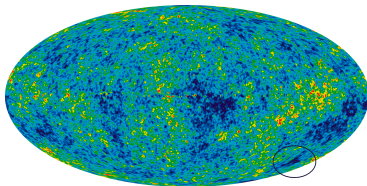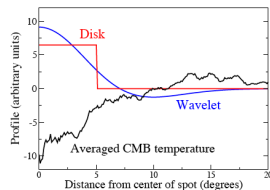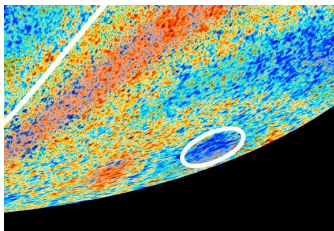# Detection of a Supervoid Aligned with the CMB Cold Spot

András Kovács[1], István Szapudi, Ben Granett, Zsolt Frei,
Joe Silk, Fabio Finelli, Juan García-Bellido, Francesco Paci,
& Pan-STARRS1 Collaboration

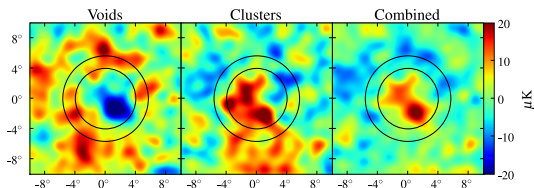[1] Eötvös University, Budapest; moving to IFAE Barcelona

The CMB Cold Spot

- Discovered in WMAP data and confirmed by Planck
- Cold Spot 0.5% unlikely (Cruz et al. 2006), $\Delta T \simeq -70~\mu K$
- extends at least $5°$, and up to $15°$ on the CMB
- explanation ranges from textures to statistical fluke or a supervoid...

Supervoid origin of the Cold Spot

Imprints of superstructures - Granett et al. (2008)

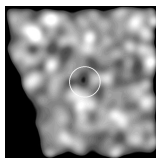- Inoue & Silk (2007): $\sim 200h^{-1}\mathrm{Mpc}$ void with $\delta = -0.3$ could imprint the CS via linear ISW
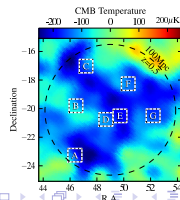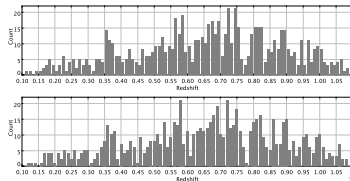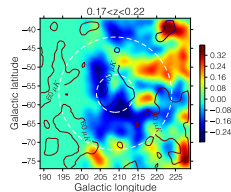
Discovery of a supervoid

Q1: is there a low density region (supervoid) in the CS region?
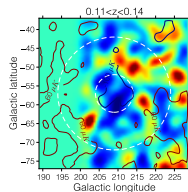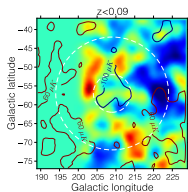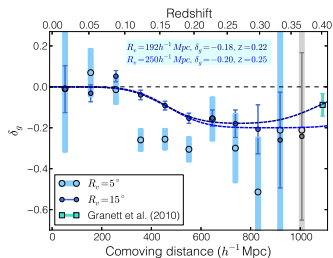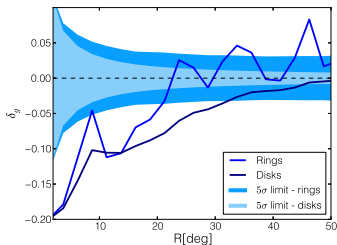
Explanation for the Cold Spot

Q2: how was the Cold Spot imprinted?

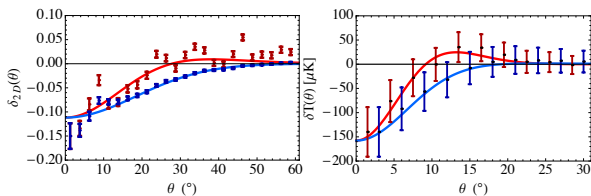$$\Delta\Phi \approx -\frac{\Omega_m}{2}\Big(\frac{r_c}{c/H_0}\Big)^3(1+2z)^{1/2}(1+z)^{-2}\,\delta \approx \frac{1}{2}\frac{\Delta T}{T}$$
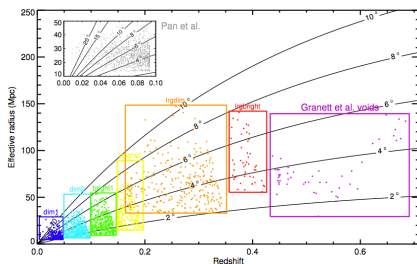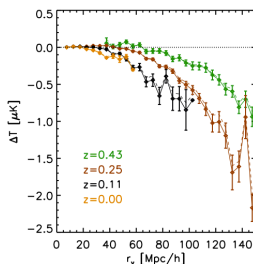
- linear ISW model? No.
- non-linear LTB model? Yes.

- Left: 2D projected density profile vs. non-linear LTB void
- Right: the red curve is the prediction for the CMB

Supervoid catalogs and simulation

Q3: how rare is this supervoid?

- typical matter fluctuation at $200h^{-1}\,Mpc$ scales is $\sigma_{200} \approx 0.04$, thus our measurement is a $\geq 3.5\sigma$ fluctuation
- we see one more similar underdensity in WISE-2MASS
- something is missing in simulations...