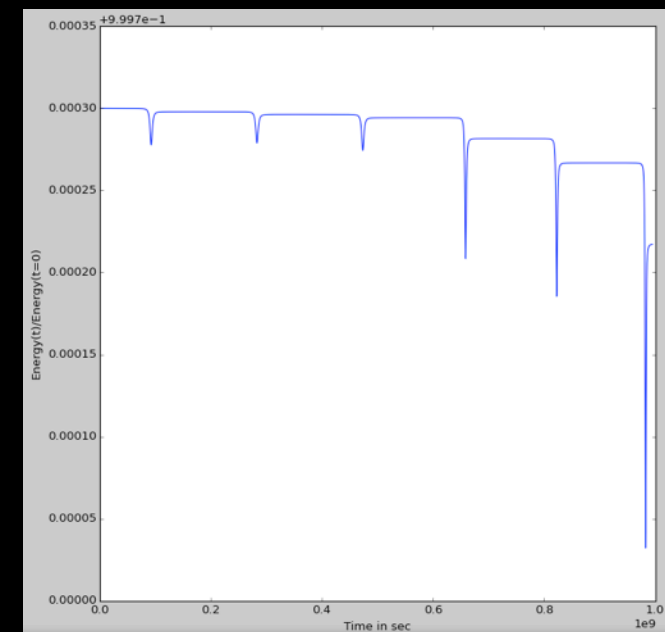


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Visualize and Analyze

Make a super cool movie



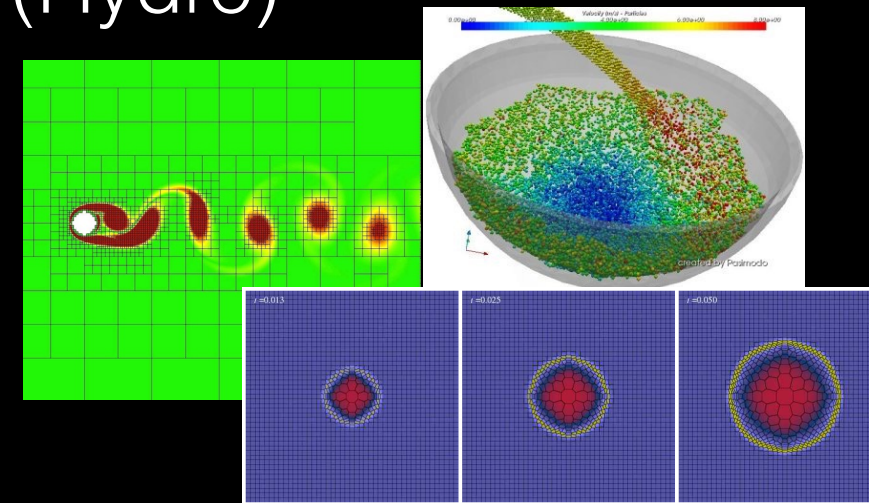
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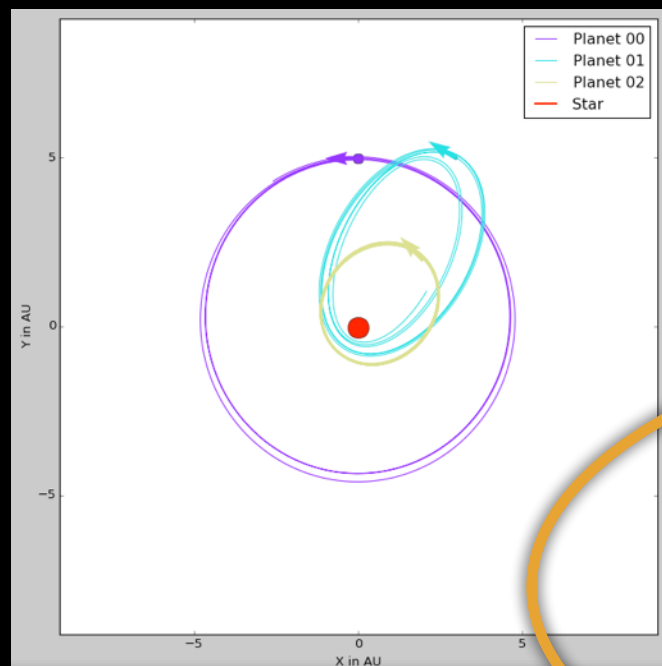


