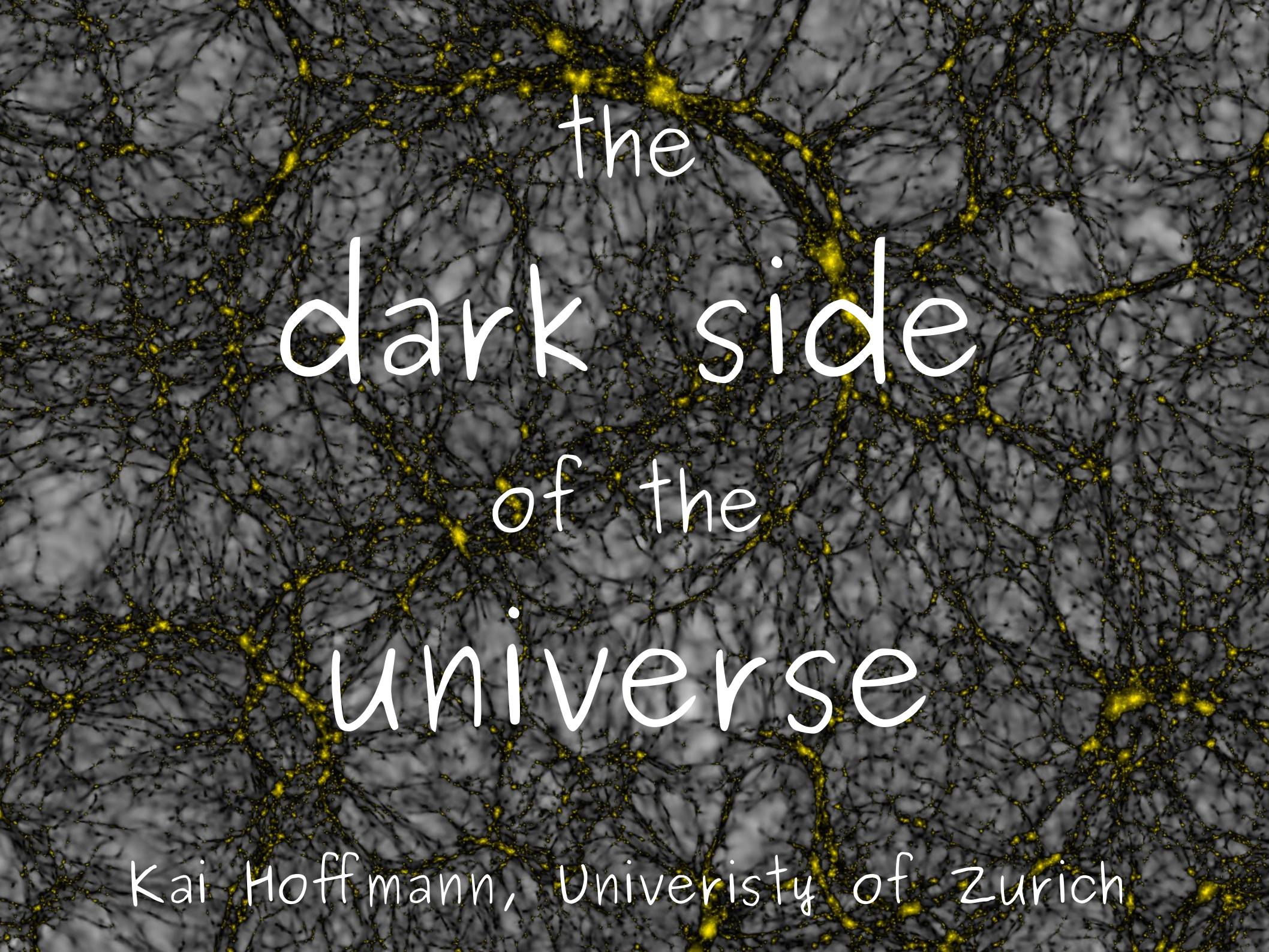
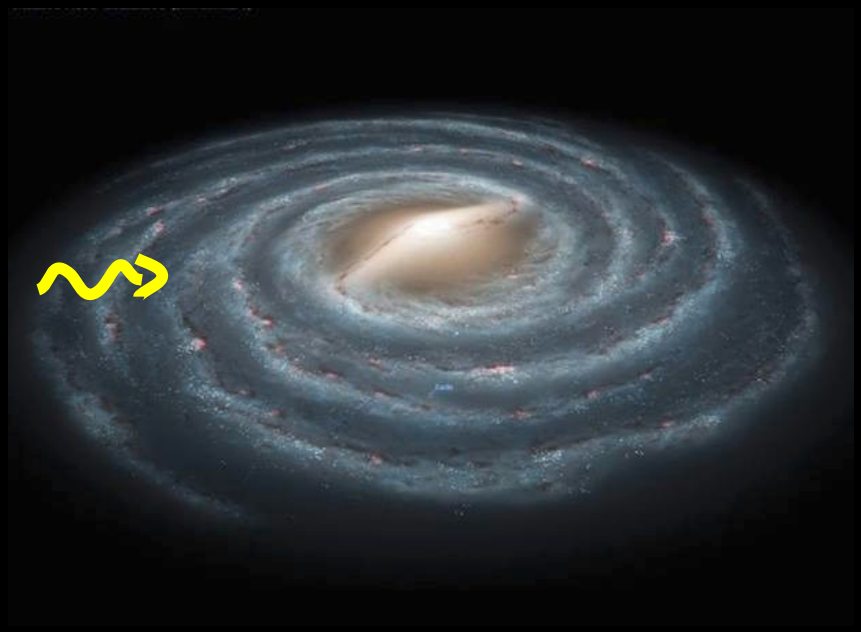


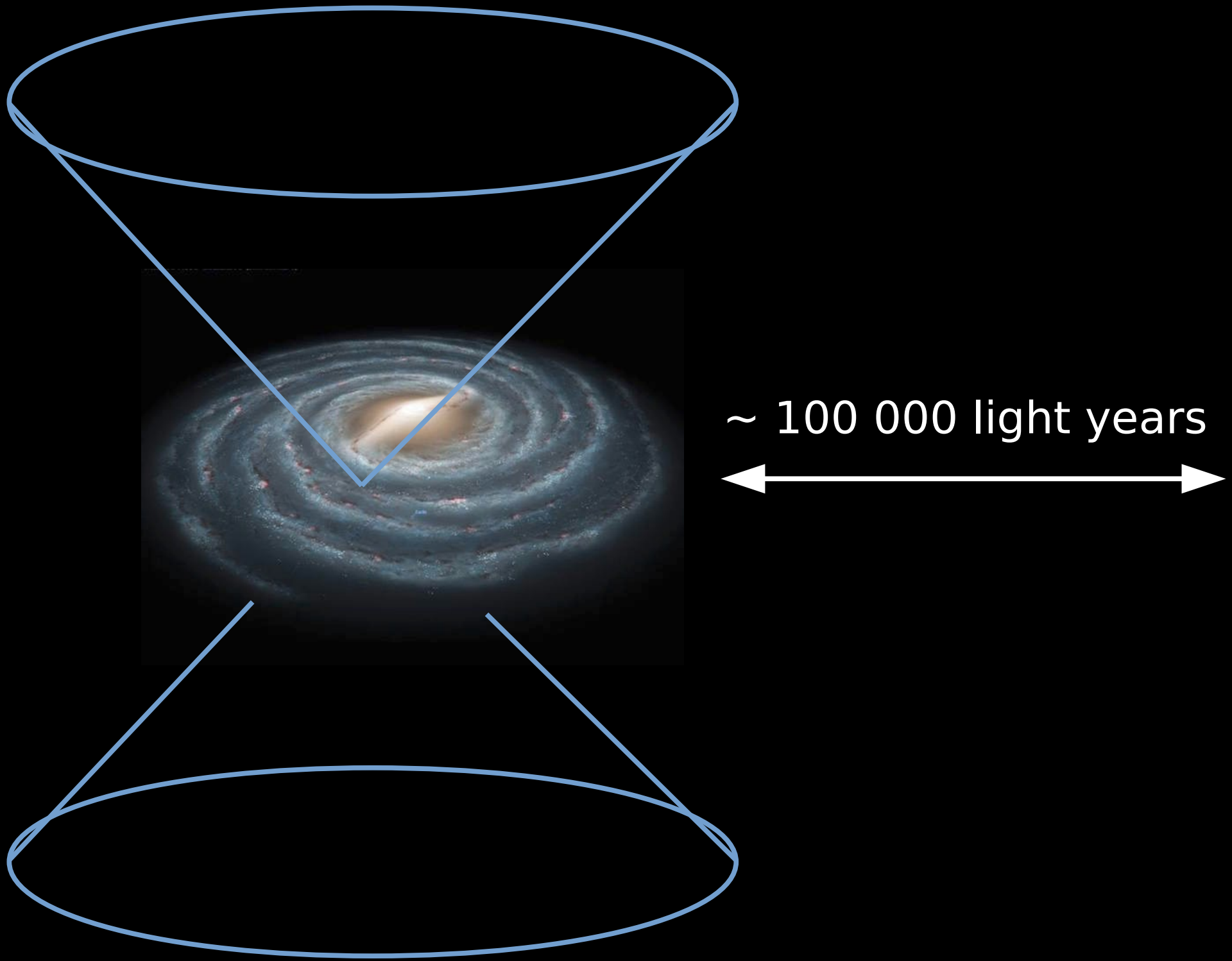
Kai Hoffmann, Univeristy of Zurich

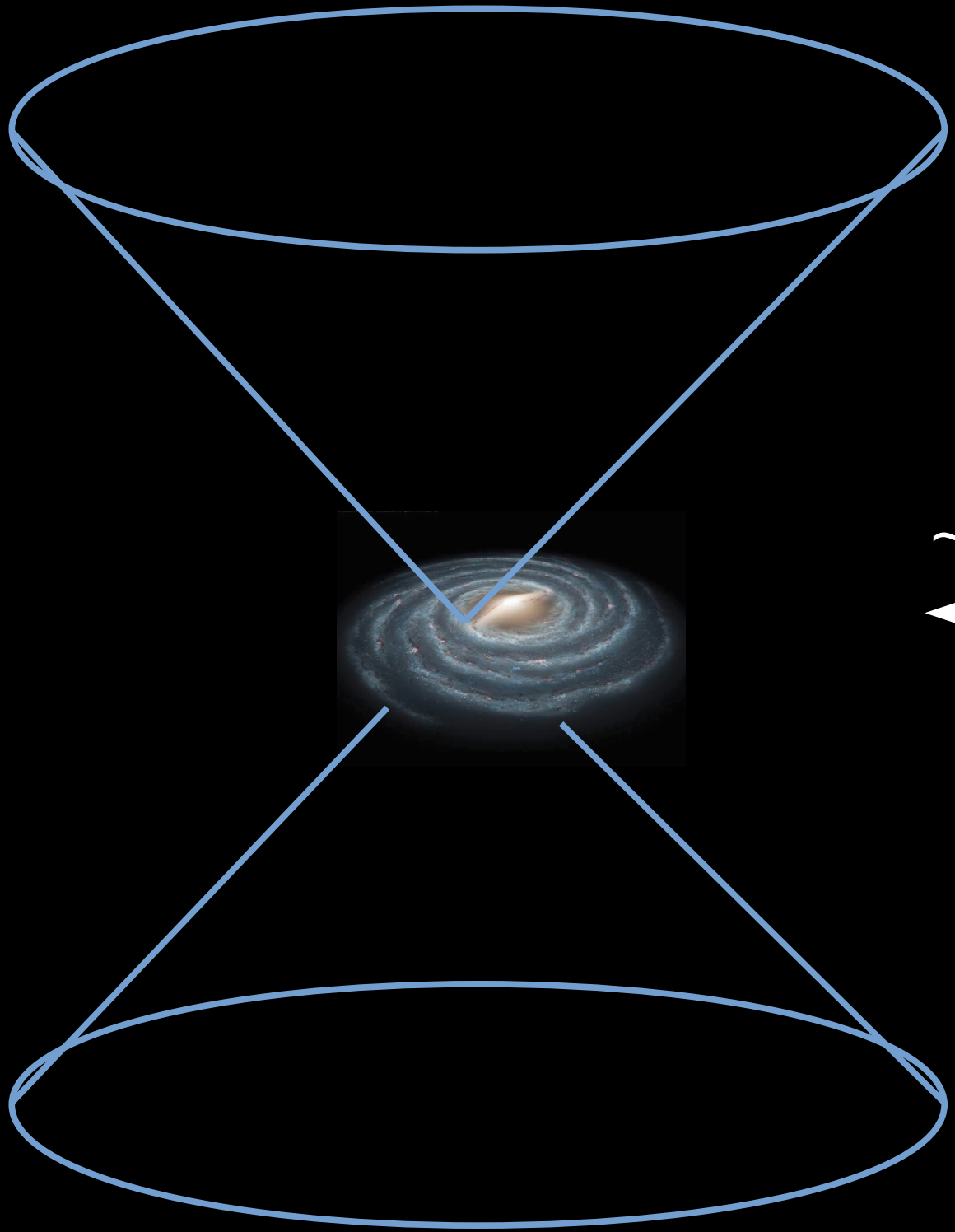
the Milky Way

Milky Way over the Himalayan peak Ama Dablam in Nepal (© Weerakarn Satitniramai/Getty Images)

