

EXTREME ASTROPHYSICS

L U I S T E O D O R O
D E P A R T M E N T O F P H Y S I C S
A N D A S T R O N O M Y
U N I V E R S I T Y O F G L A S G O W

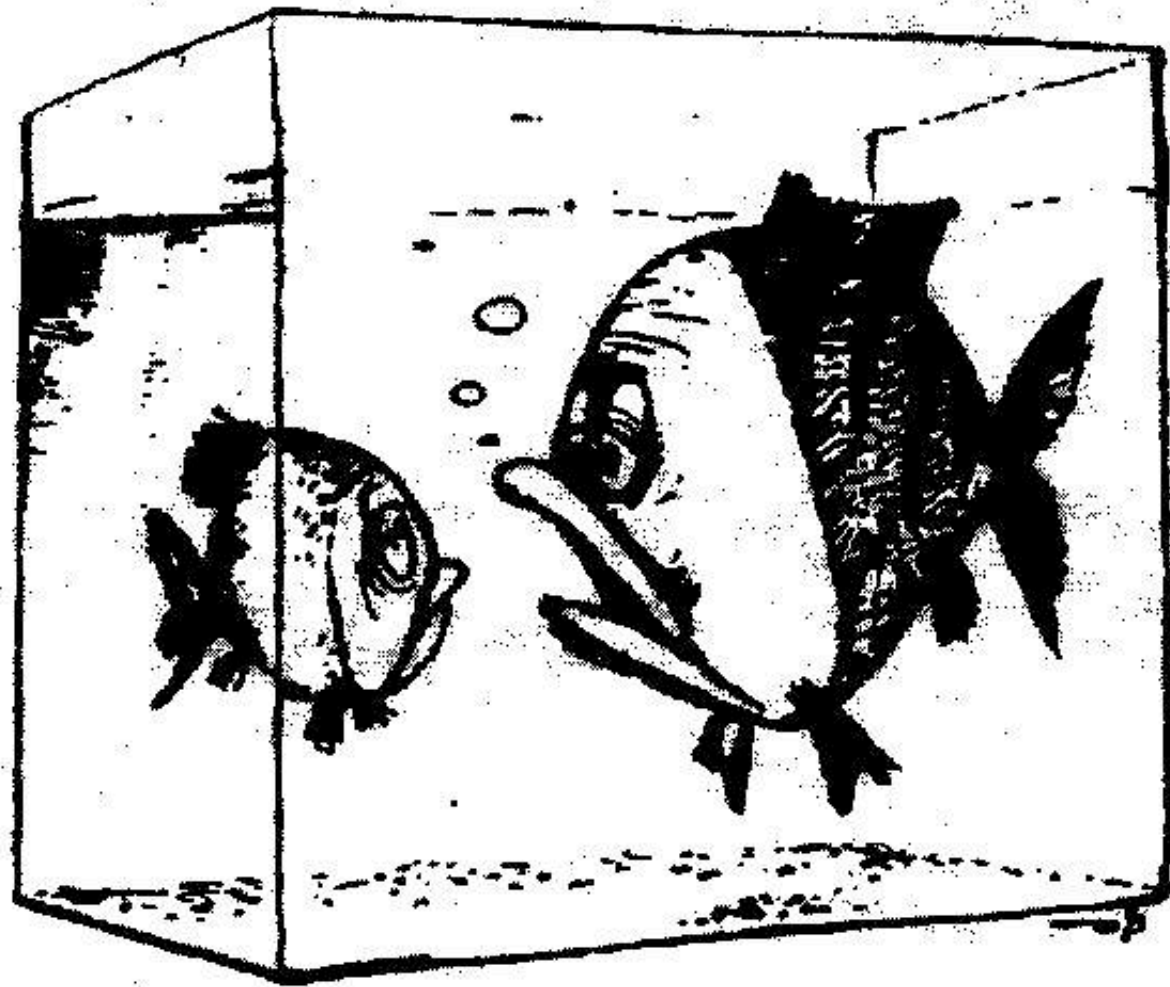
THE HITCHHIKER'S
GUIDE TO
COSMOLOGY

COSMOLOGY

O R I G I N

E V O L U T I O N

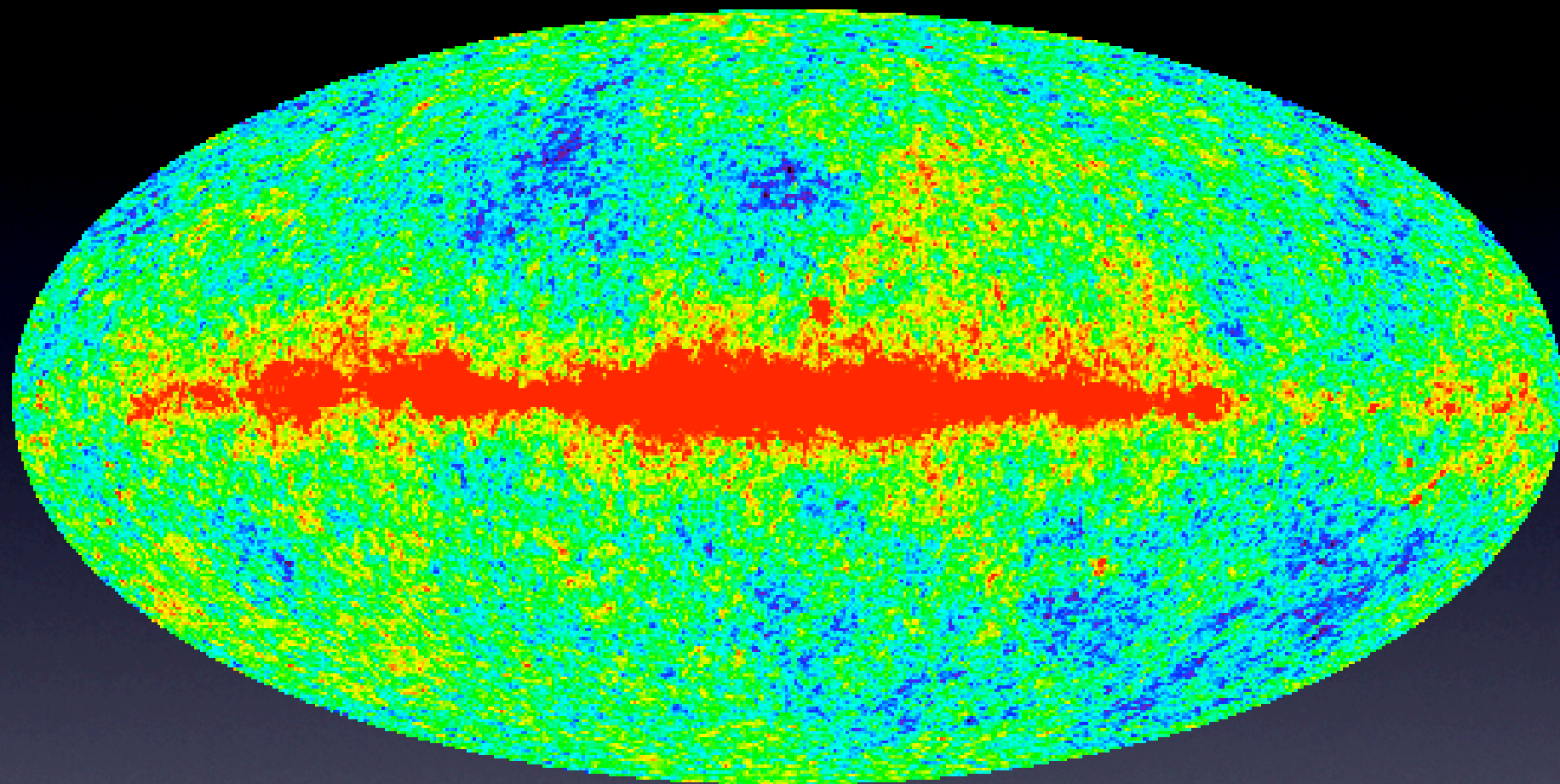
E V E N T U A L F A T E



'The universe, my son, is a large tank full of water





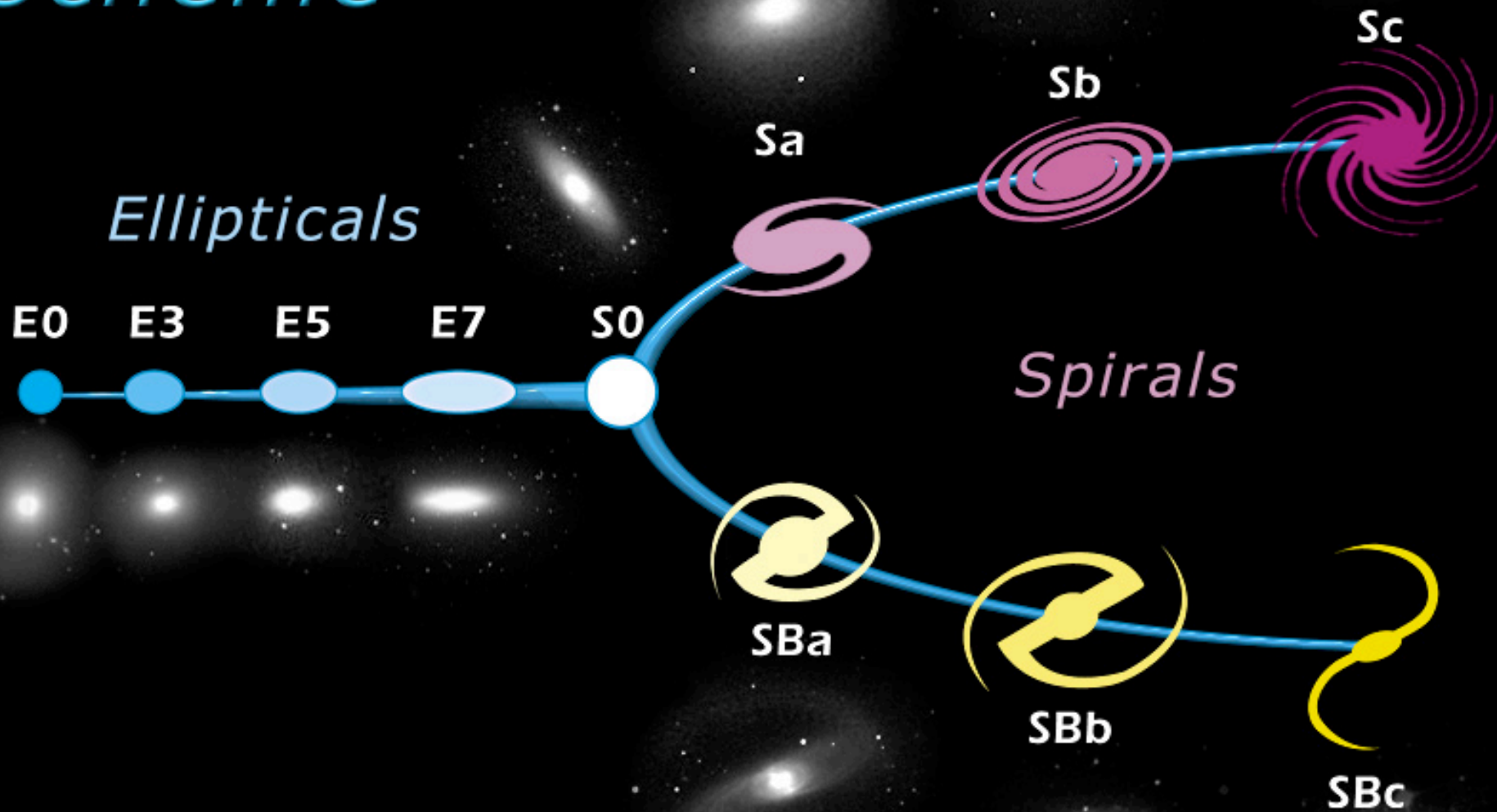


WMAP - 2003

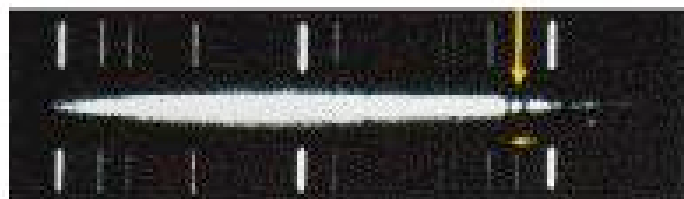




Edwin Hubble's Classification Scheme



