

Theoretical Astrophysical Observatory

Centre for Astrophysics and Supercomputing - Swinburne University of Technology

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Astronomy Australia Limited

HPC Working Group Report: Priority 1...

Australia needs to build an astronomical data fabric that links ... data flowing from telescopes like SkyMapper, ASKAP and MWA.

Astronomy Decadal Plan

Mid-Term Review: Priority 5...

Investment at a national level in eResearch-related hardware and software systems ... is needed if we are to fully exploit the coming data tsunami from the current and upcoming telescopes and instruments.



Bryan Gaensler (@SciBry)

[4/06/12 9:44 AM](#)

.[@MatthewColless](#): Prediction for astronomy in the year 2022 - 'data scientists' will outnumber 'observers' by 2:1 [#SCCSV](#)



Bryan Gaensler (@SciBry)

[4/06/12 9:39 AM](#)

.[@MatthewColless](#): The best surveys make data public as quickly as possible. Guarantees maximum uptake (and citations) [#SCCSV](#)



The All Sky Virtual Observatory

What is the All-Sky Virtual Observatory

New telescopes and facilities coming online in the next three to five years will produce data in volumes never previously experienced in Australian astronomy. To gain maximum scientific benefit from this data flood, the federation of datasets from all types of astronomical facilities in Australia will be needed. This will involve creating the hardware, tools and services to bring together data from radio telescopes, optical telescopes and supercomputers, covering all parts of the southern sky, under a Virtual Observatory.

After extensive consultation with the entire astronomy community, two Australian astronomical facilities were chosen to form the first pillar of the All-Sky Virtual Observatory:

The primary observational dataset will come from the SkyMapper facility, an optical telescope located at Siding Spring Observatory, NSW, built by the Australian National University. SkyMapper is producing the most detailed and sensitive digitized map of the southern sky at optical wavelengths. This nationally significant dataset will be a fundamental reference for astronomers in Australia, and internationally, for many decades.

The Theoretical Astrophysical Observatory (TAO), being developed at Swinburne University of Technology, will house the growing ensemble of Australian theory data sets and galaxy formation models, with value-add tools that will allow astronomers to observe each virtual universe as if it was real. This will be achieved by mapping the simulated data onto an observer's viewpoint and the application of custom telescope simulators, beginning with SkyMapper. TAO provides a direct and vital link between the theoretical and observational aspects of data collection and analysis.

Who is Astronomy Australia?

Astronomy Australia Ltd (AAL) is a not-for-profit company whose members are all the Australian universities and research organisations with a significant astronomical research capability.

Our vision is that astronomers in Australia will have access to the best astronomical research infrastructure. AAL will achieve its

 Search

VLs in project negotiation

[The All Sky Virtual Observatory](#)

[Climate and Weather Science Laboratory](#)

[Humanities Networked Infrastructure \(HuNI\) unlocking and uniting Australia's cultural data](#)

[The Genomics Virtual Laboratory](#)

[The Characterisation Virtual Laboratory: research environments for exploring inner space](#)

[Early Activities](#)

[CSIRO - Virtual Geophysics Laboratory](#)

[University of Queensland - Virtual Genomics Laboratory](#)

[University of Tasmania - Marine Virtual Laboratory](#)

Latest News ...

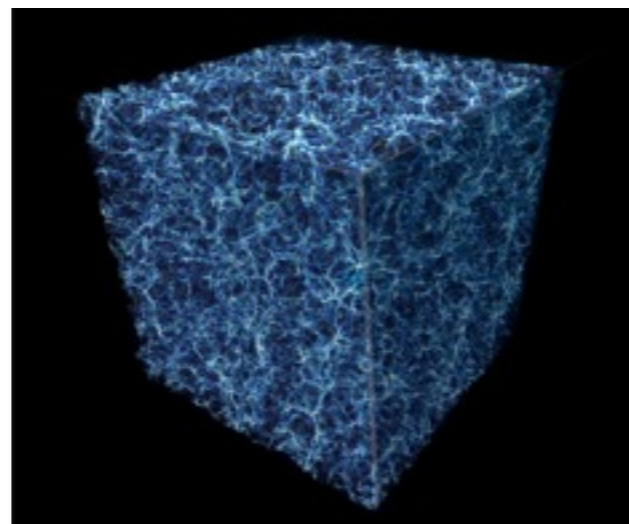


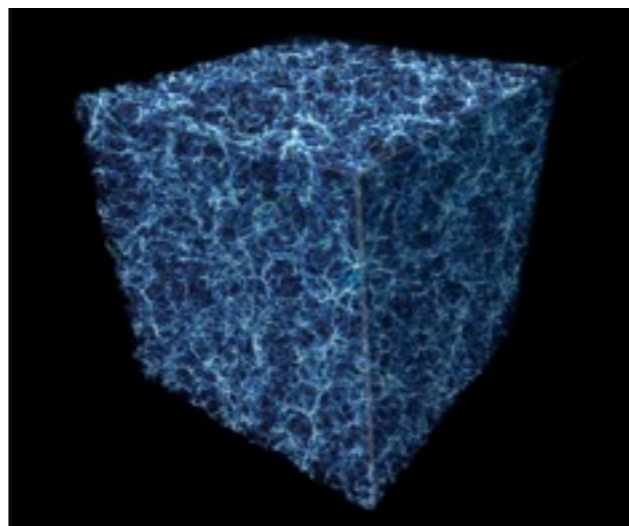
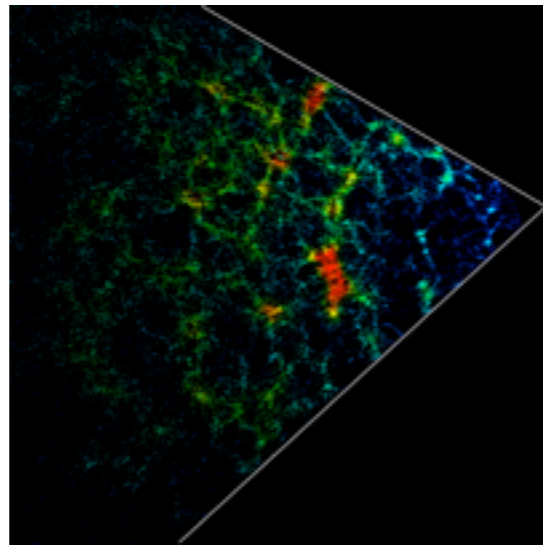
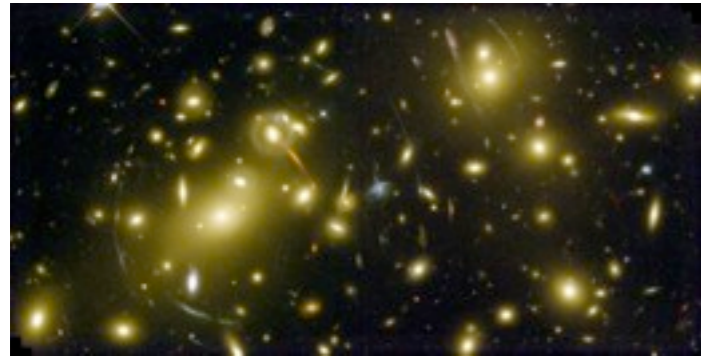
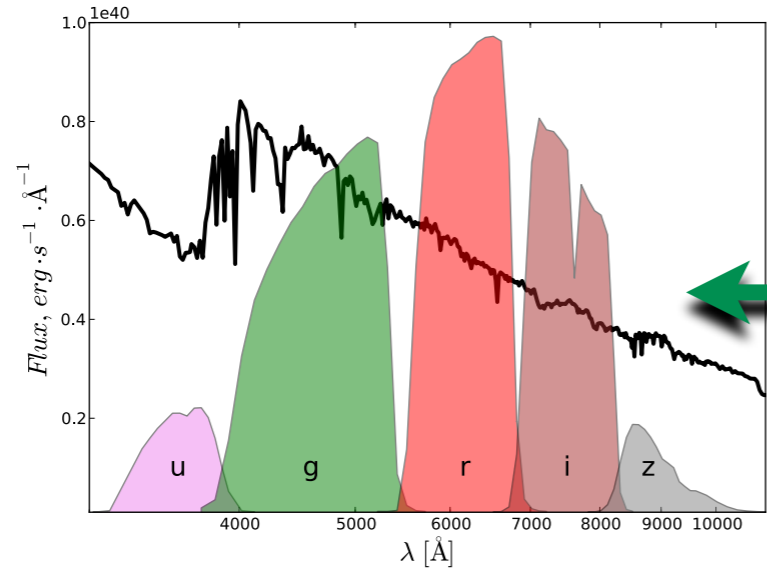
ASKAP
+Pawsey