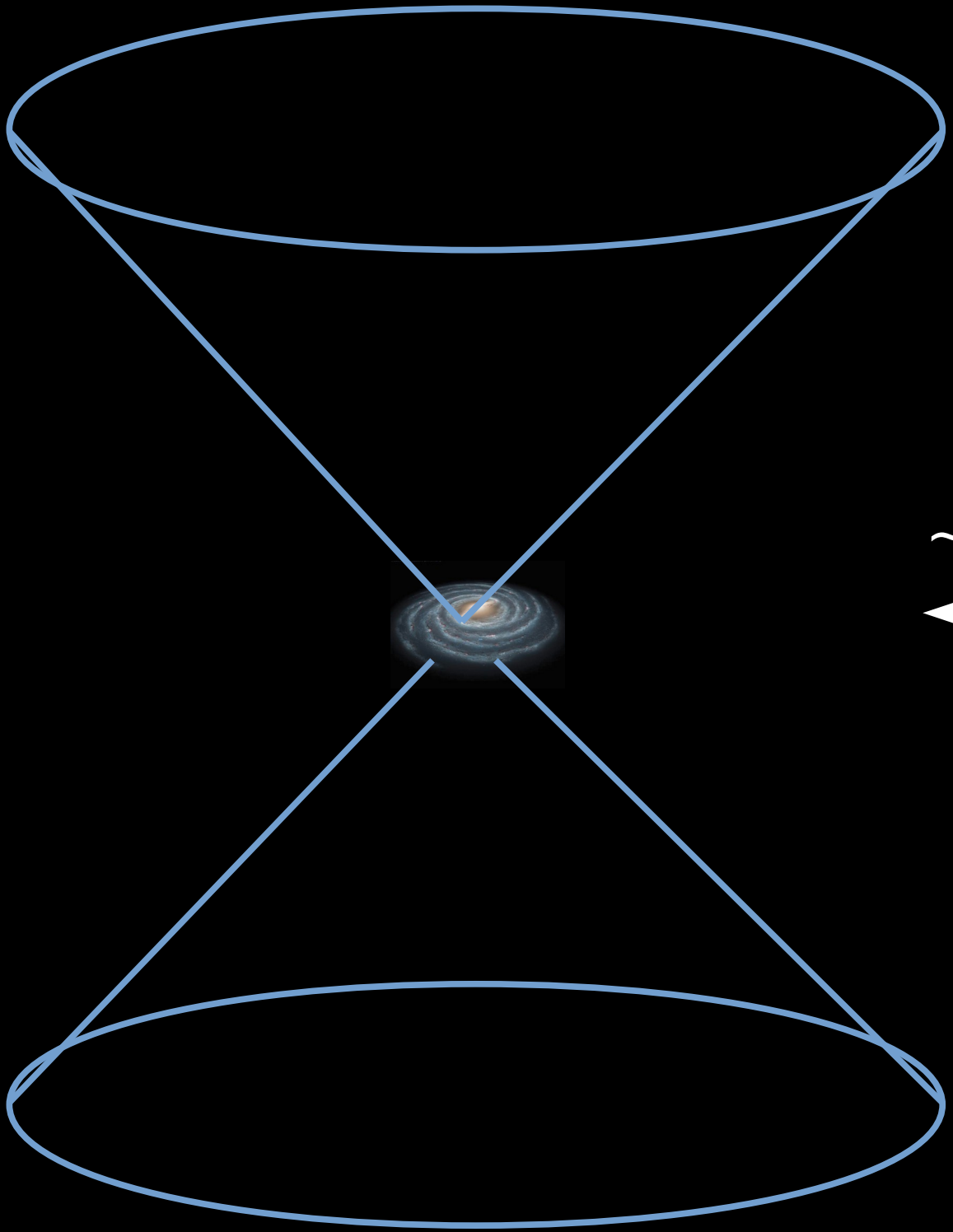


~ 100 000 light years

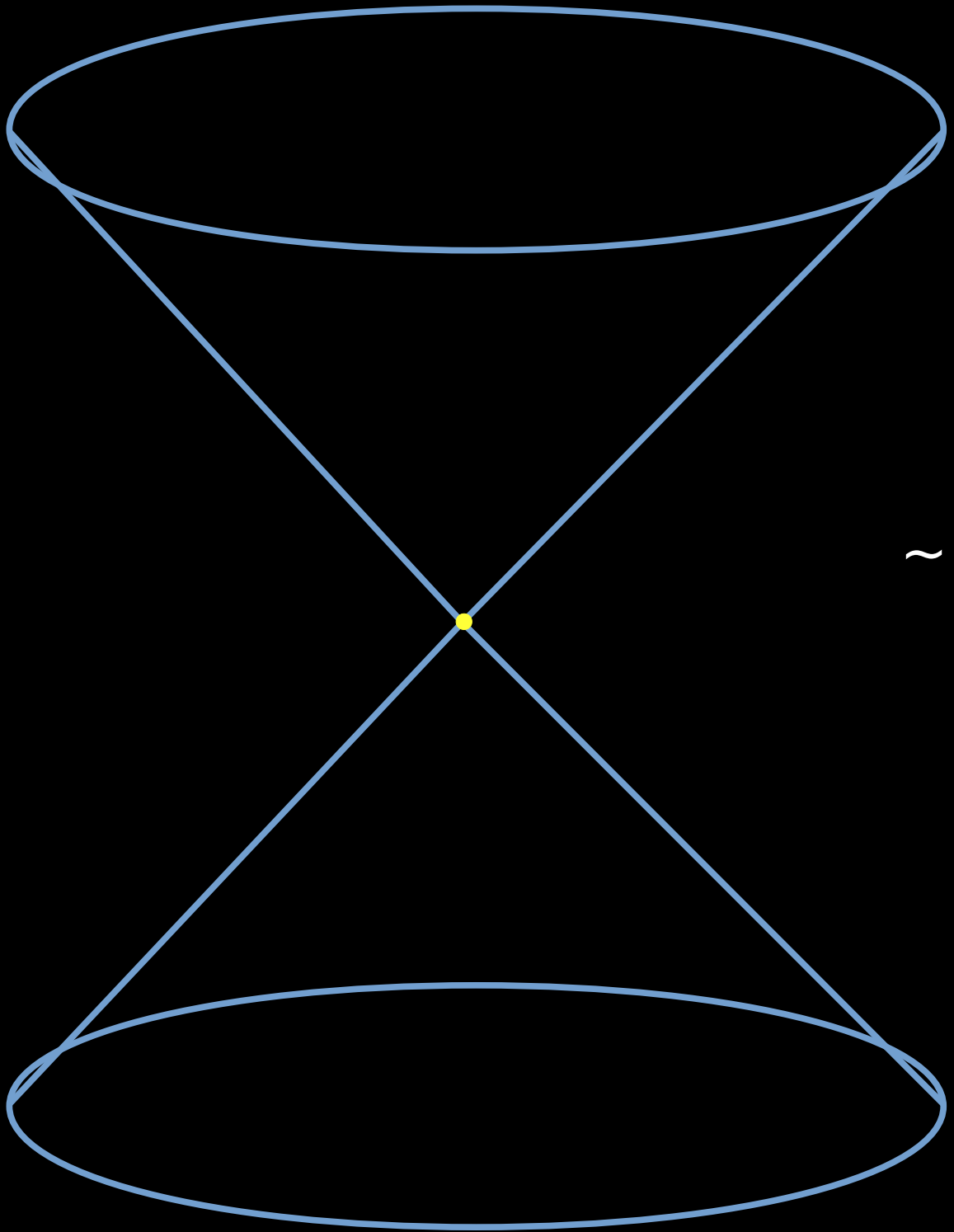

~ 100 000 light years



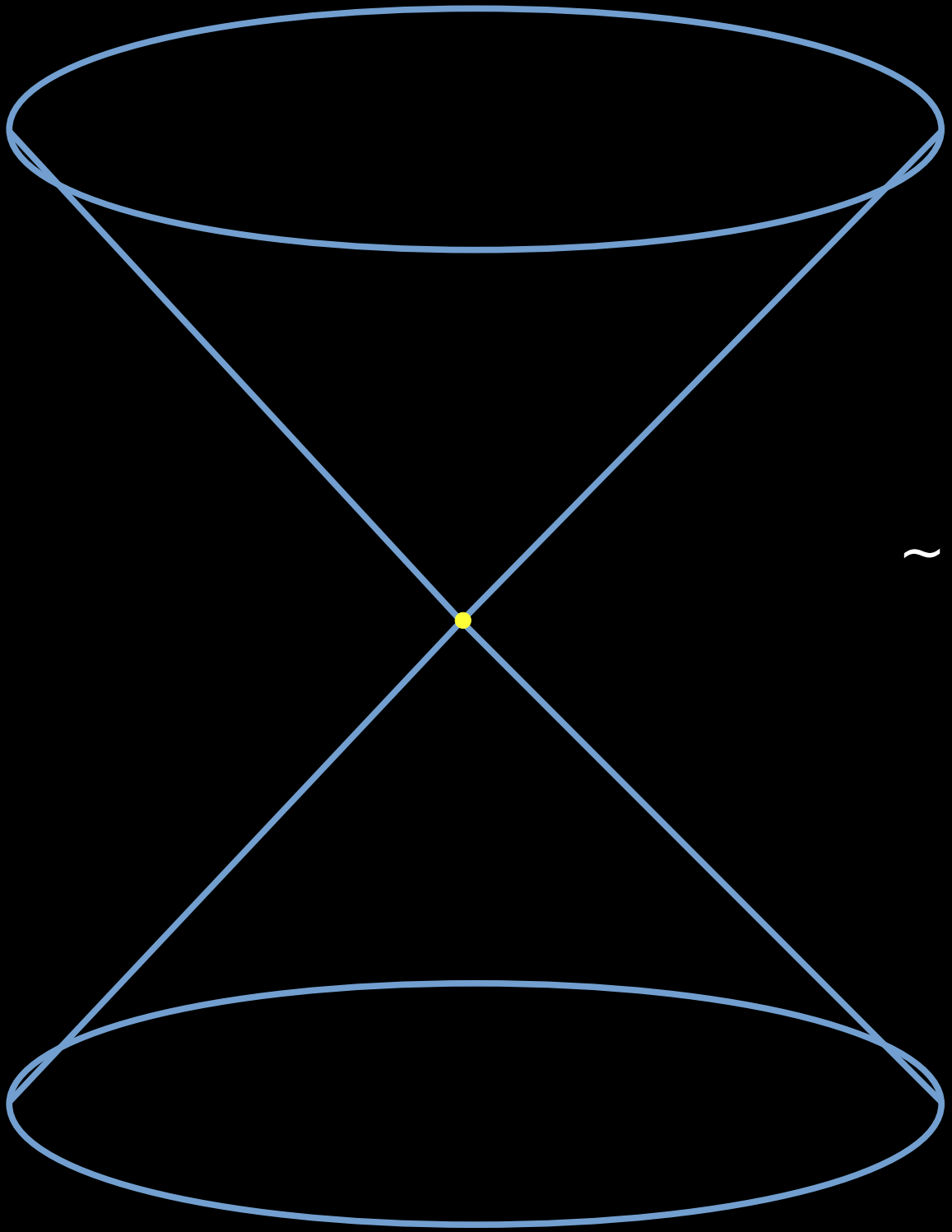
~ 100 000 light years



~ 100 000 light years



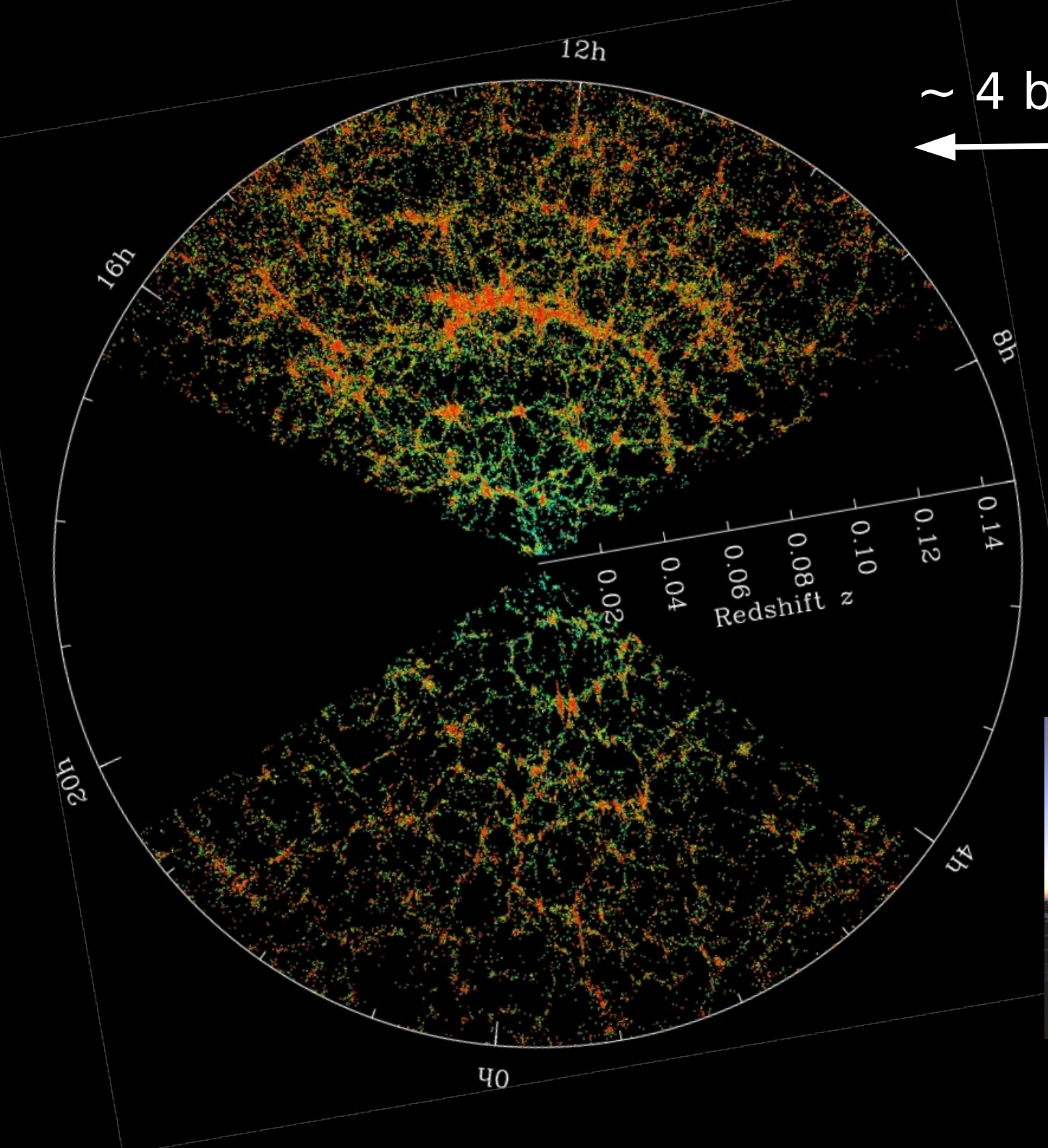
~ 1 billion light years



~ 1 billion light years

SDSS telescope

Photo by Reidar Hahn, Fermilab

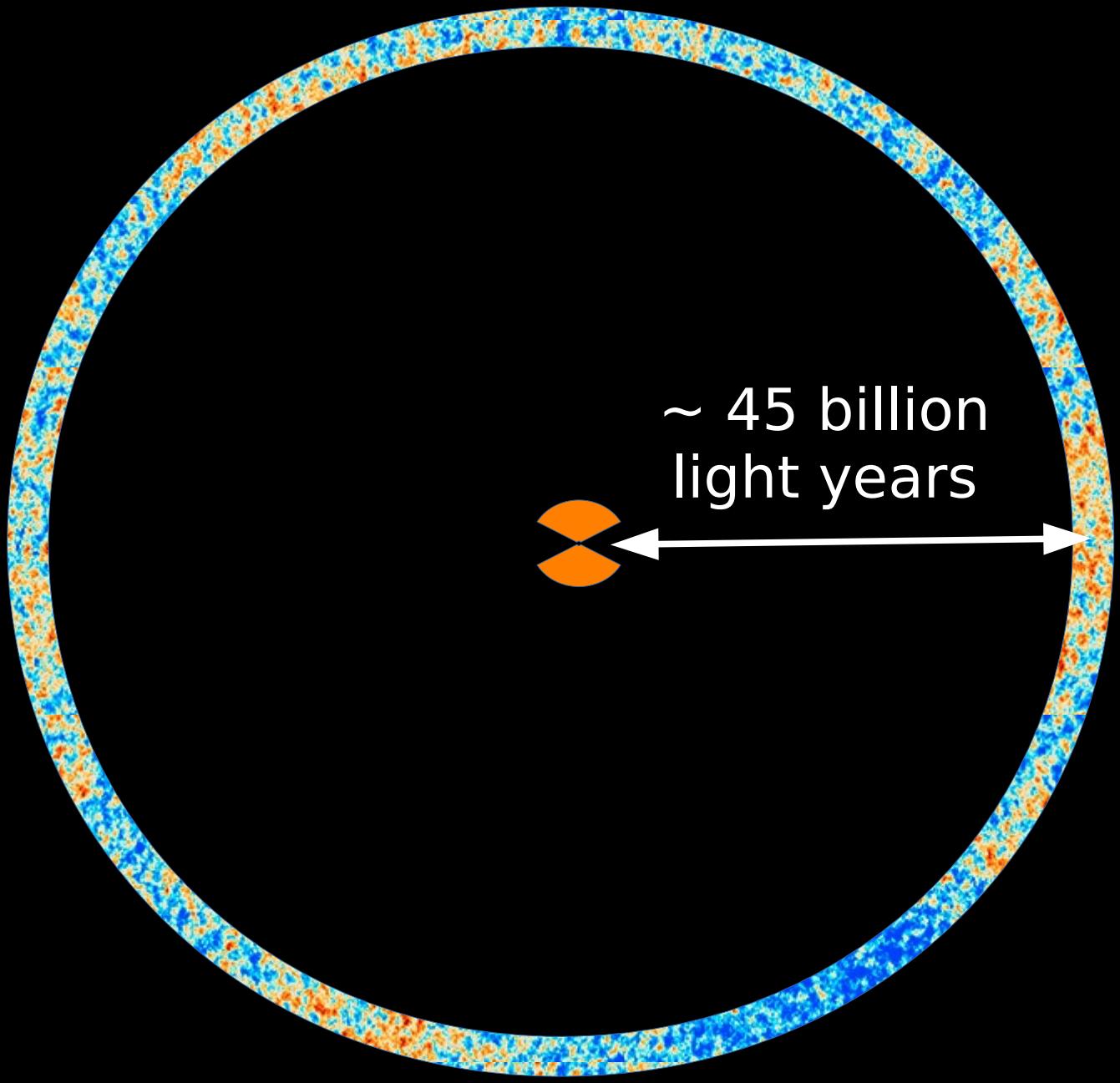


~ 4 billion light years

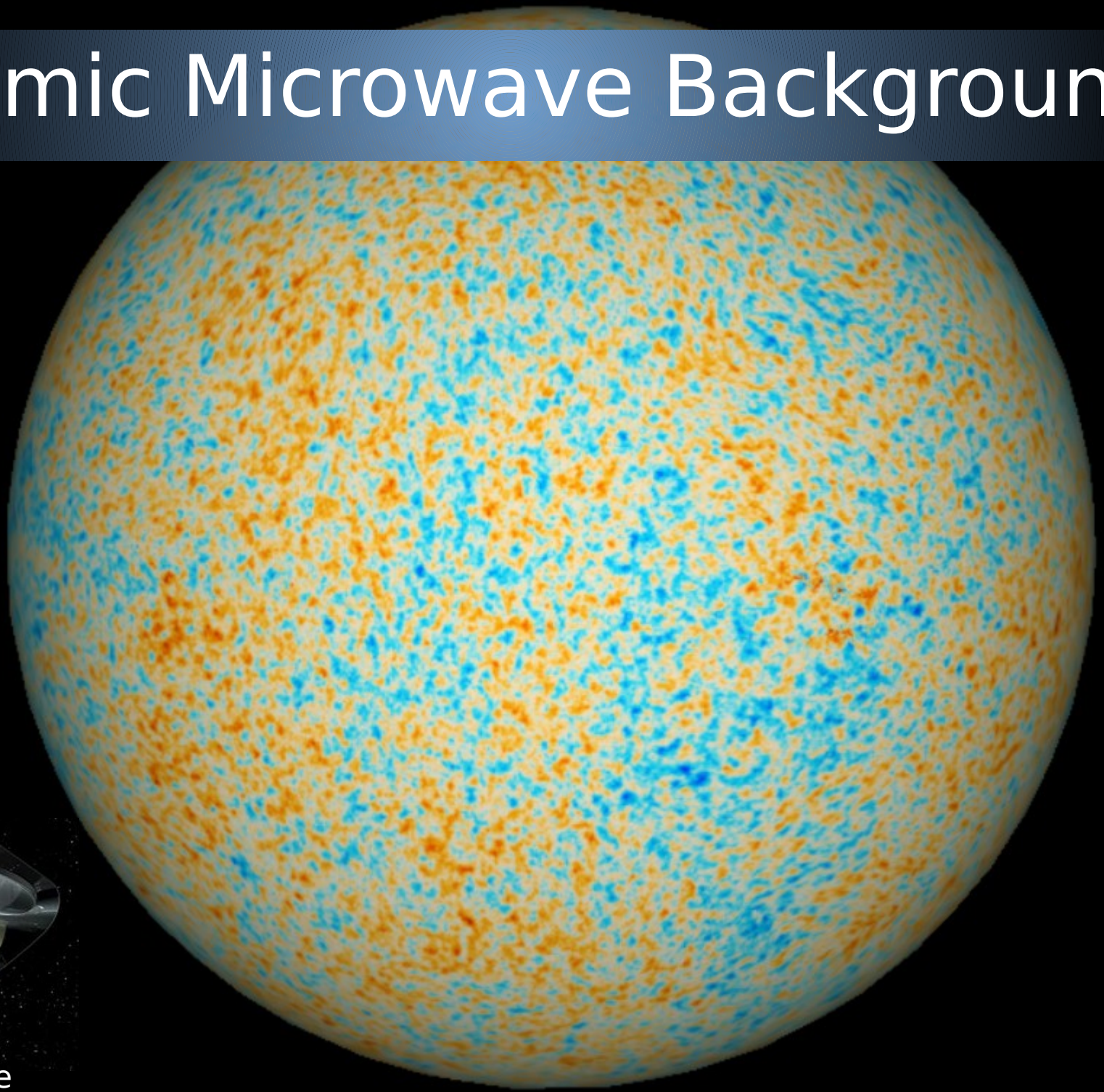
SDSS telescope