Radial Velocities in km/s



1210

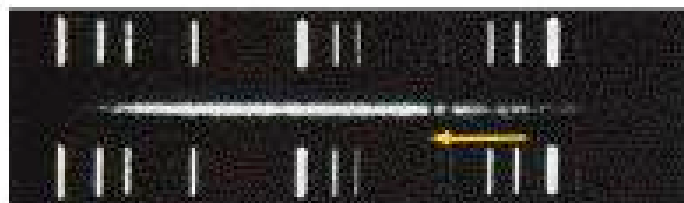
Distance
in
mega-
parsecs

18

Cluster
galaxy in



Virgo

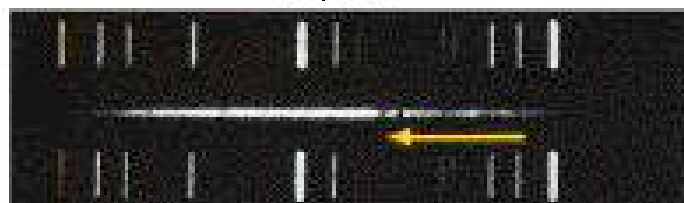


15,000

230

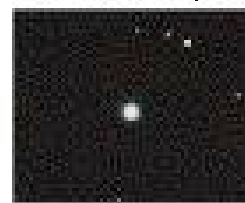


Ursa Major

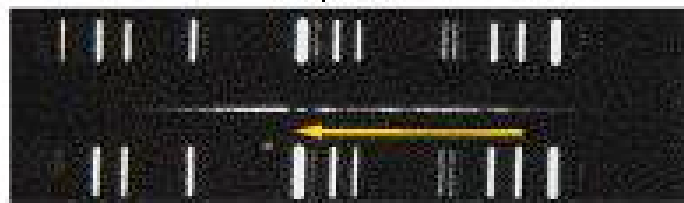


21,600

330

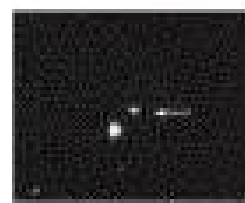


Corona Borealis

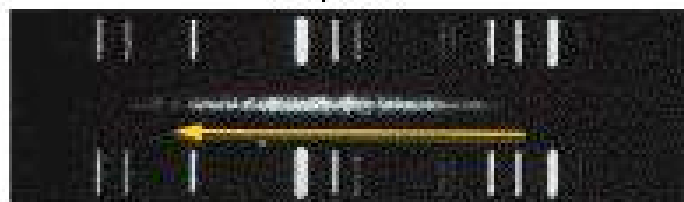


39,300

600

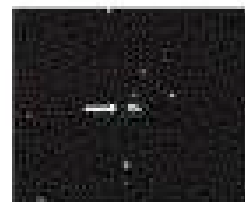


Bootes

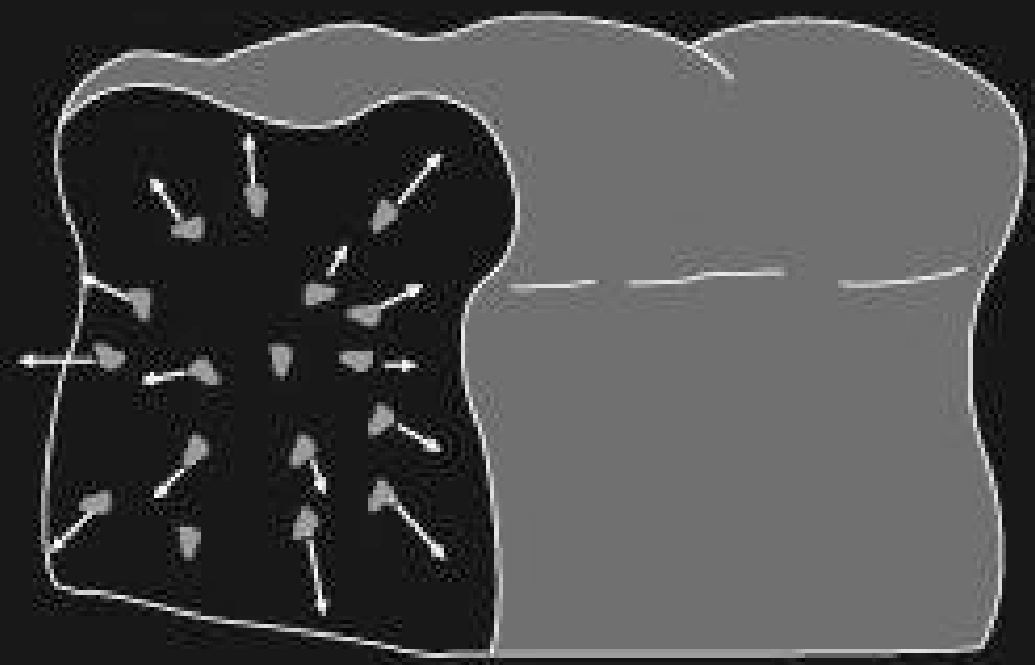
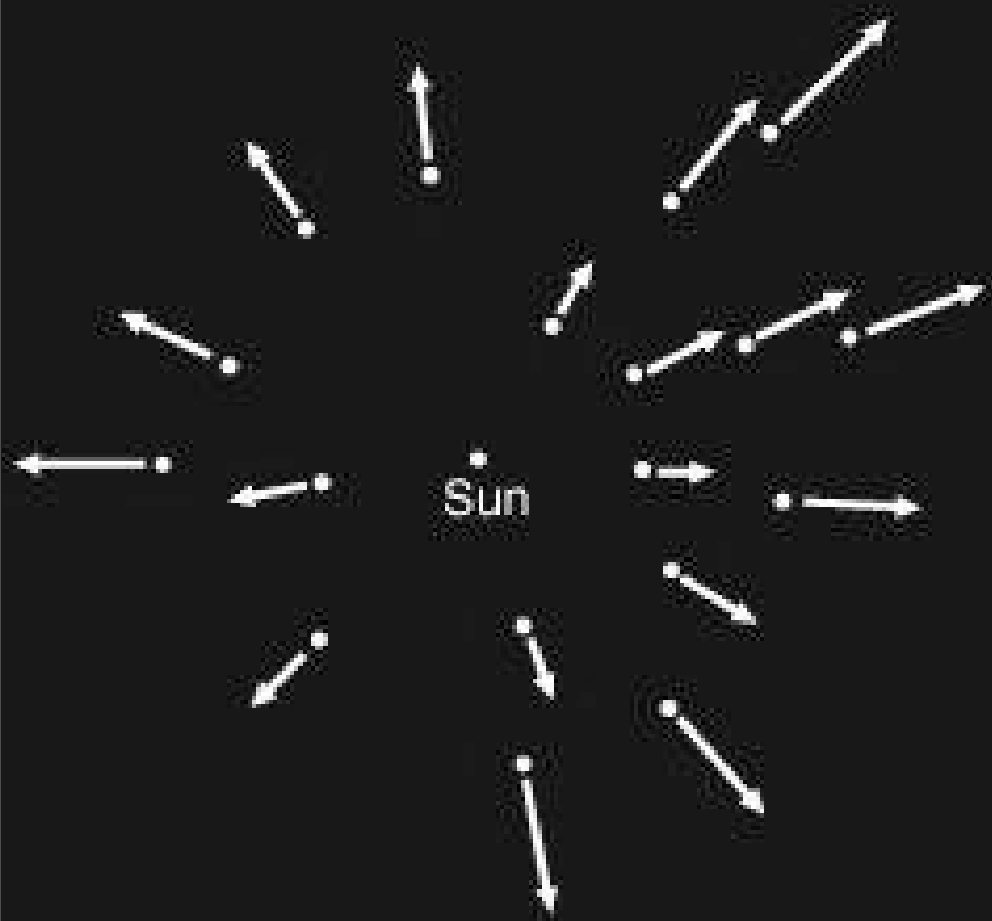