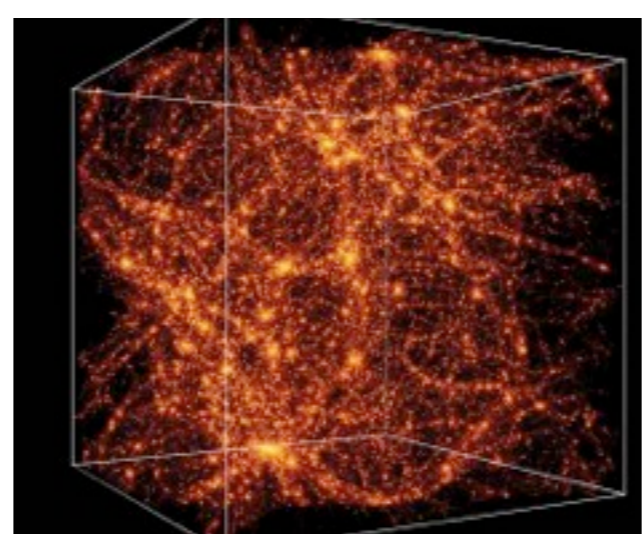
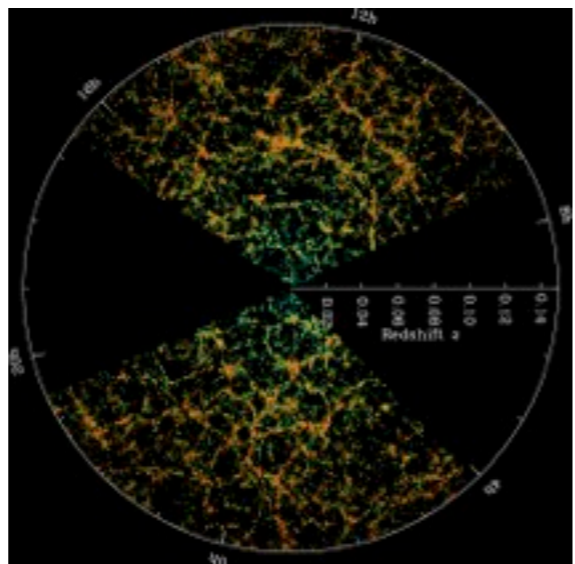
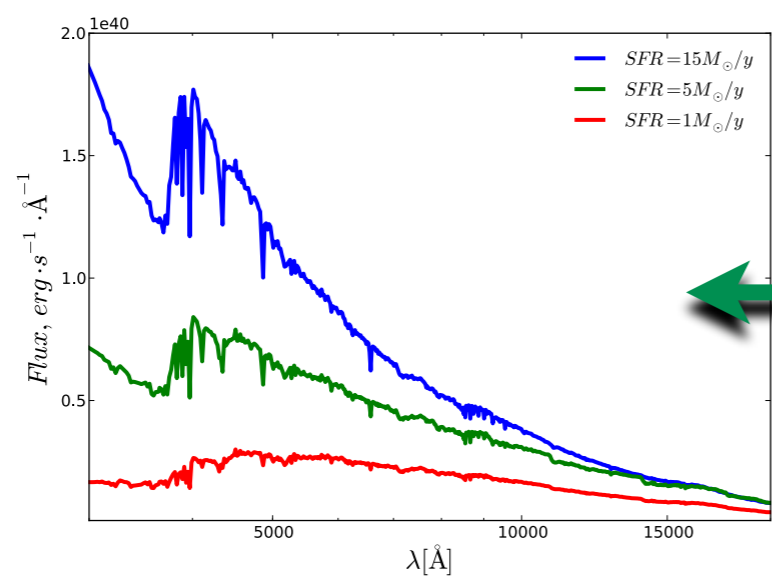


