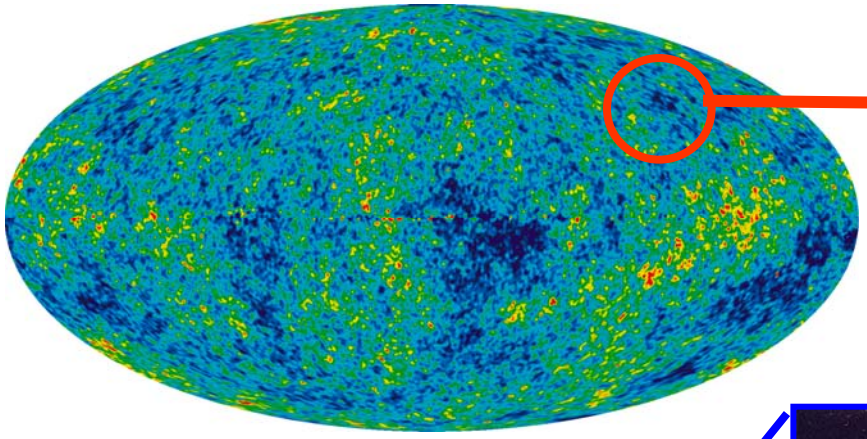
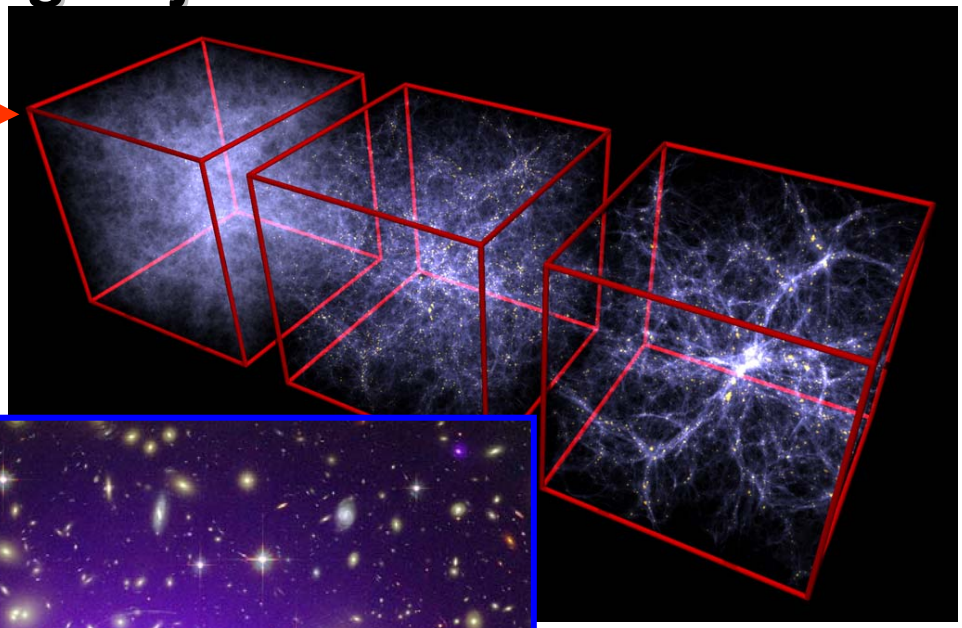
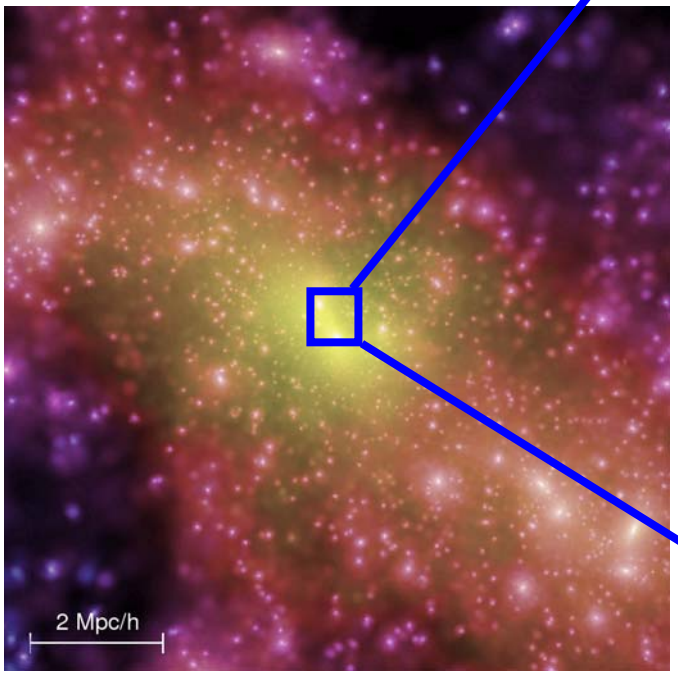
Clusters of Galaxies (星系團):