61,200

940



Hydra



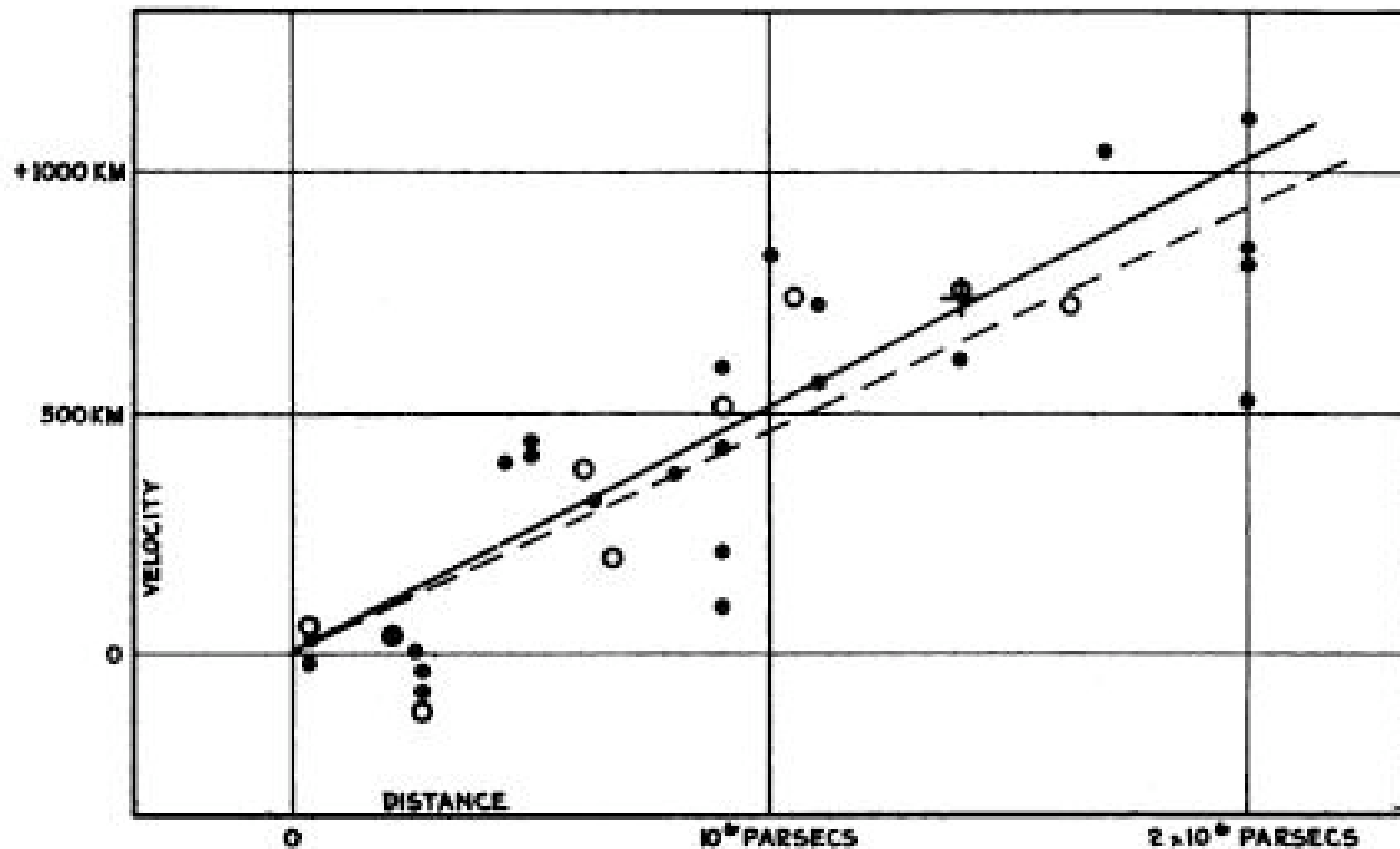
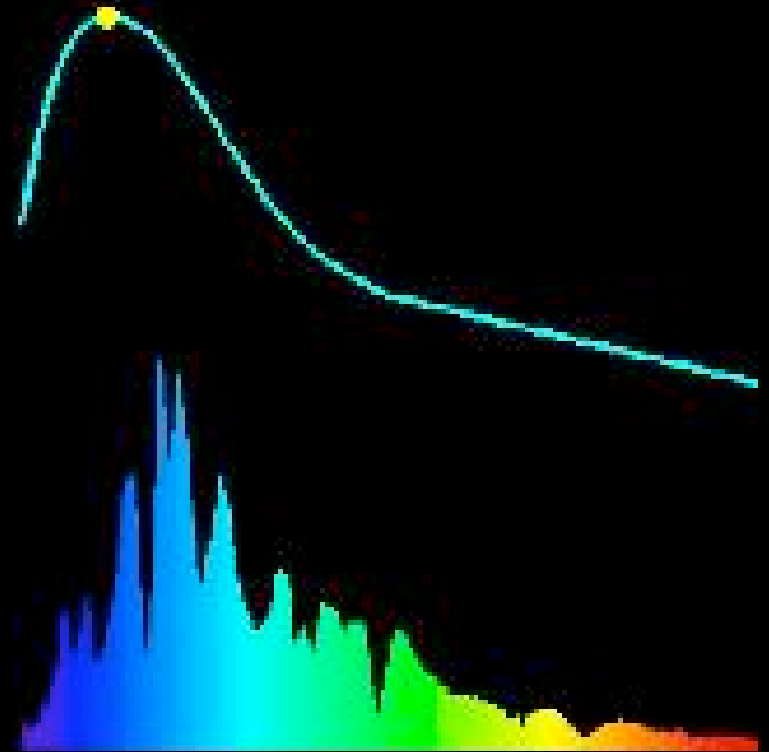
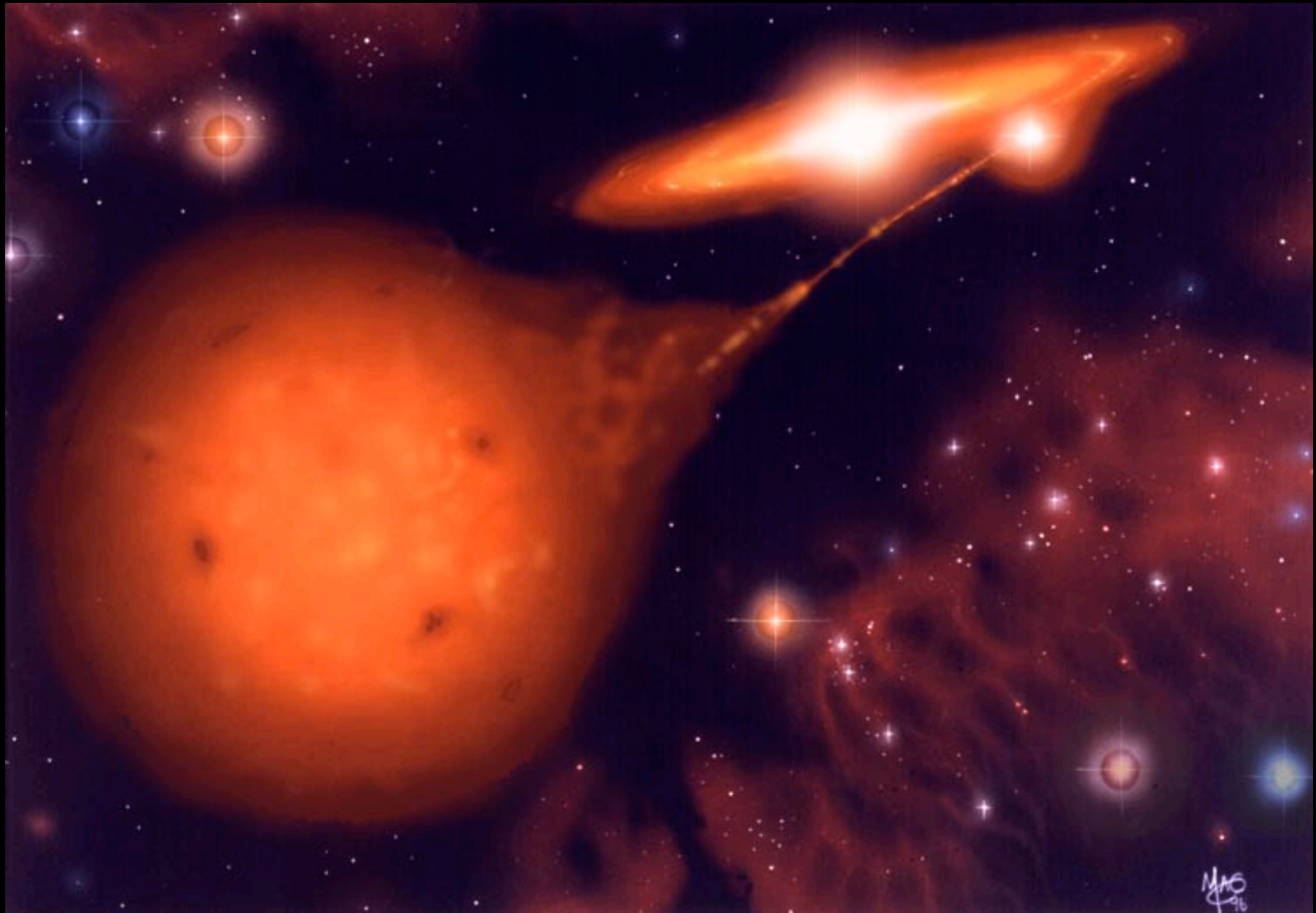


FIGURE 1

Velocity-Distance Relation among Extra-Galactic Nebulae.

