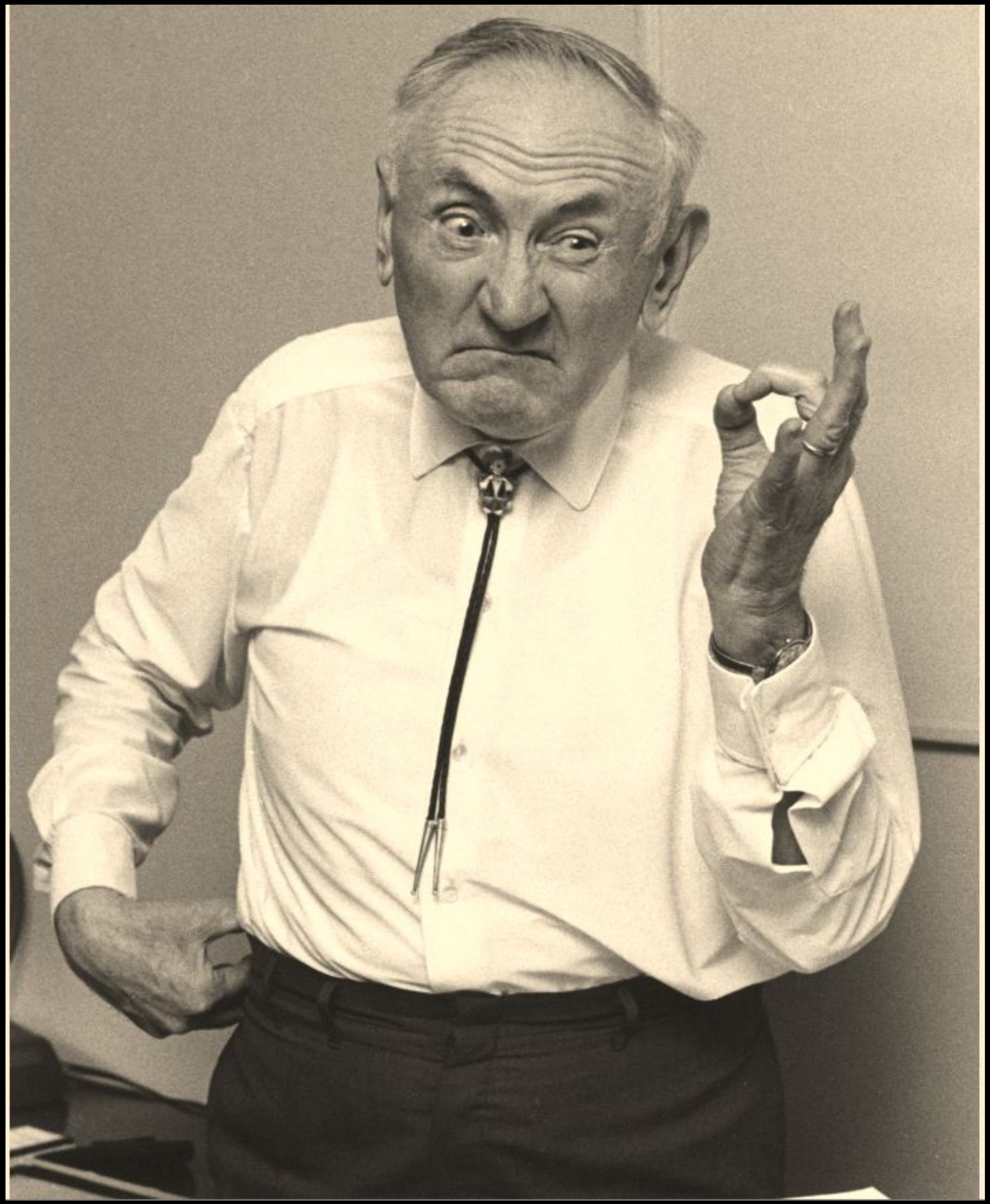
The Death of Cold Dark Matter

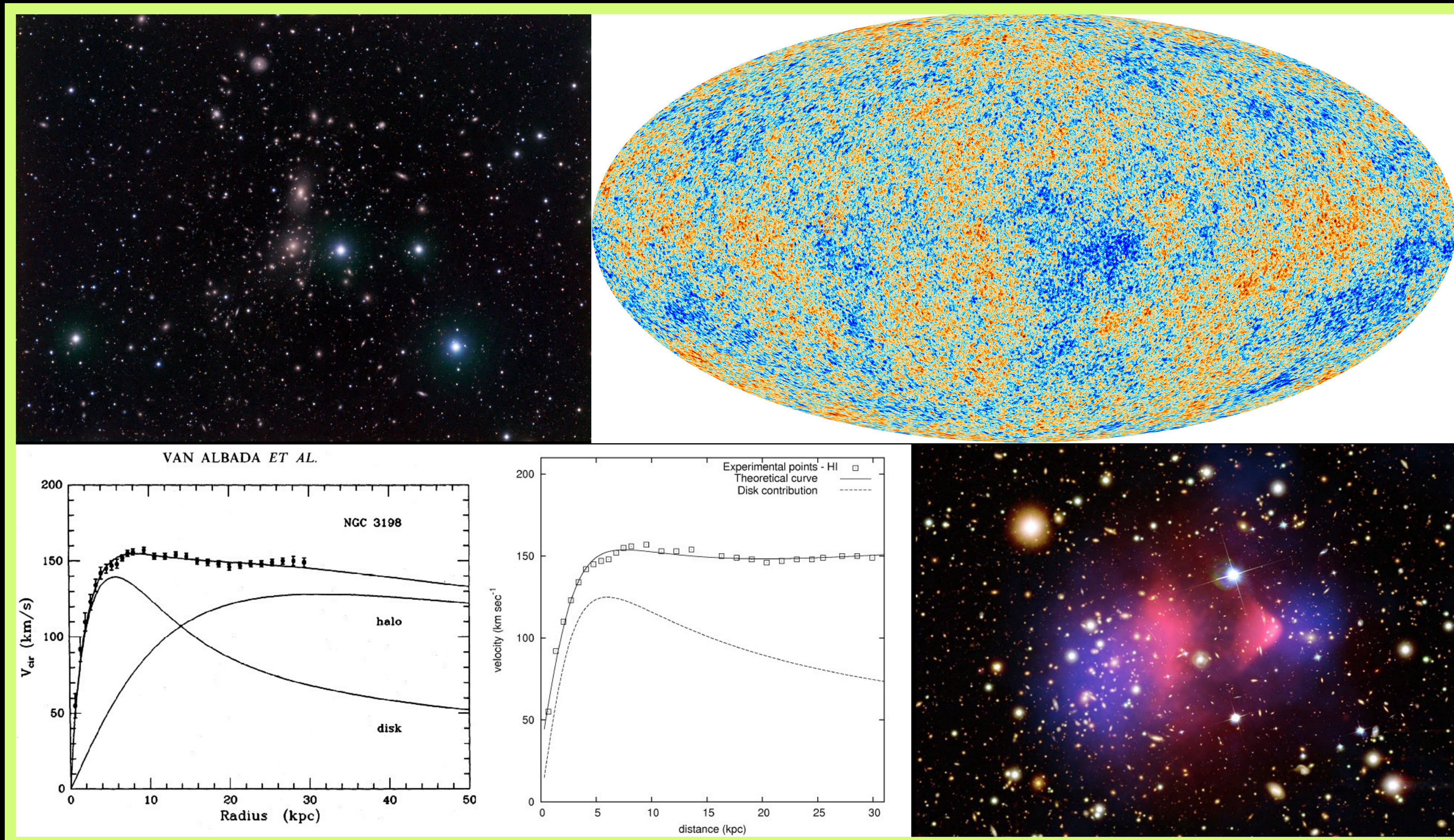
Jack Richings

Carlos Frenk, Adrian Jenkins,
Carlton Baugh, Celine Boehm