SkyMapper
+NCI





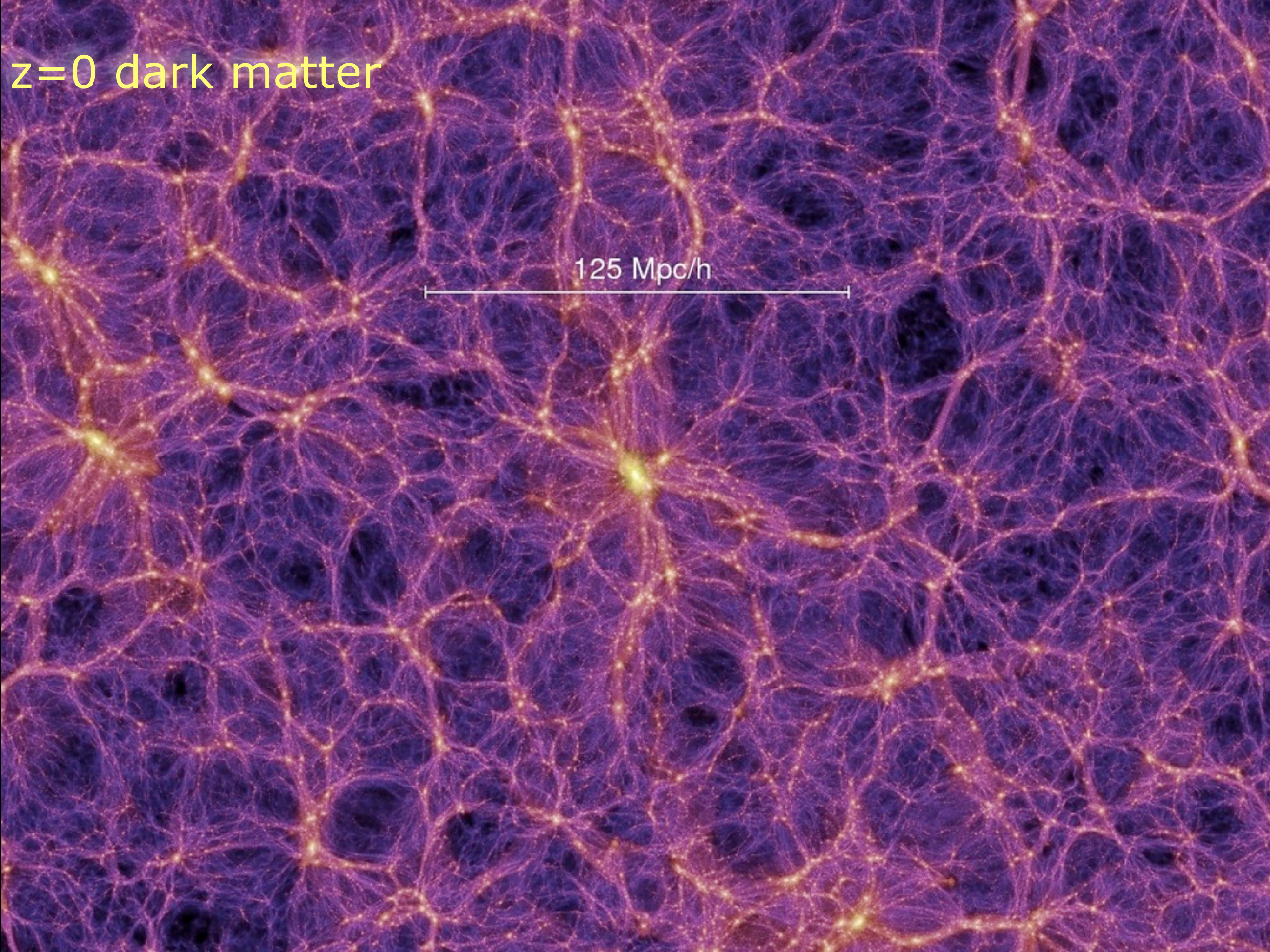


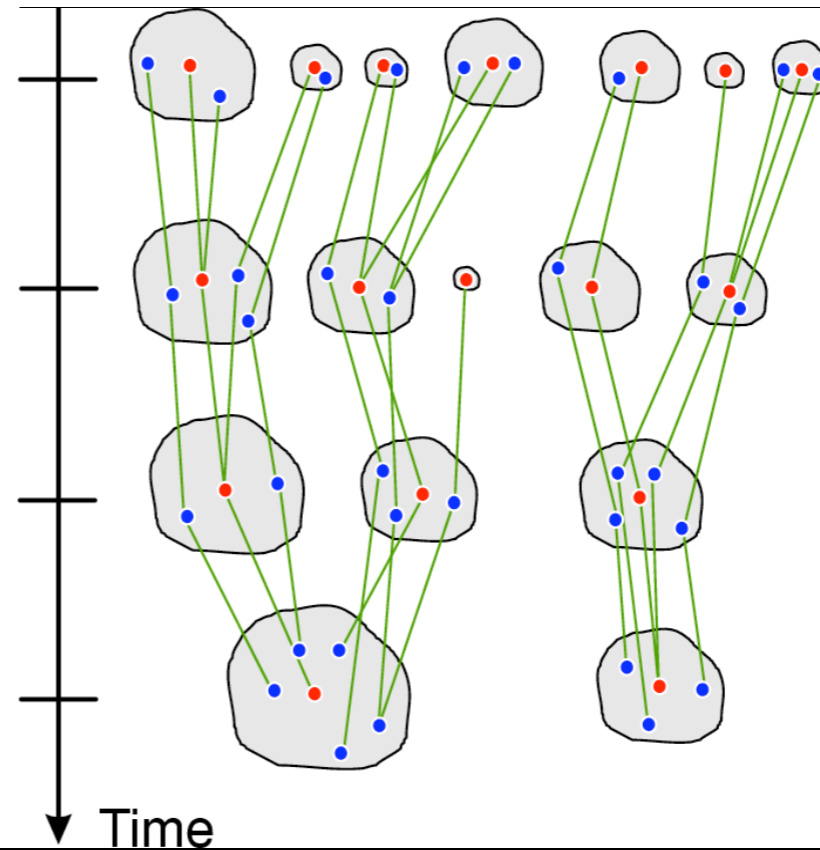
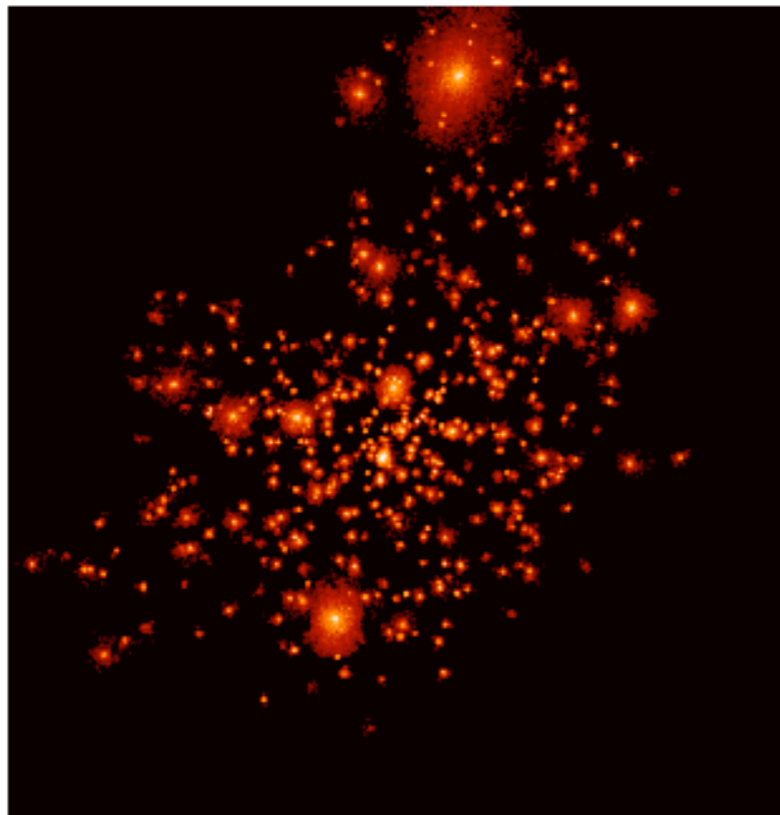
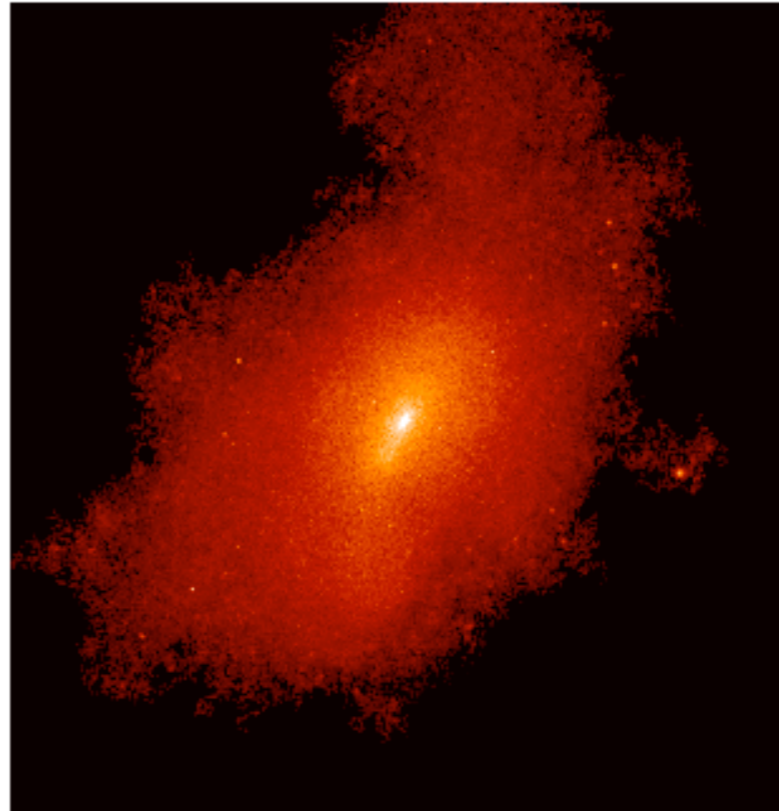
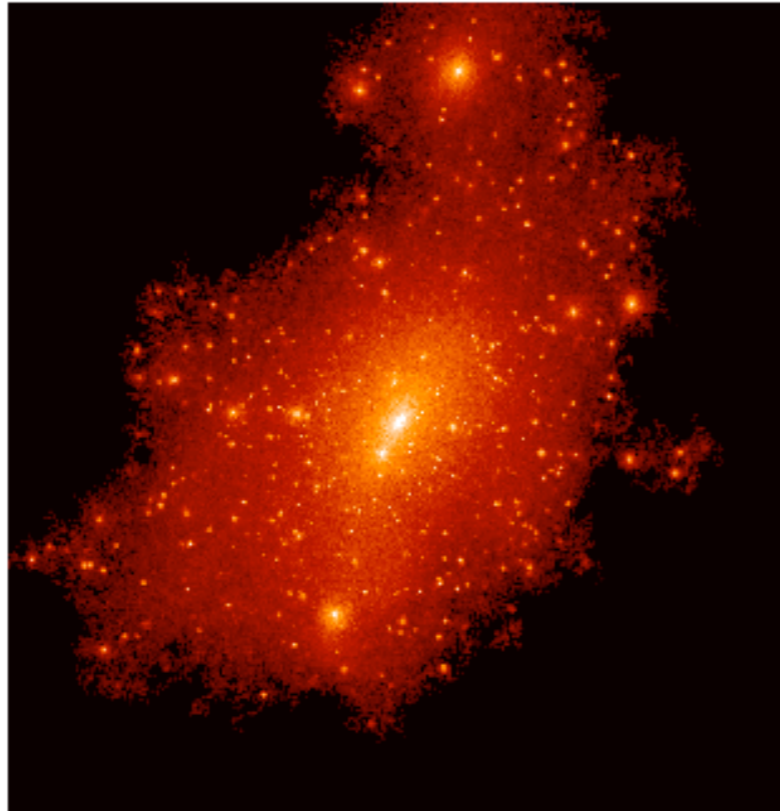