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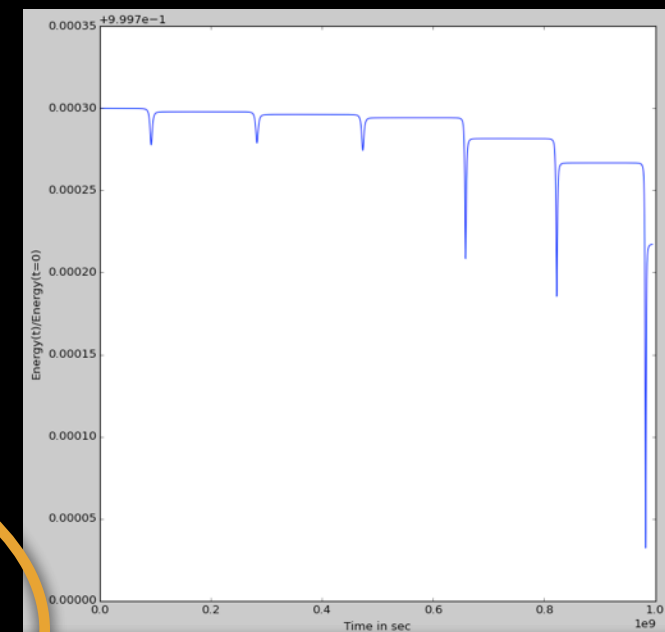
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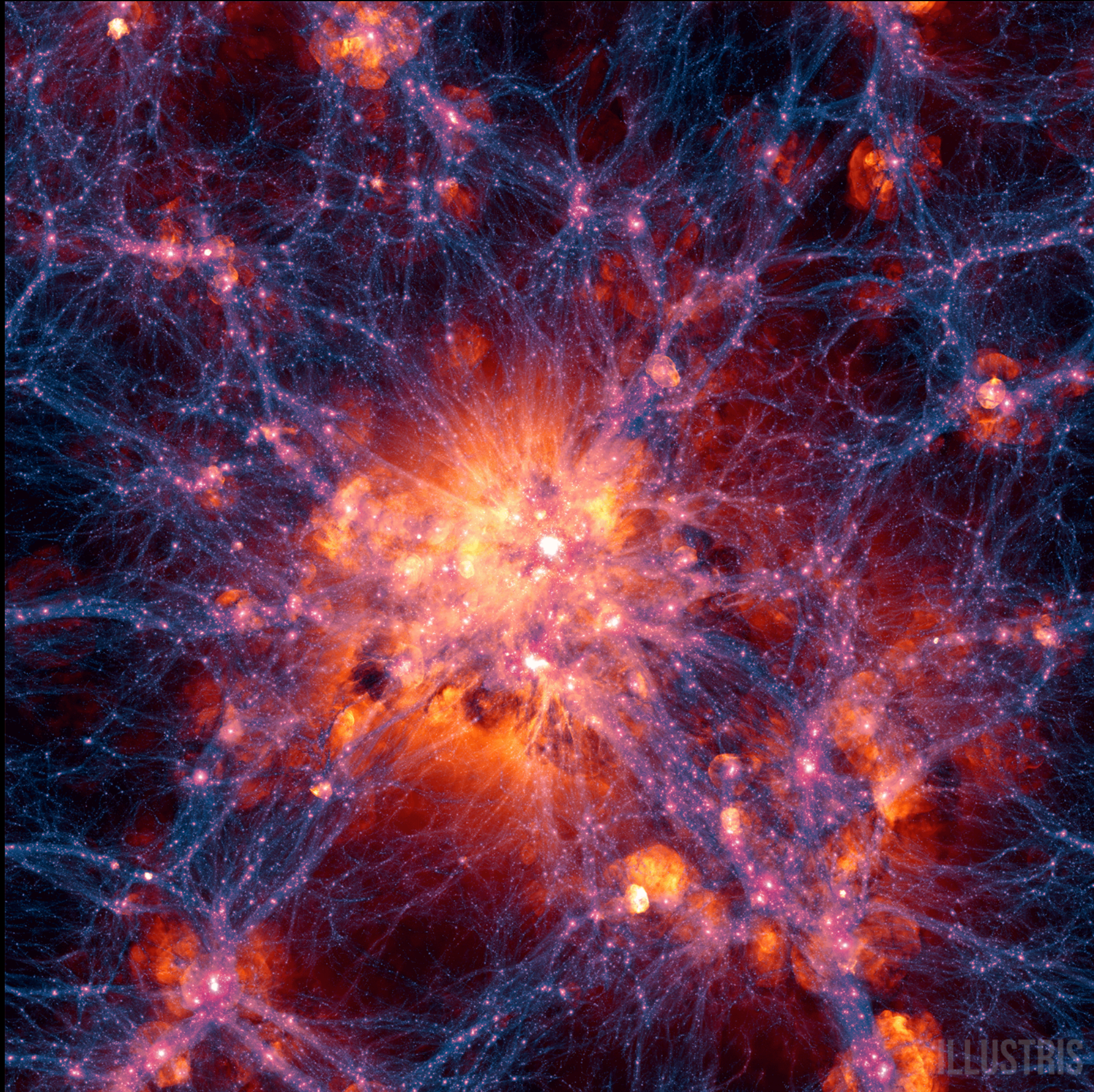
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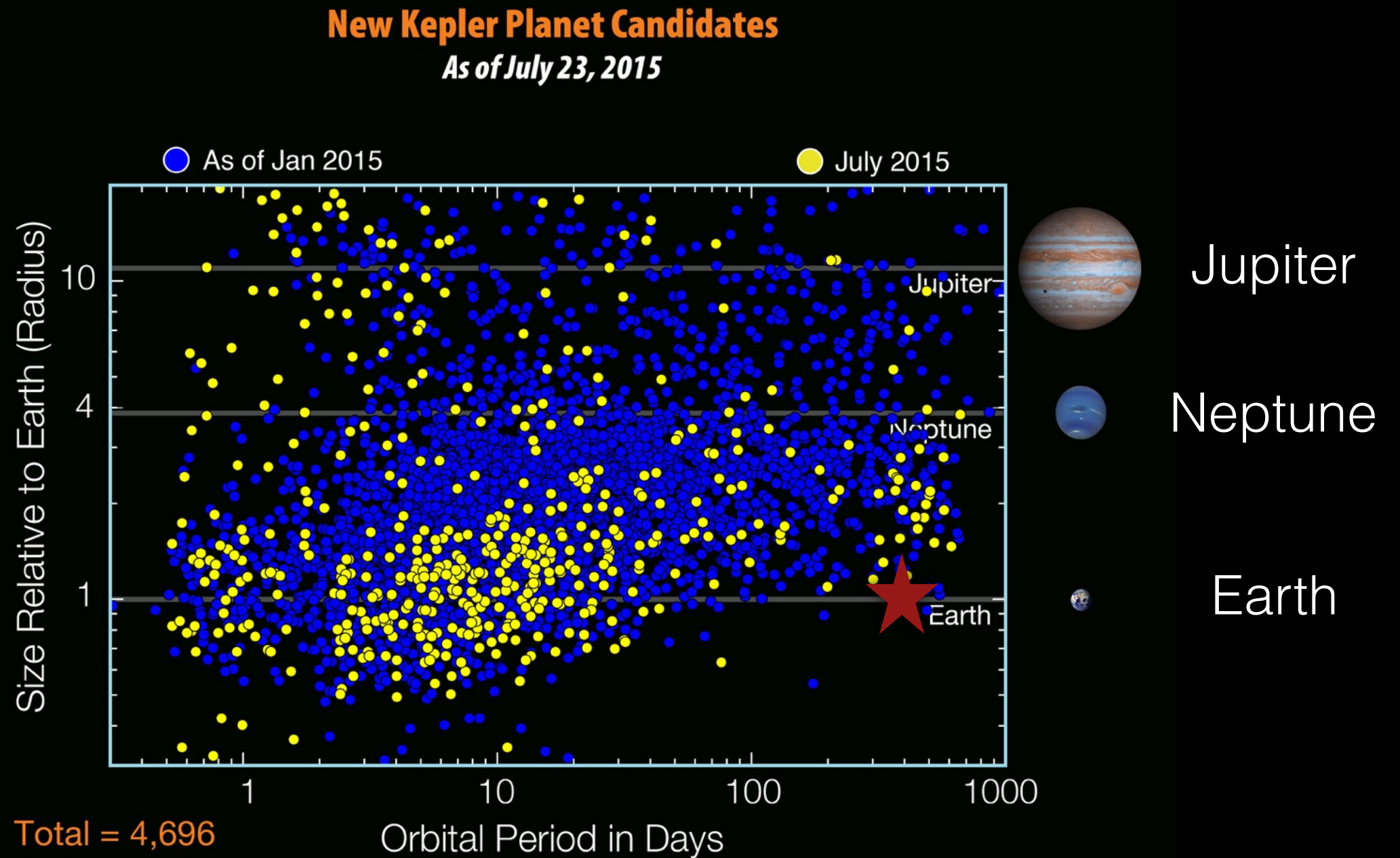
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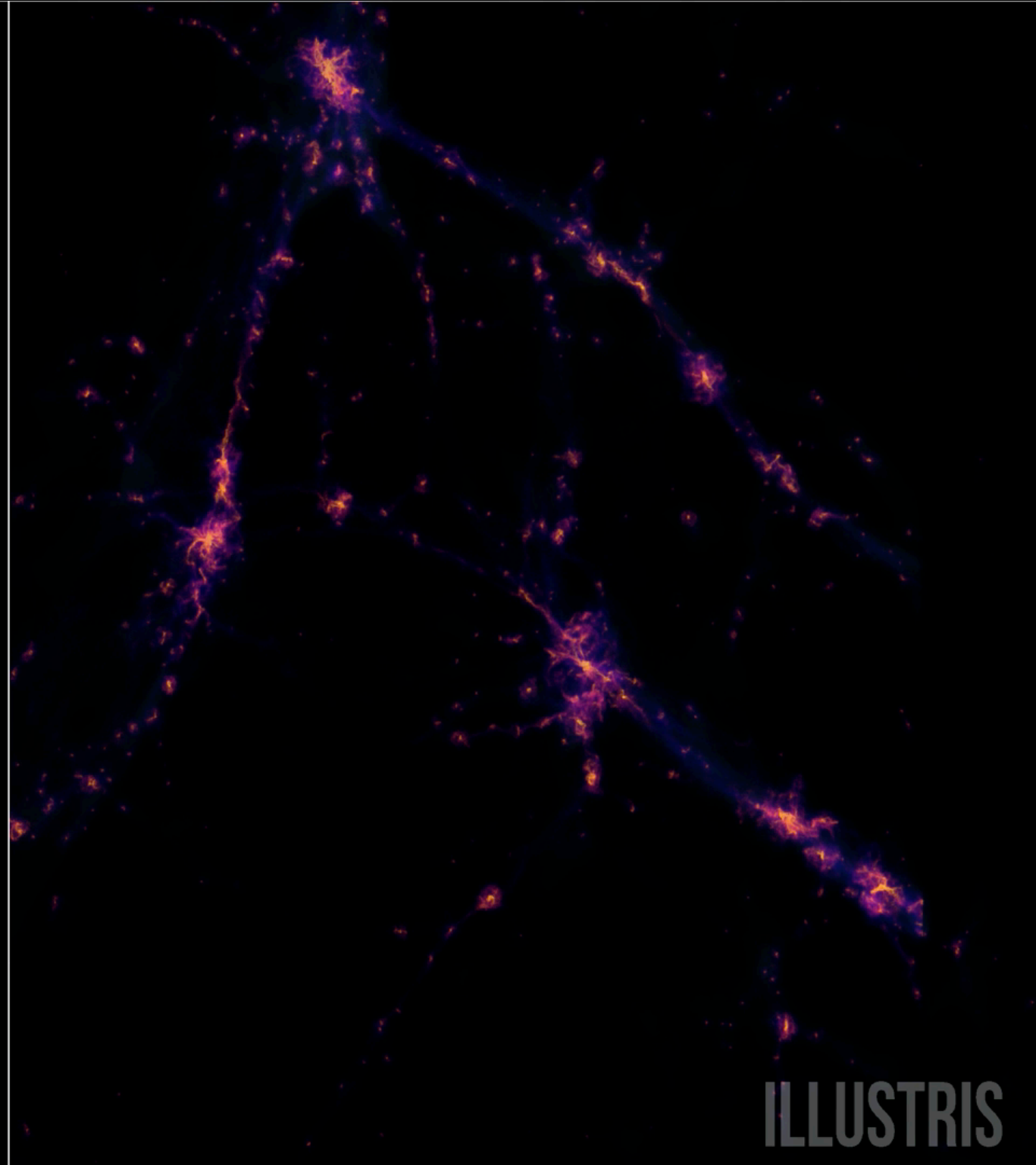