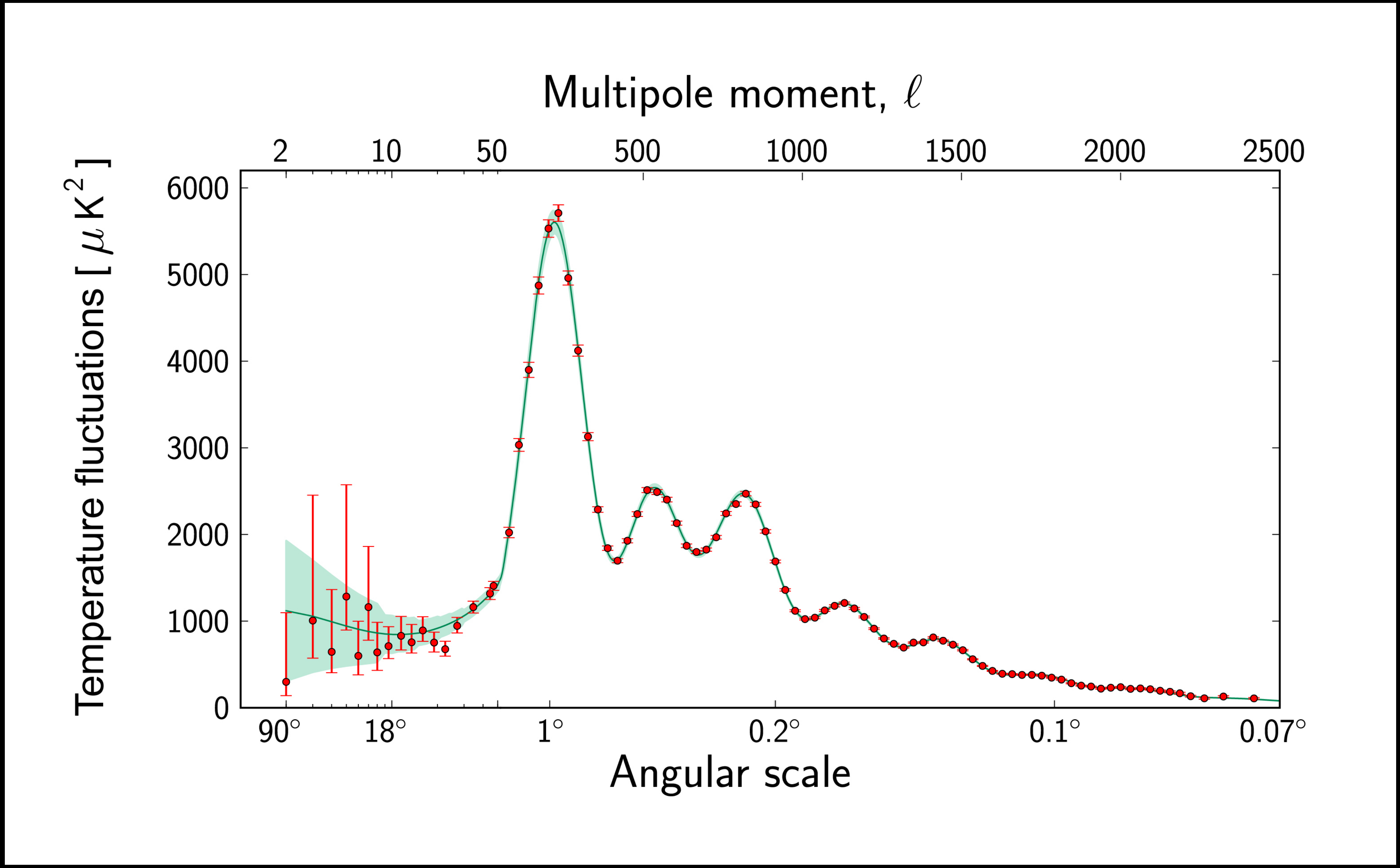
The Death of Cold Dark Matter

- What is cold dark matter?
- Does observational data support the CDM model?
- New tests of the CDM paradigm.

