Weak Lensing Mass – IR Luminosity Scaling Relation for Galaxy Clusters

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Overview

- Cluster Physics and Motivations
- LoCuSS, Sample and Data
- IR luminosity calculation
- Results
- Plans for the future
Abell 0209

- WL mass map – optical Subaru
- Hot gas - X-ray Chandra
- Old stars - K band UKIRT
- New stars – FIR Herschel
How do global cluster properties affect total SFR?

Finn et al. 2005

Bai et al. 2011
Galaxy Evolution Sample

- Multi-wavelength survey
  29 galaxy clusters
- Original selection from ROSAT All Sky Survey
- \(0.15 < z < 0.3\)
- Massive X-ray bright clusters \(L_x > 3 \times 10^{44} \text{ergs}^{-1}\)
- Morphologically unbiased sample
Rich Data Set

- Herschel
  - PACS 100 160μm
  - SPIRE 250 350 500μm
- Spitzer MIPS 24μm
- Weak lensing masses
  Okabe et al. 2010
- Highly complete spectroscopic follow up
  from ACReS (Arizona Cluster Redshift Survey)
• Model SEDs Chary & Elbaz 2001
• Integrate over 8-1000μm
• Complete to $5 \times 10^{10} L_{\text{sol}}$
• 313 Galaxies above Demi-LIRG limit
• Calculate $L_{\text{FIR}}$ per cluster
Scaling Relation

Slope: 0.94 \pm 0.35 -0.32

Scatter: 0.67 \pm 0.14 -0.12
Cluster Merger State

Cool-core (blue) Non cool-core (red)

\[ M_{\text{WL}}/L_{\text{FIR}} = 1662 \pm 336 \quad 2886 \pm 666 \]

X-ray centroid shift: small (blue) large (red)

\[ 2110 \pm 606 \quad 2546 \pm 591 \]
Comparison with Chung et al. 2011
The Future

- Other indicators of cluster dynamical state
- Links between SFR and 'environment'
  - Making the most of the multi-wavelength data to explore where these galaxies are sitting
  - Radial trends of SFR
- Substructure within clusters
  - SFR of galaxies in in-falling groups
  - How long is group environment retained when in-falling? How quickly does cluster environment influence galaxies in group?
Conclusions

- No trend in $M_{\text{WL}}/L_{\text{FIR}}$ ratio with cluster mass but very high scatter
  - Slope: 0.94 $\pm$ 0.35 $-0.32$
  - Scatter: 0.67 $\pm$ 0.14 $-0.12$
- Mechanisms that scale with cluster mass do not have significant impact on the evolution of star formation in these clusters
- Evidence for merger state of cluster having small impact on mean $M_{\text{WL}}/L_{\text{FIR}}$
- Lower mass and lower redshift samples are consistent with our results