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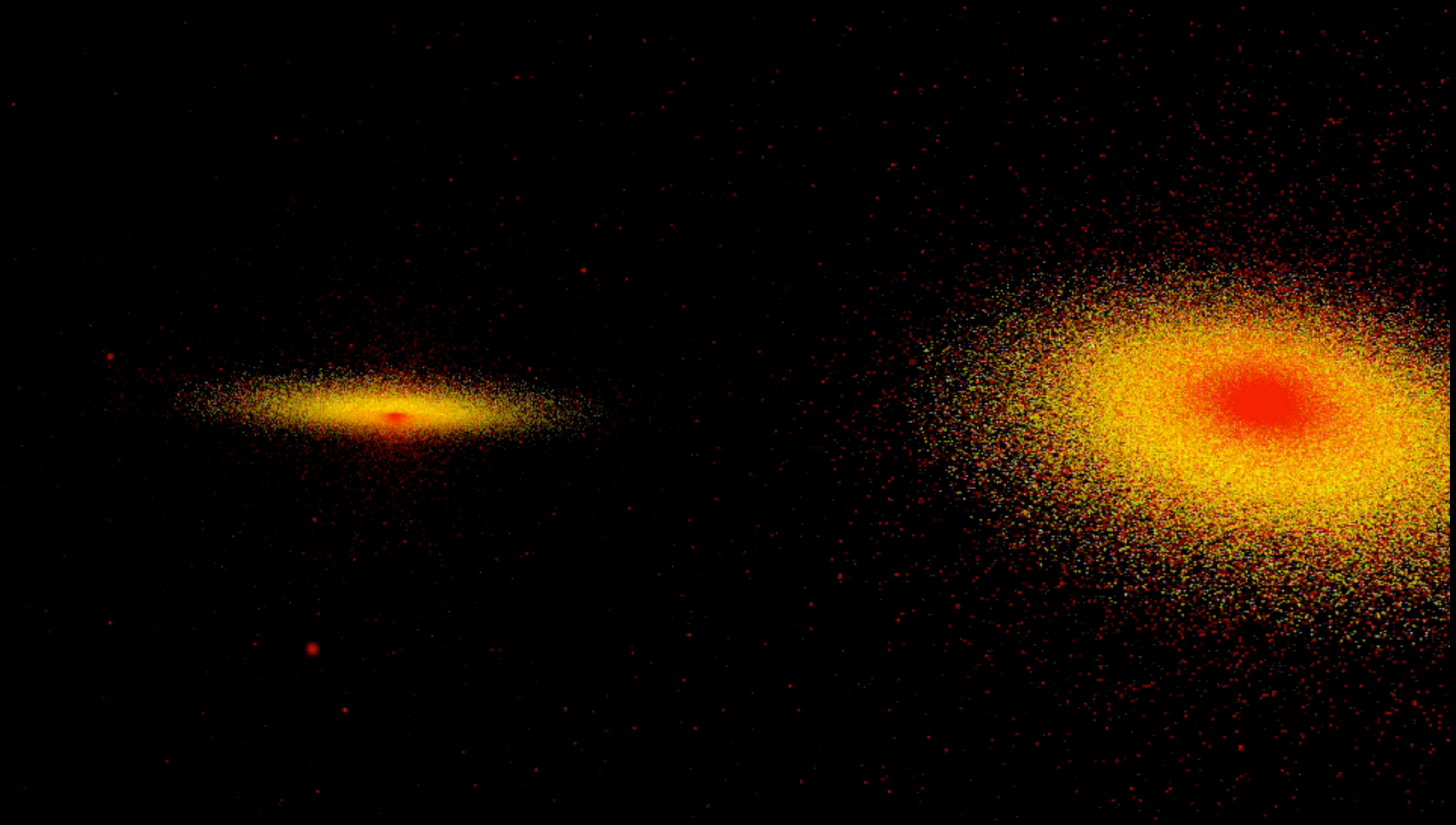
What is a visualization?

$z=4.00$ $\log_{10}(M_*)=10.4$ $\text{SFR}=80.0$ $\text{sSFR}=3.07\text{Gyr}^{-1}$