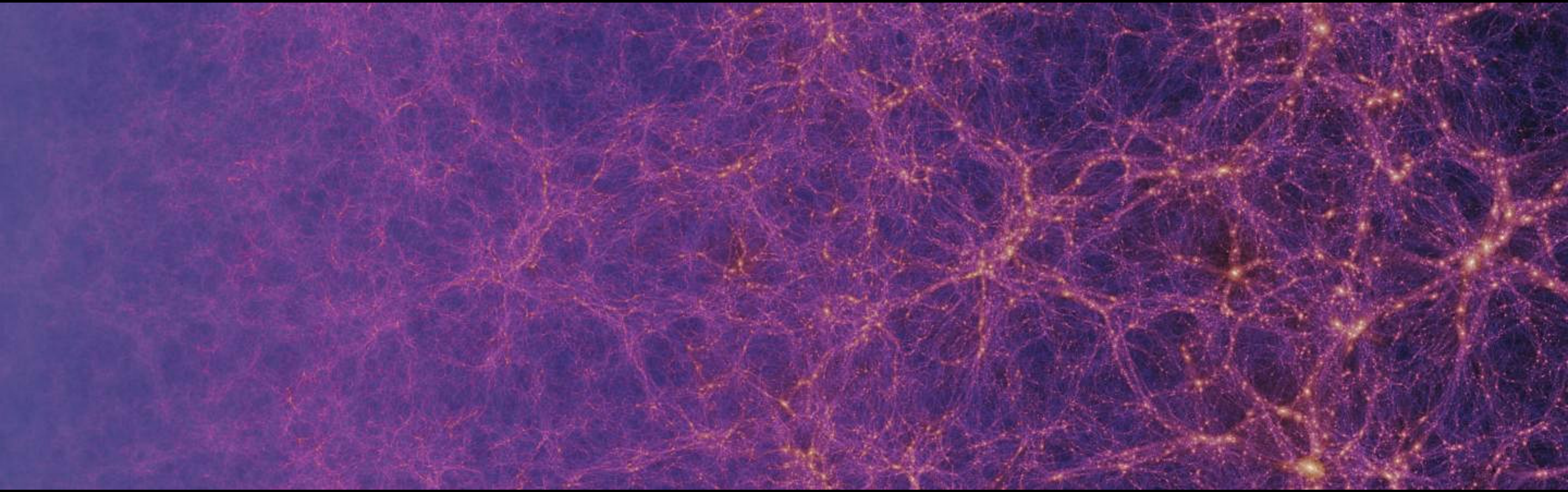




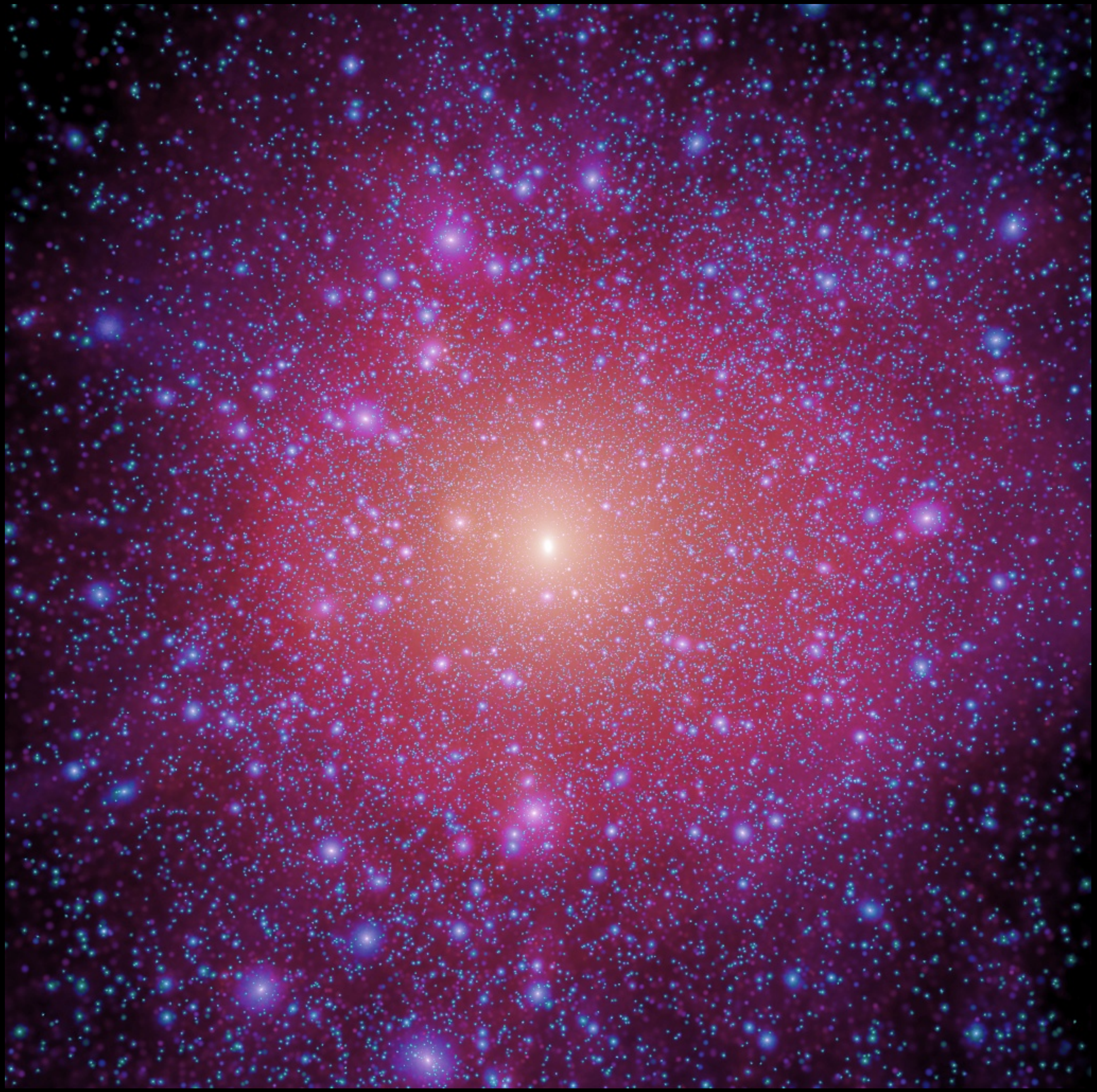
Most of the matter in the universe is dark



The CMB power spectrum tells us that the dark matter is thermally cold