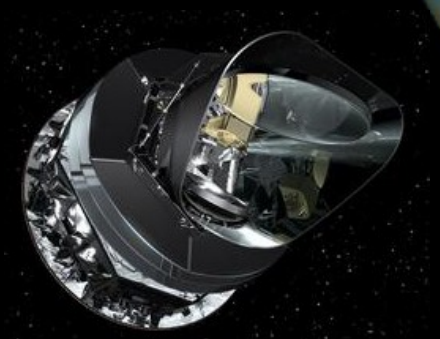
Photo by Reidar Hahn, Fermilab

Cosmic Microwave Background



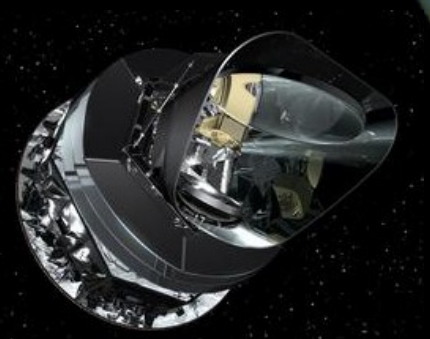
Cosmic Microwave Background



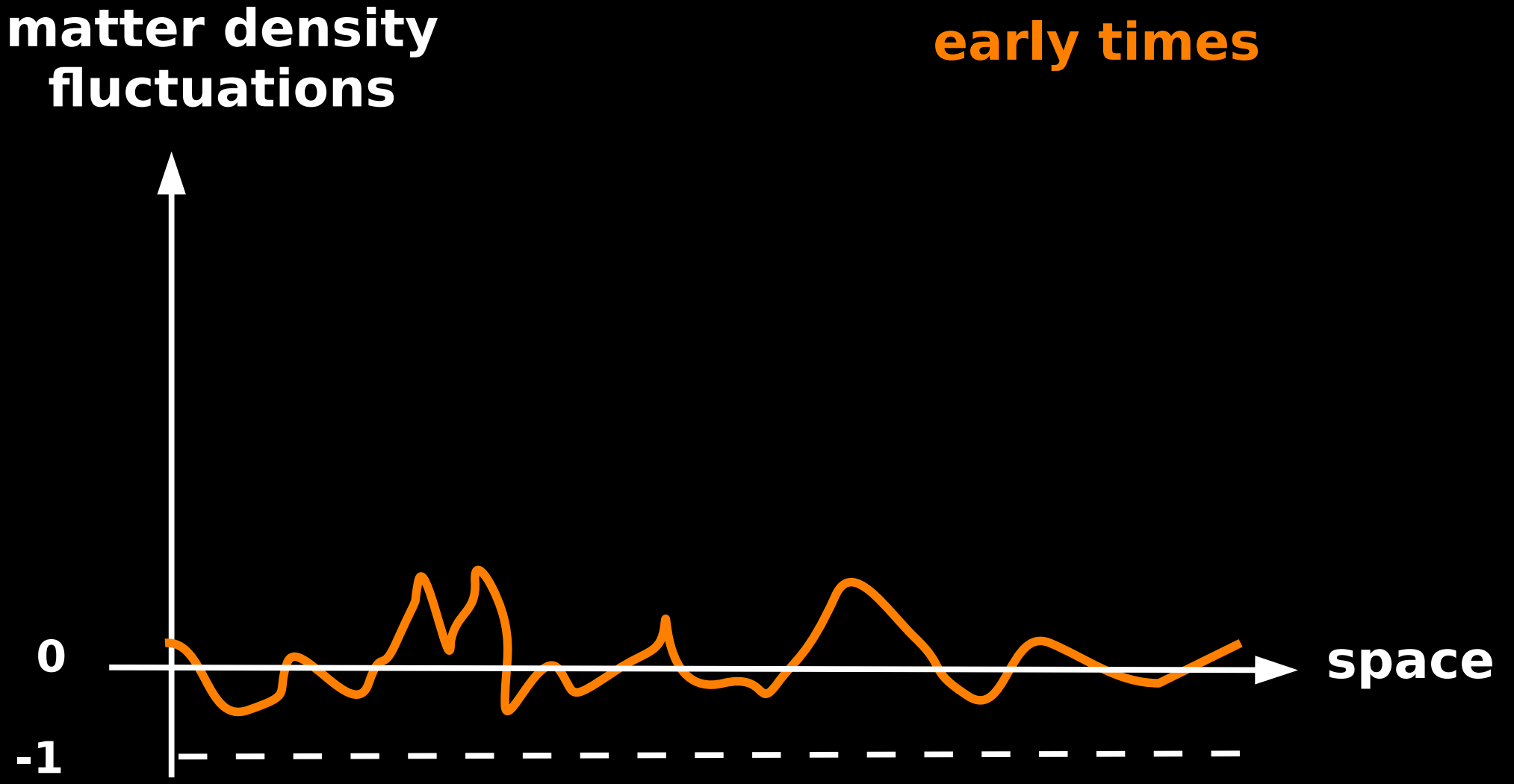


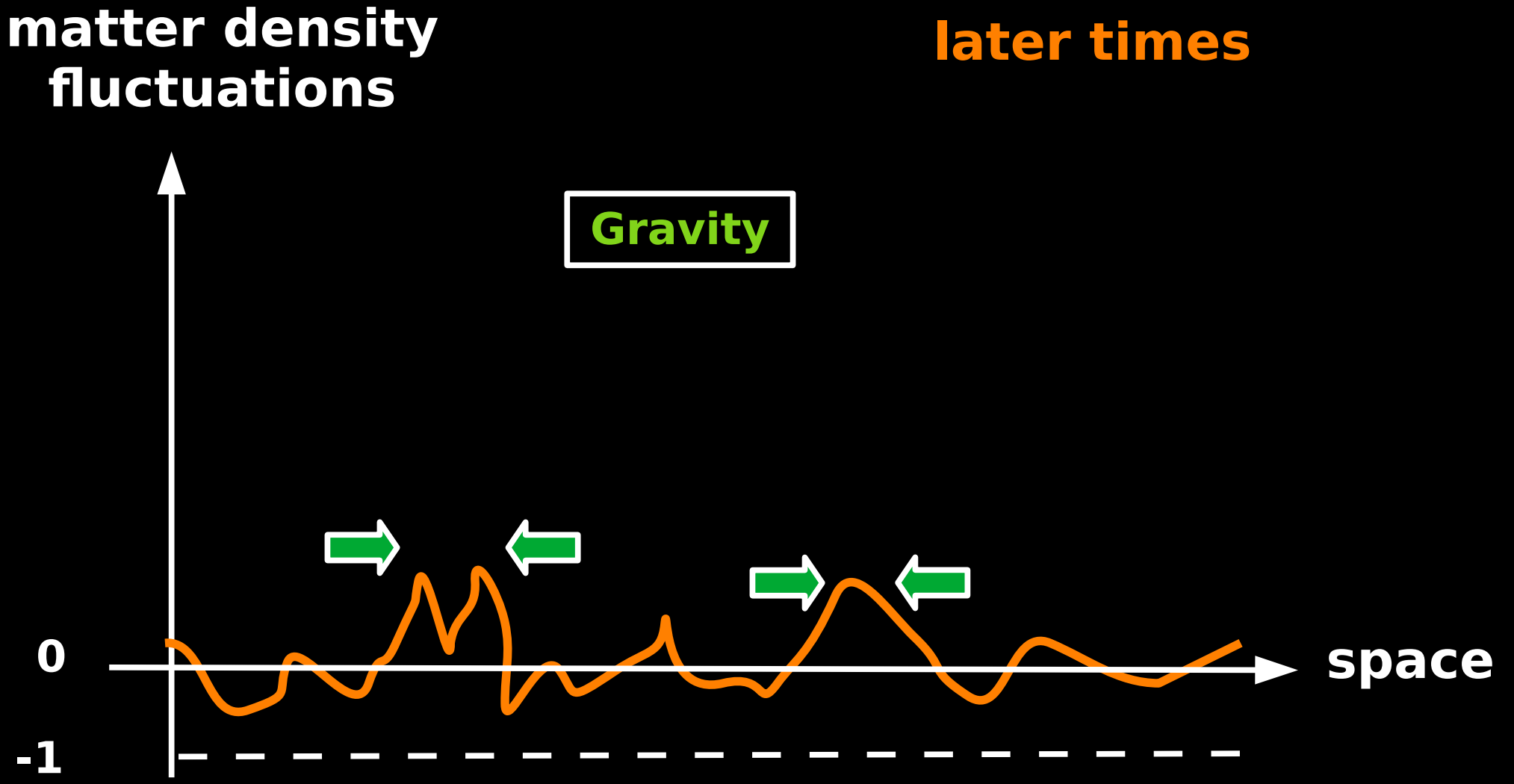
Planck satellite

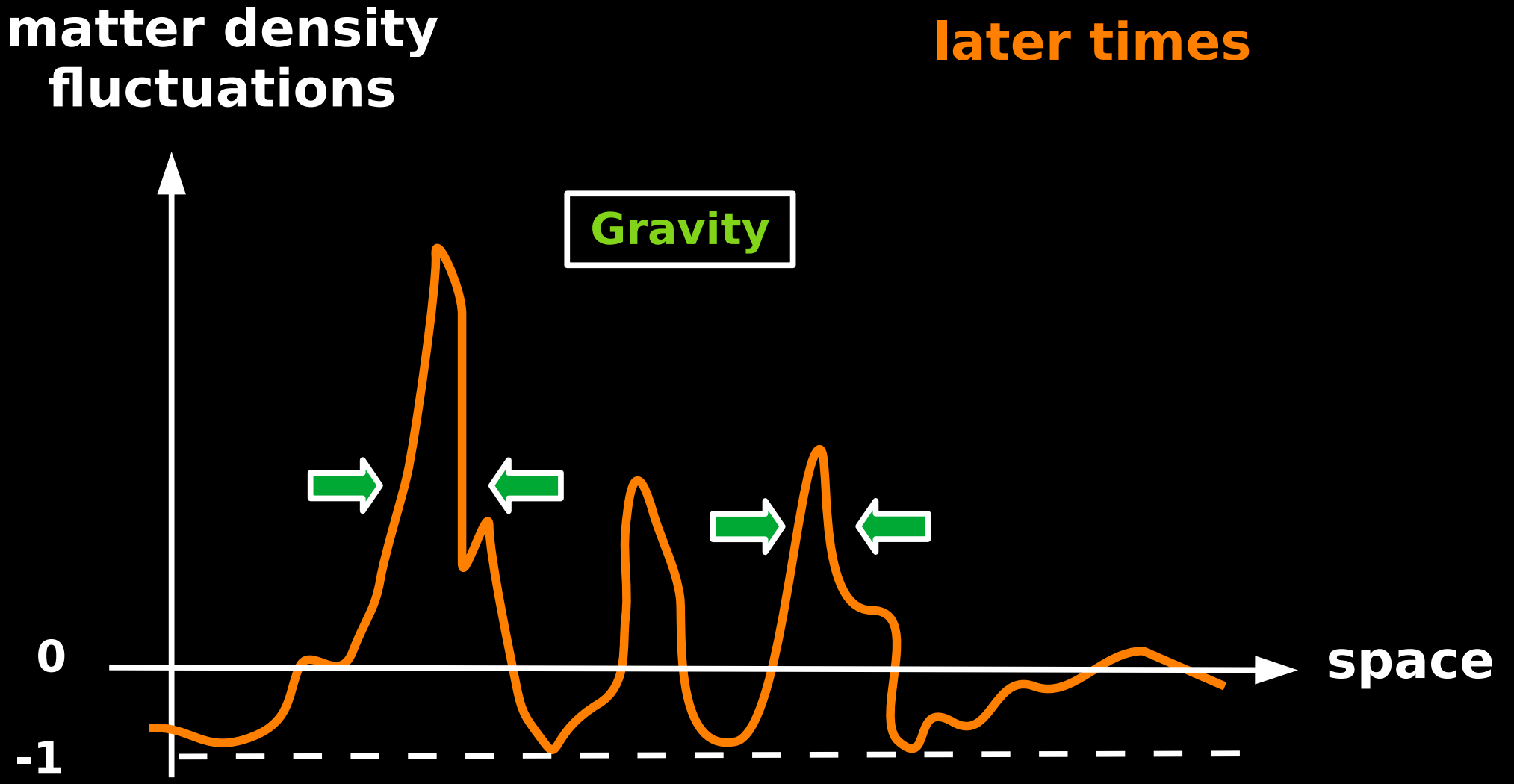
Cosmic Microwave Background

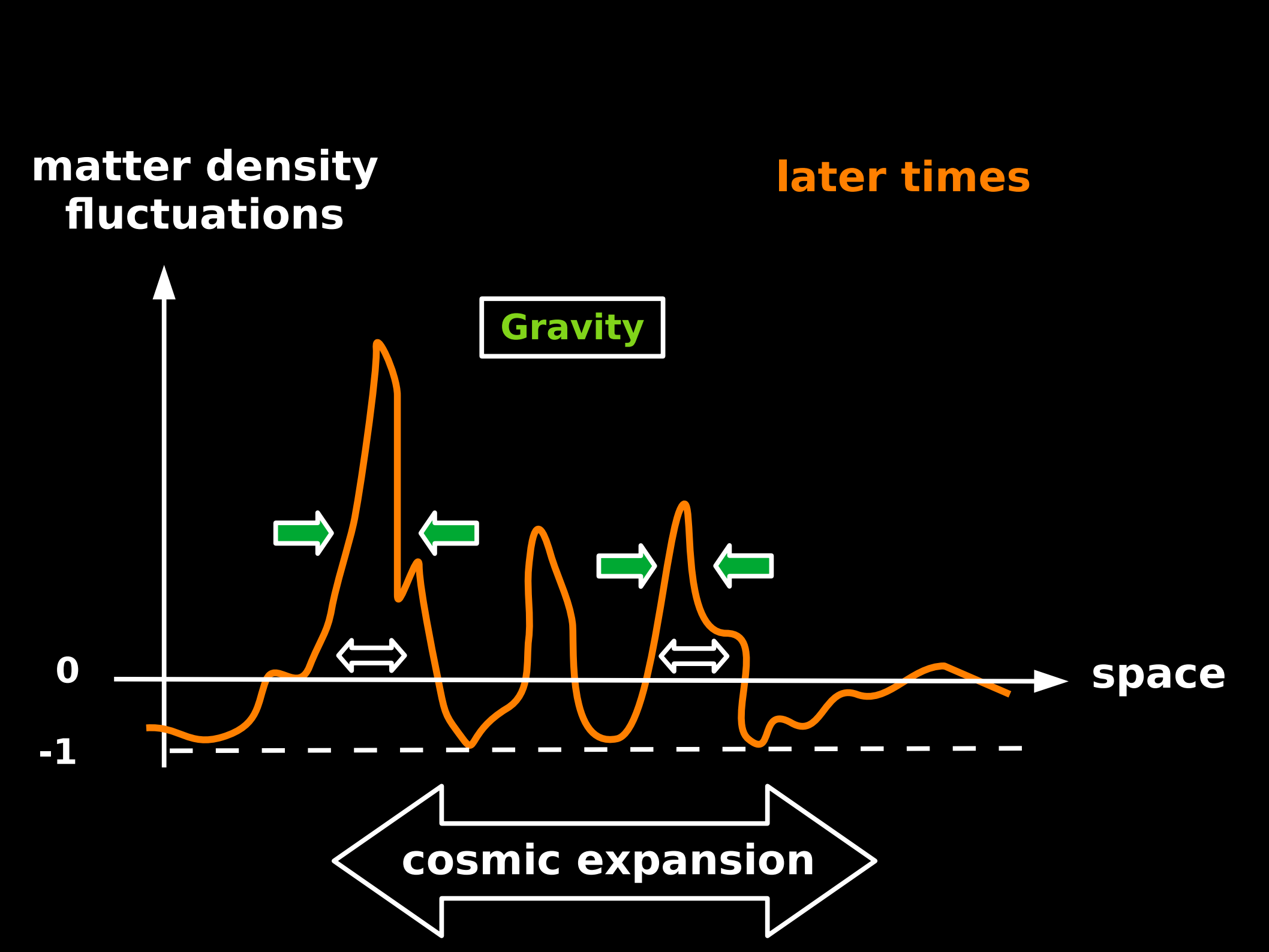


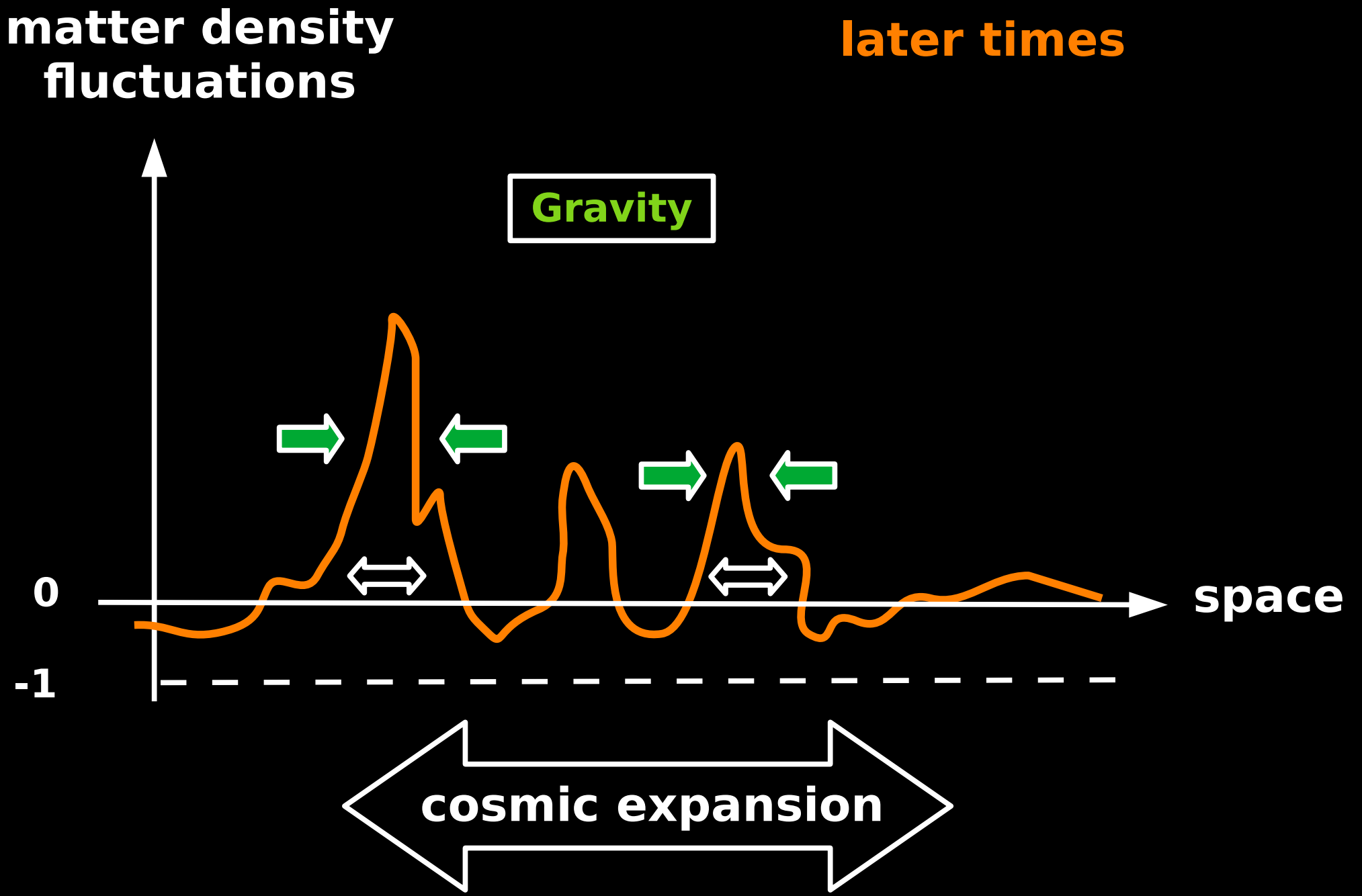
Planck satellite

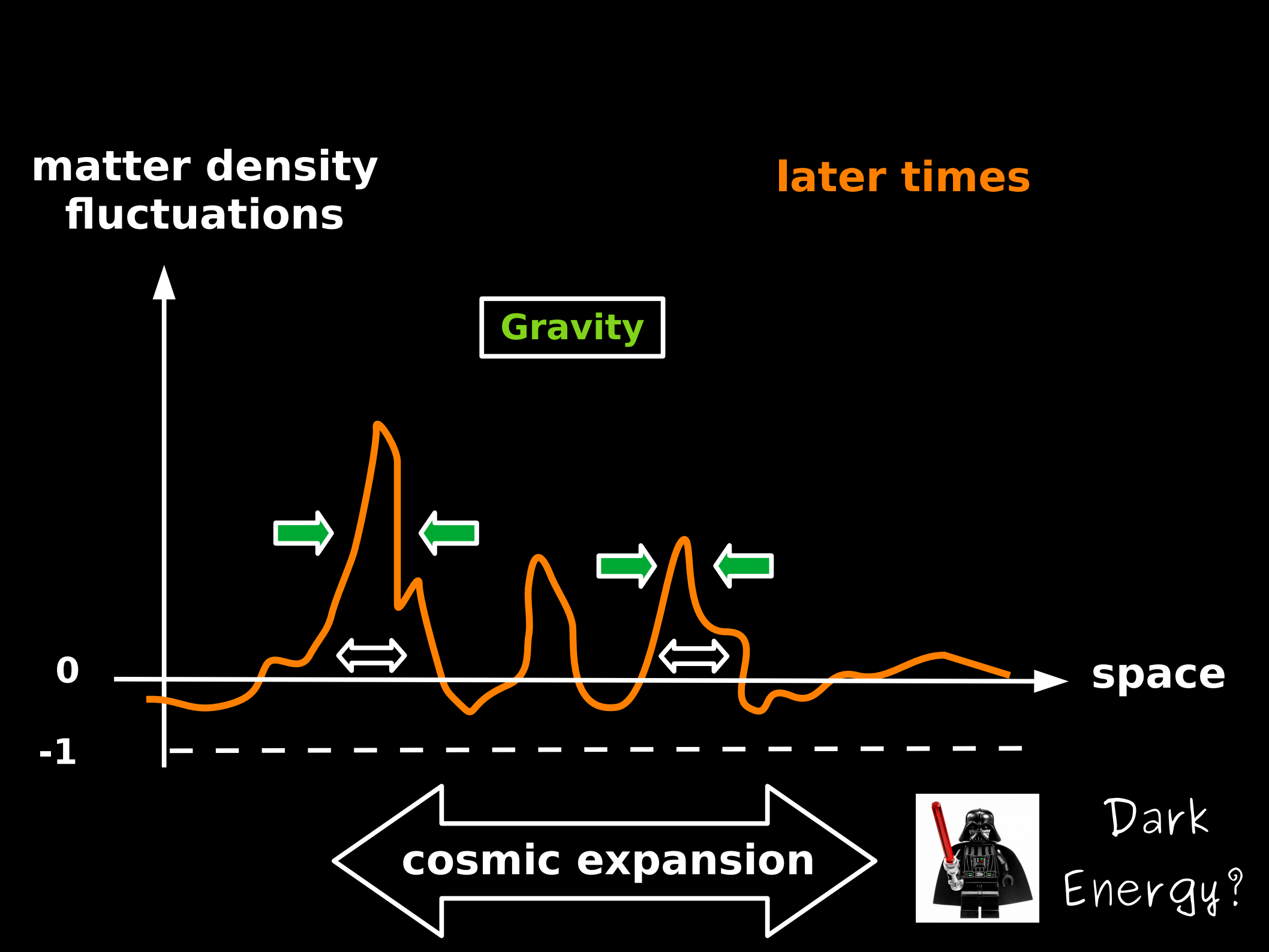

matter density