ILLUSTRIS

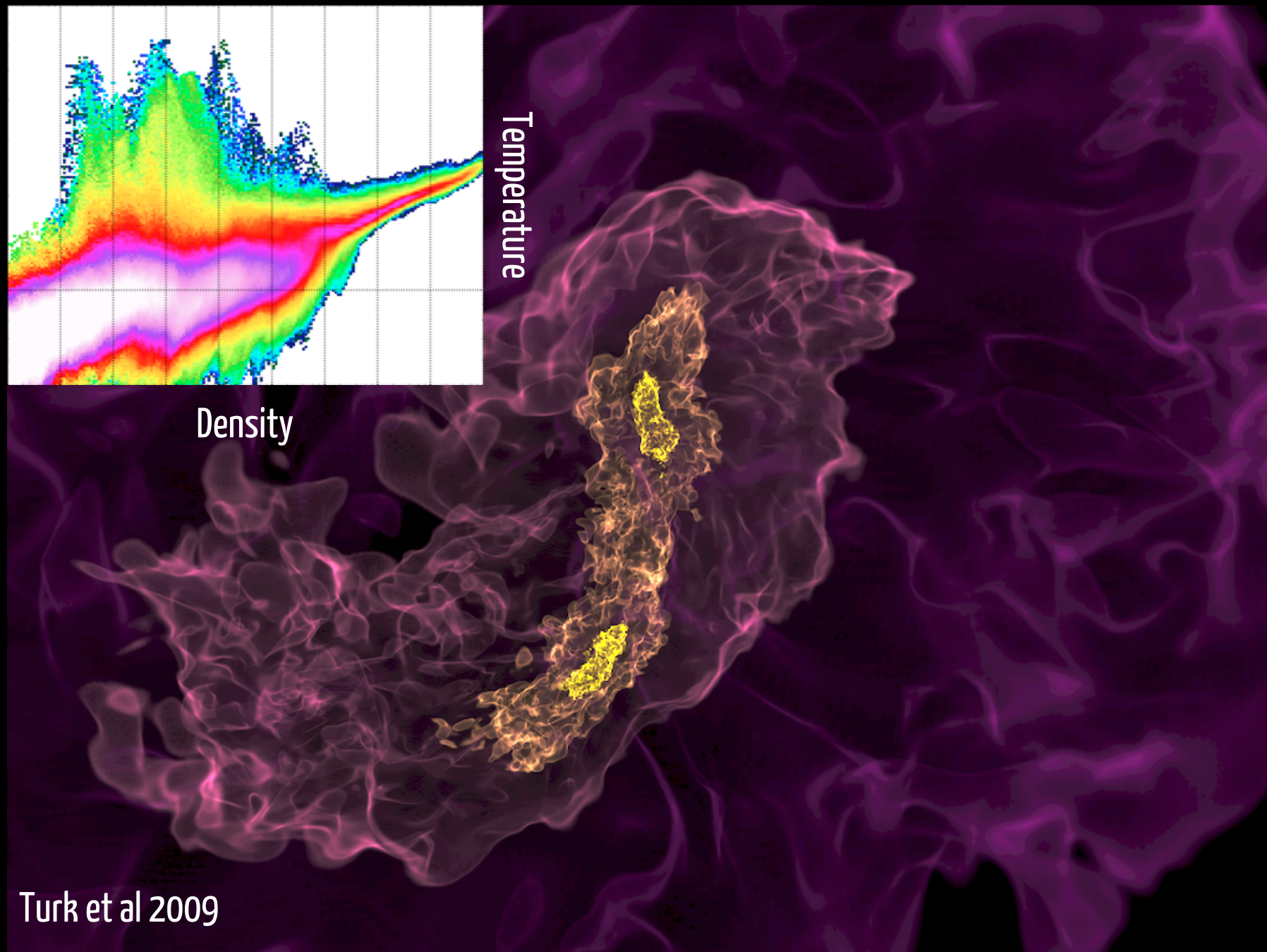
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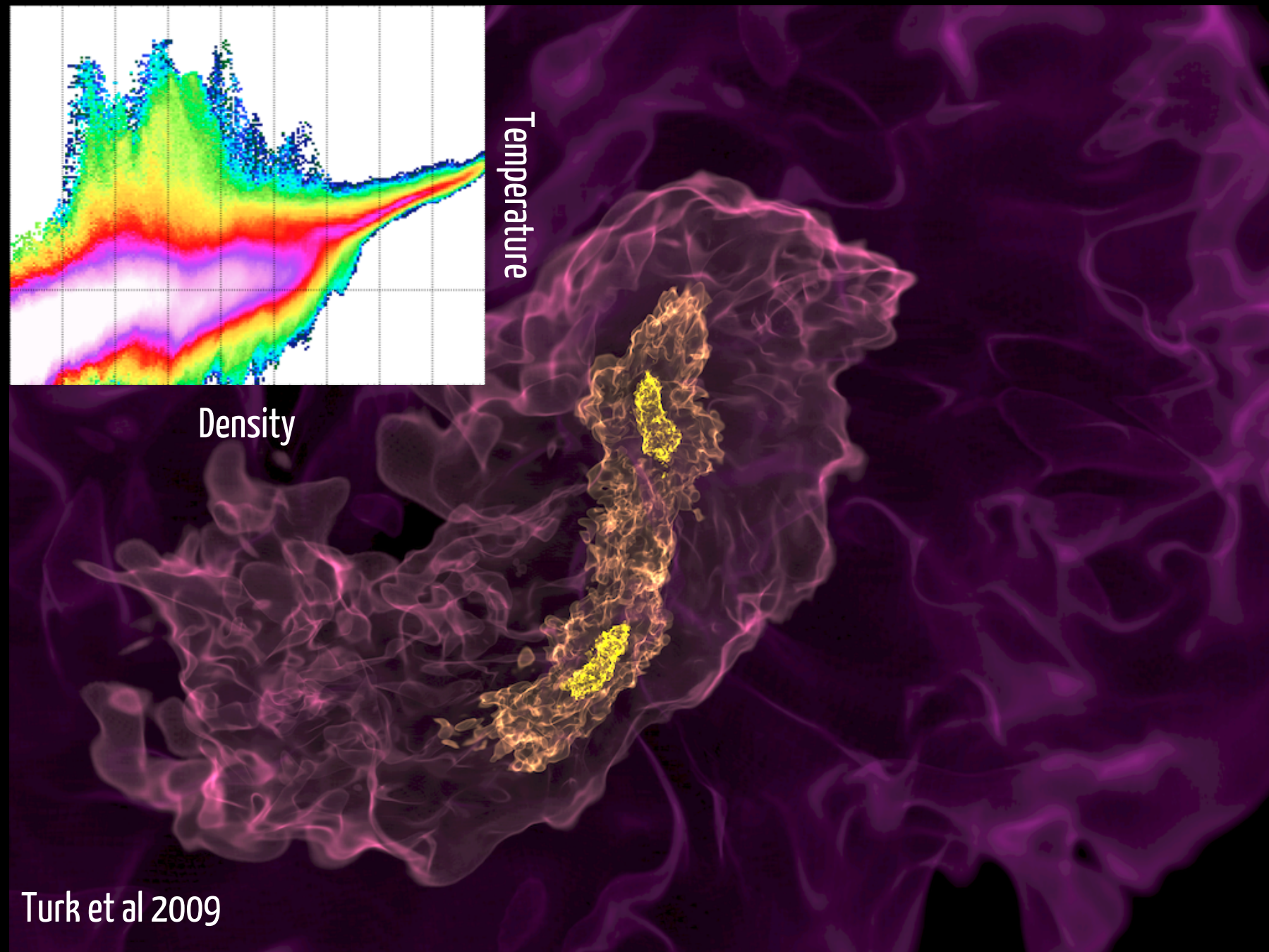
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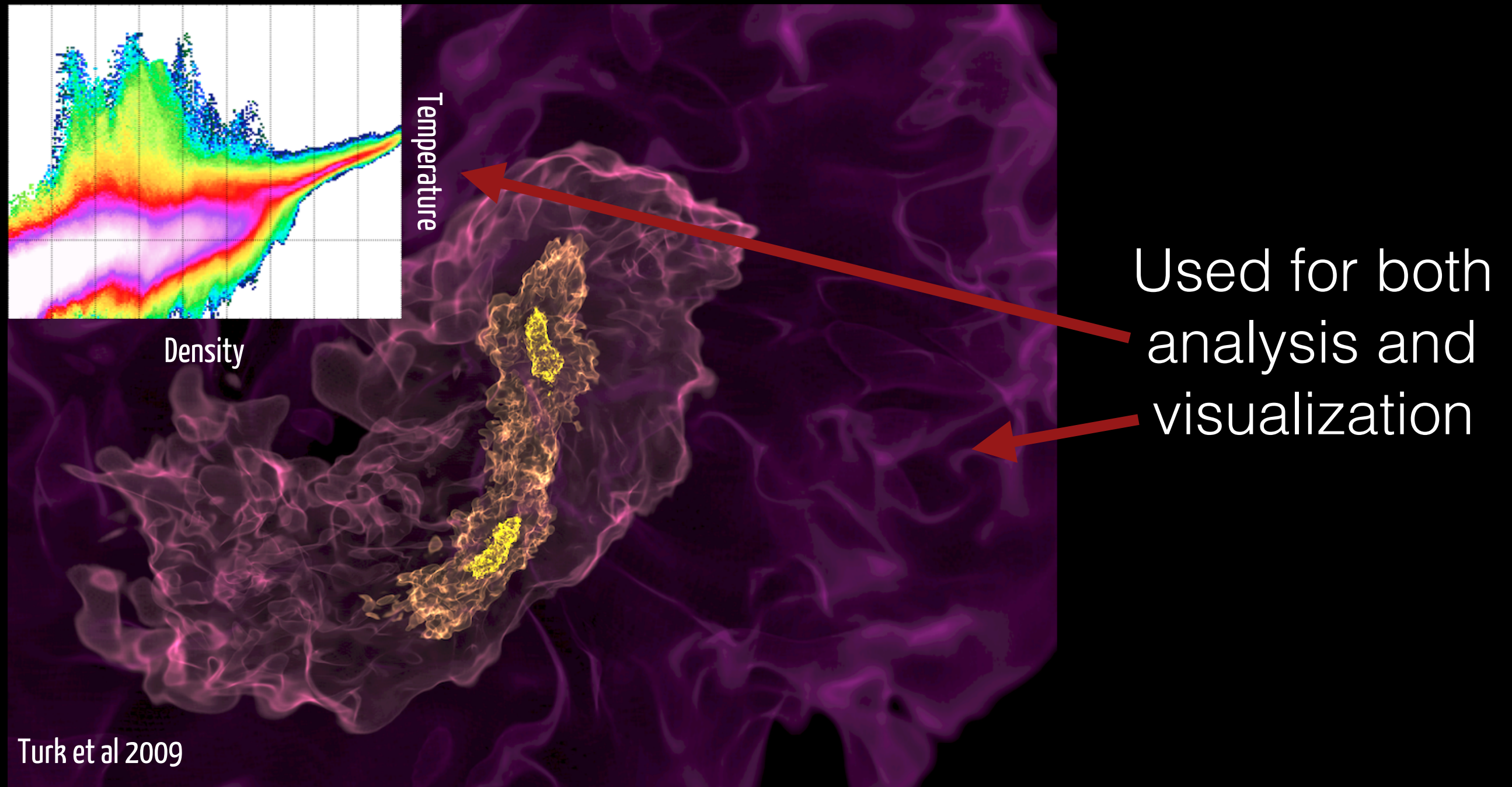