N-body simulations of structure formation show that CDM works well on large scales



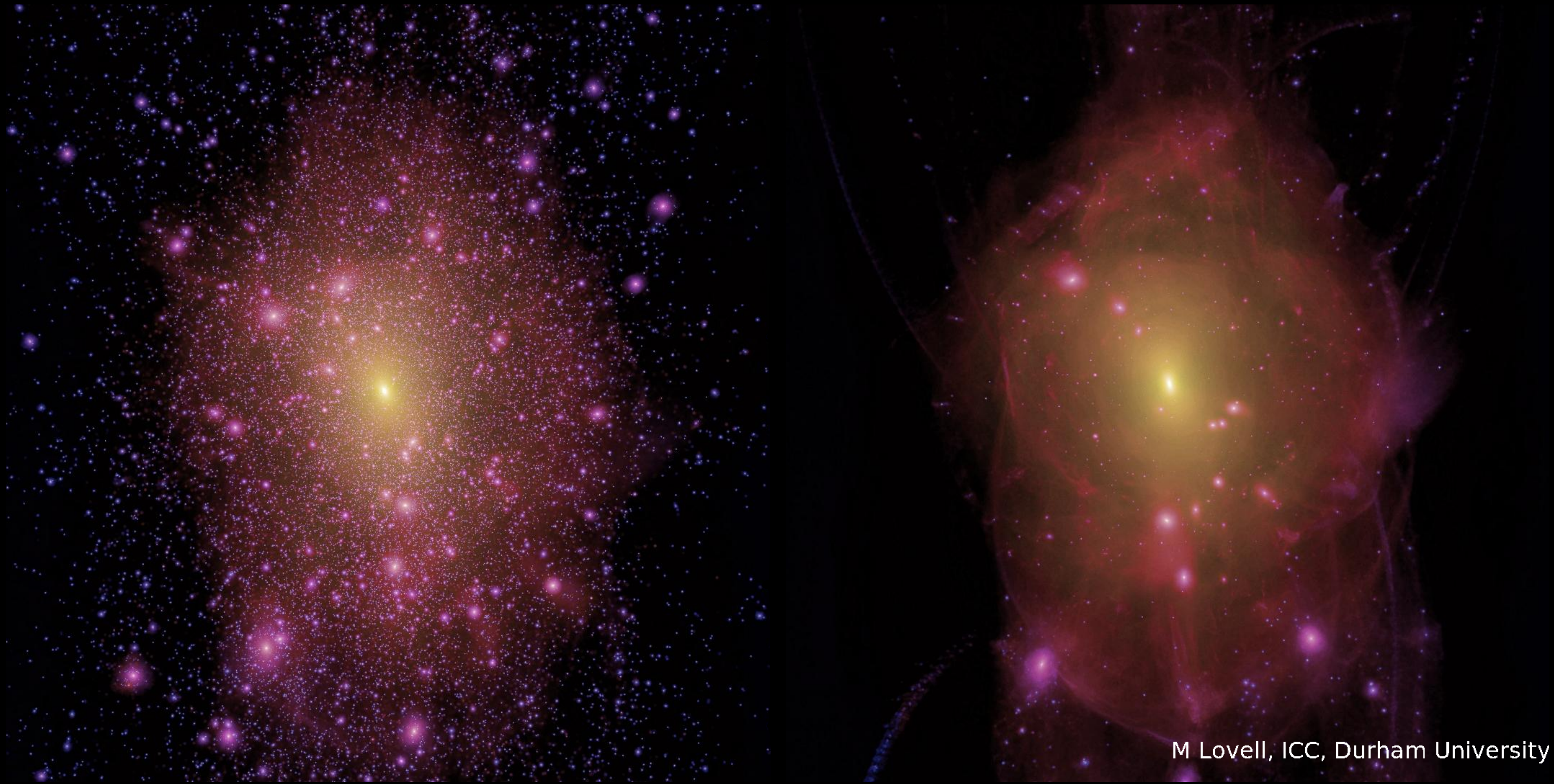
As simulations get better we can resolve the internal structure of individual galaxies

