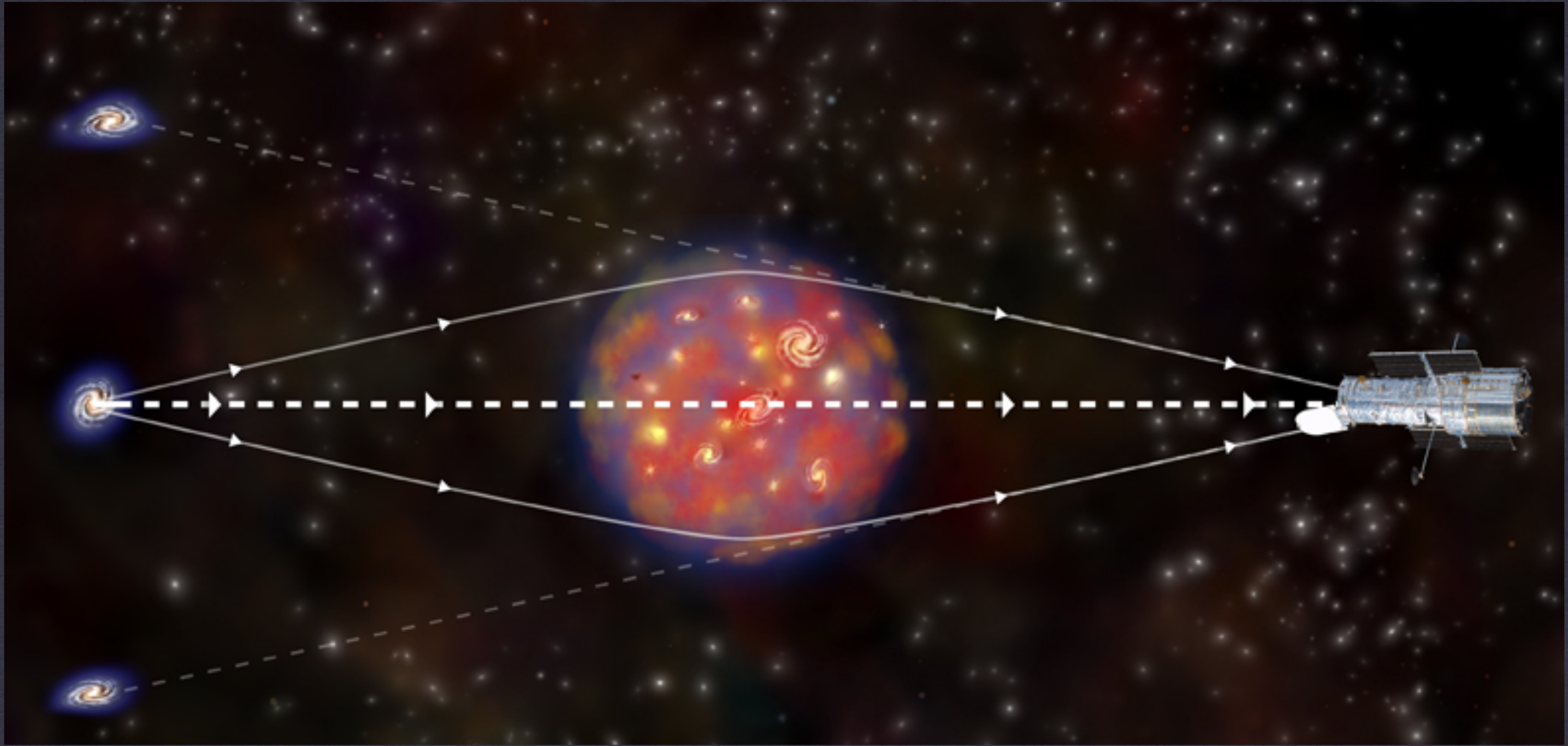