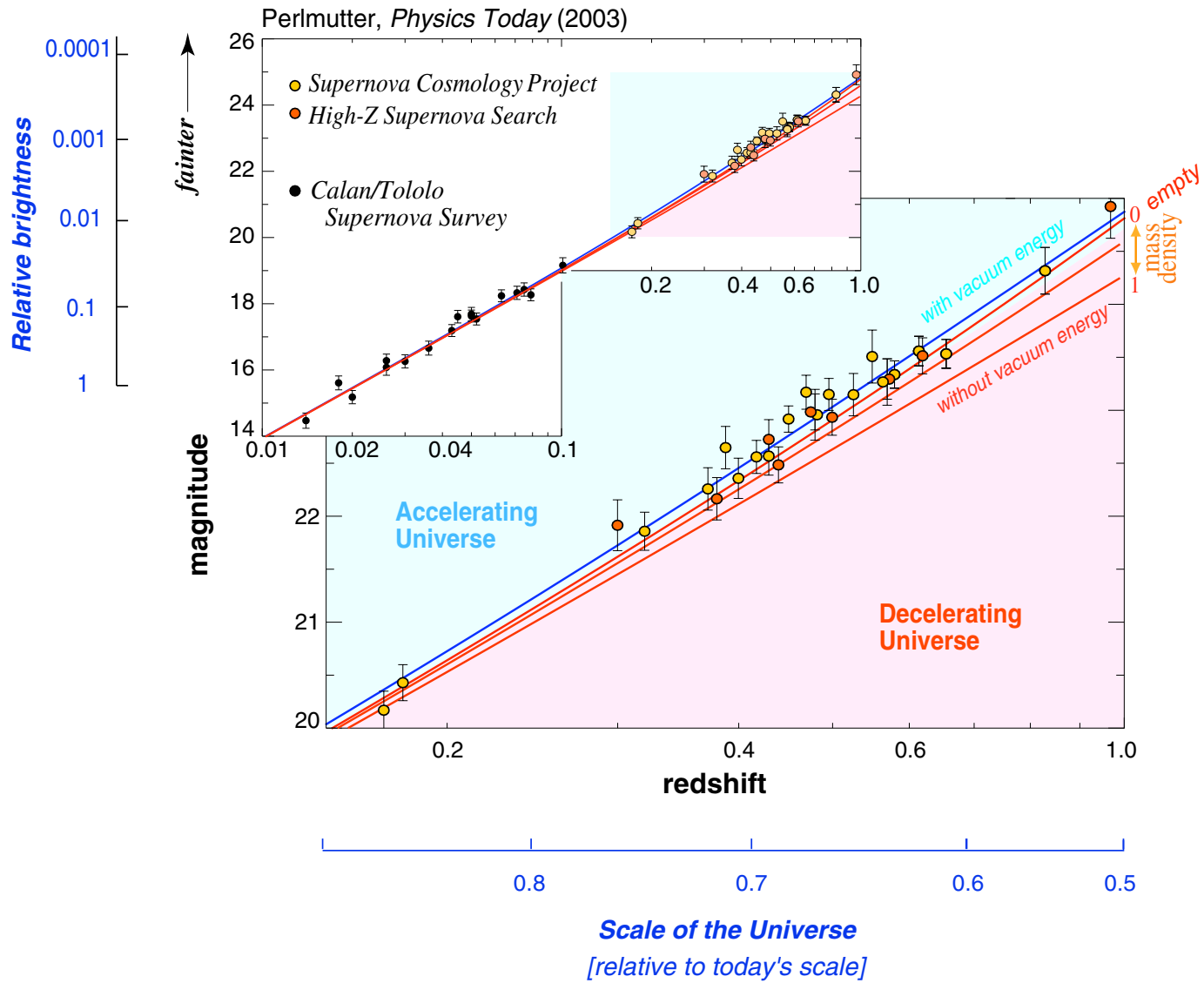
Radial velocities, corrected for solar motion, are plotted against distances estimated from involved stars and mean luminosities of nebulae in a cluster. The black discs and full line represent the solution for solar motion using the nebulae individually; the circles and broken line represent the solution combining the nebulae into groups; the cross represents the mean velocity corresponding to the mean distance of 22 nebulae whose distances could not be estimated individually.

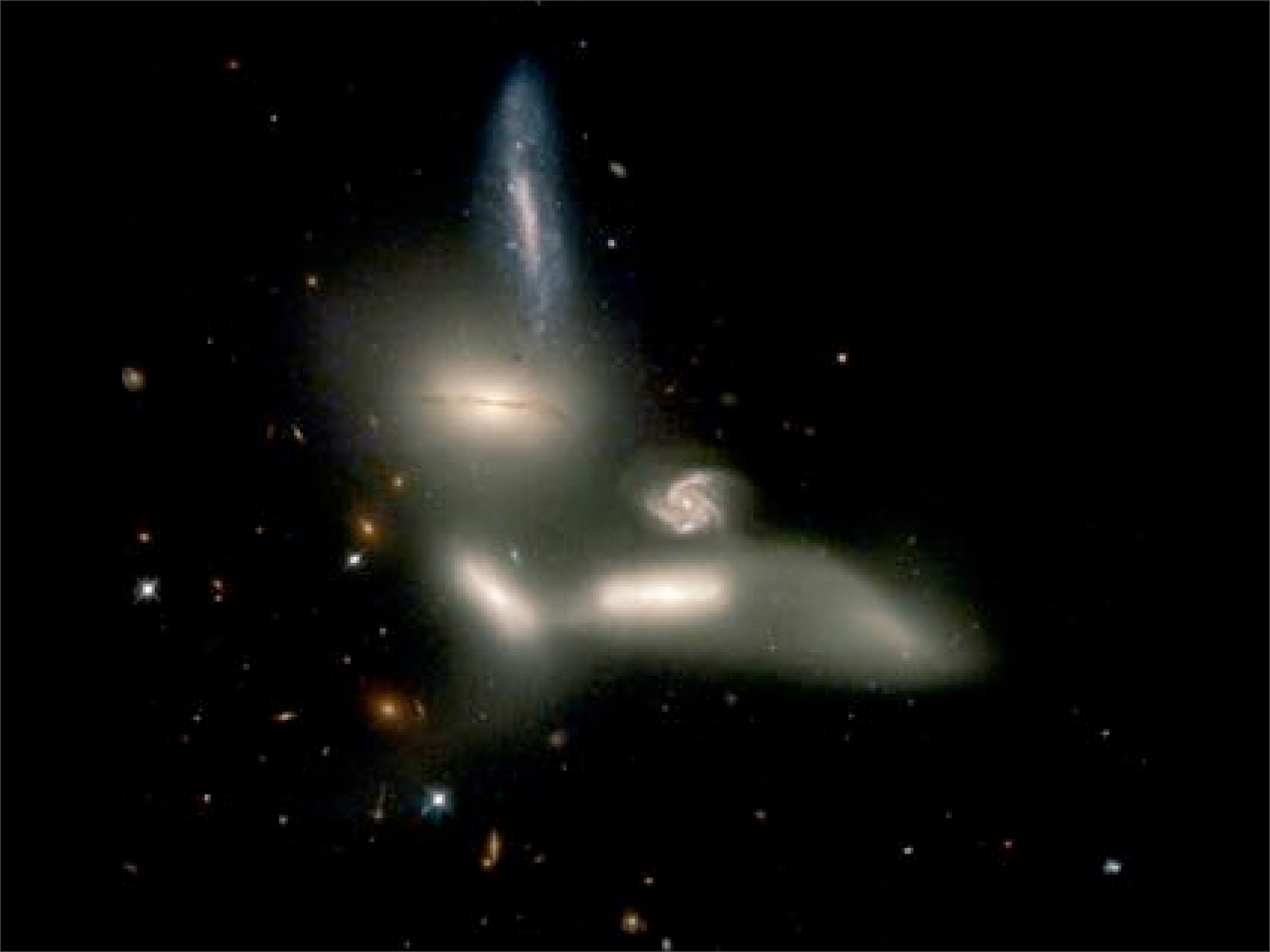


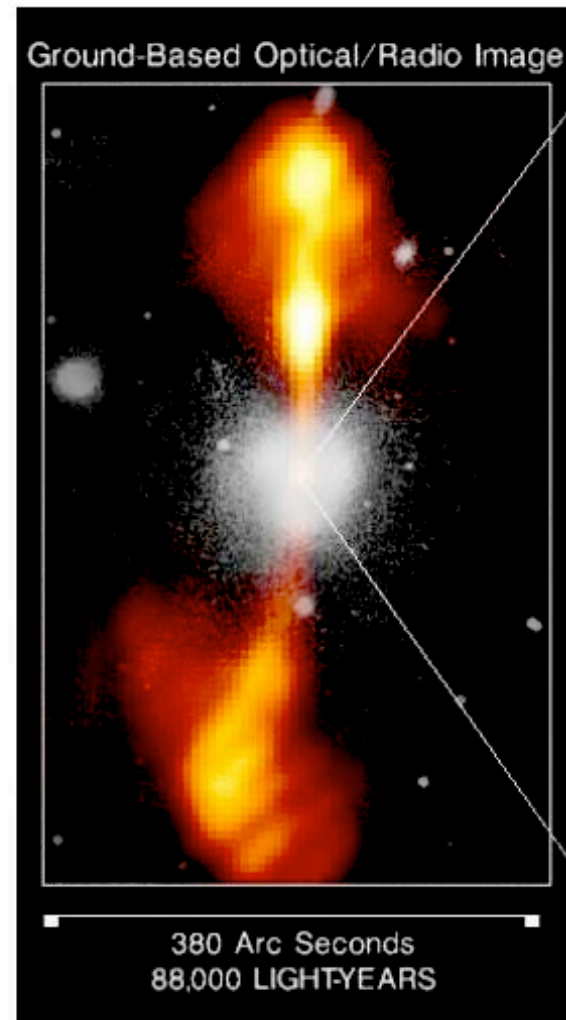
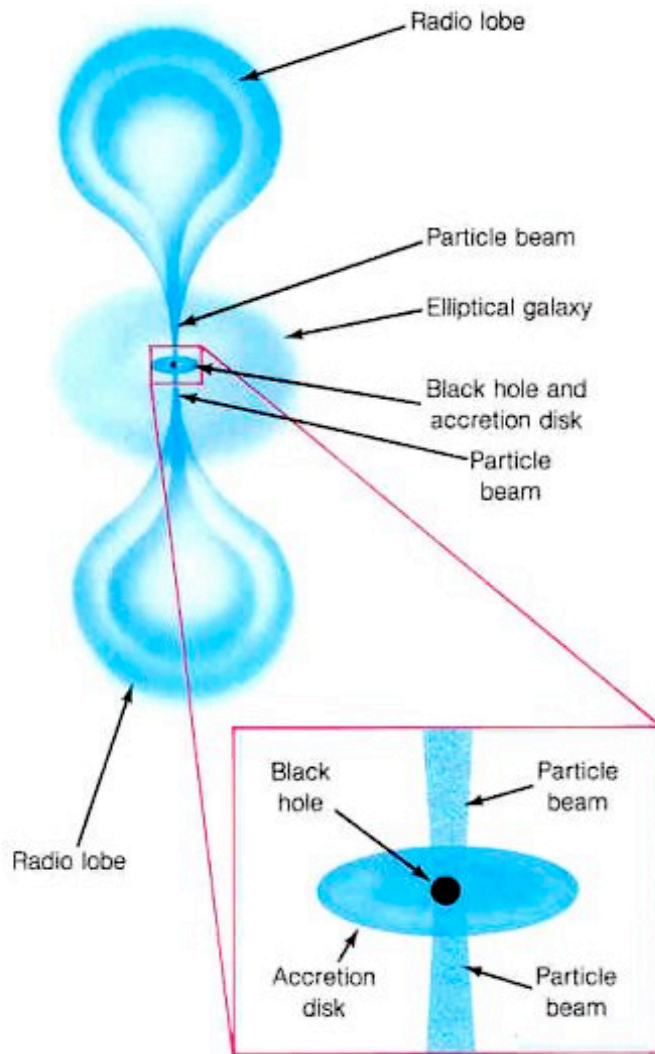