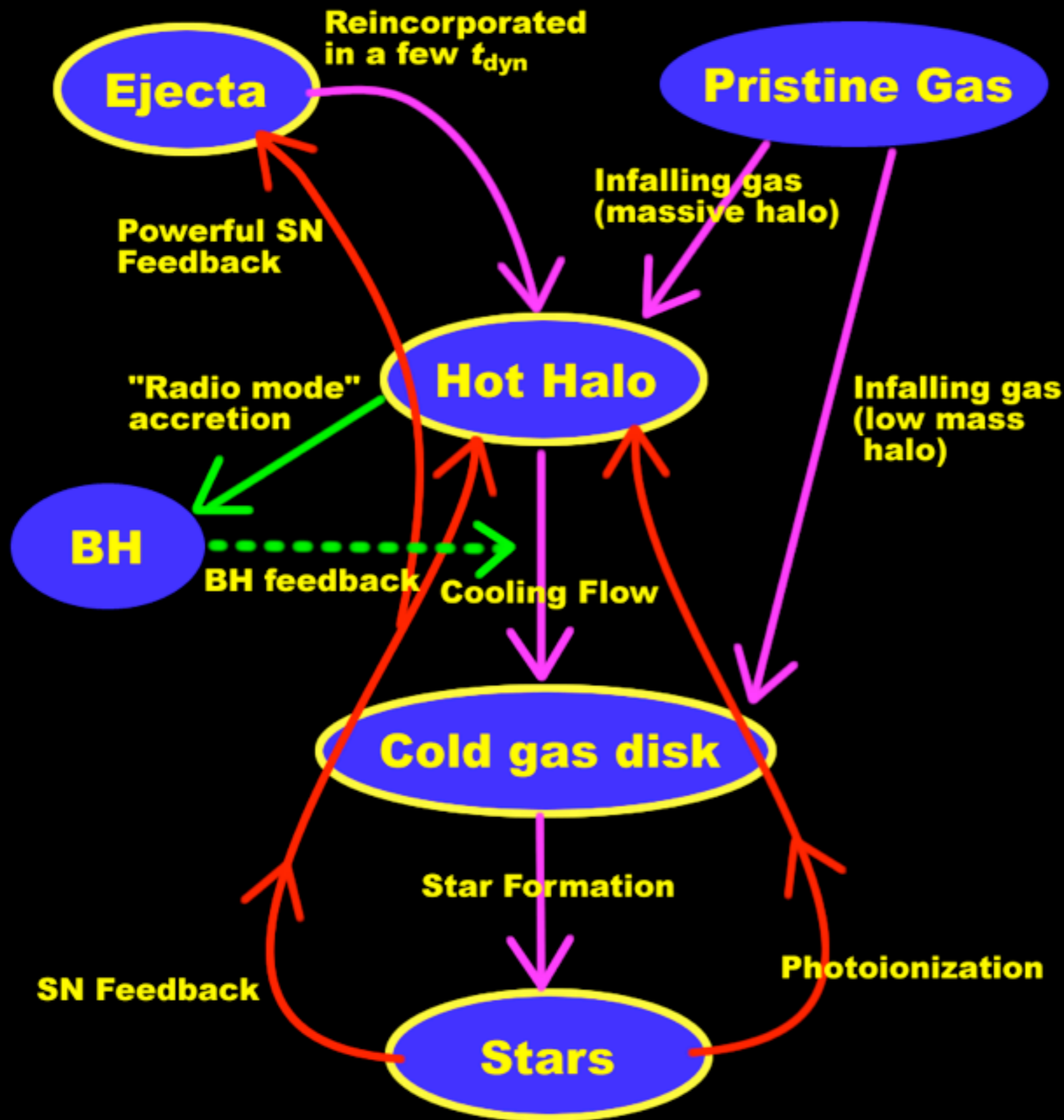
Simulations of galaxy formation

$z=0$ dark matter

125 Mpc/h





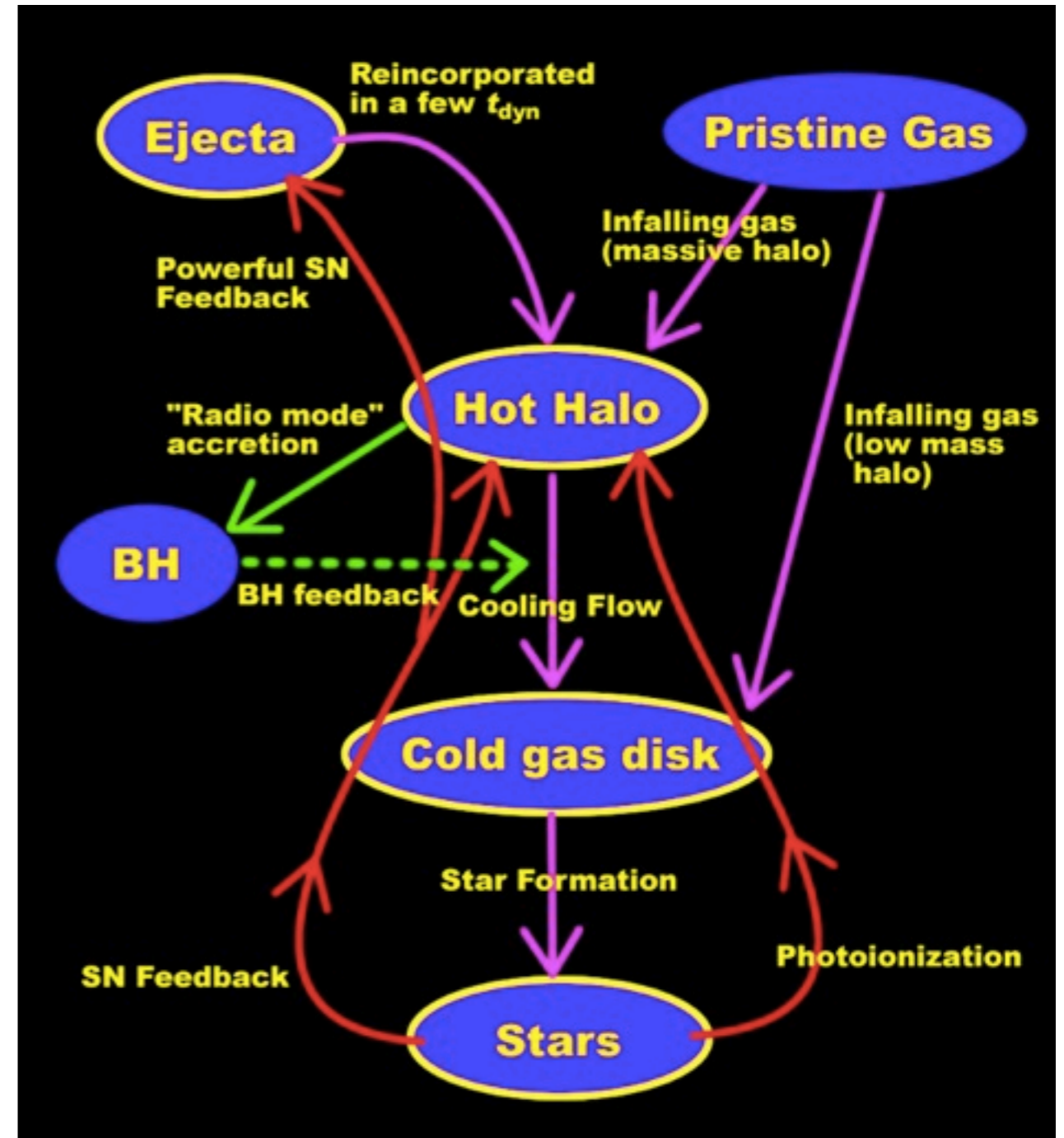
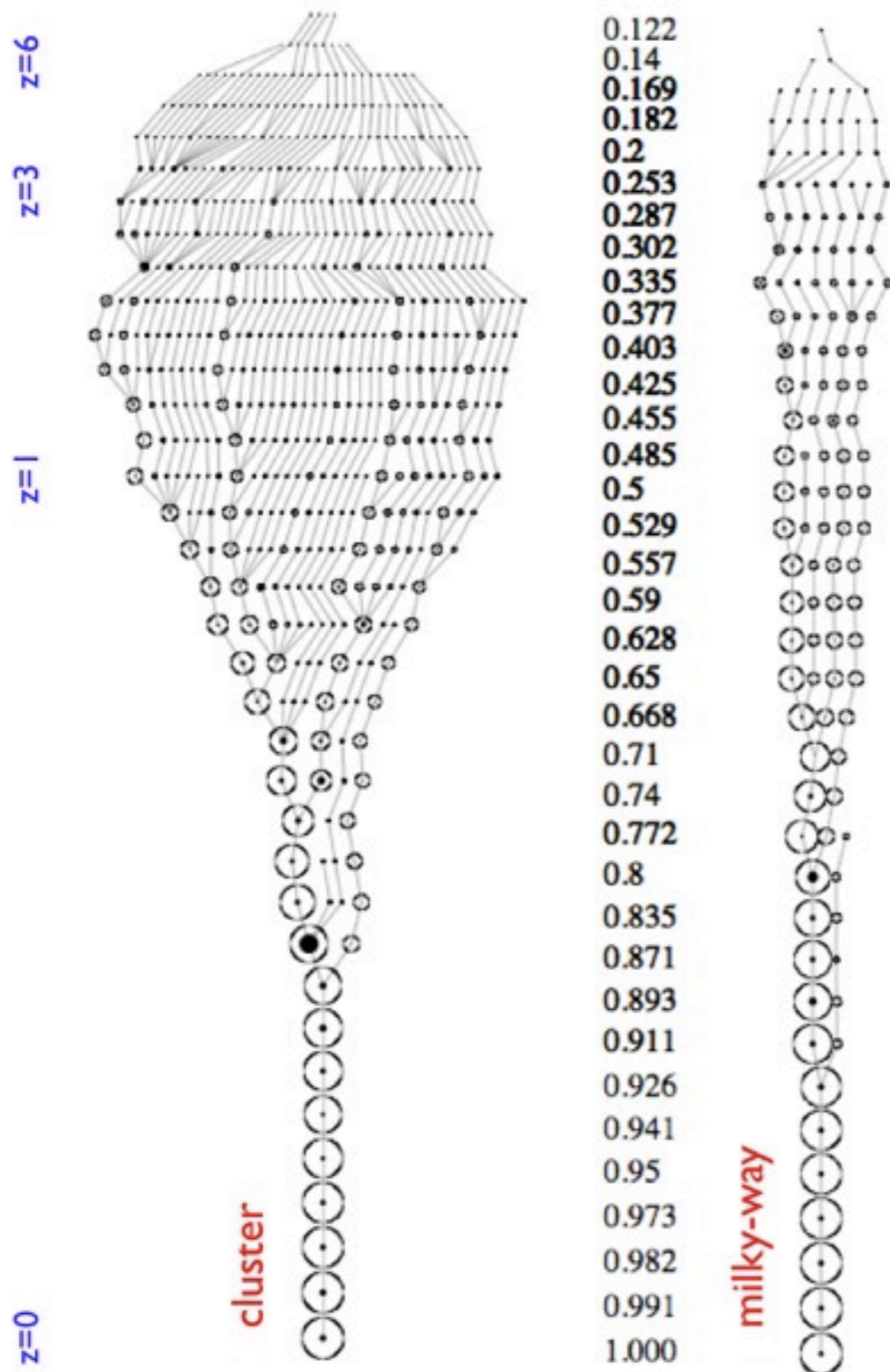


- ▶ Schmidt law star formation
- ▶ SFR dependent SN winds
- ▶ satellite gas stripping
- ▶ morphological transformation
- ▶ assembly through mergers
- ▶ starbursts through mergers
- ▶ Magorrian relation BH growth
- ▶ jet & bubble AGN feedback