fluctuations
early times
0
-1
space


matter density fluctuations
later times
Gravity
0
-1
space

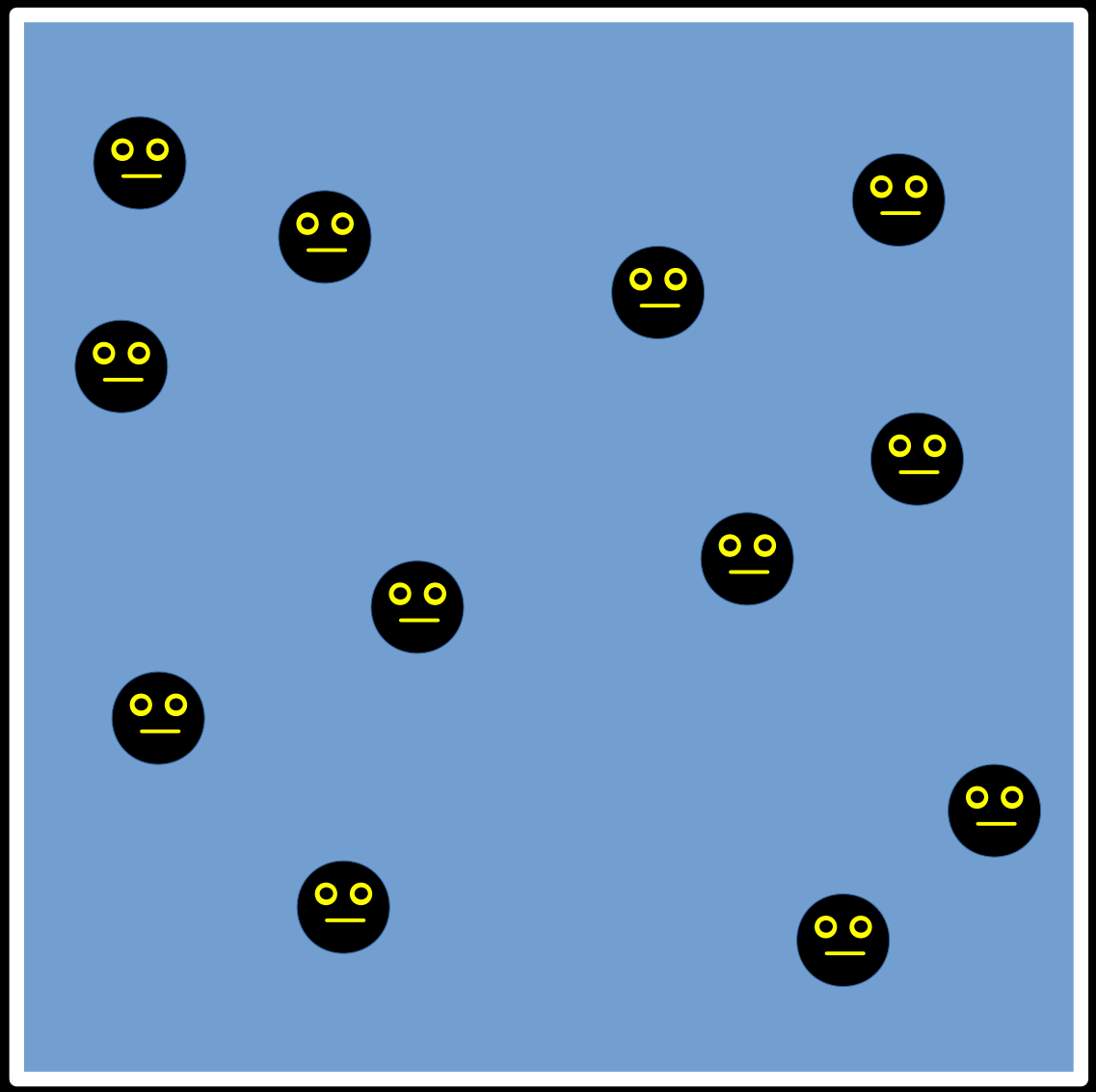

matter density
fluctuations
later times
Gravity
0
-1
space


matter density fluctuations
later times
Gravity
0
-1
space
cosmic expansion

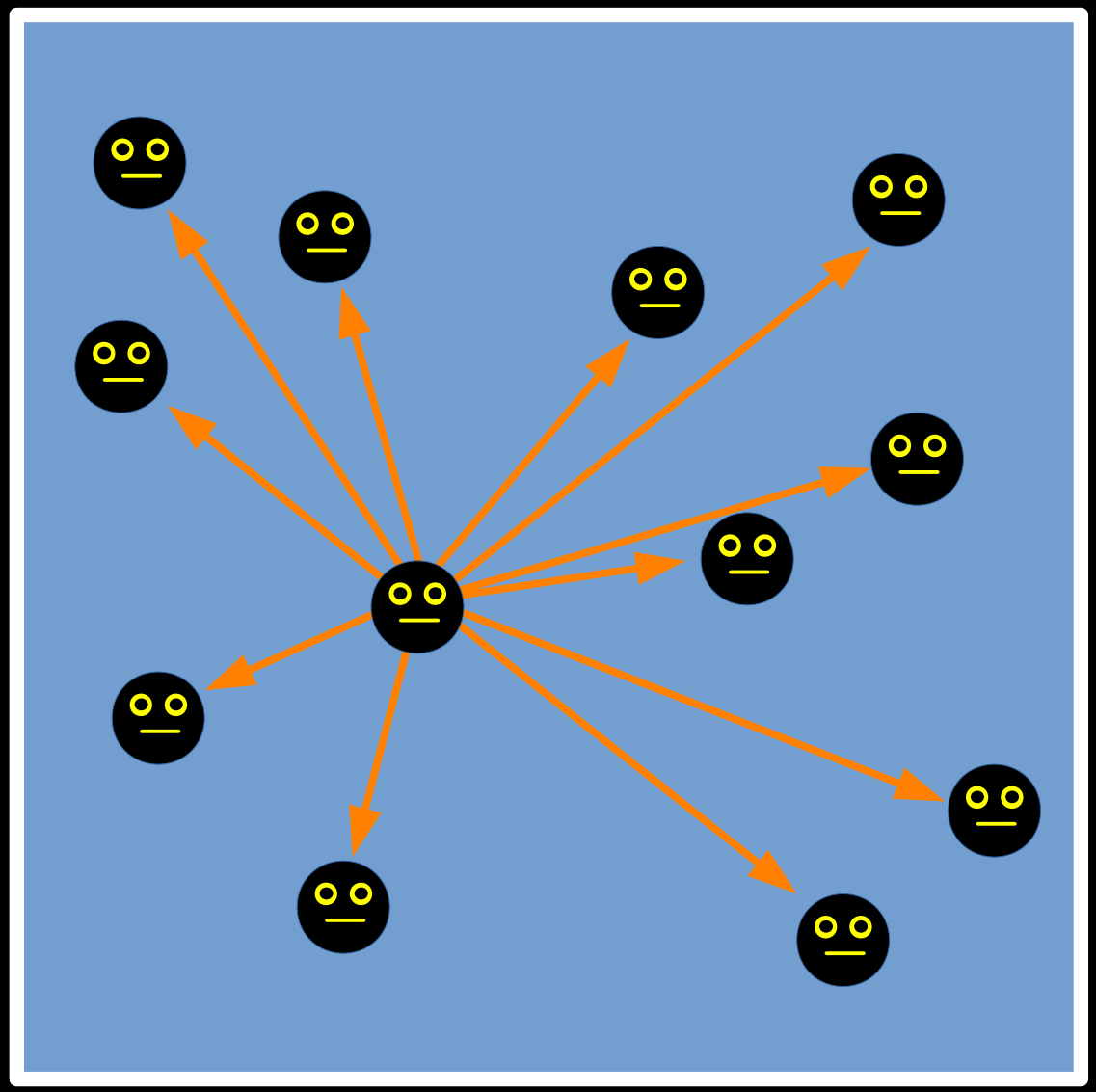

matter density fluctuations
later times
Gravity
0
-1
space
cosmic expansion


matter density fluctuations
later times
Gravity
0
-1
space
cosmic expansion
Dark Energy?