MAS
1976

Type Ia Supernovae

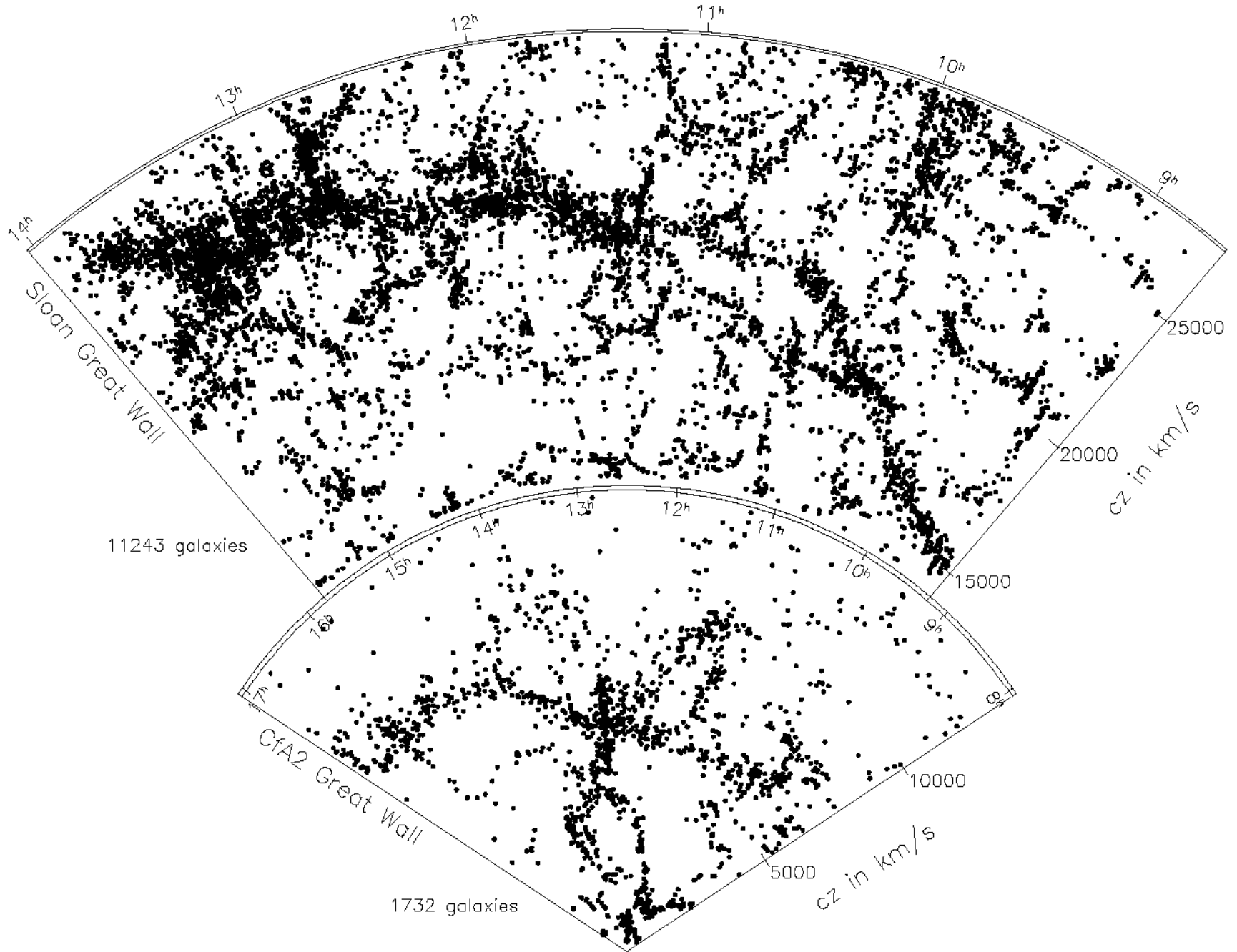






Galaxies at their infancy

Right ascension



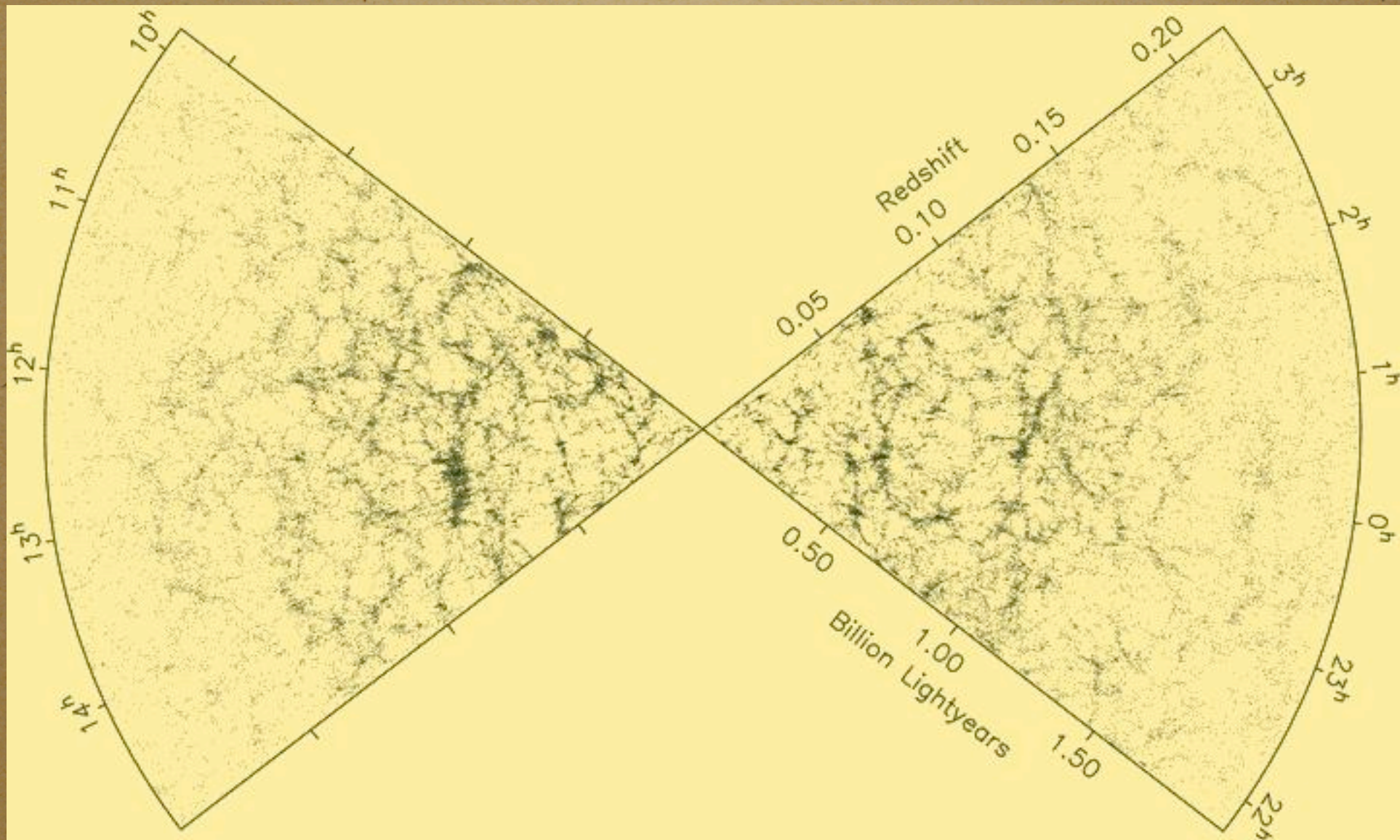
11243 galaxies

CfA2 Great Wall

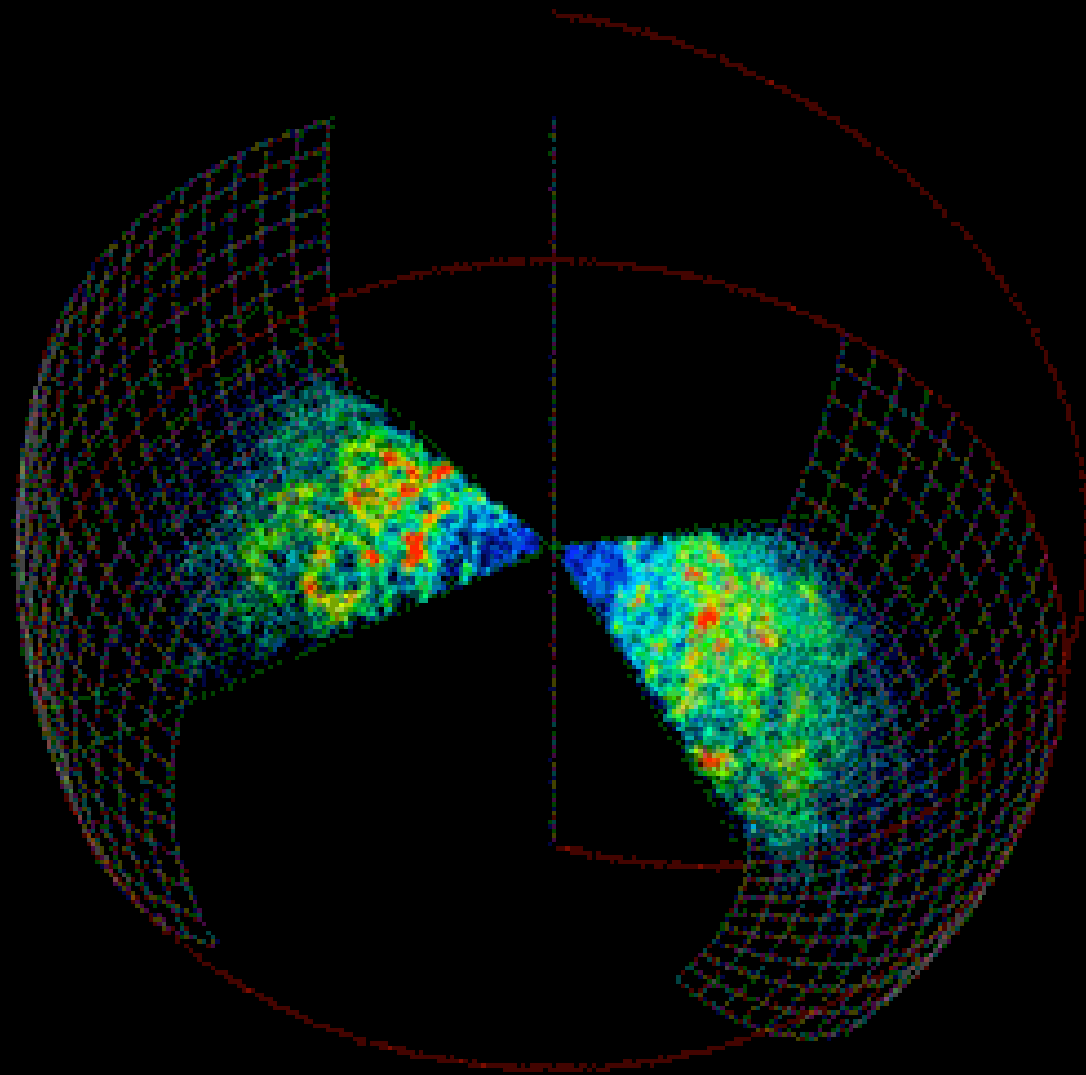