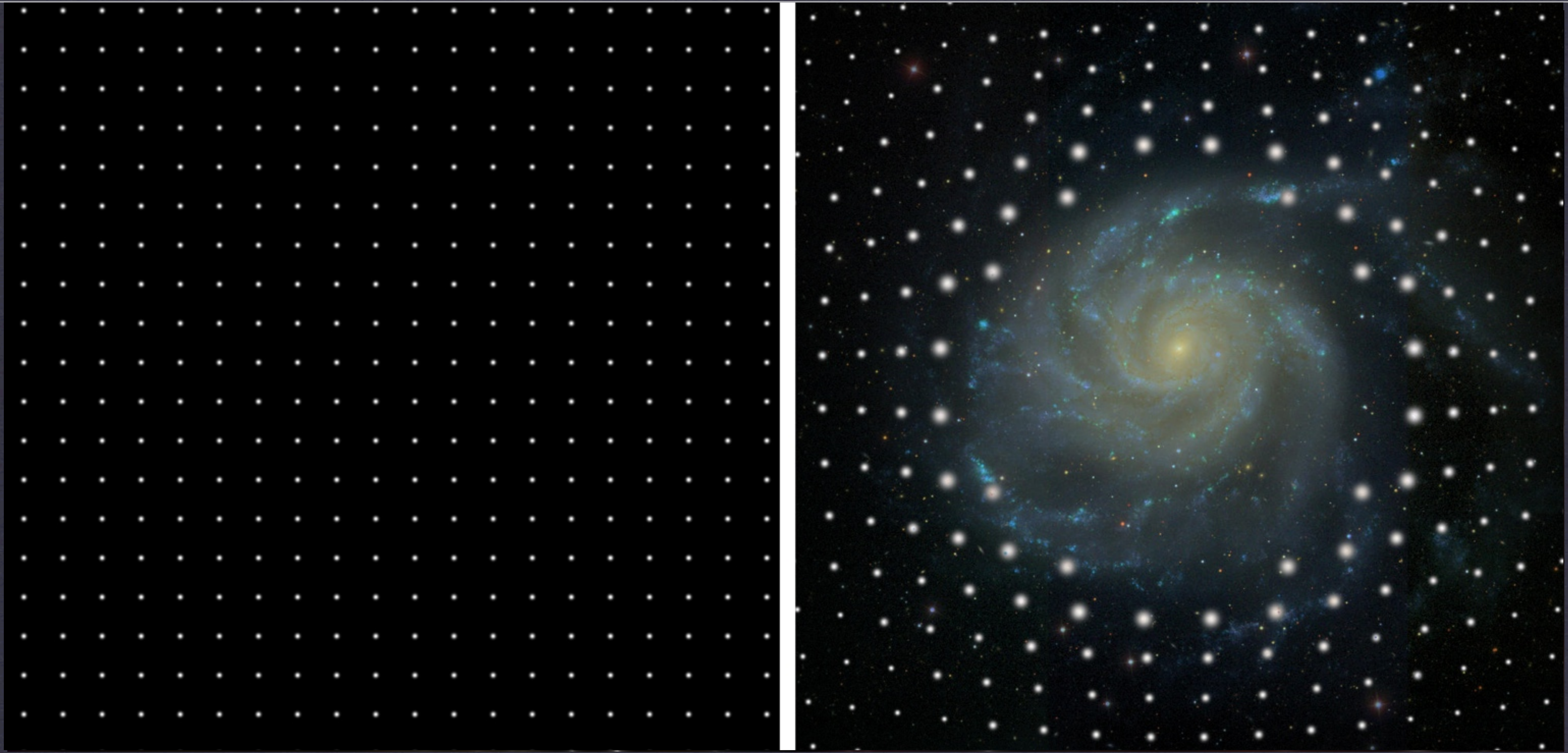
Weak Gravitational Lensing