N-body simulation

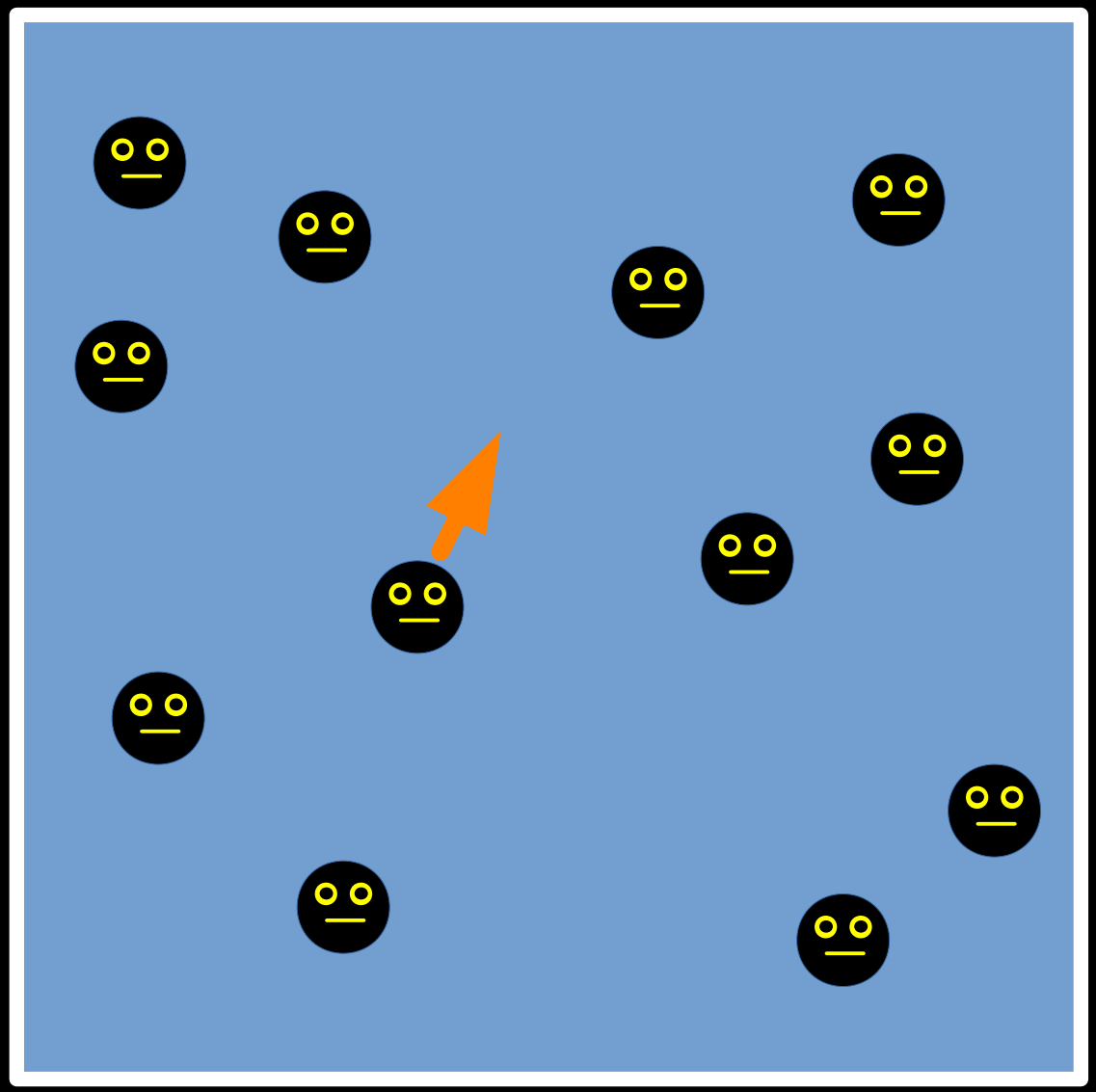


N-body simulation



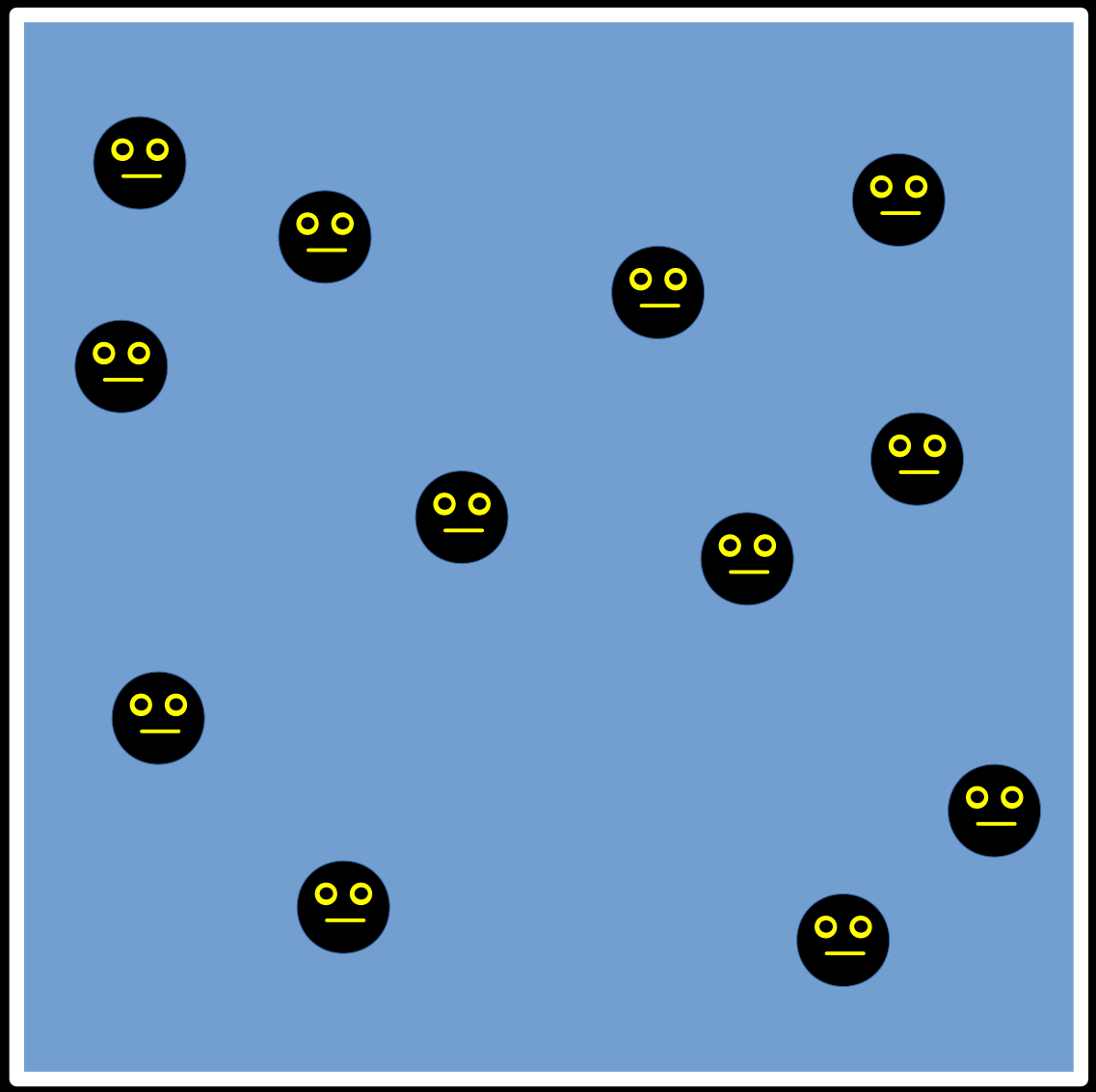
gravitational force

N-body simulation

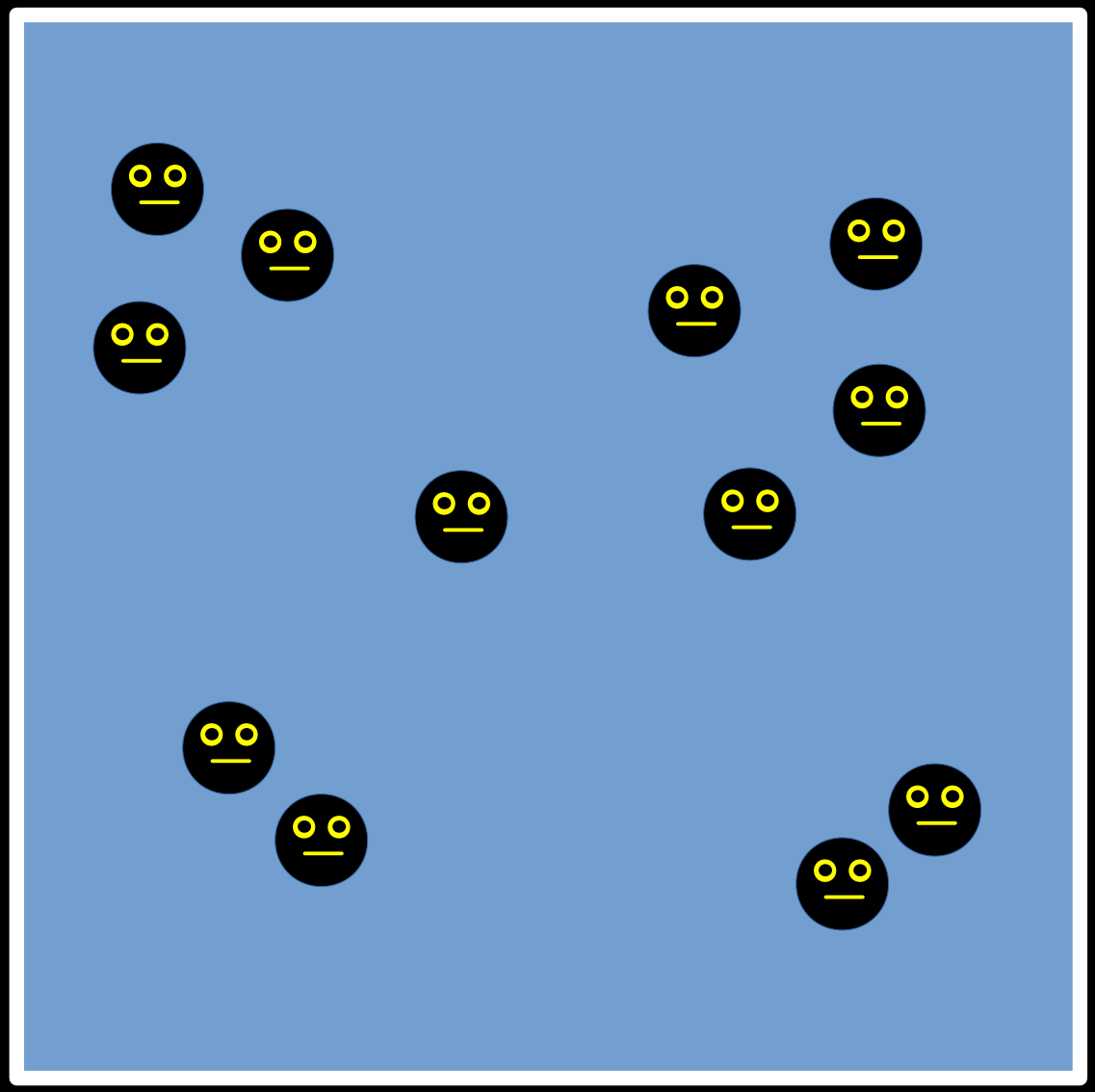


gravitational force

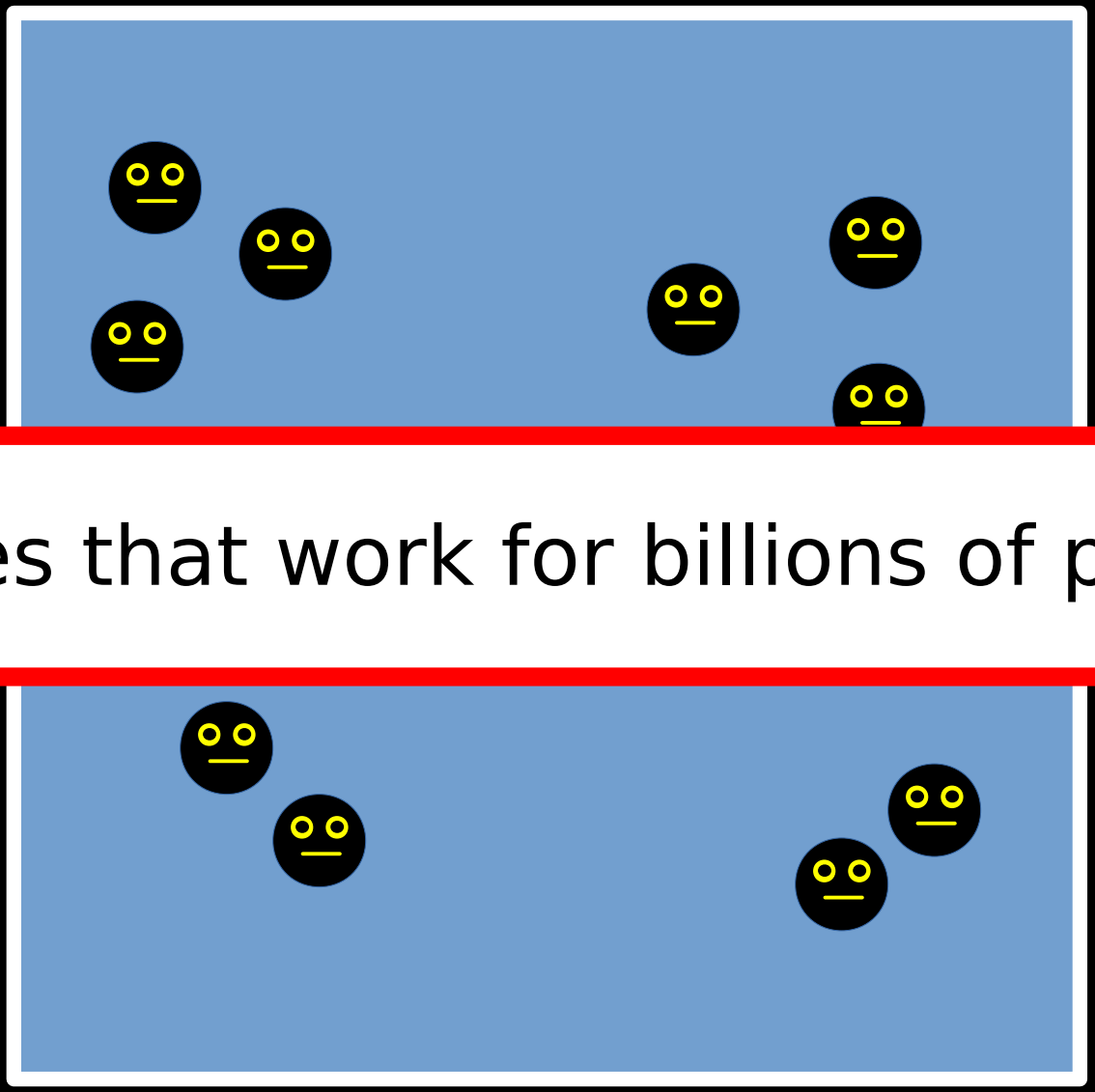
N-body simulation



N-body simulation



N-body simulation



How does that work for billions of particles?