Simulation gas collapsing and forming two dense cores that will become some of the first stars in our Universe.

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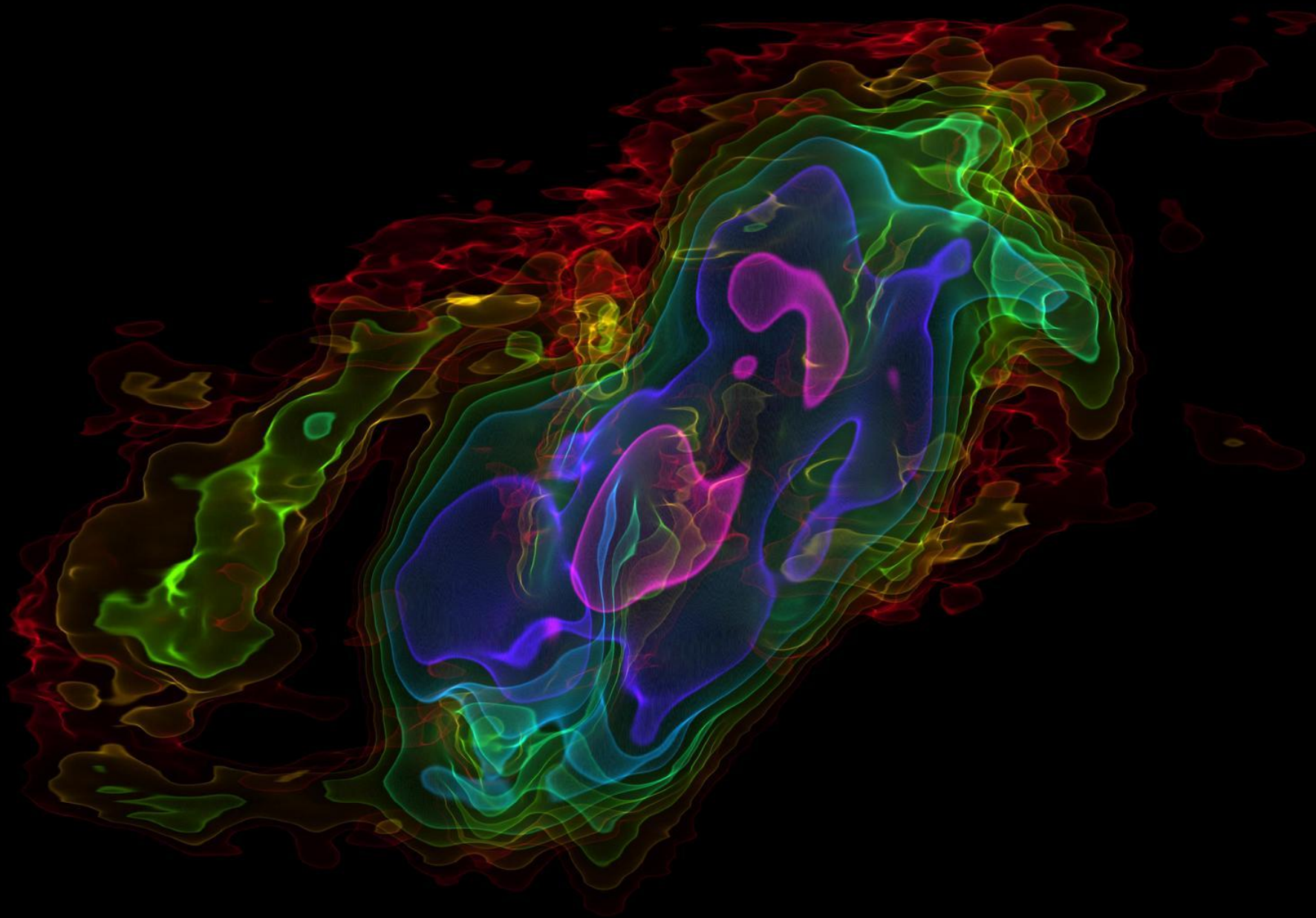
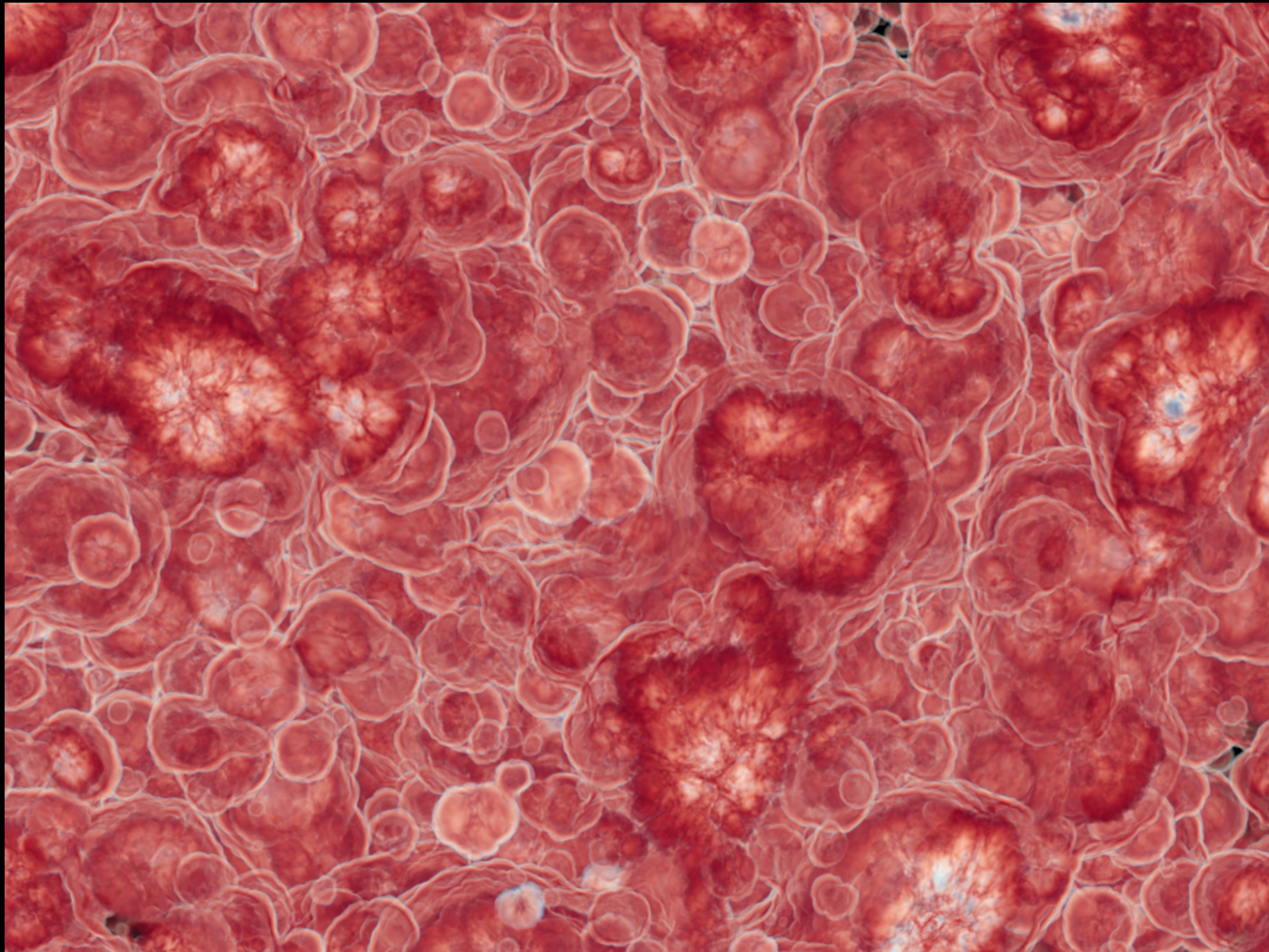