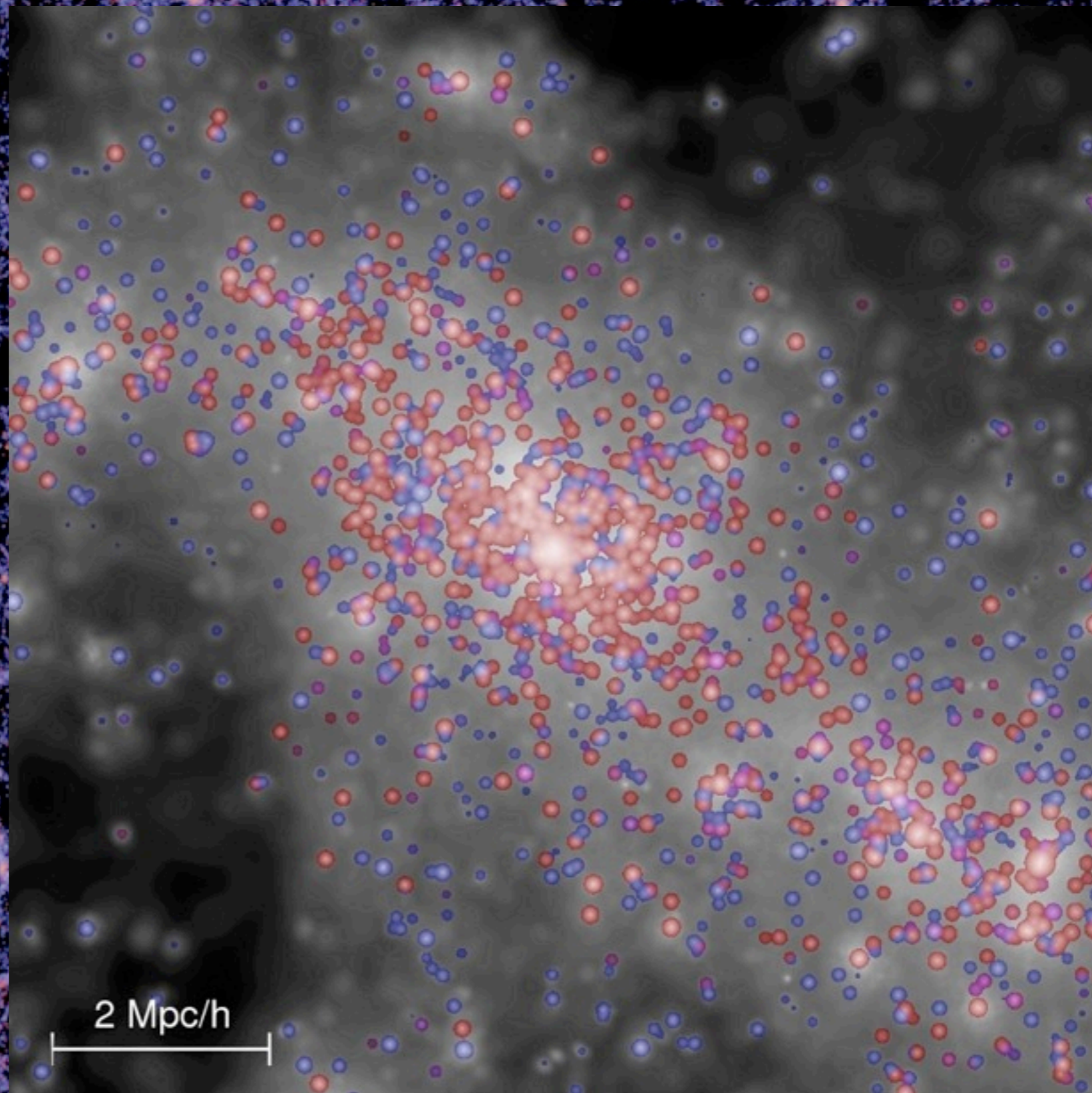
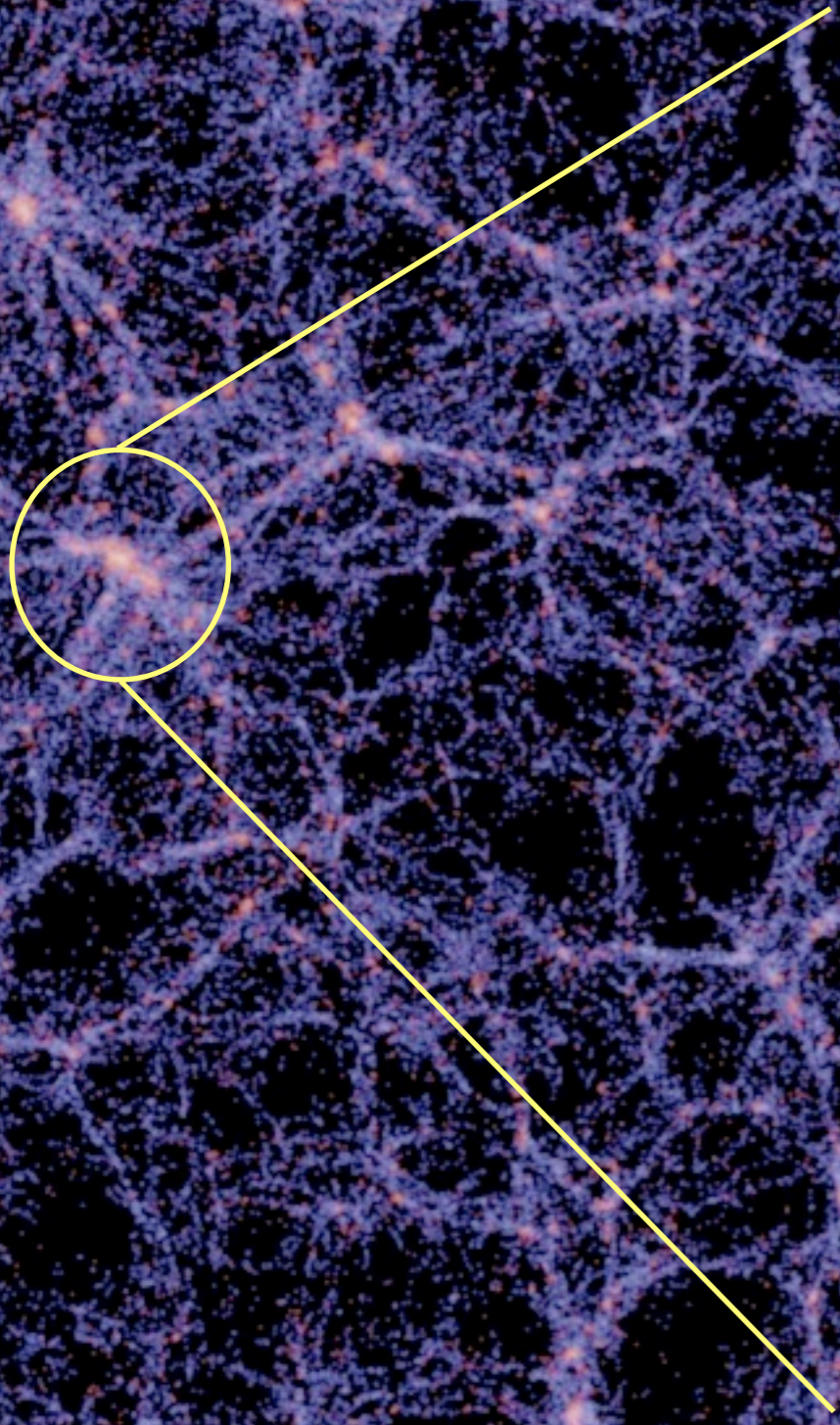
Numerical Simulation

+

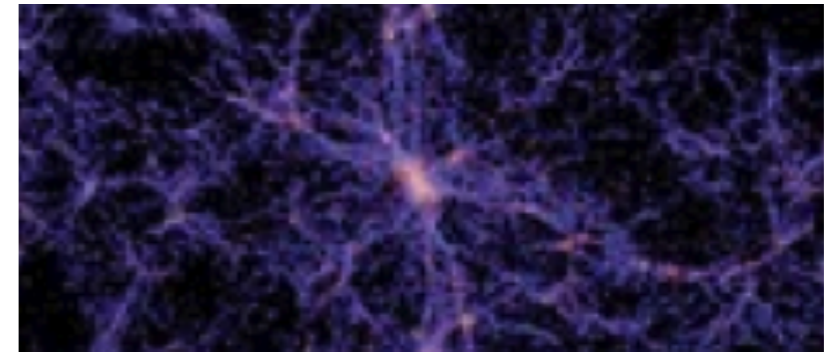
Analytic Simulation



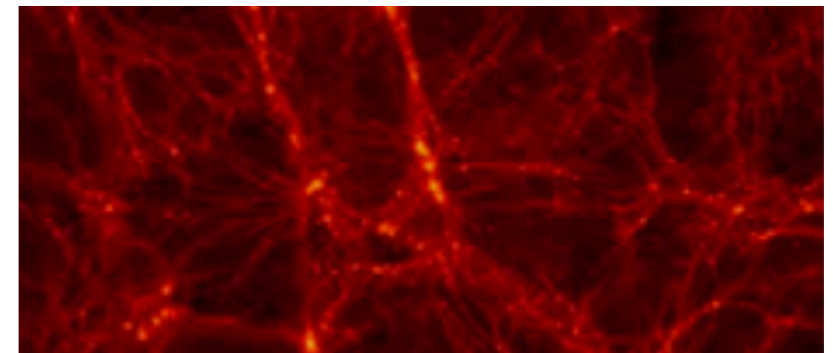
$z=0$ galaxy light



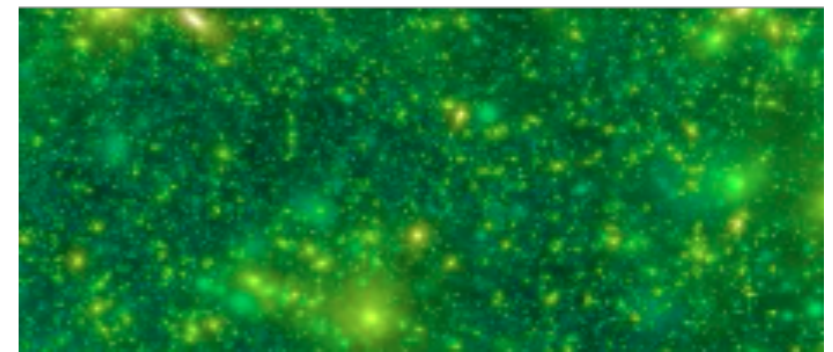
Millennium (Springel et al. 2005)



Bolshoi (Klypin et al. 2010)



GiggleZ (Poole et al. in prep.)