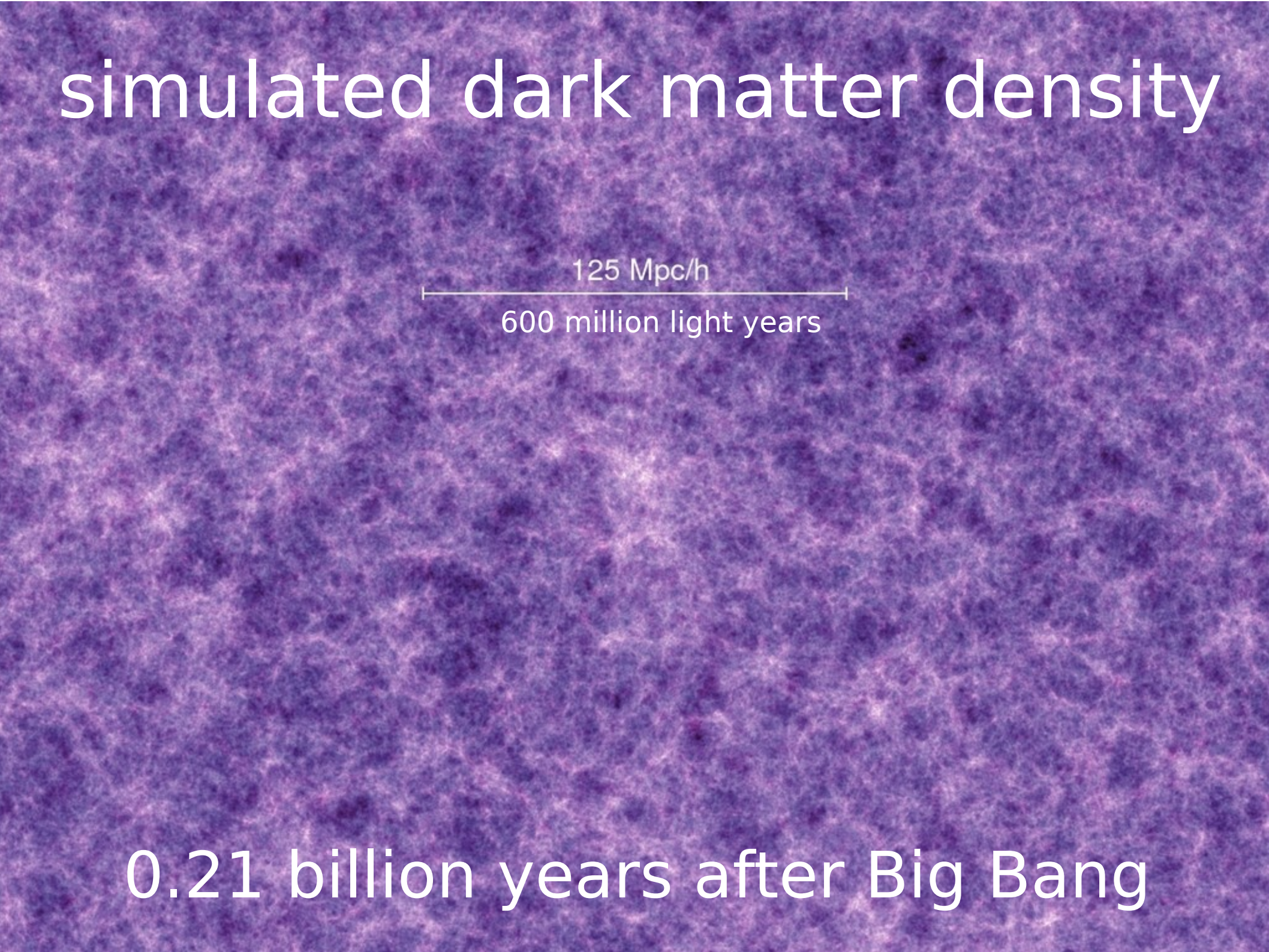
Supercomputers

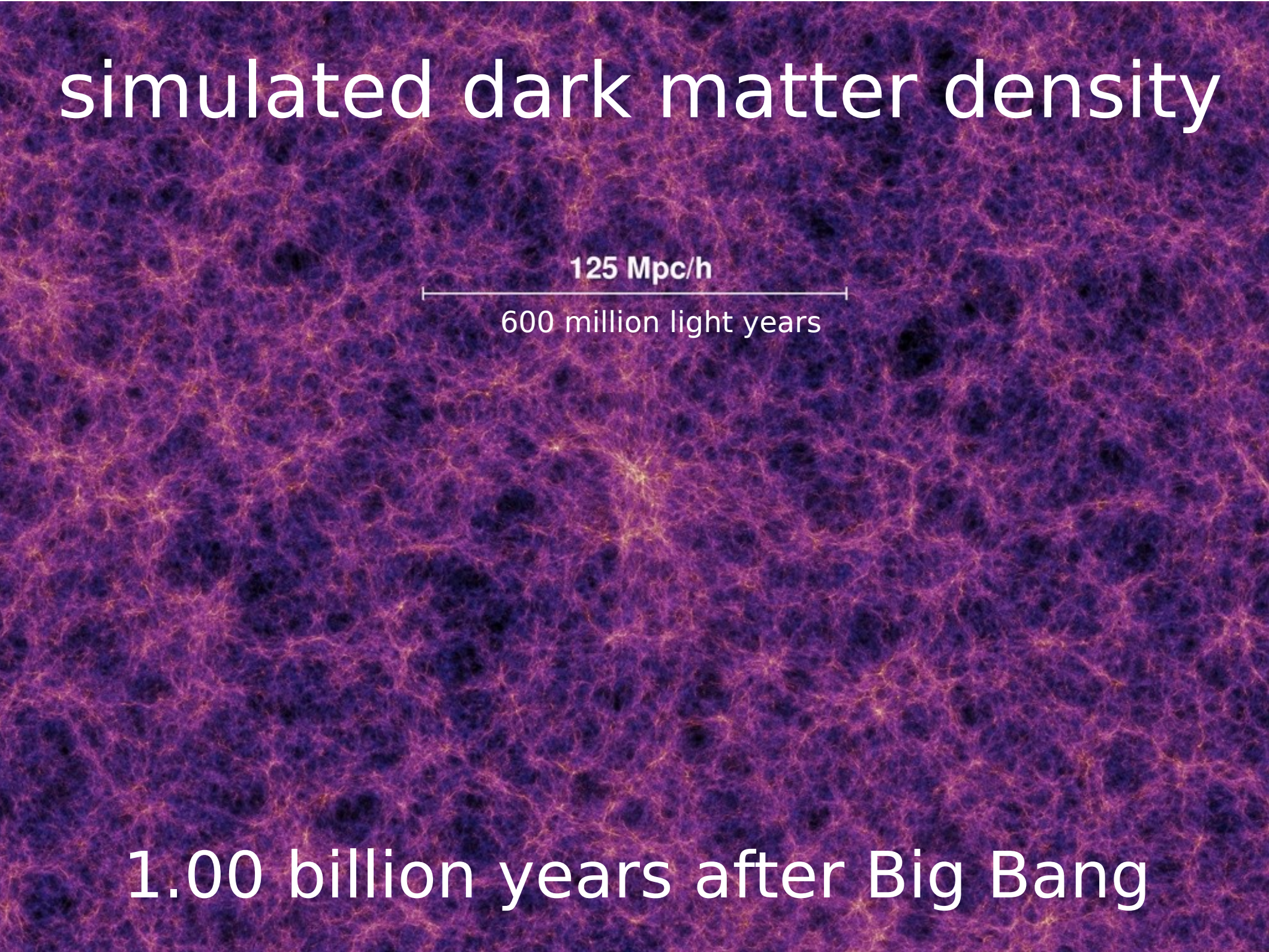
MareNostrum (Barcelona)

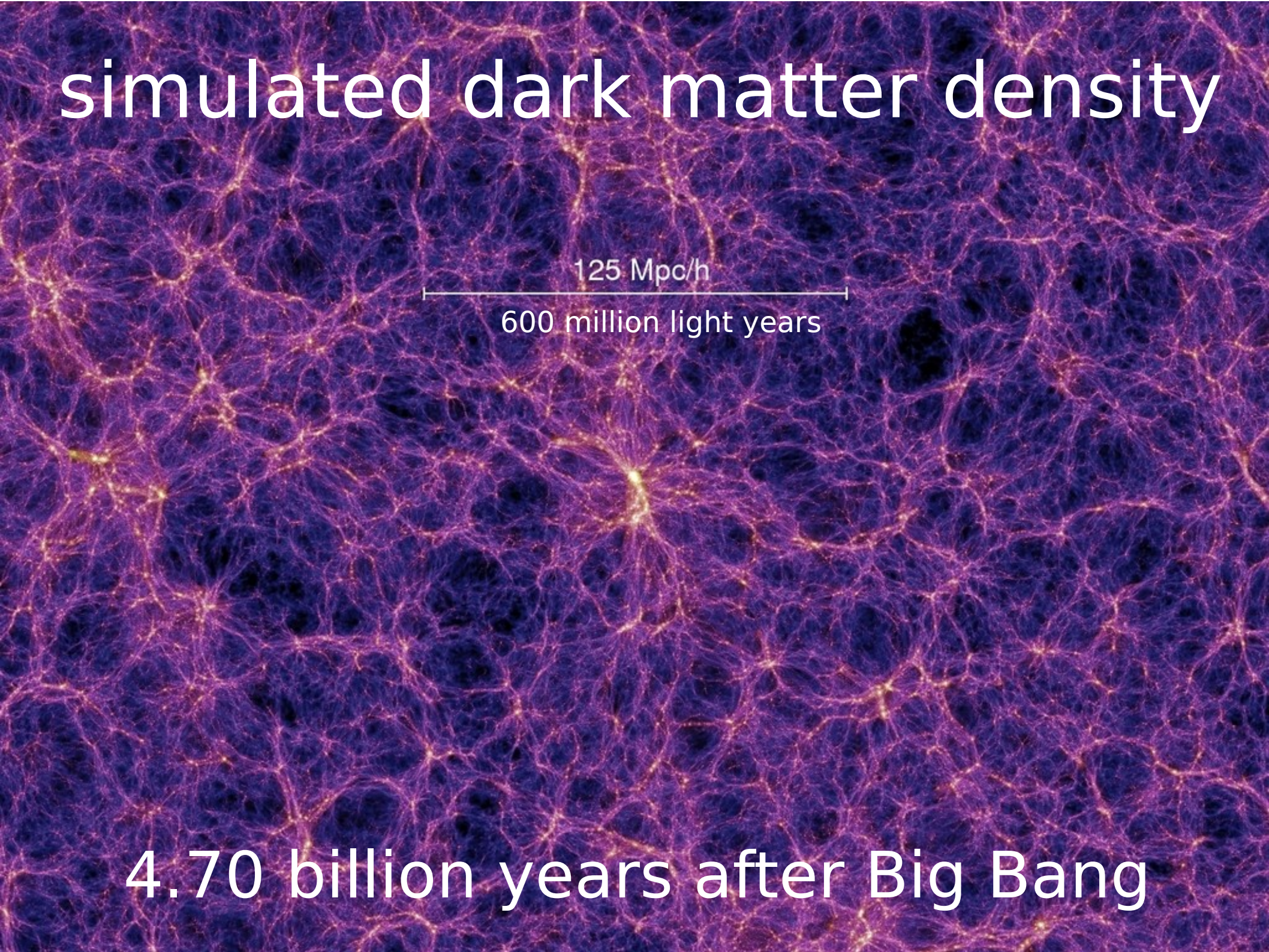
Supercomputers

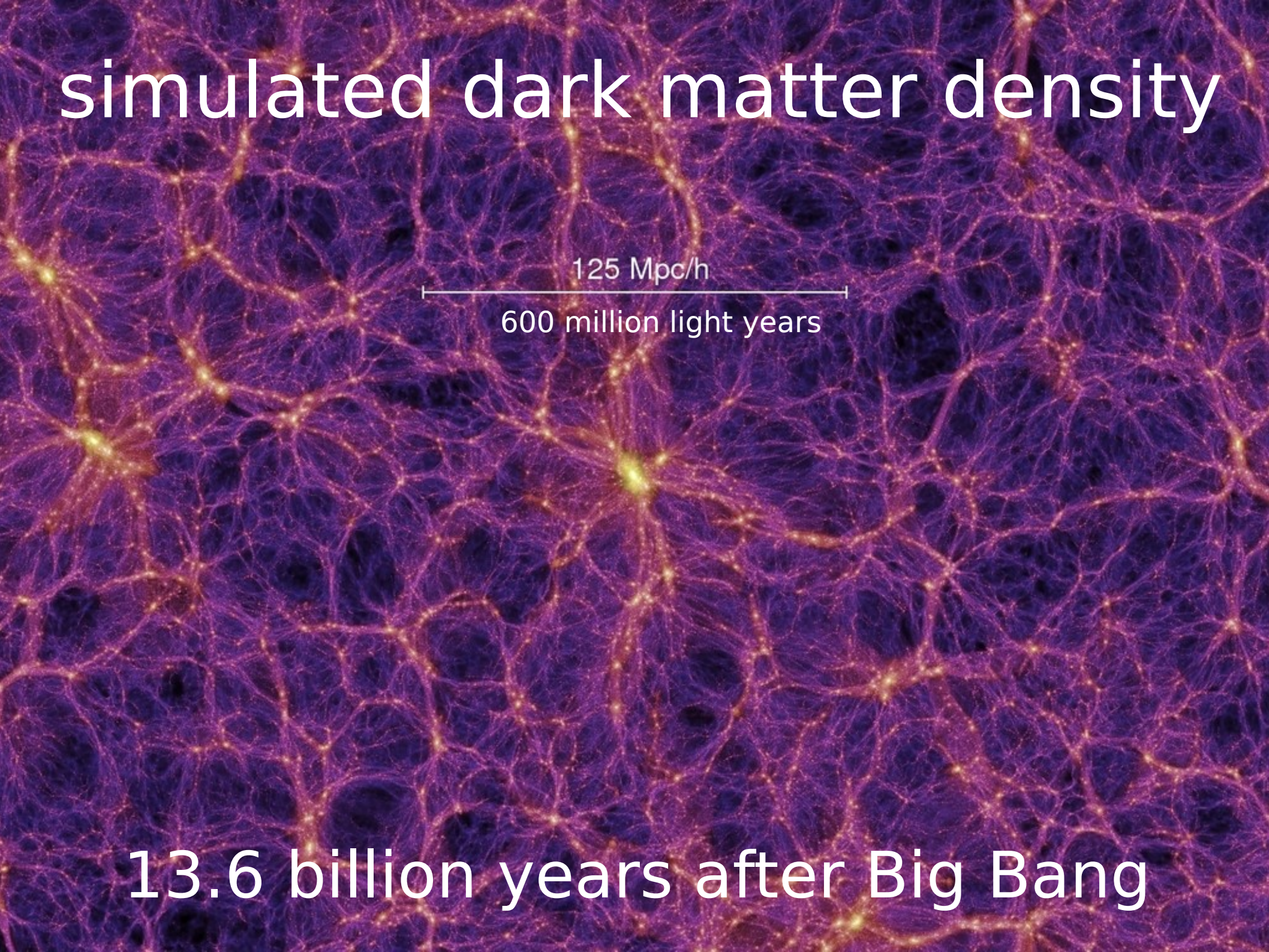
Piz Daint

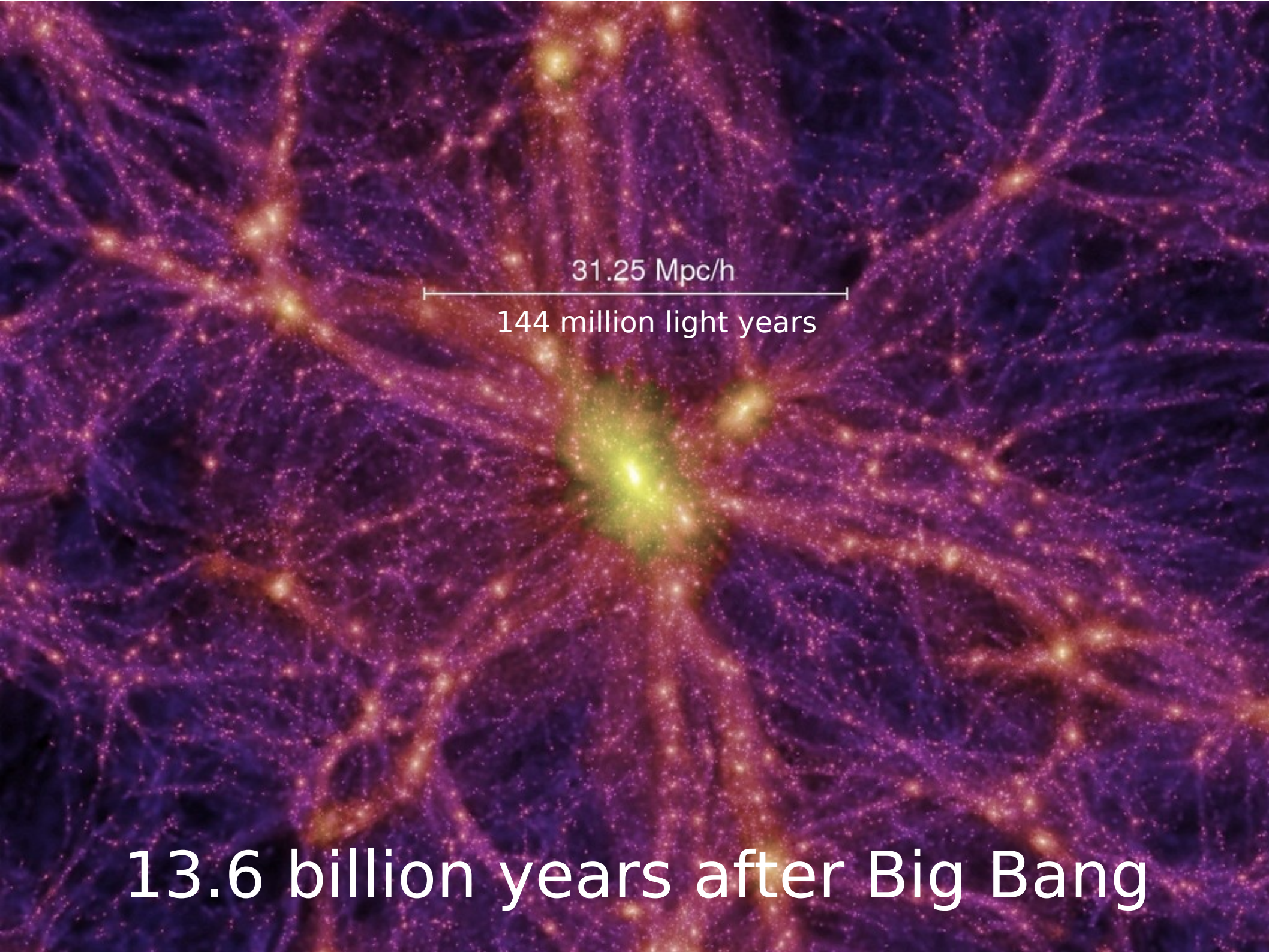
- Swiss National Computing Center (CSCS, Lugano)
- over 5000 GPU Nodes
- 6th Fastest Computer in the World Now!