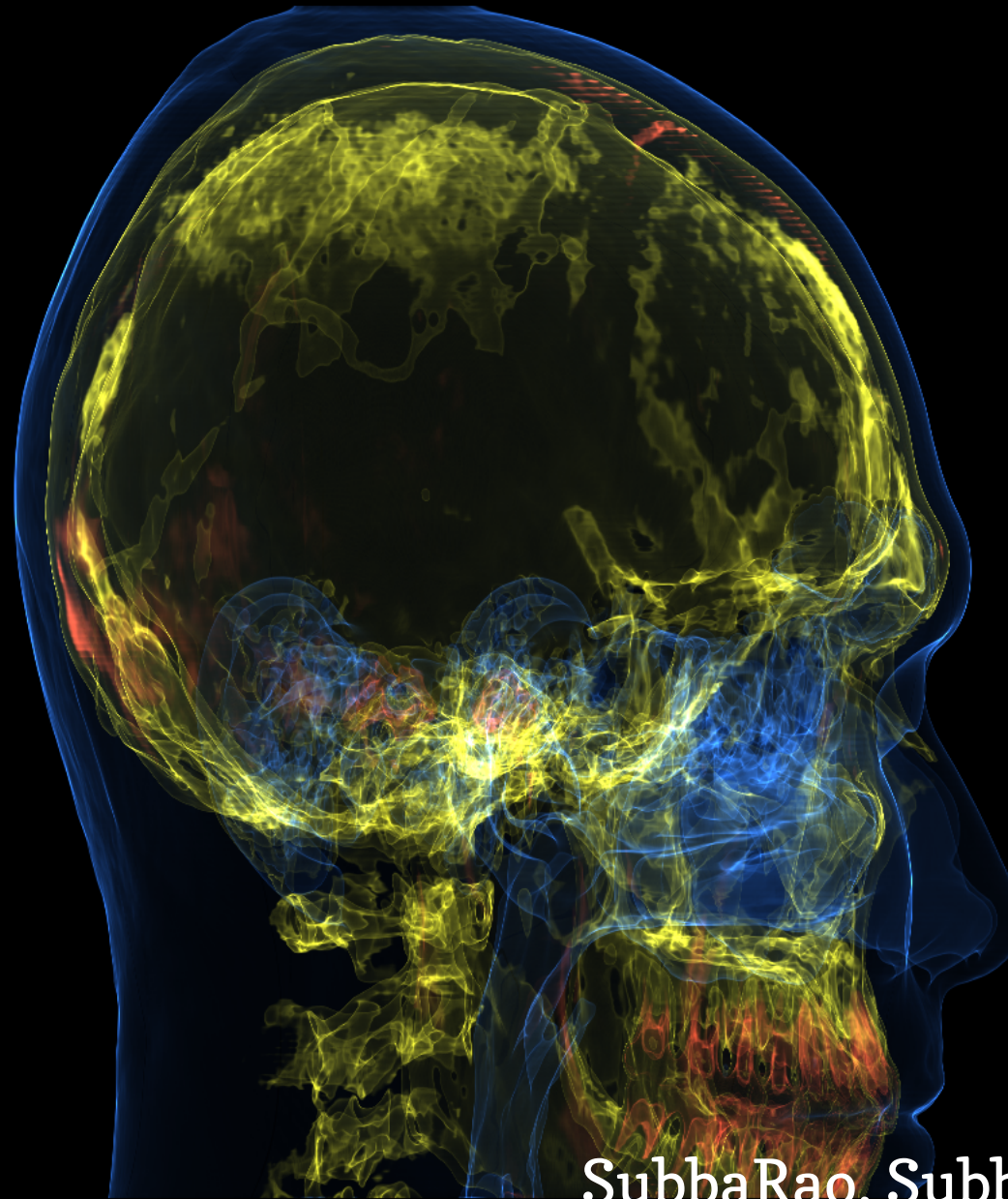
Image Credit: Erik Rosolowsky & ALMA

What is a visualization?



What is a visualization?