1732 galaxies

cz in km/s

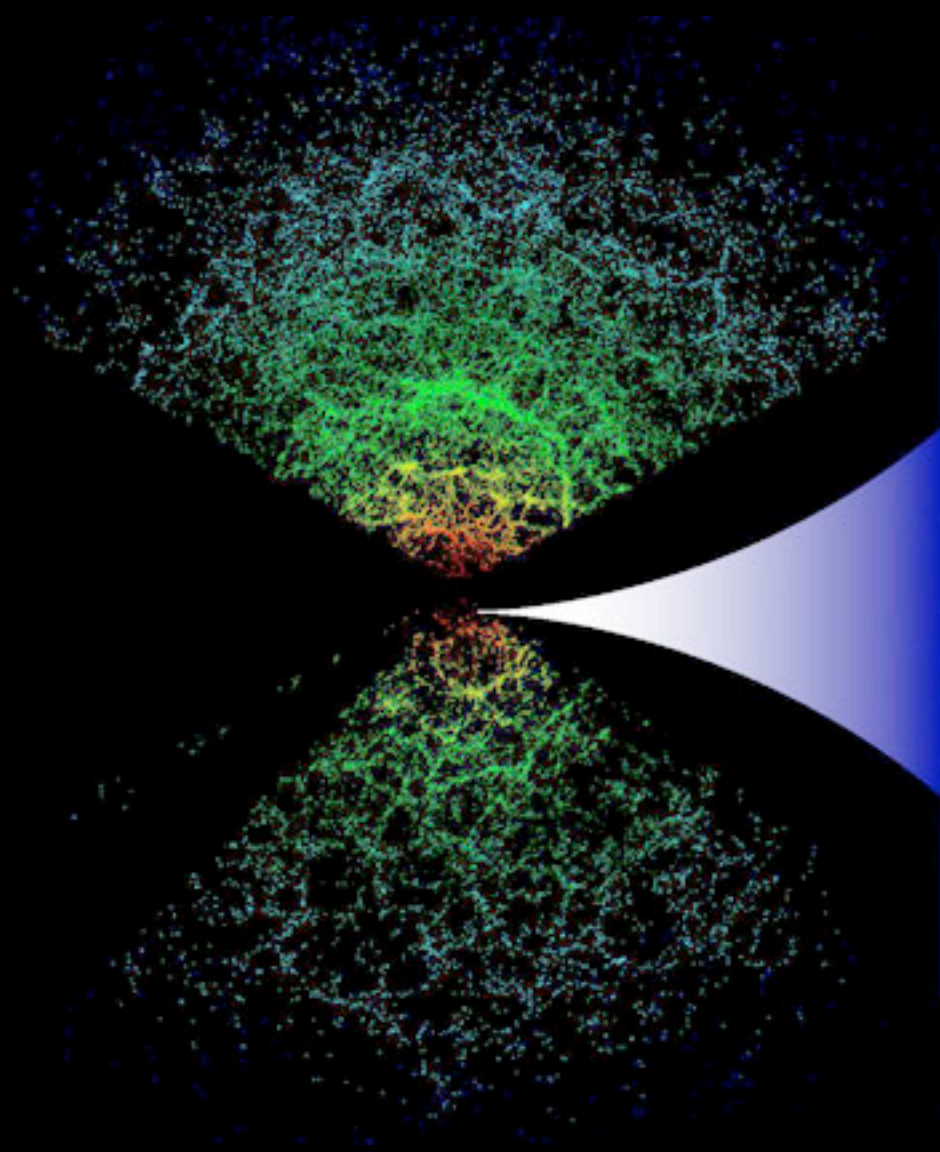
cz in km/s



2 degree Field: 240,000 galaxies

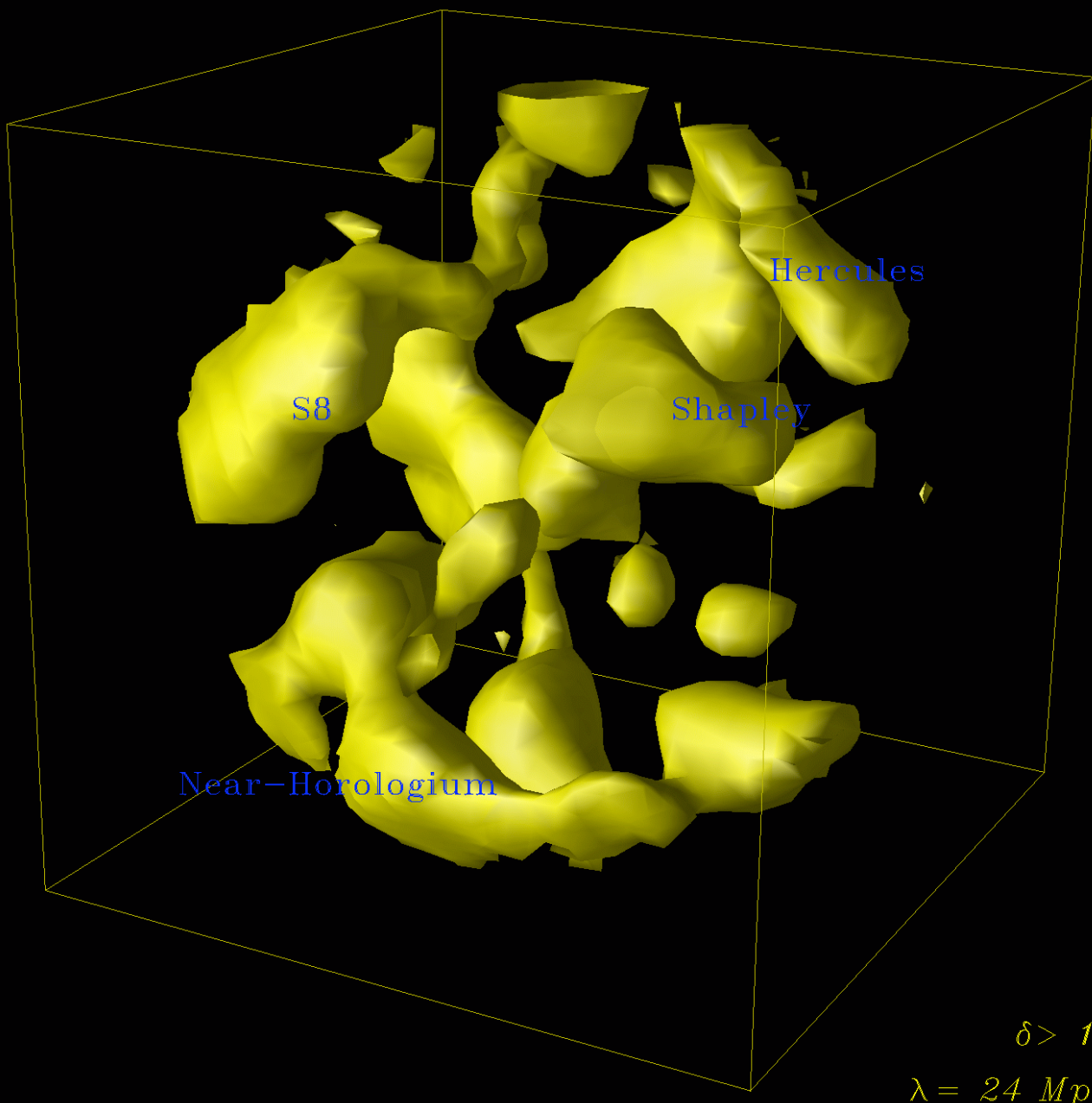


2dF 3-D map



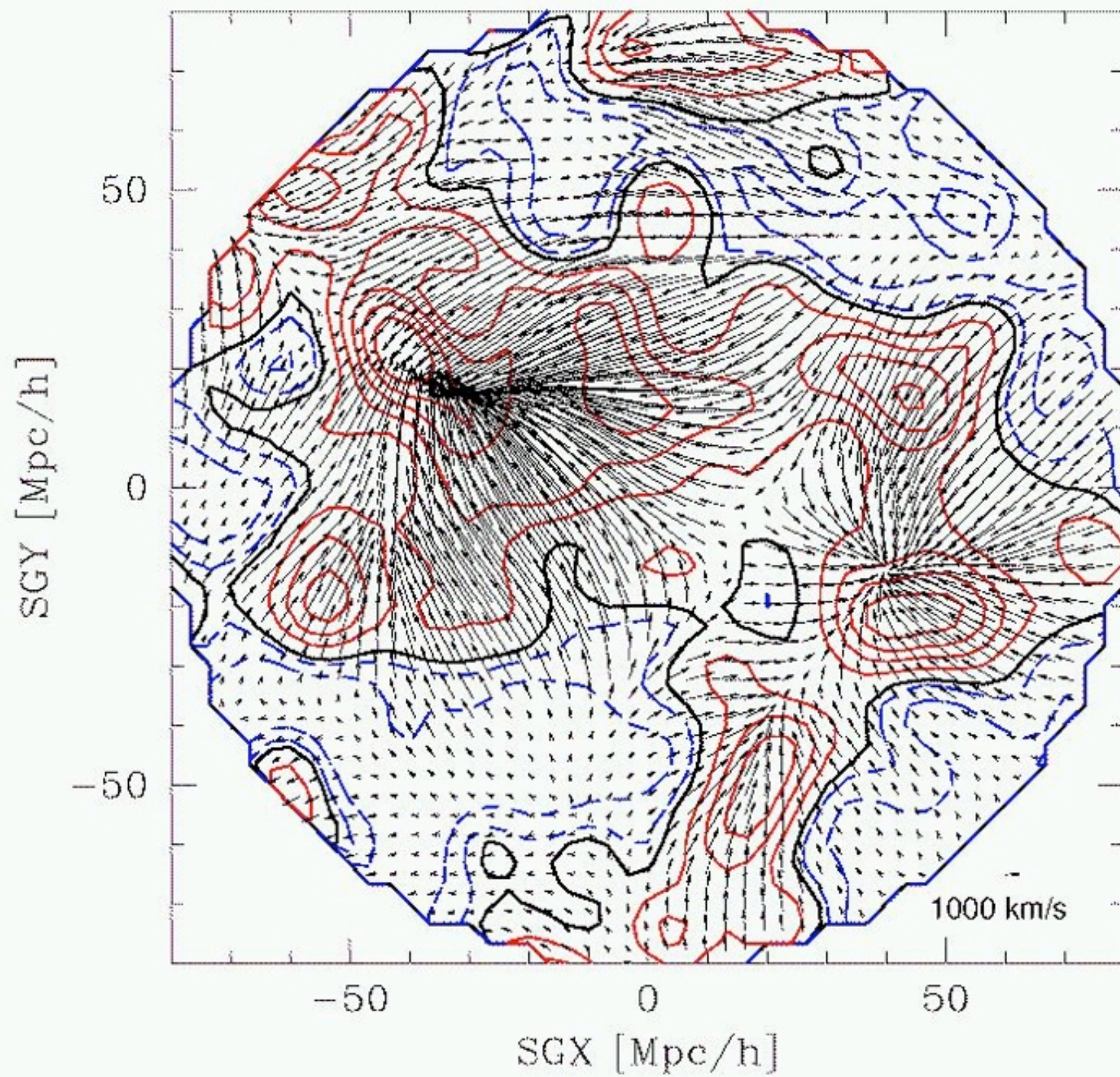