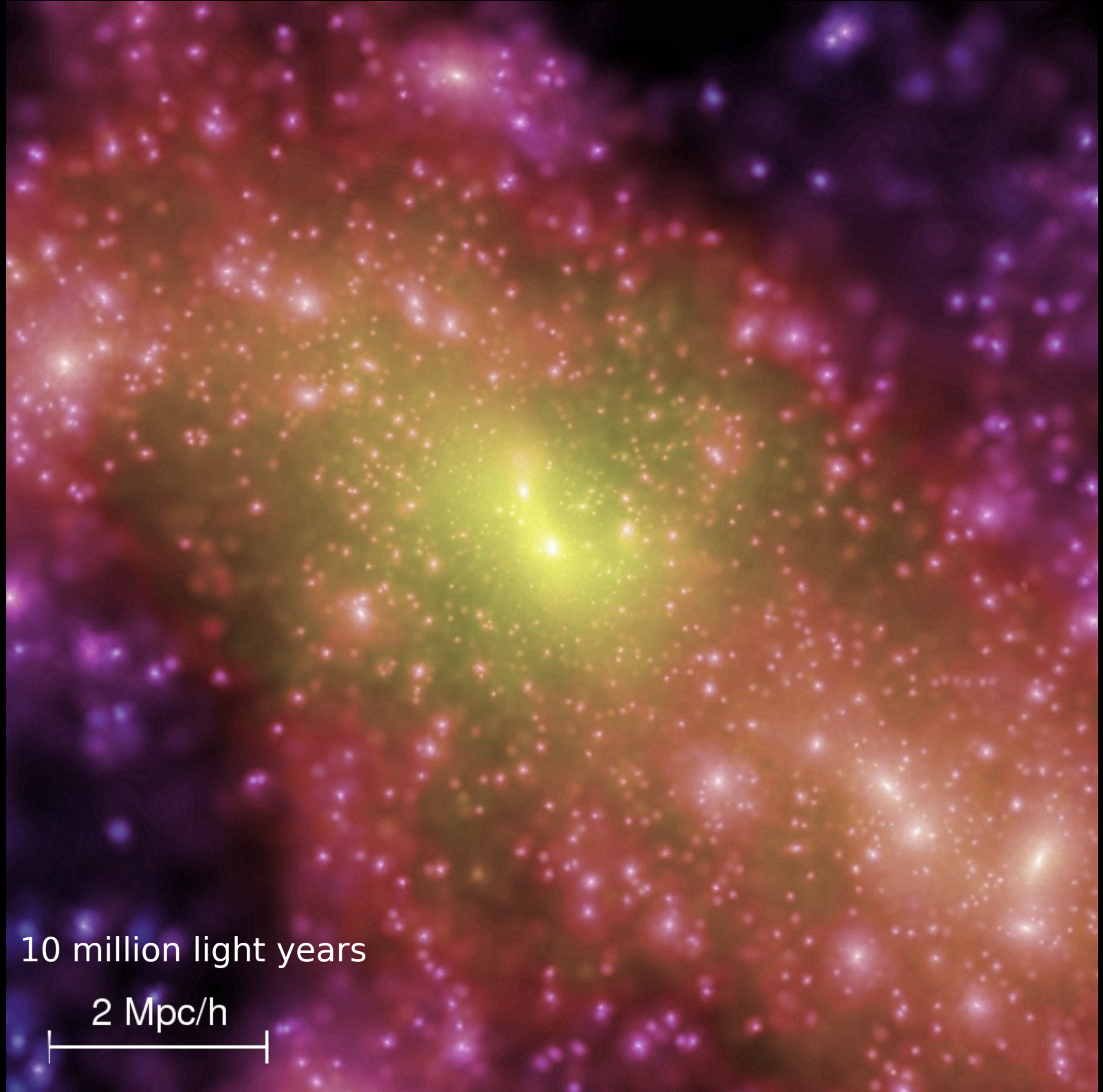

simulated dark matter density
125 Mpc/h
600 million light years
0.21 billion years after Big Bang

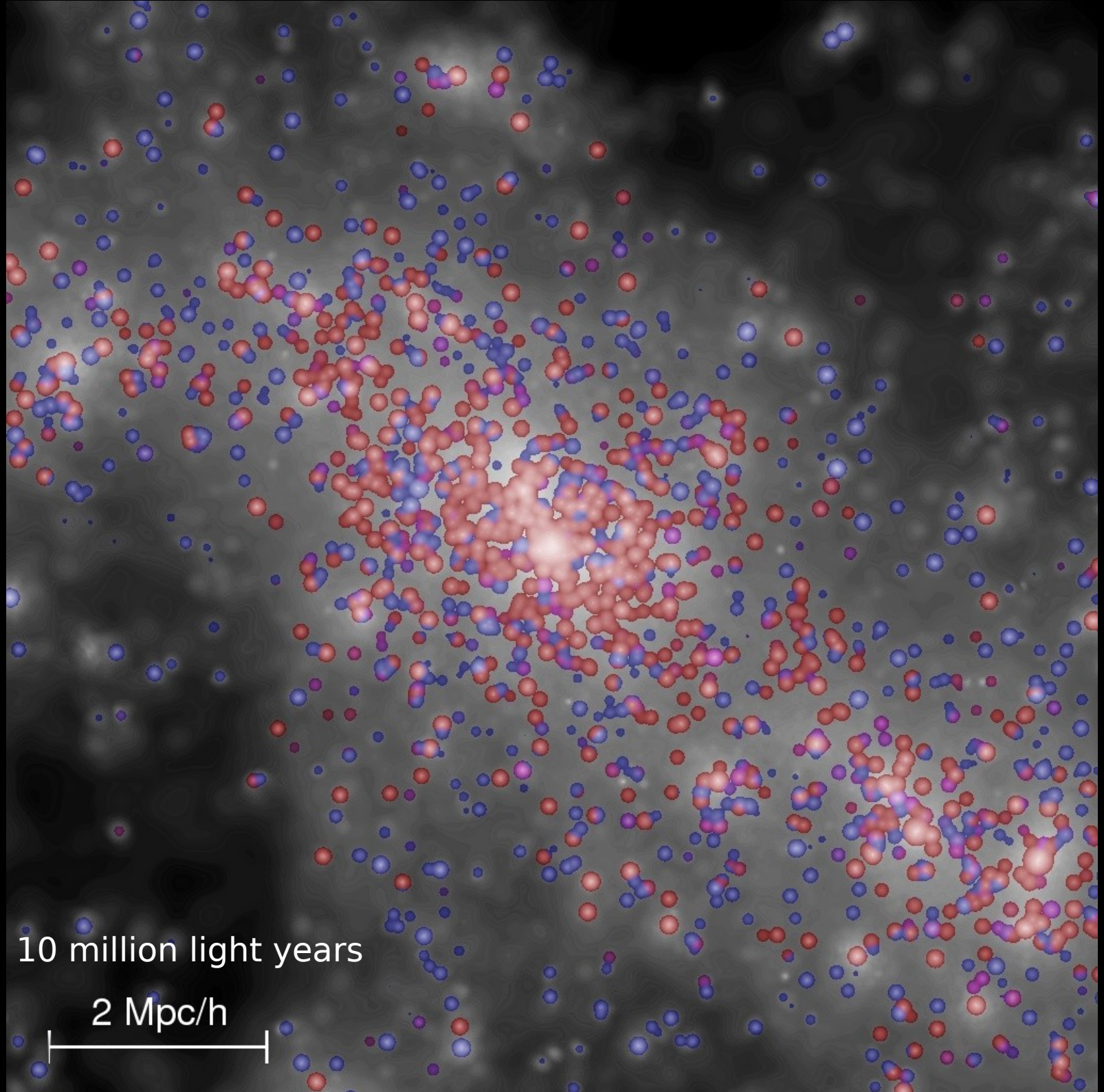

simulated dark matter density
125 Mpc/h
600 million light years
1.00 billion years after Big Bang


simulated dark matter density
125 Mpc/h
600 million light years
4.70 billion years after Big Bang

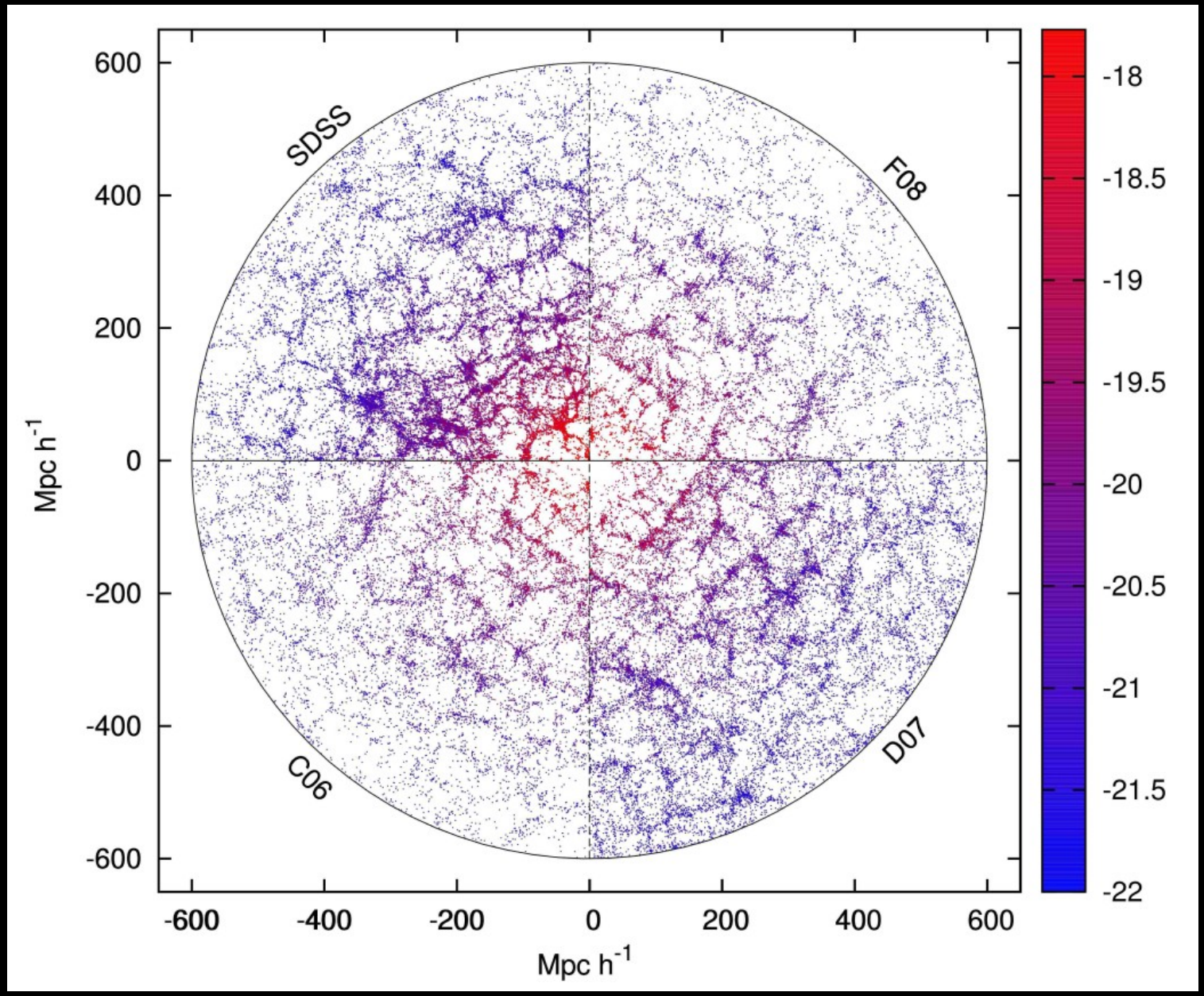

simulated dark matter density
125 Mpc/h
600 million light years
13.6 billion years after Big Bang


31.25 Mpc/h
144 million light years
13.6 billion years after Big Bang

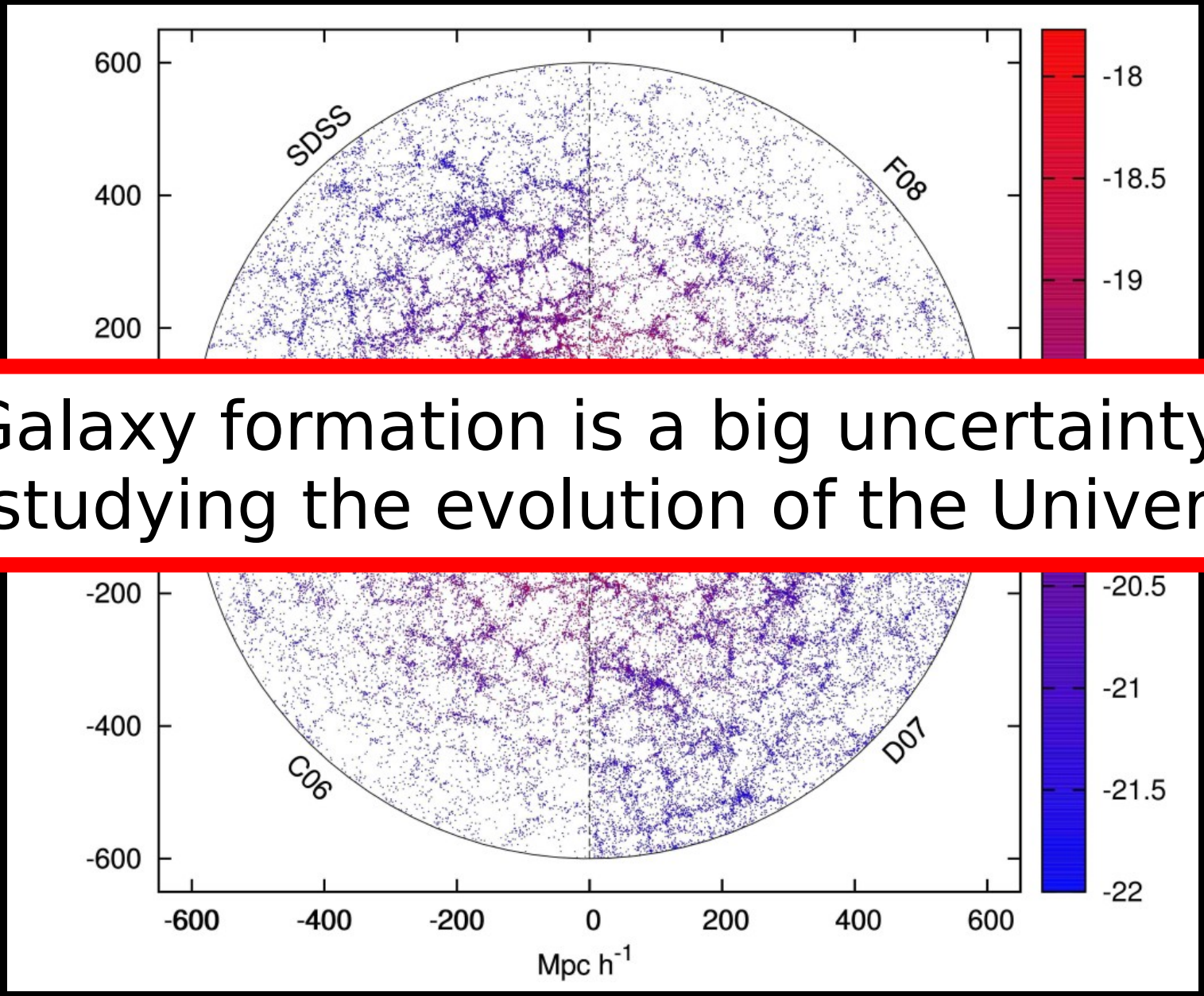

10 million light years
2 Mpc/h


10 million light years
2 Mpc/h

simulation vs. observation

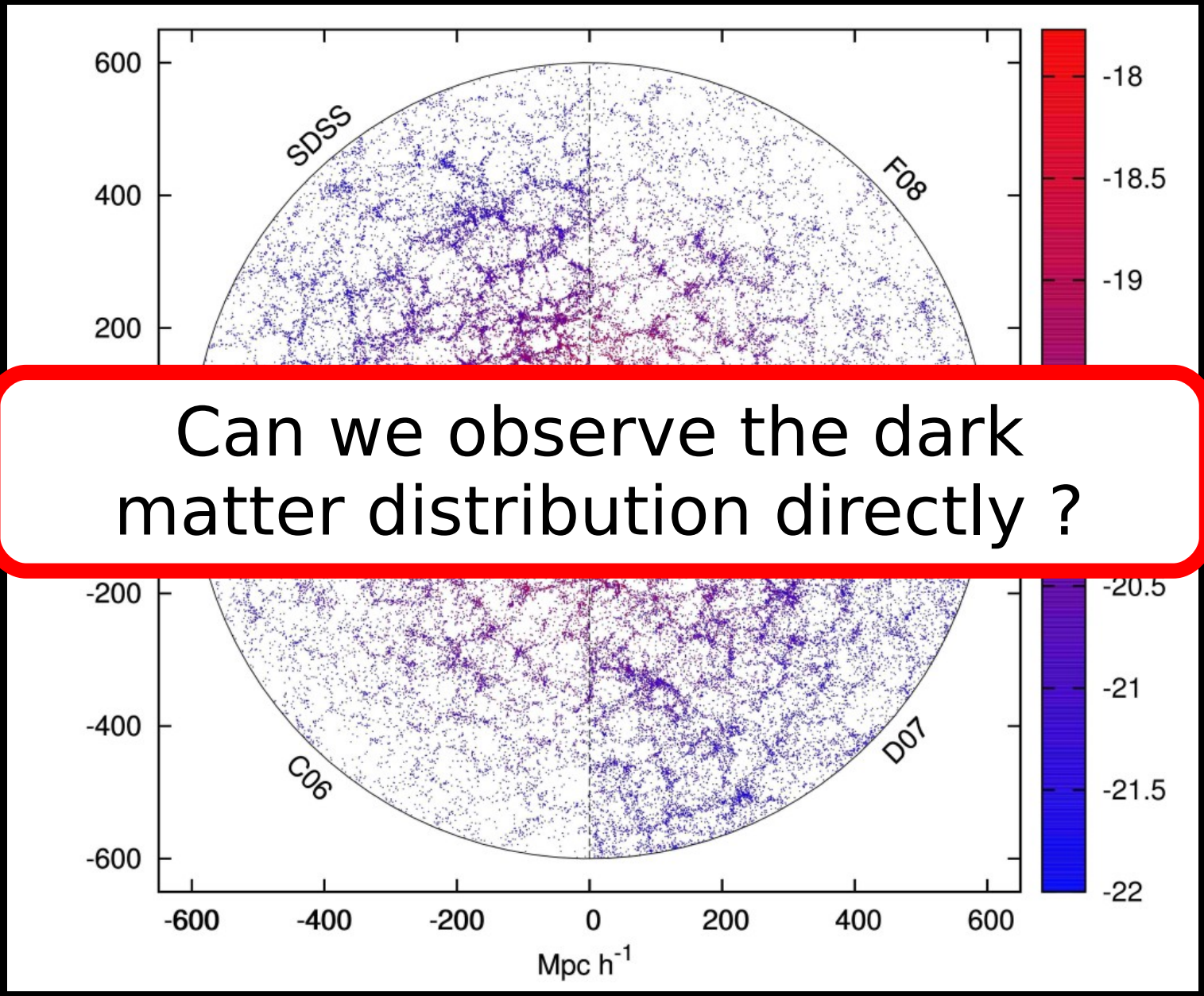


simulation vs. observation



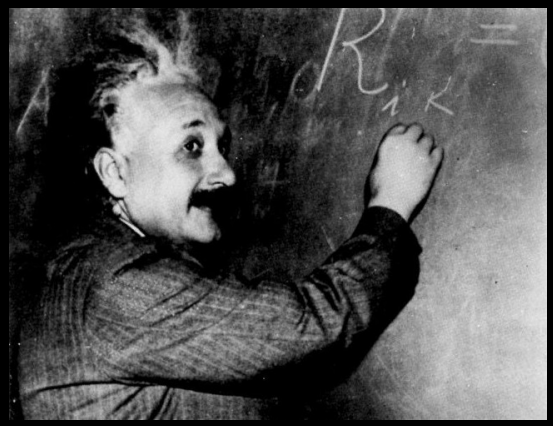
Galaxy formation is a big uncertainty for studying the evolution of the Universe!