The small-scale crisis in CDM

- CDM simulations of Milky Way-sized haloes do not seem to be consistent with observations of the Milky Way.

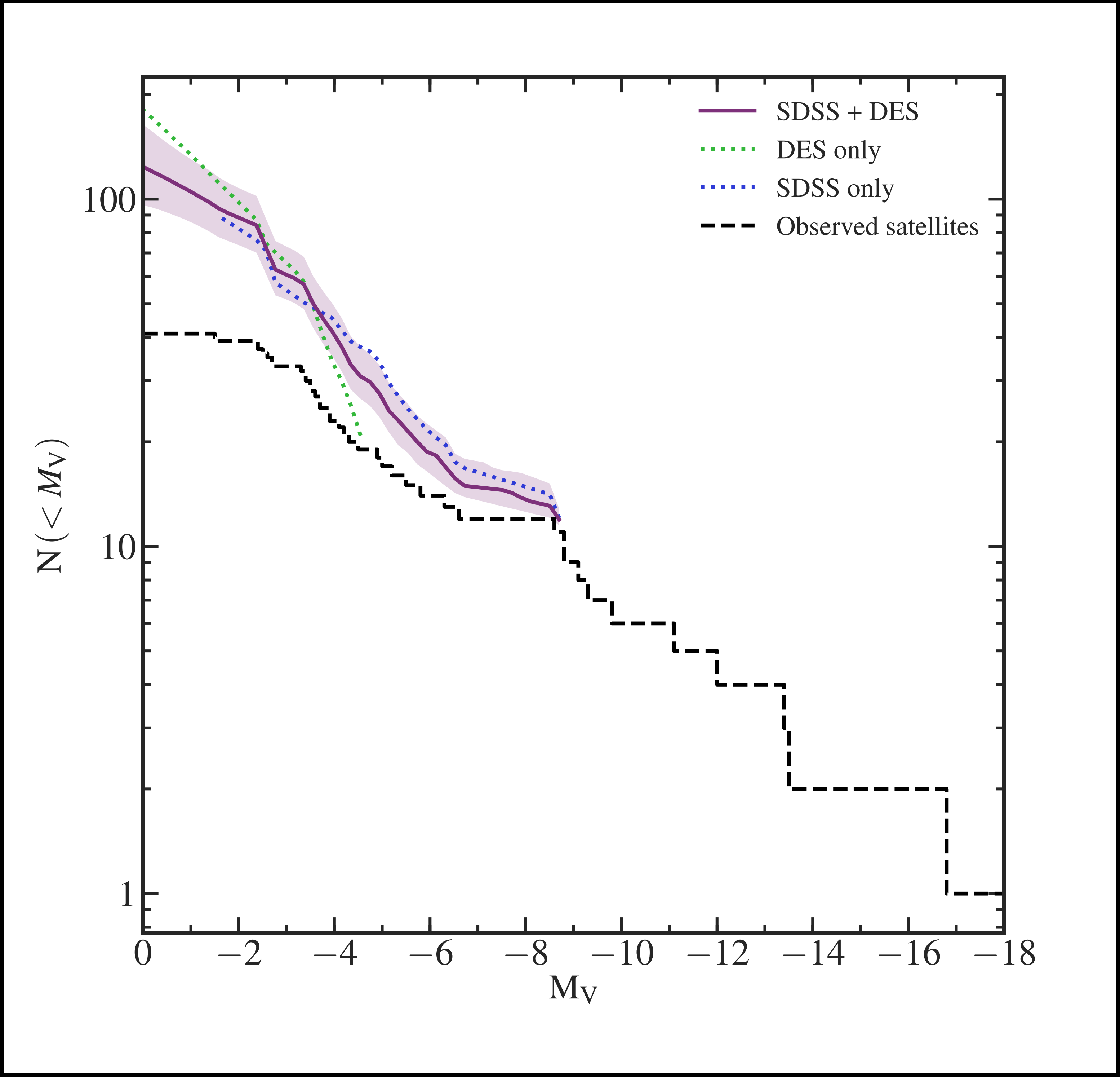
  - Simulations predict too much substructure. This is known as the **missing satellites problem**.