NeCTAR
ASVO-TAO
“Virtual Laboratory”

Telescope simulator



Image generation



Light cone generation

Real time,
arbitrary parameters

Almost complete
(Maraston, Conroy, others)

SEDs + Filters



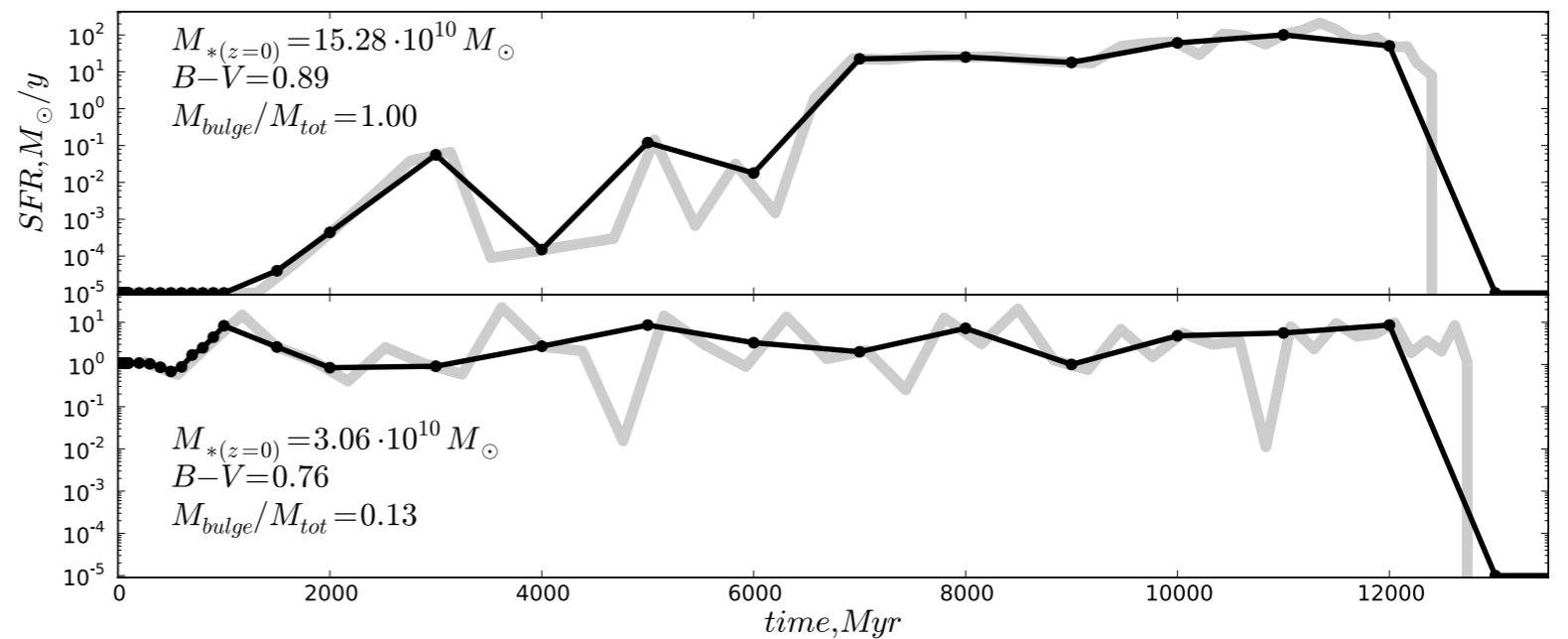
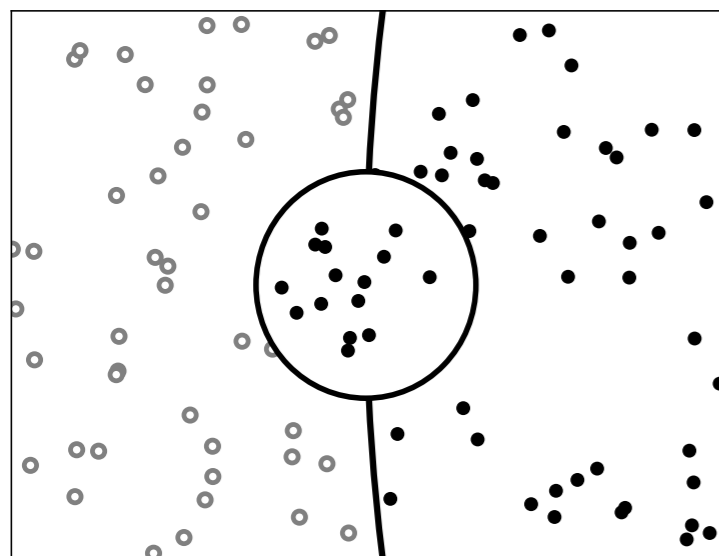
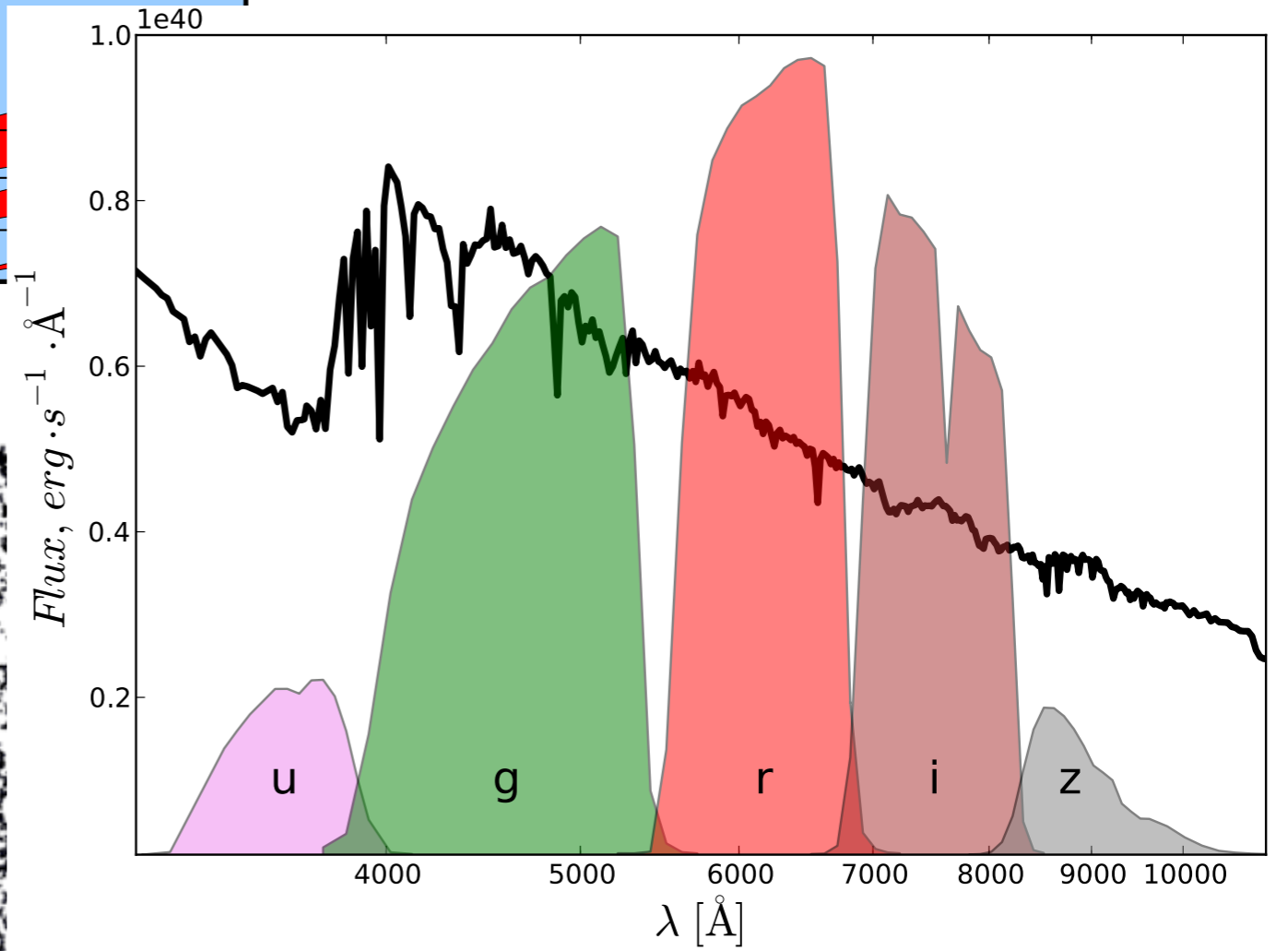
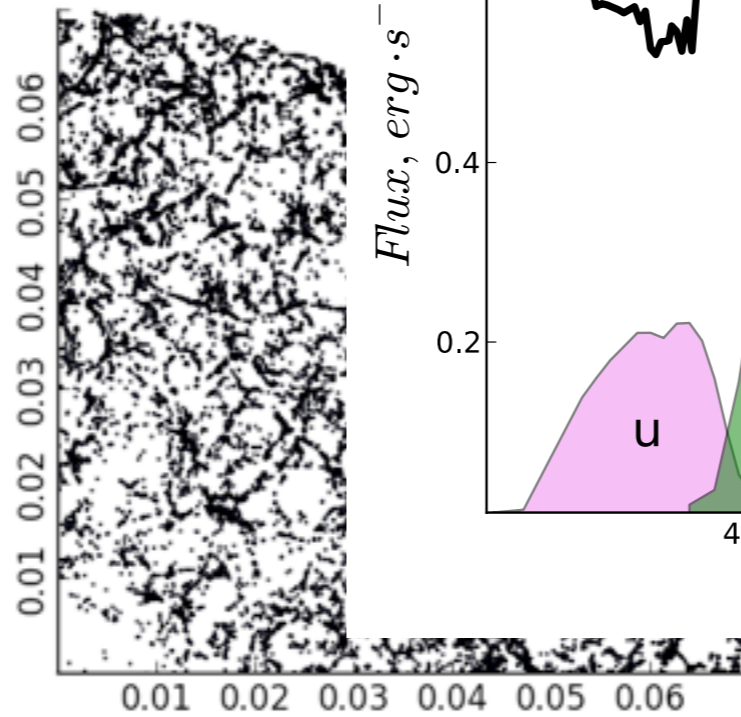
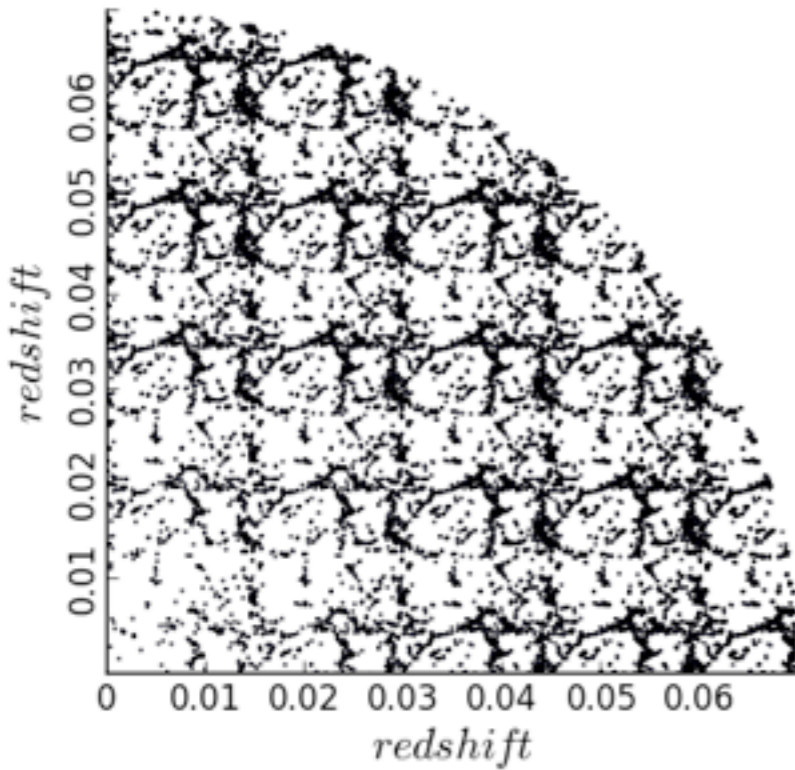
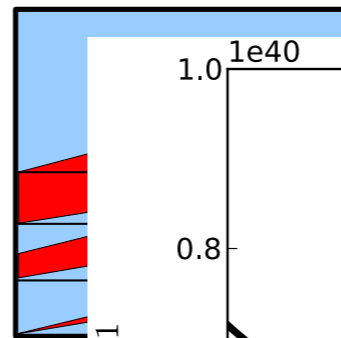
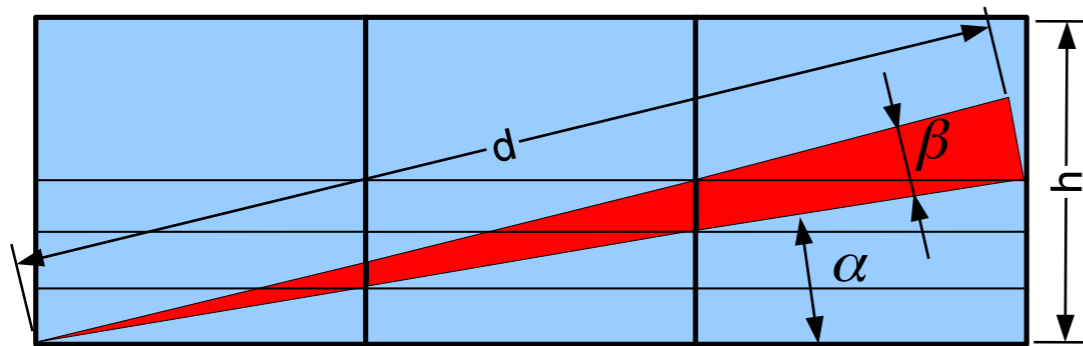
Web form data query