Slon Digital Sky Survey

PSCz density field < 180 Mpc/h.

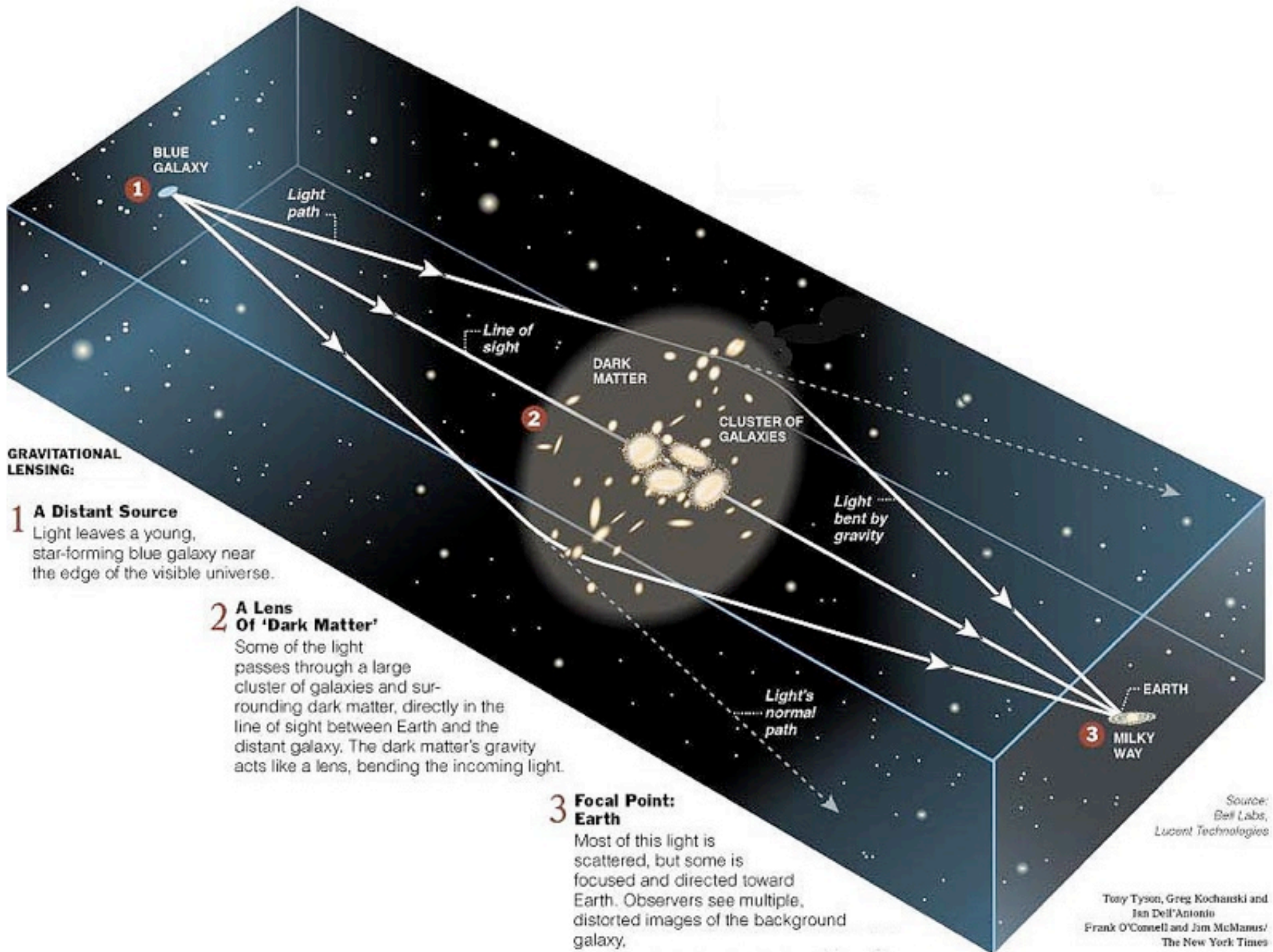


$\delta > 1.50$

$\lambda = 24 \text{ Mpc}/h$

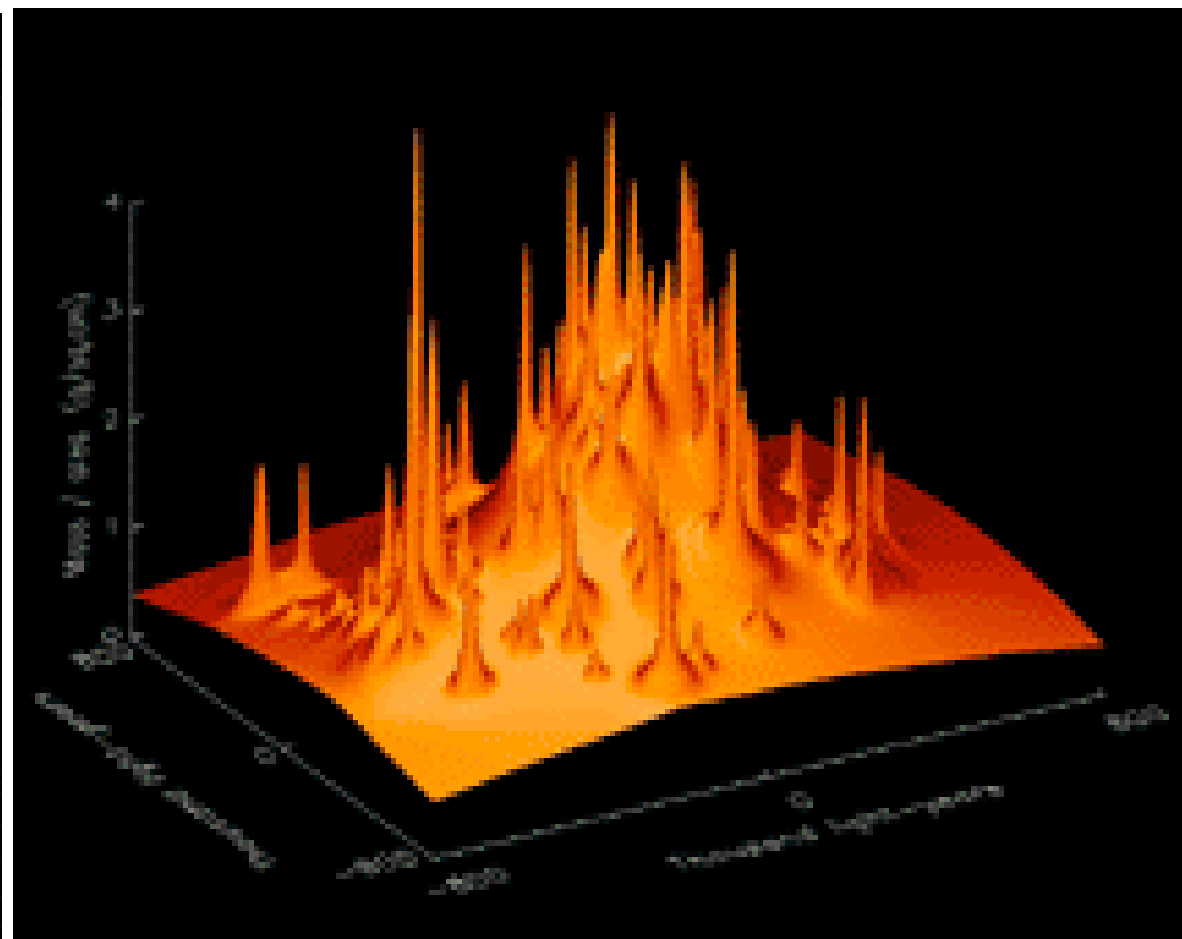
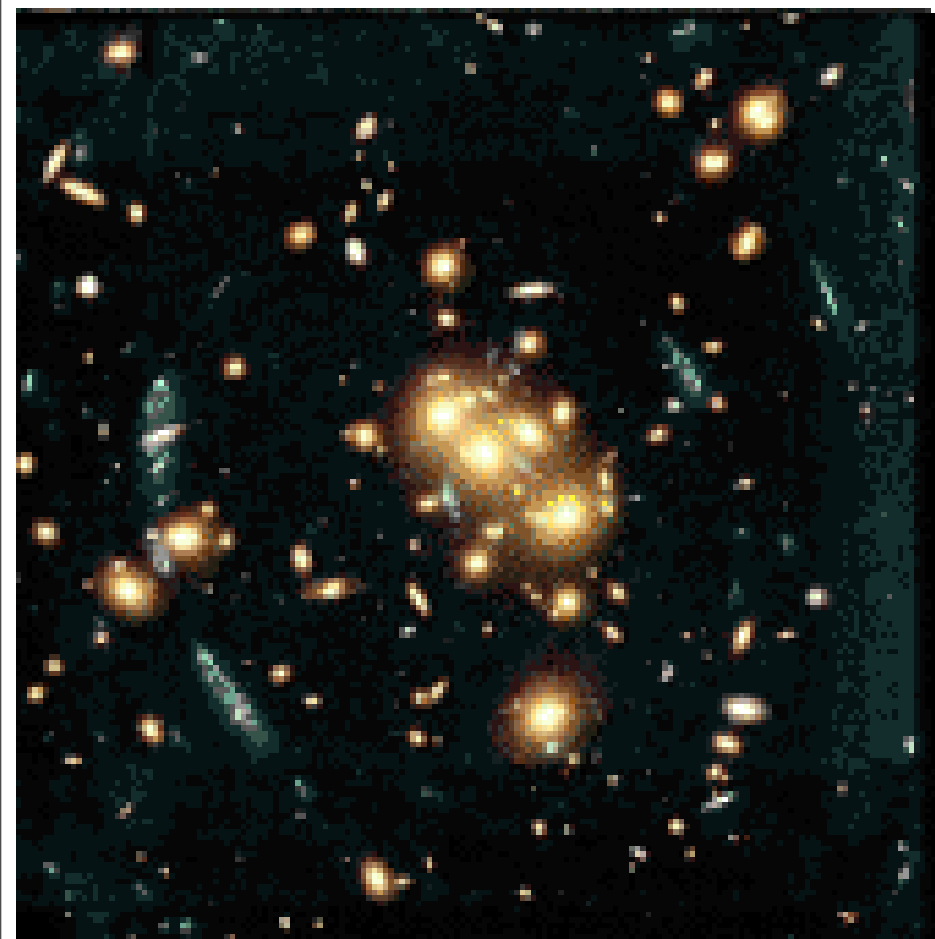