The Largest Self-Gravitating Objects in the Universe





Dark matter (mass) distribution around a simulated cluster

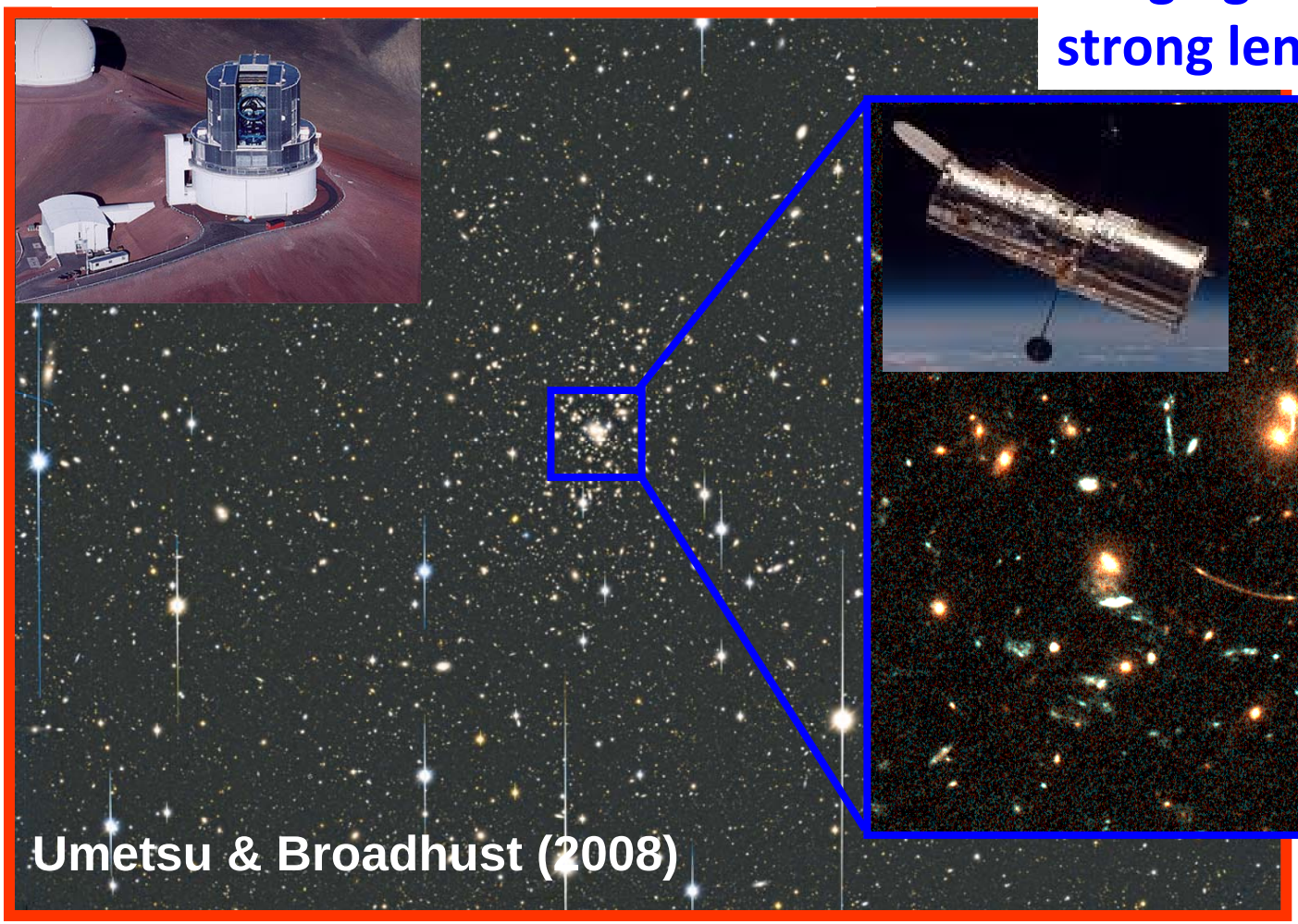


"Visible" galaxies and hot gas in the cluster A1689 at z=0.183

Weak & Strong Gravitational Lensing

***SUBARU* wide-field imaging (*Suprime-Cam*) for weak