The Large-Scale Filament feeding the Massive Galaxy Cluster MACSJ0717.5+3745

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Cosmological Context ...

✓ Large-scale Universe
  • complex structures \( \rightarrow \) filamentary structures

Neural networks

Marble
Cosmological Context ...

- Large-scale Universe
  - complex structures \( \rightarrow \) filamentary structures

Neural networks

SDSS galaxy map
Cosmological Context ...

COSMIC WEB

Neural networks
Marble

125 Mpc/h

Millenium simulation
MACS X-ray luminous cluster:

- $L_X = 24.6 \pm 0.3 \times 10^{44}$ erg s$^{-1}$
  $\sim 1.5 \times L_{X-A1689}$

- $z = 0.55$

- Largest $\theta_E$ known: $\theta_E \sim 55''$
  $\theta_{E-A1689} \sim 45''$
2. MACSJ0717.5+3745 : Previous Analysis

Ma et al. 2009

Ma et al. (2009) : Active triple merger

Limousin et al. (2012) : Confirmed the complex dynamics of the cluster core

Ma et al. (2010) : Elongated structure in the field linked to the cluster core

NODE of the COSMIC WEB

End of the filament

Ma et al. (2009) CXO press release
3. MACSJ0717.5+3745 WEAK LEN SING ANALYSIS

⇒ 18 HST/ACS maps in 2 bands: F814W & F606W
⇒ ~ 10 × 20 arcmin²
3. MACSJ0717.5+3745  WEAK LENSSING ANALYSIS

18 HST/ACS maps in 2 bands: F814W & F606W
→ ~ 10 x 20 armin\(^2\)

**WL analysis: Recipe**

1. Detection
2. Selection (galaxies, stars & fakes)
3. **CORRECT FOR PSF**
   (anisotropies & circularization) & Shape measurements
4. Redshift information
5. Mass distribution reconstruction
DETECTION OF A FILAMENTARY STRUCTURE!

→ WL detection of a large-scale filament with $3\sigma$
→ $\sim 4.5$ Mpc long & $\Sigma_{\text{filament}} = 2.92 \pm 0.66 \times 10^8 M_{\text{SUN}} \cdot \text{kpc}^{-2}$
a) **DENSITY PROFILES**

- Cluster core: Really good agreement with SL analysis (Limousin et al. 2012)
  
  \[ M_{WL}(R<500 \text{ kpc}) = 1.04 \pm 0.08 \times 10^{15} \, M_{\odot} \]
  \[ M_{SL}(R<500 \text{ kpc}) = 1.06 \pm 0.03 \times 10^{15} \, M_{\odot} \]

- Filament starts to dominate the profile at \(~2\text{Mpc}\) from the core

- Fitting by NFW, SIS profiles not relevant due to the complexity of the cluster

- Slope of the density profile within \(2\text{Mpc}\) from the core evolves as \(\Sigma(R) \propto R^{-2}\)
Ma et al. (2008): 
• Offset in the redshift distribution.

Ebeling et al. (2012, in prep):
• Measured variation in the mean radial velocity of galaxies along the filament.
• Comparison to expectations of Hubble-flow velocities & predictions of peculiar velocities within filaments from numerical simulations (Colberg et al. 2005, Cuesta et al. 2008, Ceccarelli et al. 2011).
• A self-consistent description: an average inclination angle of 75° of the filament with respect to the plane of the sky.
5. MACSJ0717.5+3745 : DISCUSSION

b) 3D-PICTURE OF THE FILAMENT

→ ~ 18 Mpc long filament
   \[ \rho_{\text{filament}} = 3.13 \pm 0.71 \times 10^{13} \text{M}_{\odot}\text{Mpc}^{-3} \]
   \[ \rho_{\text{filament}} = 206 \pm 46 \rho_{\text{crit}} \]

→ A more complex density distribution along the filament POSSIBLE & PLAUSIBLE

→ Density depends STRONGLY on \( \alpha \)
   well constrained in average but uncertain at large cluster-centric distances

\[ \alpha = 75^\circ \]
Thank you for your attention