Joachim Harnois-Déraps, SNUG Meeting, March 2011



WEAK LENSING BY A MASSIVE OBJECT

DISTORTION OF THE SOURCE IMAGE



WEAK LENSING BY A MASSIVE OBJECT

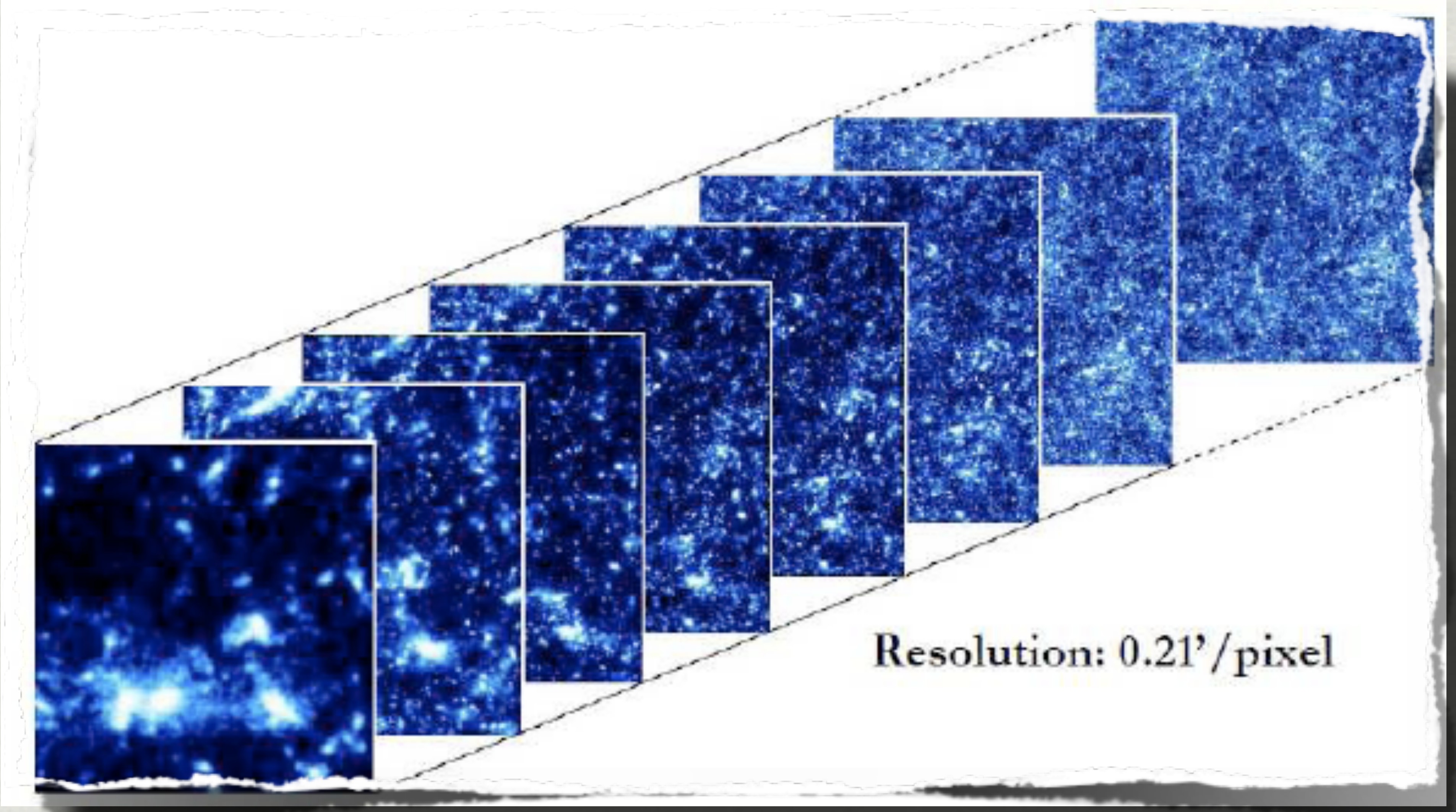
DISTORTION OF THE SOURCE IMAGE

Why?

- 1-Detect distortions of (well understood?) source images
- 2-Extract statistical information on the gravitational lenses
- 3-Measure mass and growth of large scale structures
- 4-Constrain parameters from theoretical models of cosmology
- 5-Advantage: sensitive to both Dark matter and “normal” matter

How?