  - Simulated rotation curves do not match observed counterparts. This is the **core cusp problem**.



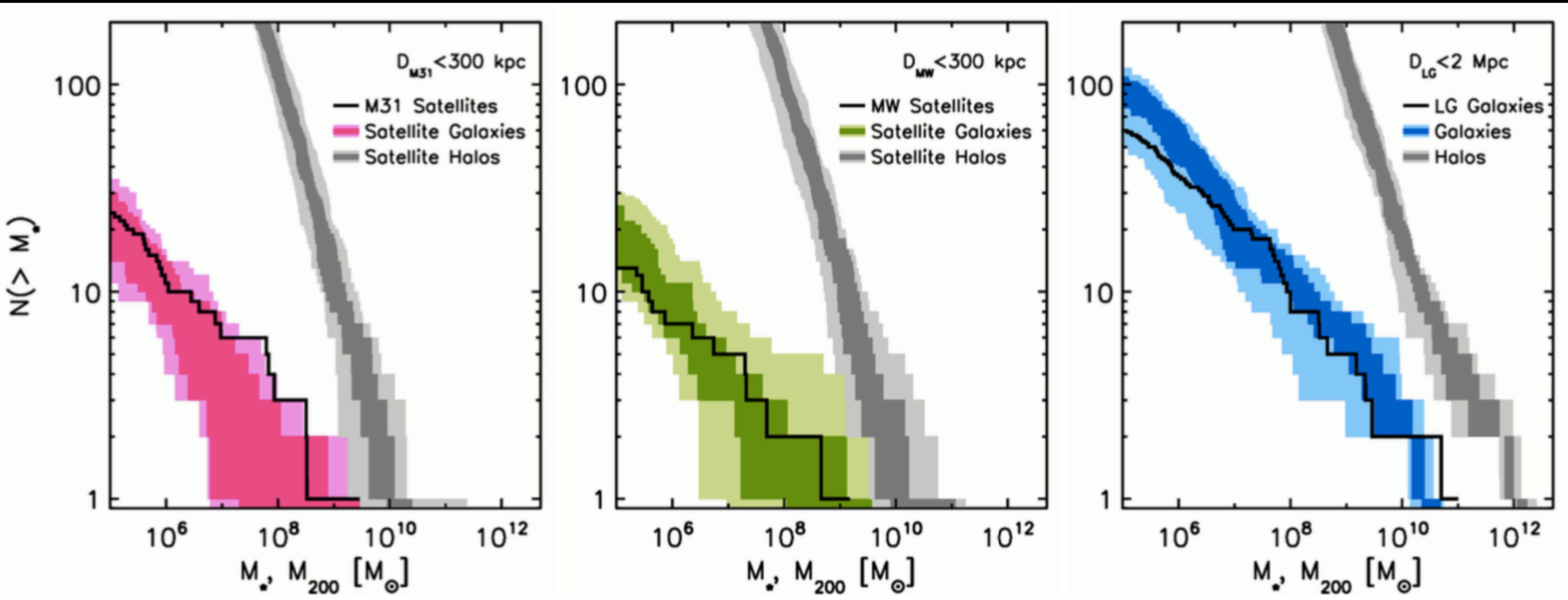
Warm dark matter proposed to solve the missing satellites problem