lensing**

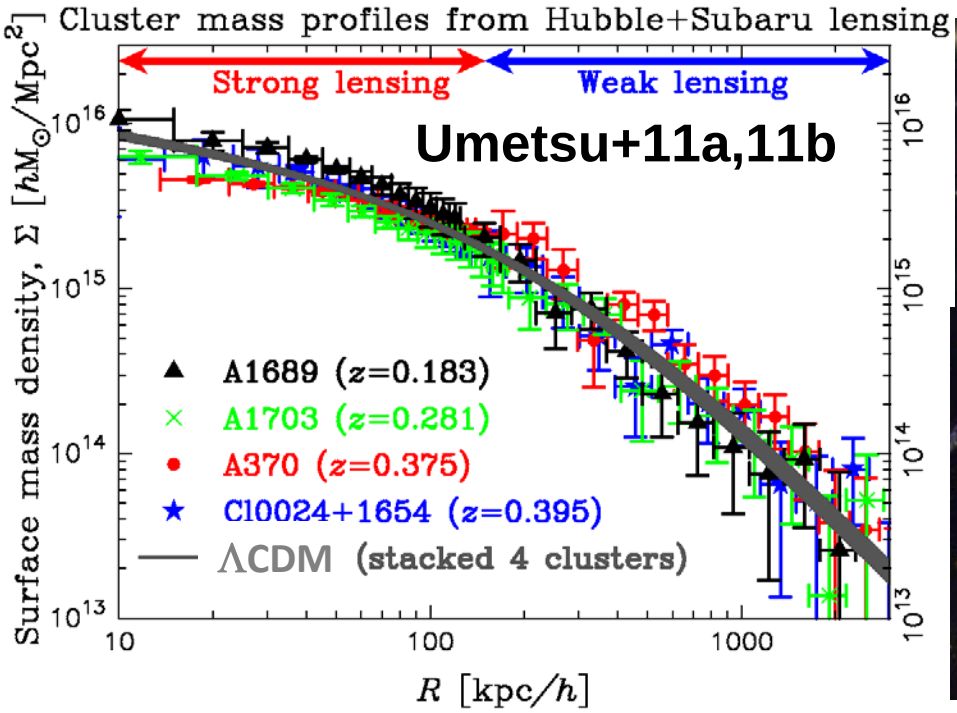
High-resolution space imaging with *Hubble* for strong lensing

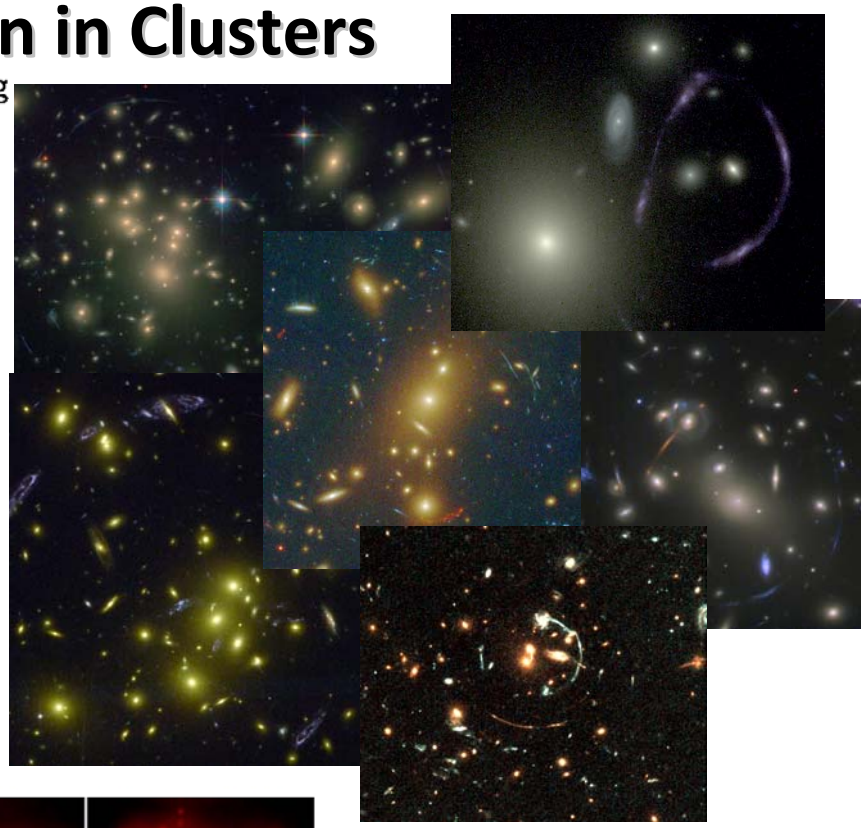


Observable deformation of background galaxy shapes and expansion of the sky can be used to map the DM distribution in large scale structure in the Universe.