- Measure signal from data
- Understand uncertainty from simulations:
- 1-Simulate LSS with N-Body codes
- 2-Construct density projections (tiling)
- 3-Interpolate onto location of camera pixels
- 4-Measure mass density and distortion matrix



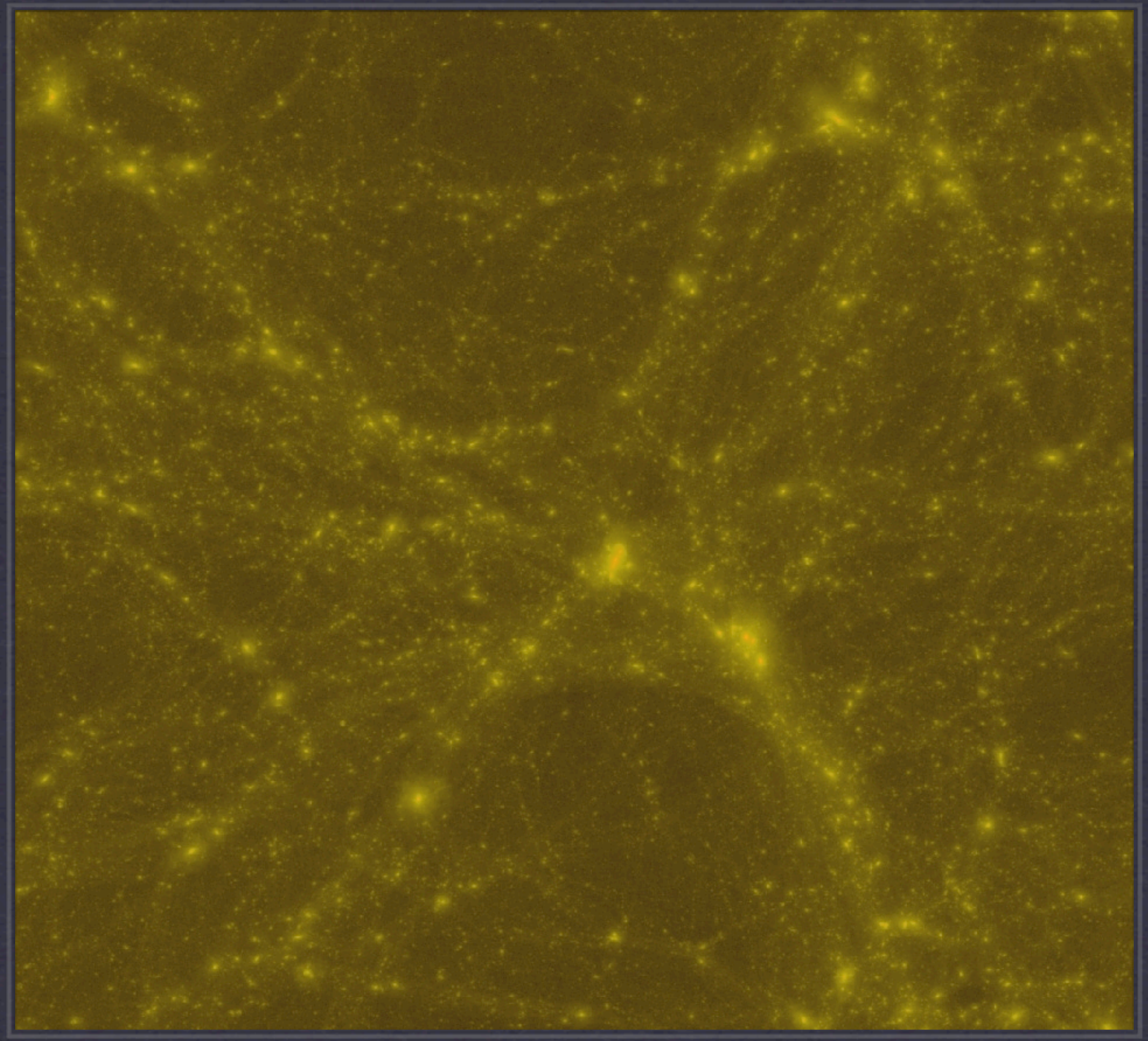
$cubep^3m$

Dark matter N-body (baryons are coming!)

