

# How to grow a universe – just add a supercomputer

Scientists using Harvard's Odyssey high-performance supercomputer have created the most realistic simulation of cosmic evolution to date.

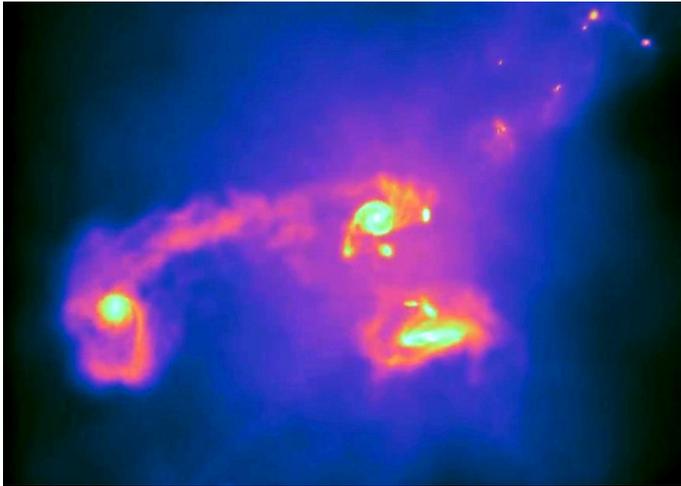


Image courtesy Harvard-Smithsonian Center for Astrophysics/UCSD/Heidelberg Institute for Theoretical Studies/M. Vogelsberger & V. Springel

Scientists using Harvard's [Odyssey high-performance supercomputer](#) have created the most realistic simulation of cosmic evolution to date. The researchers, from the [Harvard-Smithsonian Center for Astrophysics](#) and the [Heidelberg Institute for Theoretical Studies](#), have developed a new computational approach that can accurately model the birth and evolution of thousands of galaxies over billions of years. Produced using newly created software called Arepo, the simulation is significantly more detailed than previous attempts at modeling the evolution of our universe and could become a vital tool for cosmologists. In creating Arepo, the team basically took all the advantages of previous models and removed the disadvantages,

Posted on AUG 22  
2012 8:32AM



**Andrew Purcell**  
European editor

## Share this story



[↻ Republish](#)

## Tags

big bang

evolution

expansion

formation

galaxies

planets

stars

universe

explains [Volker Springel](#), one of the astrophysicists who worked on the simulation.

Using the observed afterglow of the big bang as input, Arepo is able to accurately simulate the evolution of portions of our universe to date.

"We've created the full variety of galaxies we see in the local universe," says [Mark Vogelsberger](#) another member of the team.

This level of detail and accuracy is achieved by using a model grid that flexes and moves in space to match the motions of gas, stars, dark matter, and dark energy. By contrast, previous models have generally divided space into cubes of fixed size and shape and, as such, these models have tended to produce blurred, blobby galaxies. Arepo, however, is able to use its 'moving-mesh' approach to produce galaxies which really look like galaxies in all their full-fledged glory - the Milky Way, for example, really does have the broad disc and outstretched arms of a spiral galaxy in the simulation.

## Arepo simulation of galaxy formation



Watch part of the simulation the researchers created using Arepo. Video courtesy Harvard-Smithsonian Center for Astrophysics/UCSD/Heidelberg Institute for Theoretical Studies/M. Vogelsberger & V. Springel

Of course, this fluid dynamic approach requires a huge amount of computing power. However, by running the simulation on Harvard's Odyssey high-performance supercomputer - using a total of 1024 processor cores - the researchers were able to compress 14 billion years of cosmic evolution into just a few months computing time.

Debora Sijacki, another astrophysicist who contributed to the research, sees the simulation's improvement on its predecessors as a giant leap

forward, as significant in its own way as the benefits that the completion of the Giant Magellan Telescope is likely to bring the astrophysics community at the end of the decade. The next step, according to her and the rest of the team, is to simulate much larger volumes of the universe at the high resolution the Arepo software allows.

The research is available on the arXiv [here](#).

## Join the conversation

Contribute



Do you have story ideas or something to contribute? **Let us know!**

### OUR UNDERWRITERS

---

Thank to you our underwriters, who have supported us since the transition from International Science Grid This Week (iSGTW)

### CATEGORIES

---

Advanced computing  
Research networks  
Big data

### CONTACT

---

Science Node  
Email: [editors@sciencenode.org](mailto:editors@sciencenode.org)  
Website: [sciencenode.org](http://sciencenode.org)

into Science Node in 2015. We are incredibly grateful.

Tech trends

Community building



[View all underwriters](#)

Copyright © 2022 Science Node™ | [Privacy Notice](#) | [Sitemap](#)

Disclaimer: While Science Node™ does its best to provide complete and up-to-date information, it does not warrant that the information is error-free and disclaims all liability with respect to results from the use of the information.