NeuroDome



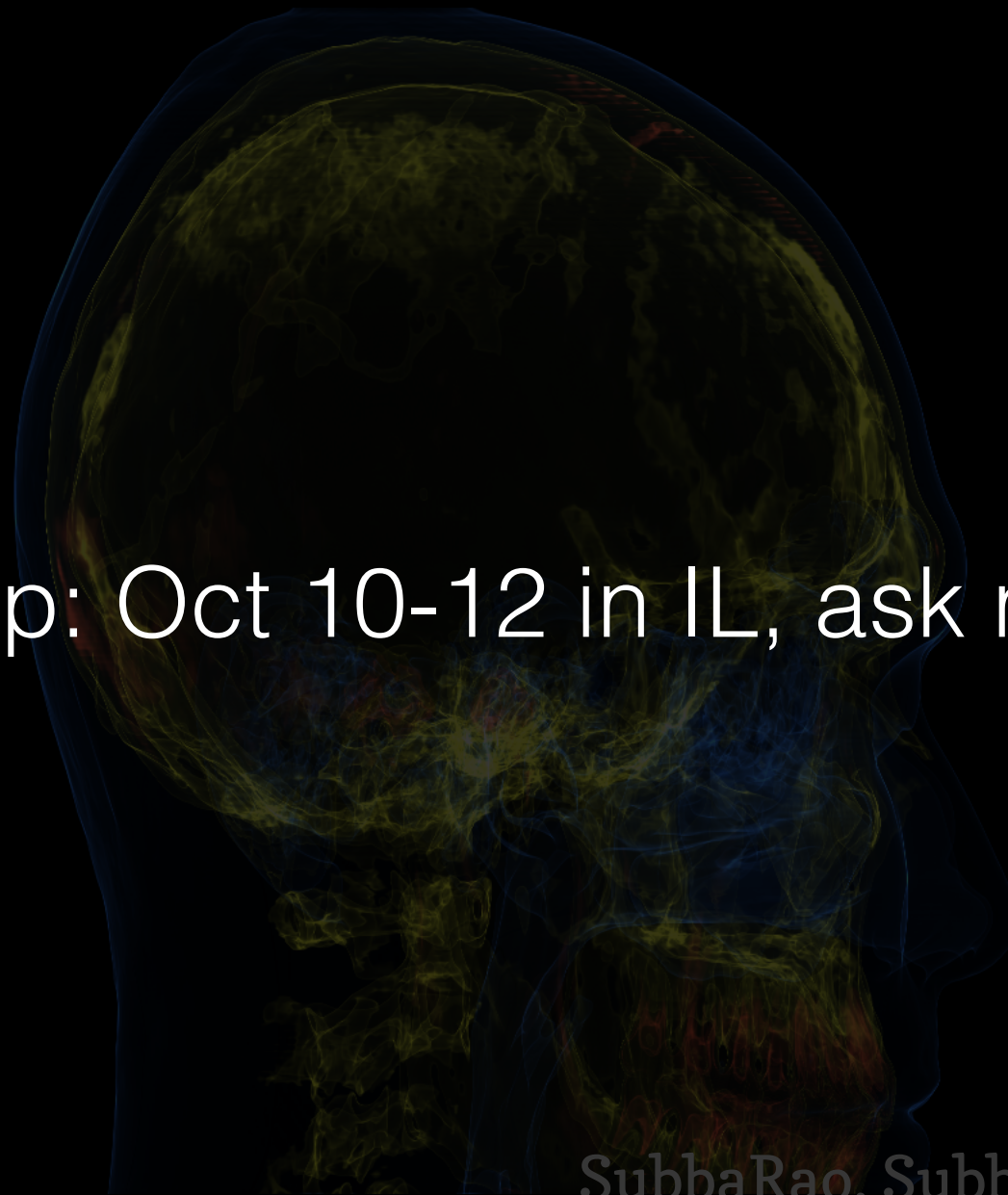
SubbaRao, SubbaRao & Fisher

What is a visualization?

Aside!

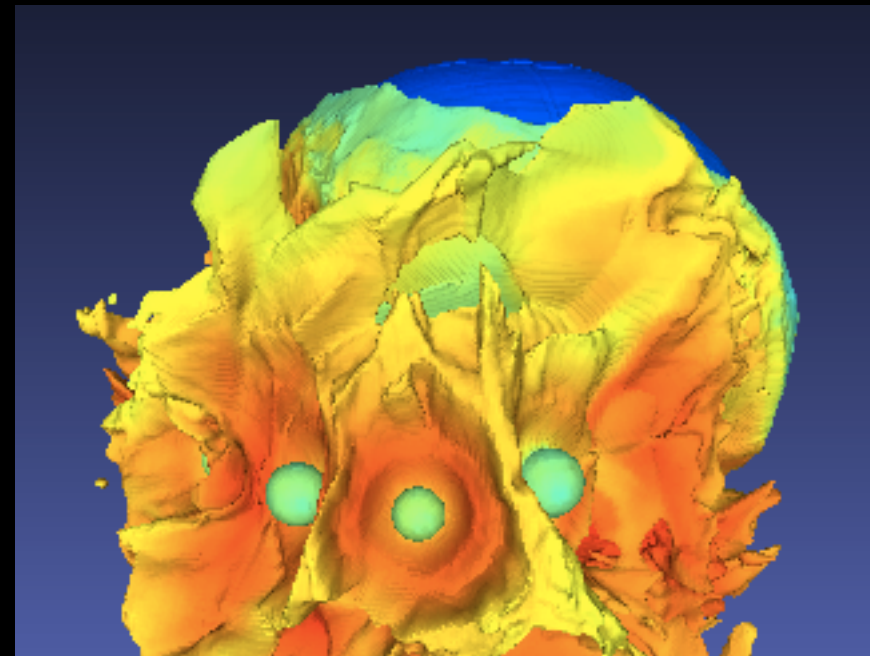
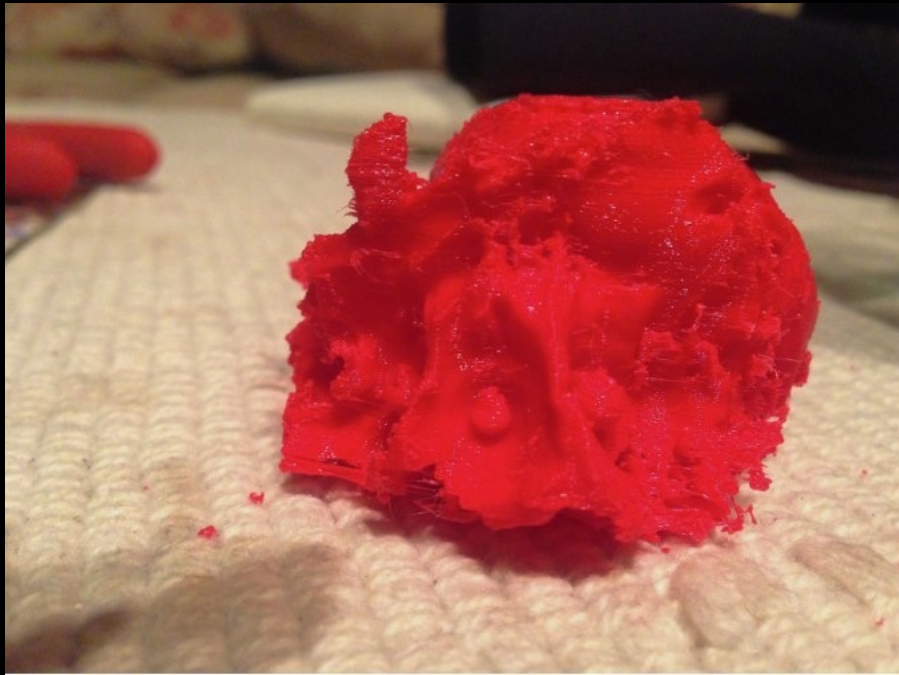
NeuroDome

yt users workshop: Oct 10-12 in IL, ask me about funding!



SubbaRao, SubbaRao & Fisher

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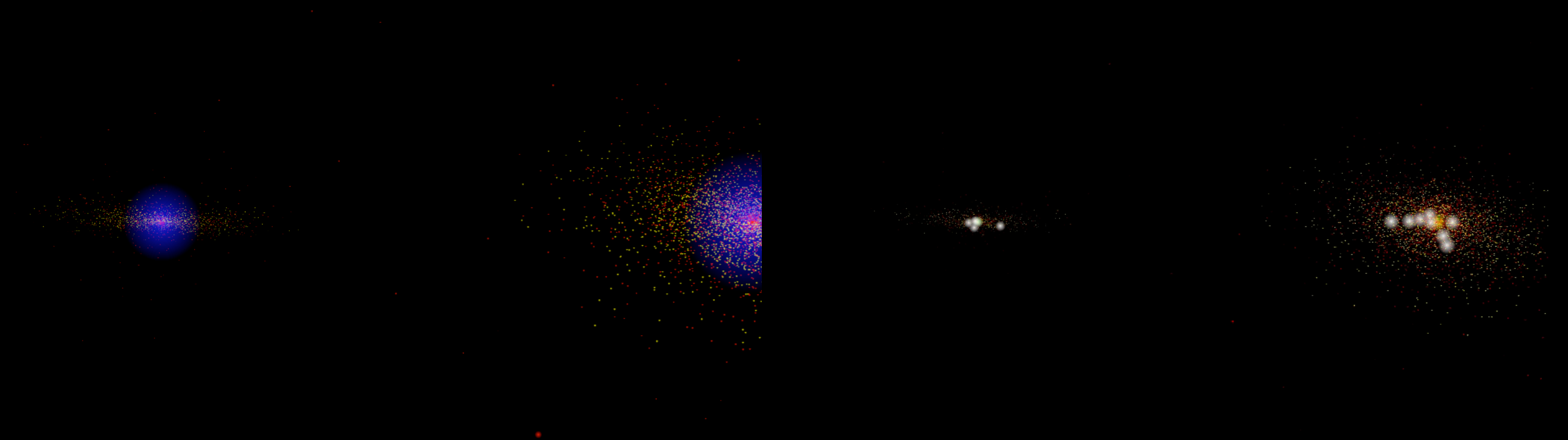


What is a visualization?