2-level grid, “pp” at the sub-grid

openmp + mpi

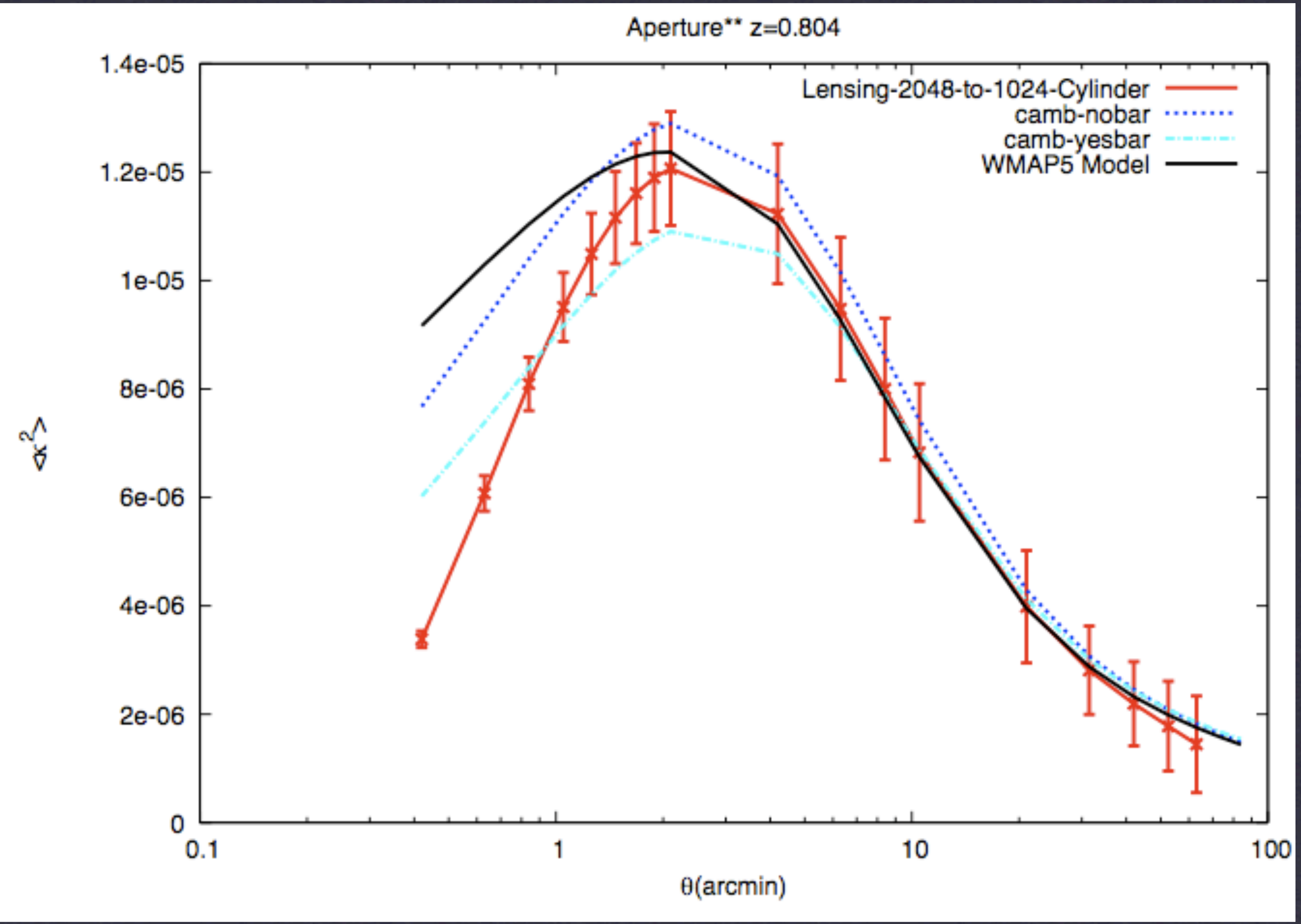
code known to scale up to 20,000 cores

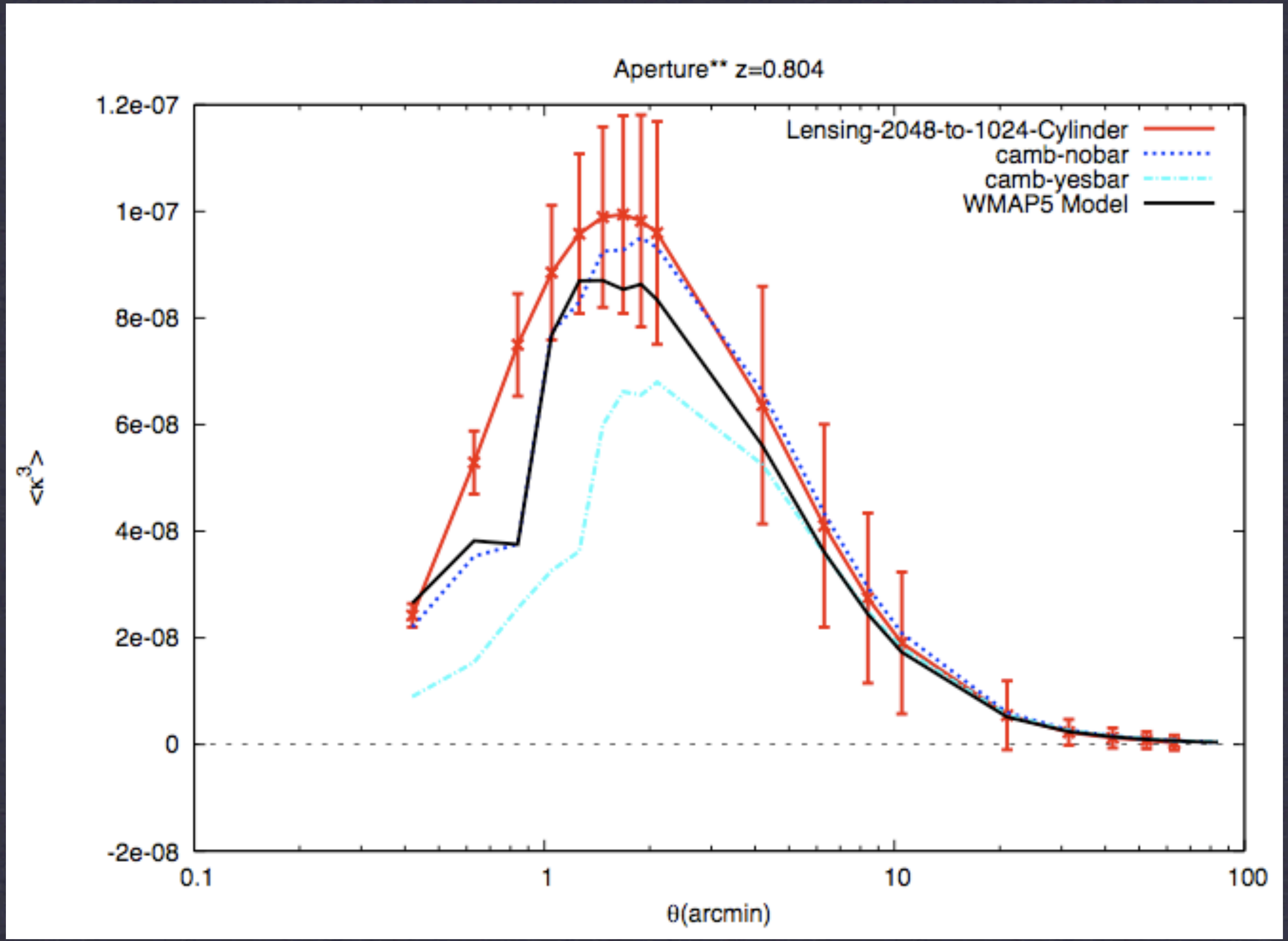


5^0, $Z = 0.1$, $N = 512^3$, $M = 1.3E7\ M_{SUN}$

Technicalities

- Run on TCS (currently have problems with fftw on GPC)
- 8 nodes, 512 (hyper) cores
- Takes 32.5 hours per “line of sight”
- Code is roughly 70% efficient (catch: mpi fftw is not threaded)
- Keep only 2D projections, delete particle catalogues to save space





WE WILL MEASURE COVARIANCE MATRIX

SMOOTH MAPS WITH VARYING FILTER SIZE, SUM OVER NEW MAPS