simulation vs. observation



Can we observe the dark matter distribution directly ?

gravitational lensing

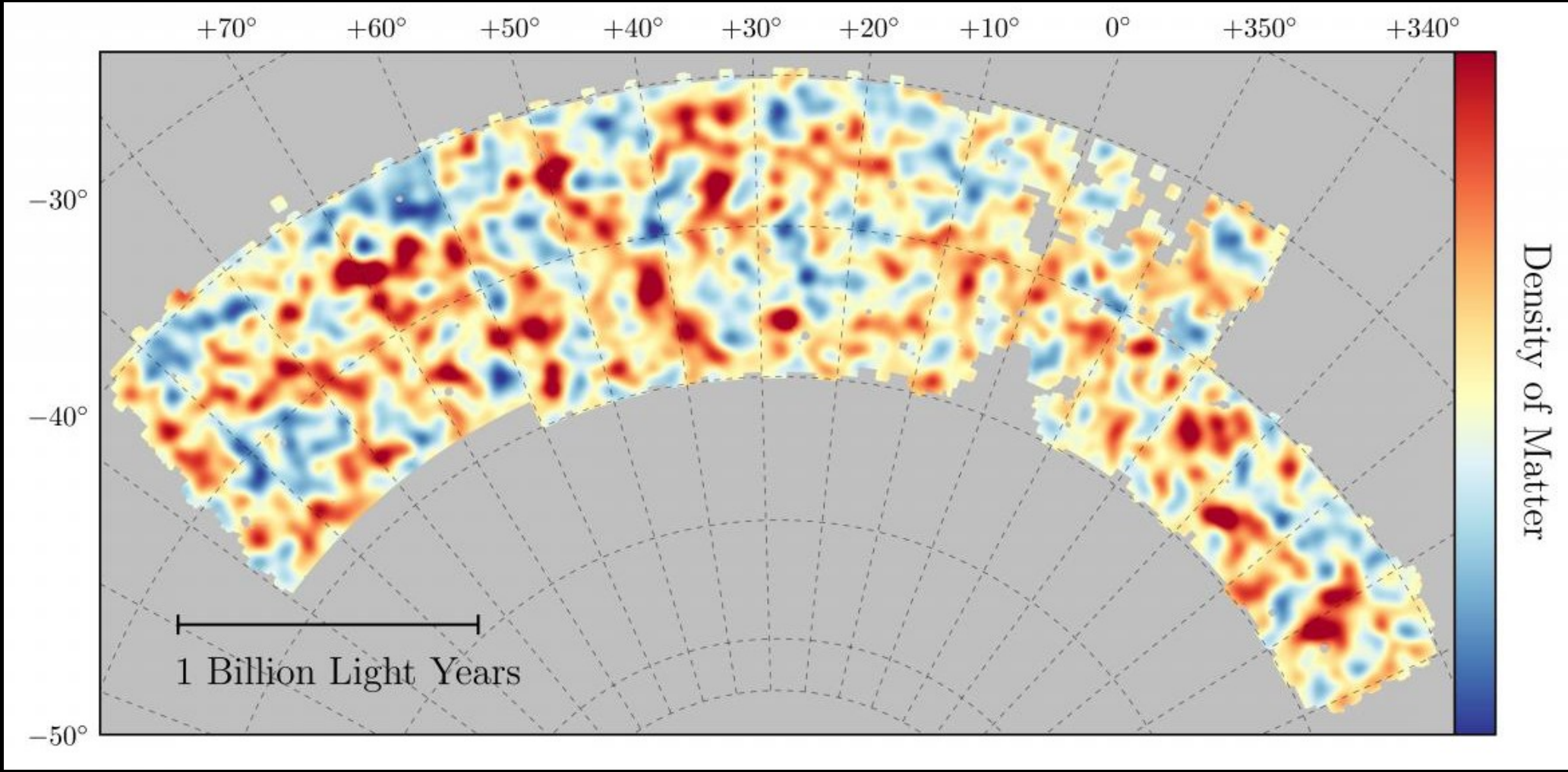


Einstein

Credit: NASA, ESA & L. Calçada

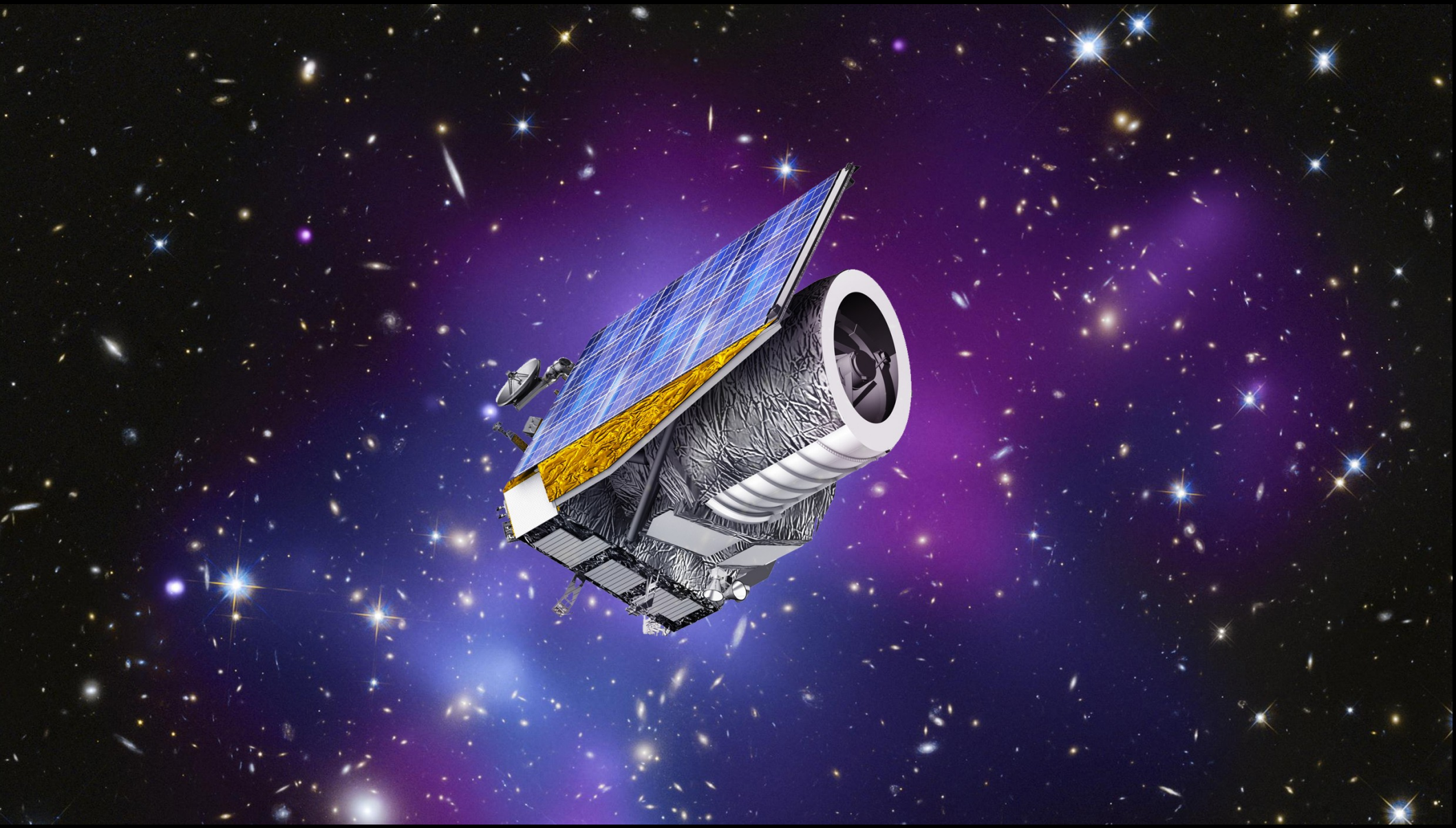
Abel 370

dark matter map from gravitational lensing



Dark Energy Survey, 2017

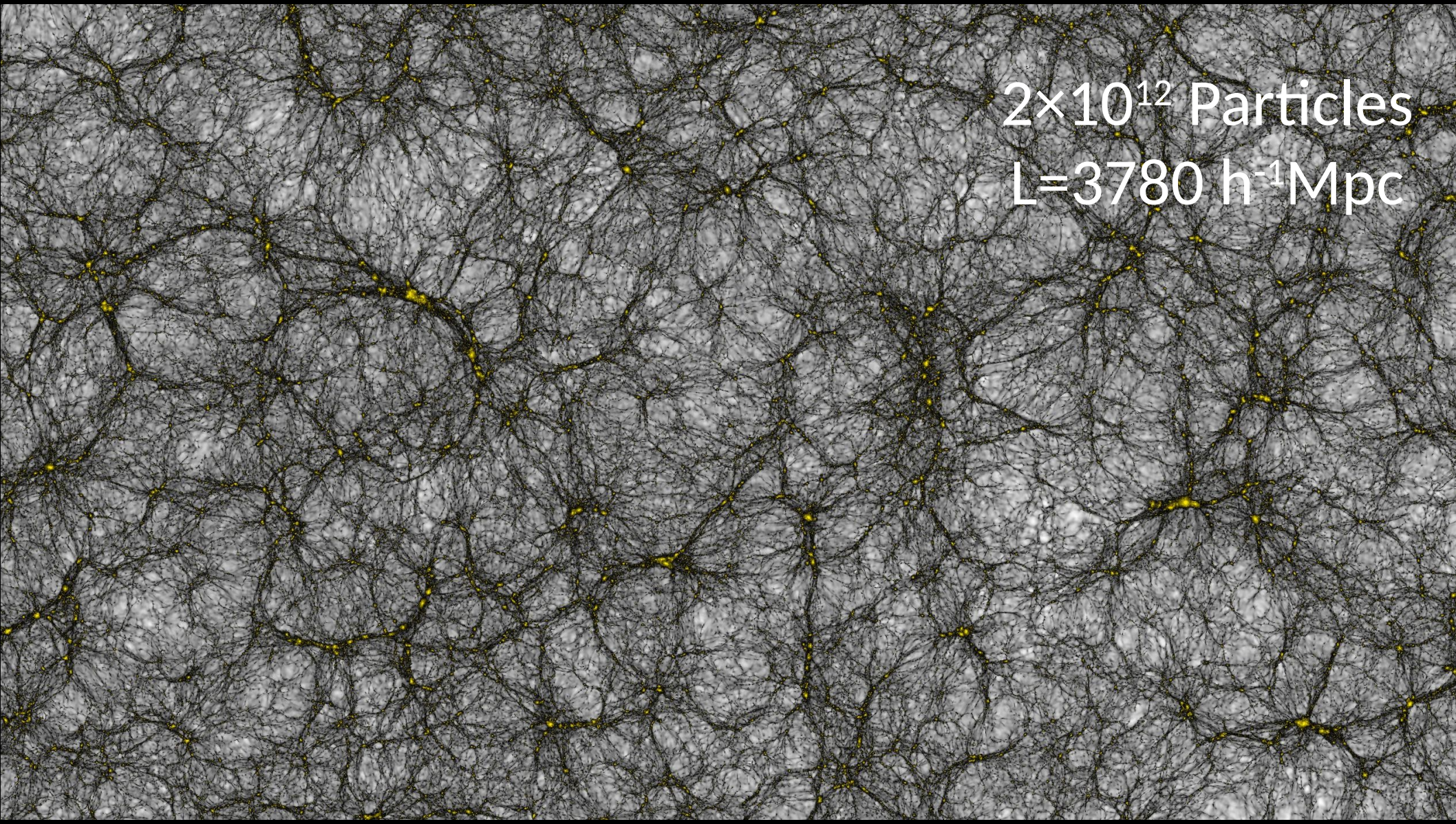
Euclid Mission 2022 - 2028



>10 billion galaxy images (photo-z) >10 million redshifts (Hα)

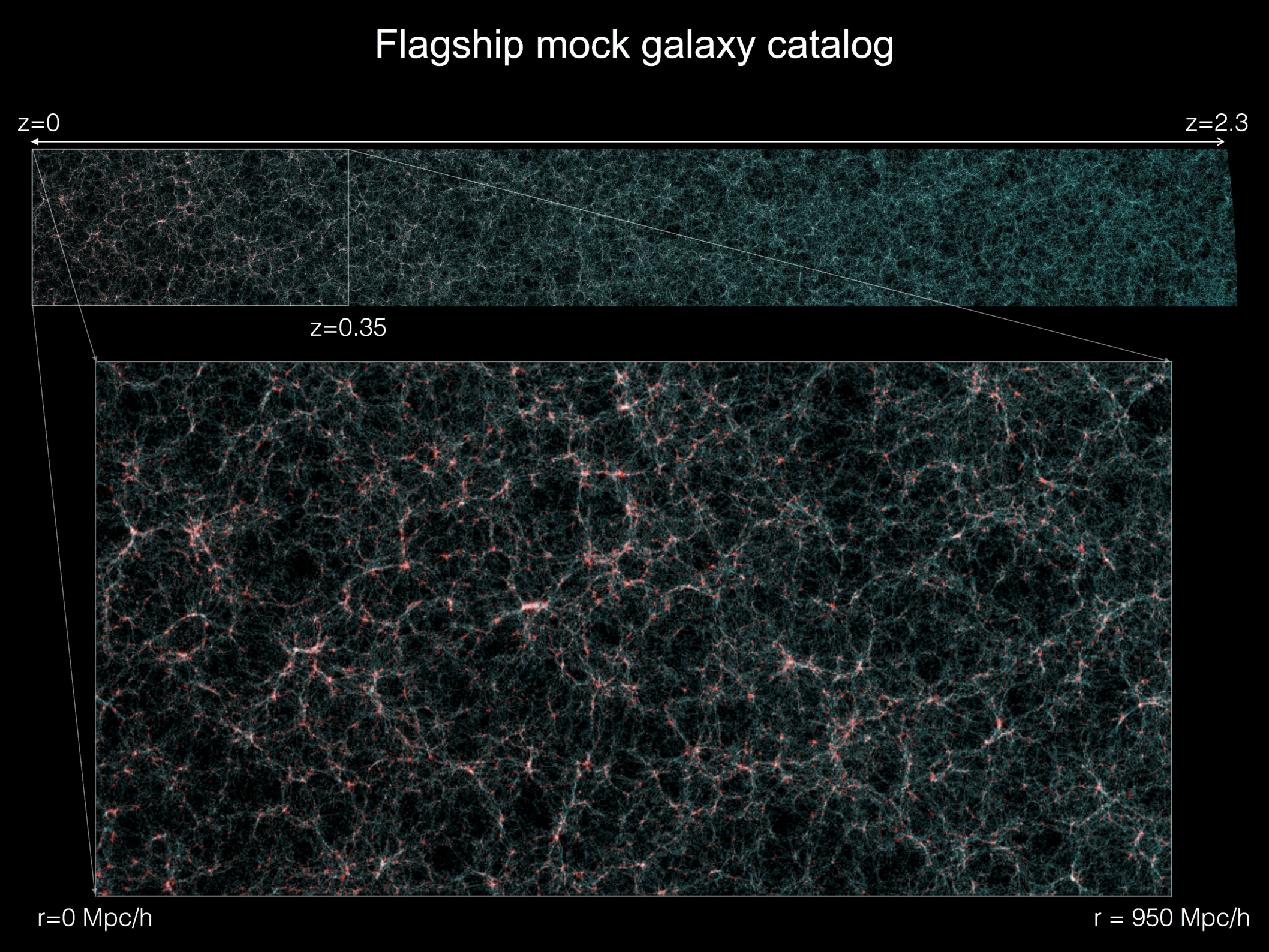

Euclid Consortium
Annual Meeting
Bonn 2018

The Euclid Flagship Simulation



Doug Potter Joachim Stadel Romain Teyssier

Flagship mock galaxy catalog




Thanks!