Source:
Bell Labs,
Lucent Technologies

Tony Tyson, Greg Kochanski and
Ian Dell'Antonio
Frank O'Connell and Jim McManus/
The New York Times

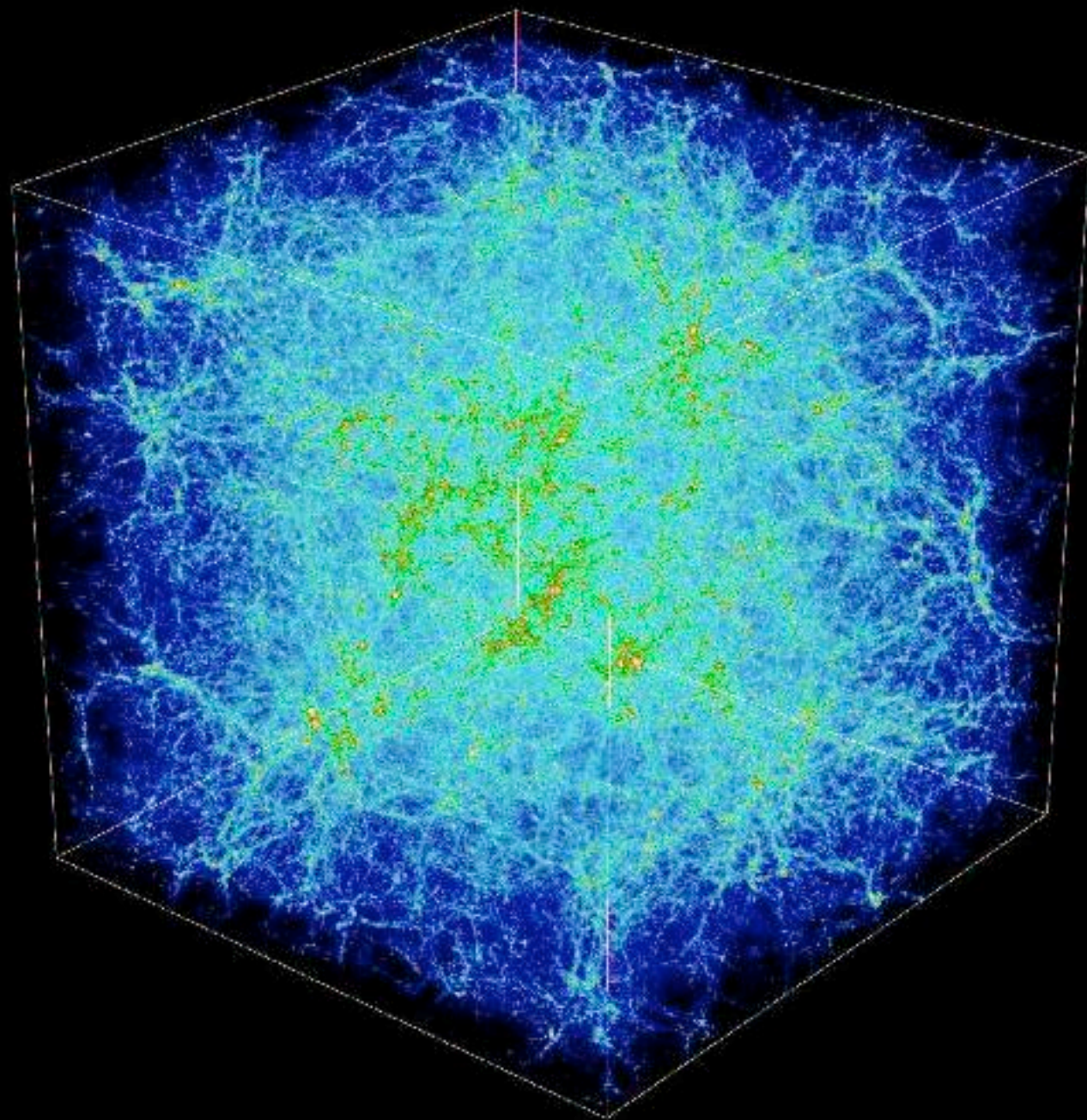


Where is the mass? I

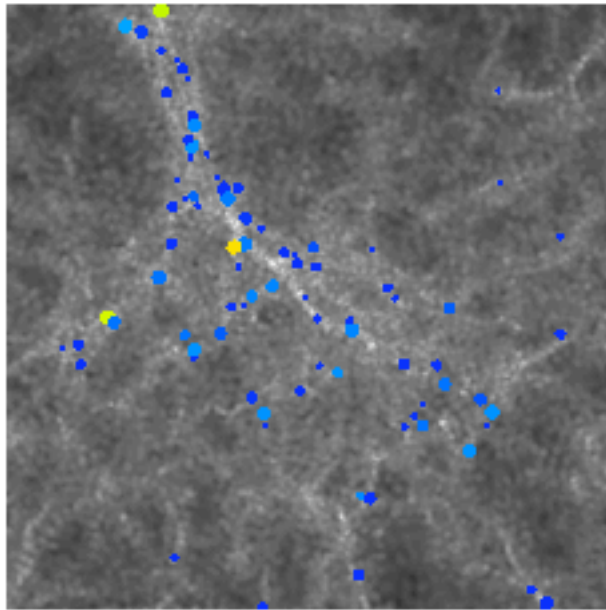




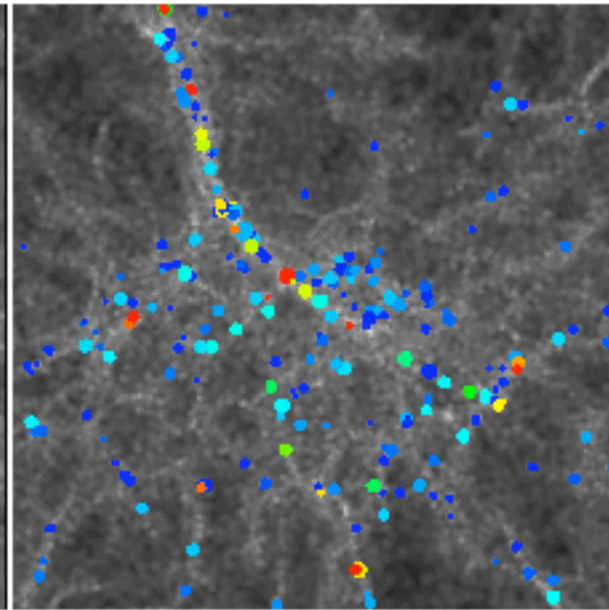




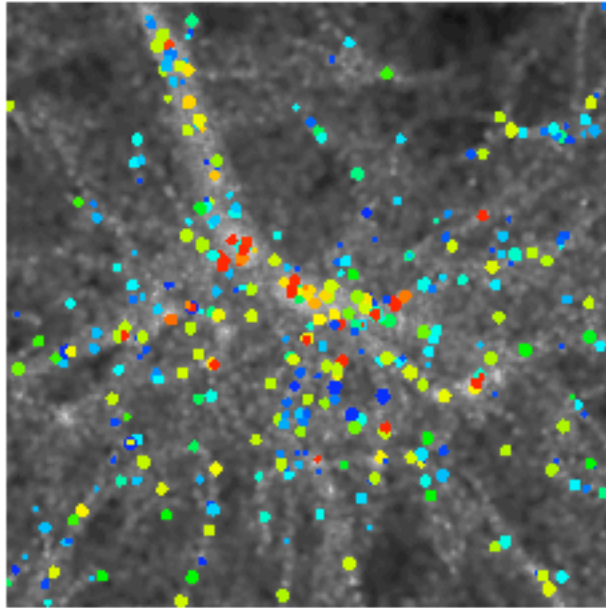
$z=3$



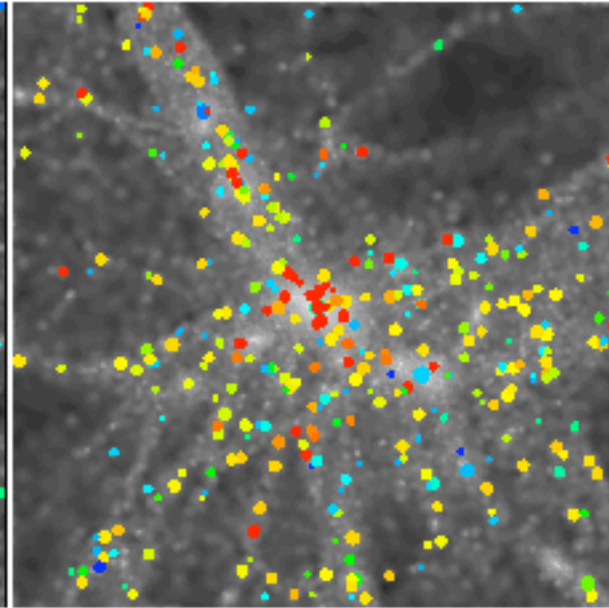
$z=2$



$z=1$



$z=0$



**Dr. Martin Hendry
will be back next week**