The background of the slide is a dark, deep-space visualization. It features several glowing, yellowish-white galaxies of various shapes and sizes, some appearing as bright, diffuse clouds and others as more distinct, elongated structures. The overall effect is a sense of vastness and cosmic scale.

Test Run of AstroBlend
3D Galaxy Model + FLASH Dwarf Galaxy Model
www.astroblend.com

What do scientists gain from visualization?



- ◆ Visualizations of galaxy mergers by transfer students during a python bootcamp
- ◆ Students had no (or minor) experience with programming and science

What do scientists gain from visualization?

Galaxy merger simulations; investigating new star formation

Sebastian Gomez ; Mark Johnson

Simulations:

- A simulation of two galaxies merging
- Increased the size of black holes for better visualization of black hole merger.
- Increased the size of new stars to visualize the stage of highest star formation.

Conclusion: The simulations showed that the two black holes merged while also depicting a significant increase in star formation.

Playing with Blender:

- | | |
|--------------------|---------------------|
| - object sizes | - Gas |
| - object colors | - Halo |
| - camera angles | - Old stars (disk) |
| - omitting objects | - Old stars (Bulge) |
| | - New stars |
| | - Black Holes |

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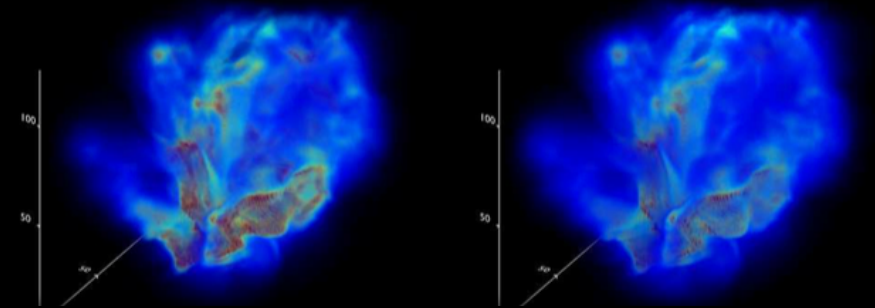
Many other astronomers working in Viz!

(Here are just a few)

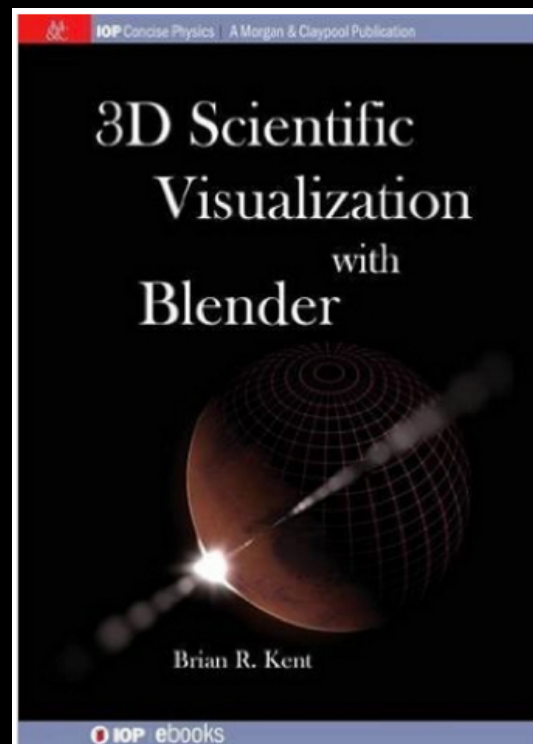
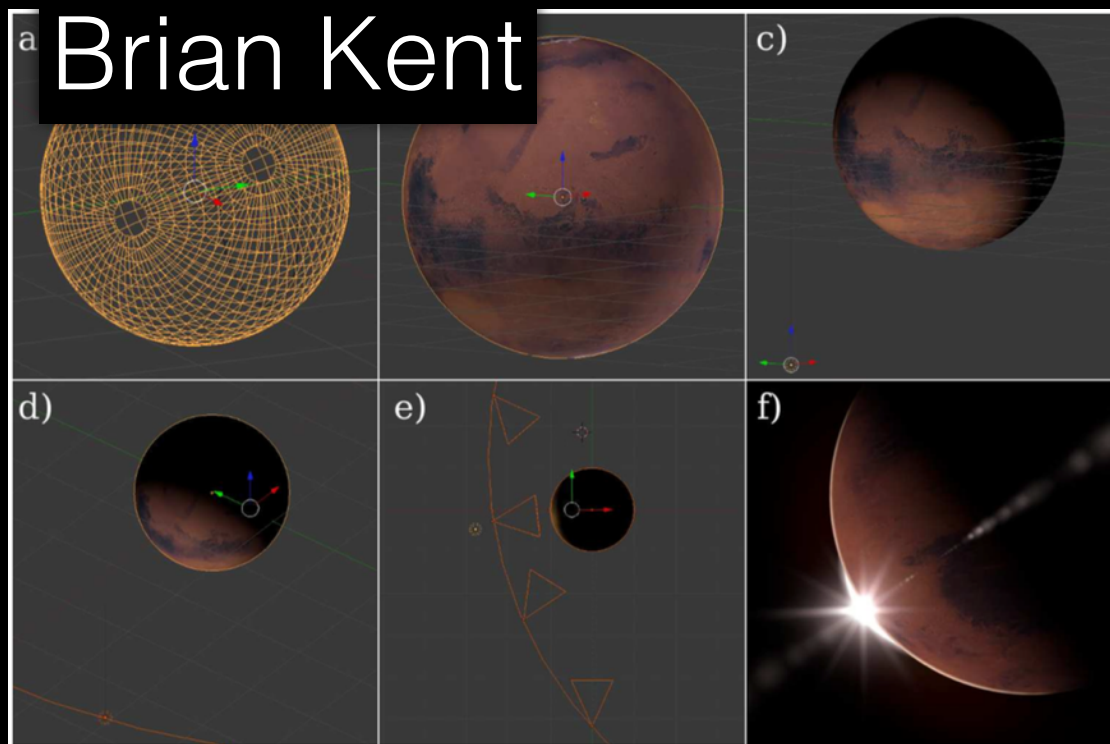


<http://skysrv.pha.jhu.edu/~miguel/visualization.html>

Rhysy Taylor



FRELLED - volume rendering
<http://www.rhysy.net/frelled.html>



<http://www.cv.nrao.edu/~bkent/blender/index.html>

Some links!

- ✦ www.astroblend.com
- ✦ <http://yt-project.org/>
- ✦ <http://www.cv.nrao.edu/~bkent/blender/>
- ✦ <http://www.nationaldataservice.org/>
- ✦ <http://www.ncsa.illinois.edu/>

Outline of Week

- ✦ Day 1: Movies!
- ✦ Day 2: 3D interactive movies/things
- ✦ Day 3: More 3D interactive movies/things, VR
- ✦ Day 4: Glue/Hololense Demo and Gallery Exhibition

Finally - Pictures?