Simple (no SQL!)

Millennium, Bolshoi, GiggleZ
plus models: SAGE,
Galacticus, others

Simulation database







Mock Galaxy Factory

(Required Fields are marked with an asterisk)

[Geometry](#)[Spectral Energy Distribution](#)[Record filter](#)[Output format](#)[Summary and Submit](#)[Next >](#)

Light Cone

General

Catalogue geometry*

Light-Cone

Dark matter simulation*

Millennium

Galaxy model*

SAGE

Right Ascension Opening Angle (degrees)*

Declination Opening Angle (degrees)*

Selected simulation details

Millennium

Paper: Springel et al. 2005

External Link: Simulating the joint evolution of quasars, galaxies and their large-scale distribution

Cosmology: WMAP-1

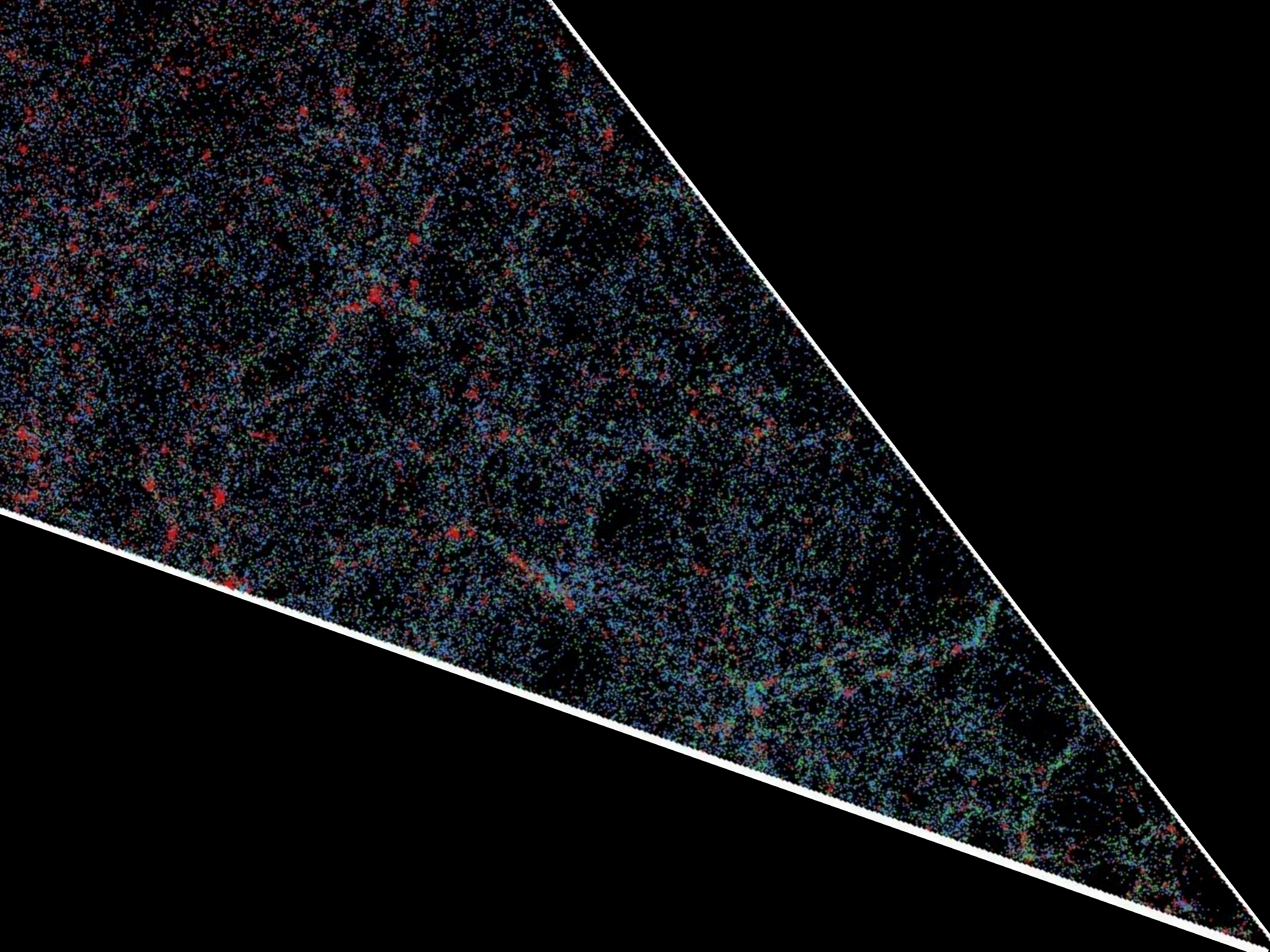
Cosmological parameters: $\Omega_m = 0.25$, $\Omega_b = 0.045$, $h = 0.73$, $\Omega_\Lambda = 0.75$, $n = 1$, $\sigma_8 = 0.9$