But there is no missing satellites problem



Modern simulations include baryons as well as dark matter

They do a much better job of reproducing observed properties of the Milky Way

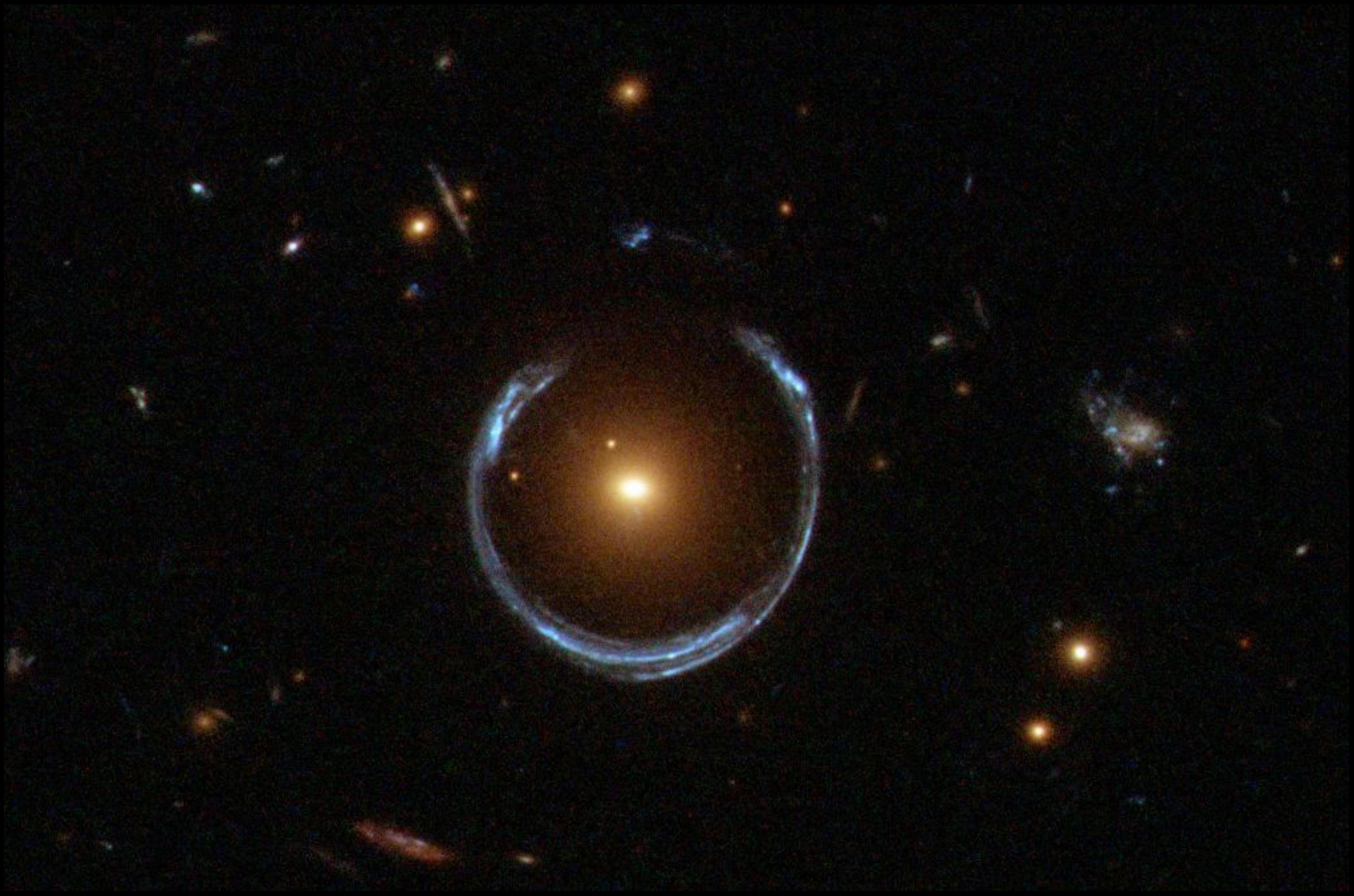


CDM simulations reproduce observed satellite populations

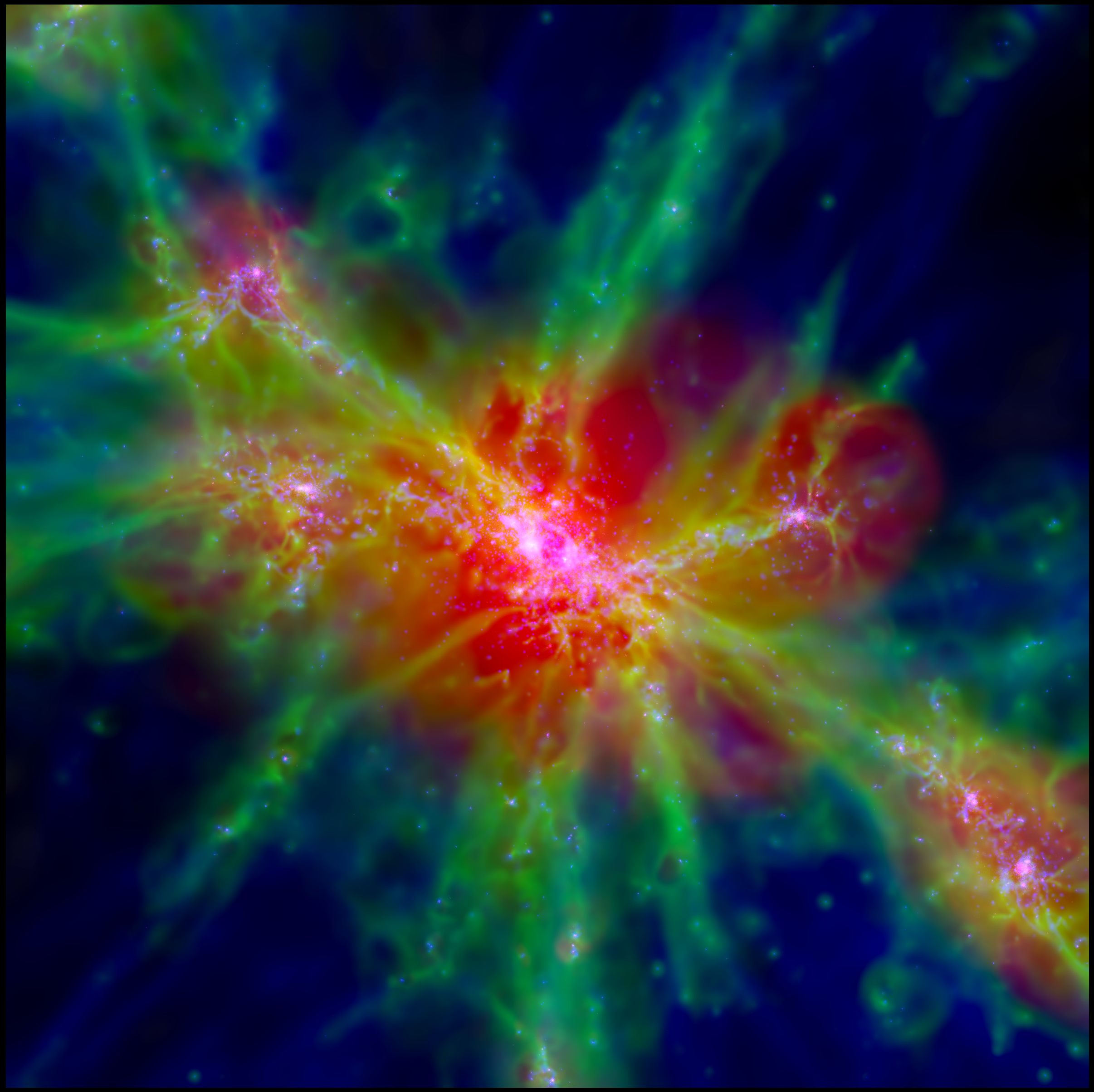
Long story short...