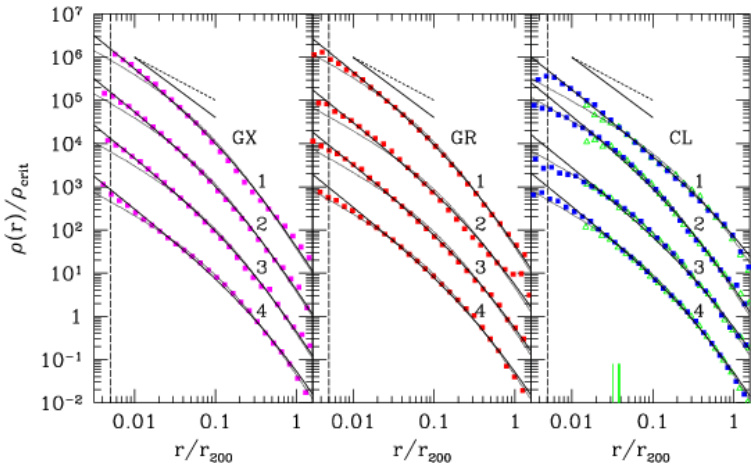
State-of-the-art Gravitational Lensing Constraints on the DM Distribution in Clusters

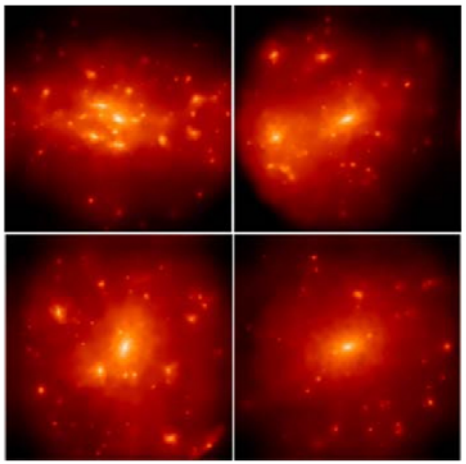
Data





ΛCDM theory





Cluster lensing observations being consistent with the collisionless, cold (non relativistic) DM model

Y.T. Lee Array for Microwave Background Anisotropy (*AMiBA*)

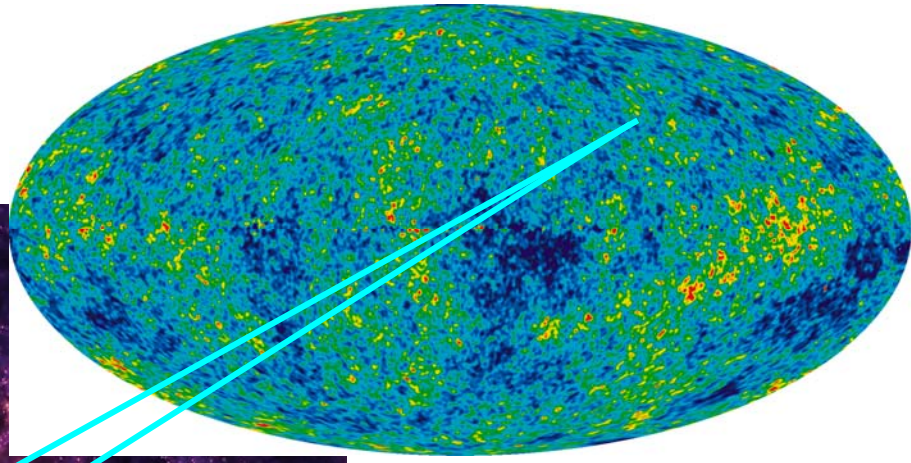
李遠哲宇宙微波背景輻射陣列望遠鏡

Mauna Kea (4200m)