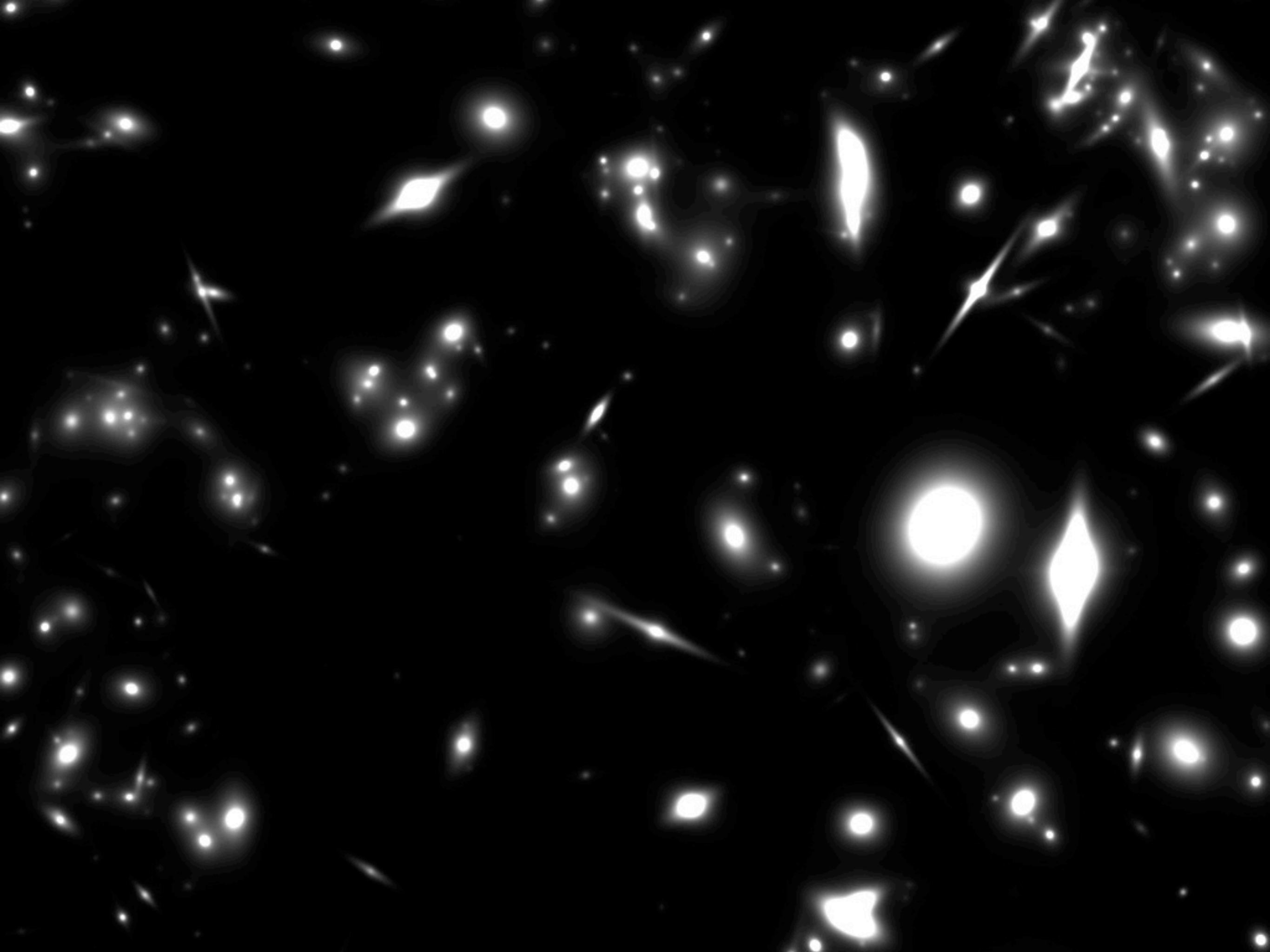
Box size: 500 Mpc/h

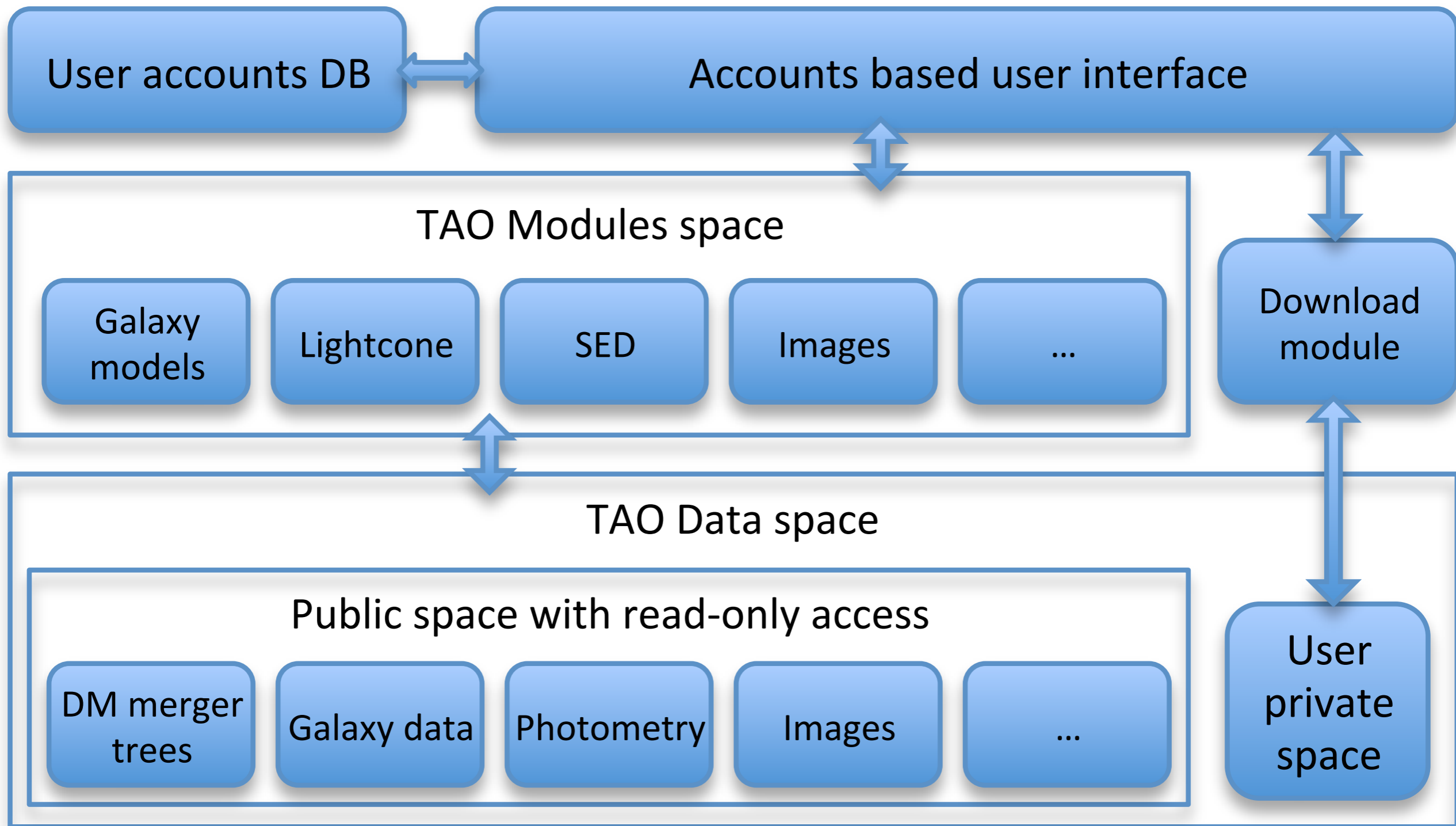
Web site: Public release of a VO-oriented and SQL-queryable database for studying the evolution of galaxies in the Λ CDM cosmogony

Selected galaxy model details

SAGE







NeCTAR
ASVO-TAO
“Virtual Laboratory”

Telescope simulator

Lensing?

Image generation

Light cone generation

Radio?

IFS?

AGN SEDs?

SEDs + Filters

Web form data query

Simulation database

<https://www.nectar.org.au/all-sky-virtual-observatory>

<http://www.asvo.org.au>

<http://tao.it.swin.edu.au/mock-galaxy-factory>