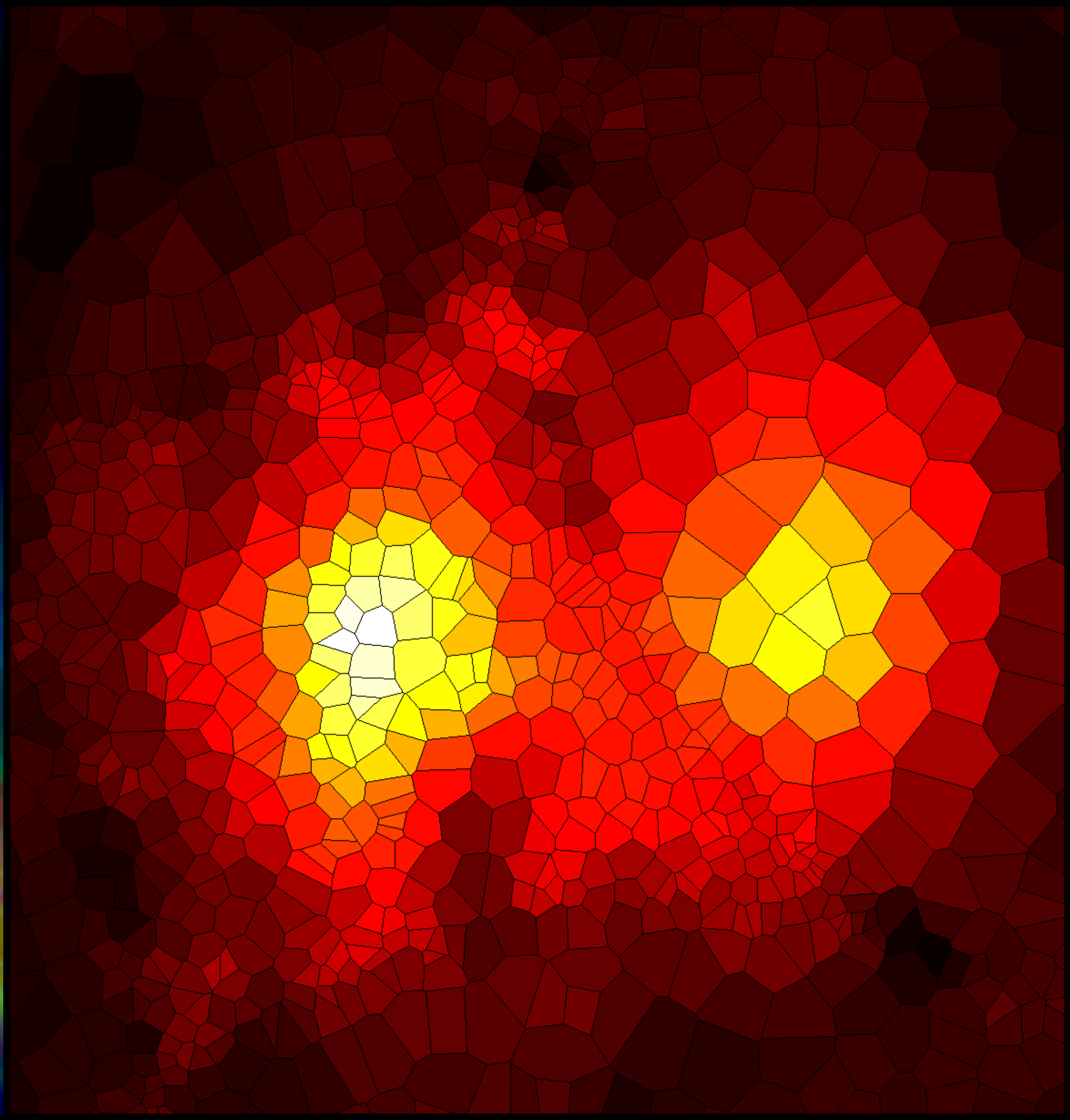
- CDM is perfectly capable of reproducing observations of the Milky Way satellite galaxy population.

- To really test CDM, we need to observe (or not) dark halos (i.e. ones which are too small to contain baryonic matter).



Distortions in strong gravitational lenses can reveal the presence of dark halos





New simulations and methods of data analysis will be necessary to make robust predictions

Prospects

- Strong lensing offers the most robust test of the CDM paradigm so far.
- Observations of 100 strong lens systems could rule out CDM.
- Uncertainties associated with baryonic physics are largely bypassed.