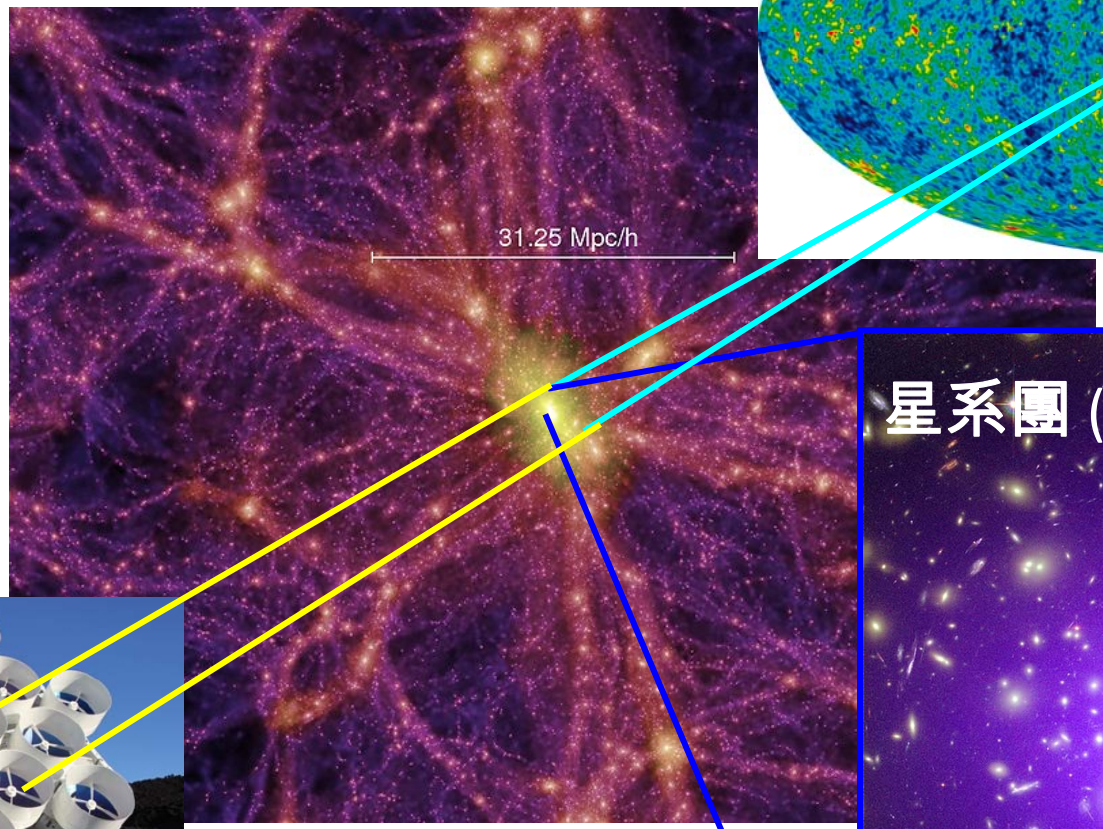
AMiBA at Mauna-Loa Observatory (3300m), Hawaii

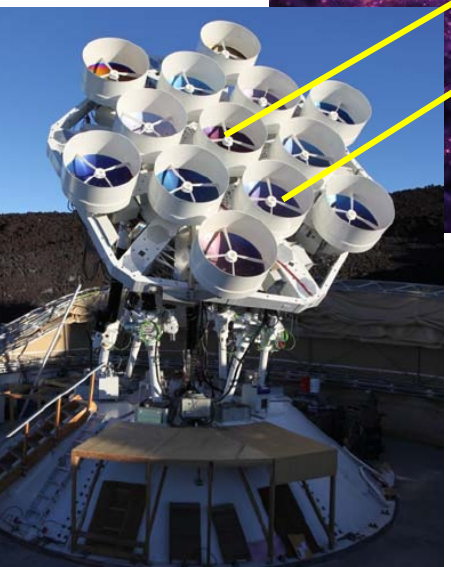
Sunyaev-Zel'dovich Effect (SZE)

宇宙微波背景輻射(CMB)



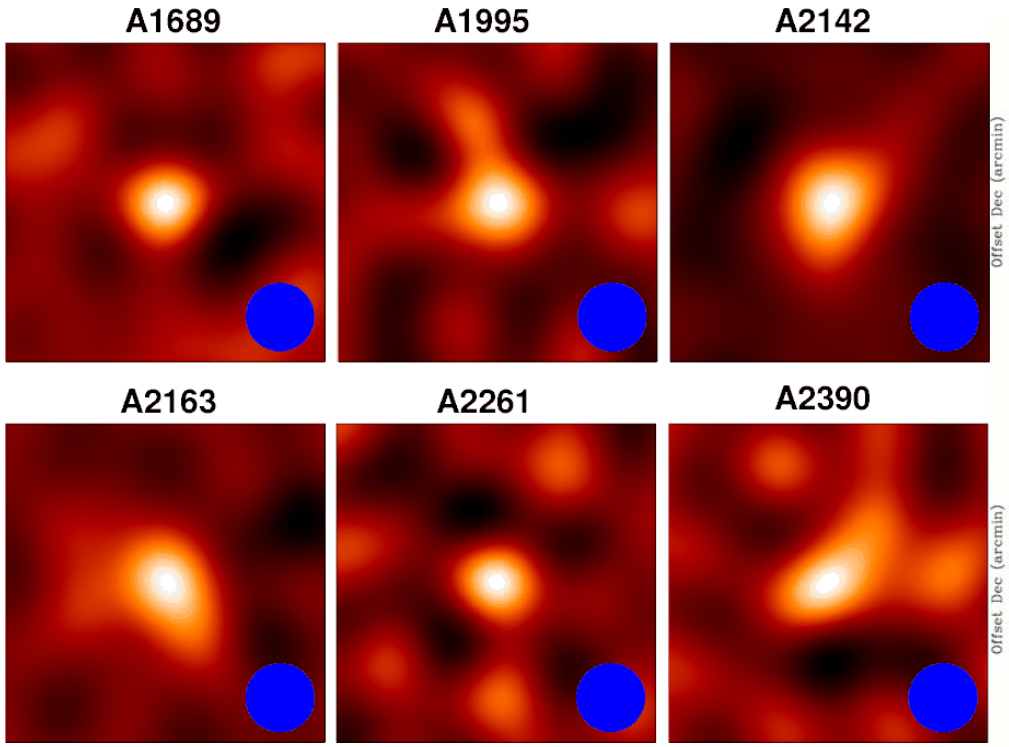
宇宙大尺度結構 (Large Scale Structure)

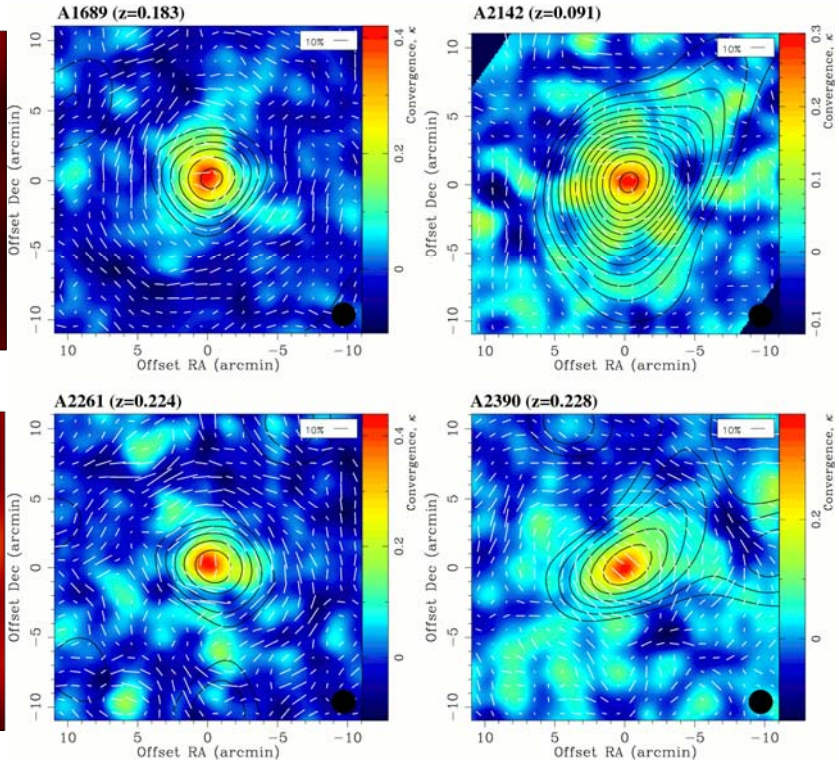




李遠哲陣列望遠鏡
(*AMiBA*)

Galaxy Clusters as "seen" by *AMiBA* SZE (left) & *SUBARU weak* lensing (right)





Hot baryons as imaged by *AMiBA* SZE

DM structure as revealed by *SUBARU* (Umetsu+09)

■ Hot baryon fraction (~B/DM mass ratio) = 13±3% from the *AMiBA* vs. *SUBARU* comparison, consistent with other observations.

■ 22±16% of the baryons missing from the hot plasma phase (WMAP cosmic baryon fraction ~17%)