Galaxy-Galaxy Merging in Groups Prior to Cluster Assembly

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Origin of Early-Type Members?

Time

Theory
Galaxy Merging
Late Assembly

Observations
Single Burst

Solution?
Late Assembly Passive

Observations

Galaxy Merging
Late Assembly

Solution?
Late Assembly Passive

Observations

Galaxy Merging
Late Assembly
Galaxy-Galaxy Merging: MS1054

MS 1054-04 (z=0.83, lookback time 7 Gyr)
~16% bound galaxy pairs (spectroscopically confirmed)

van Dokkum+99
Tran+05b
MS1054 mergers are red:
Fall on the color-magnitude relation

Averaged Pair spectrum:
No [OIII] emission
[Tran+05b]
Direct merging infrequent?

Group environment is conducive to galaxy-galaxy merging.

Need an assembling (proto) galaxy cluster
Super-Group 1120: X-ray Bright

Las Campanas Distant Cluster Survey (LCDCS; Gonzalez+2001)

Super-Group 1120-12

Projection?

Chandra: X-ray Clumps
SG1120: Redshift Survey

Spectroscopy
VLT & Magellan
330 objects
(Ks selected)

154 members
SG1120: Redshift Survey

Chandra X-ray Image

LDSS3 $g'$

3 Mpc
SG1120: Isolating Members

Merging Galaxy Groups
Virialized Halos

[VIMOS Spectra, v<550 km/s]

[Gonzalez, Tran, et al. 2005]
SG1120: Coma Progenitor

Coma Cluster (z~0.02)

SG1120 (z=0.37)

Brough+06 Eridanus Supergroup
SG1120: Dynamical State

SG 1120-12 (z=0.37, lookback time 4 Gyr) [Gonzalez, Tran, +05]

• Merging of 4-5 galaxy groups (bound)
• Snapshot of a Coma cluster progenitor
• Pre-processing of galaxies on group scales
Galaxies in Nearby Groups

Local groups have >2 times more bulge-dominated members than the field.

Tran+01

Late

Early
SG1120: Morphology

HST/ACS: 20 Brightest Members (Ks-selected)
SG1120 (z=0.37)
galaxies in merging groups
pre-processed
~twice as many passive galaxies as field (same z)

![Graph showing absorption and emission fractions vs. galaxy density.]

Absorption
Emission

Fraction

Σ(galaxies Mpc^{-2})
SG1120: Galaxy Populations

Absorption-line
BGG

Emission-line
SG1120: Galaxy Pairs

17 Individual Members

$[\Delta v<250 \text{ km/s}; \Delta d<50 \text{ kpc}]$
Coma: Ellipticals vs. SOs

Coma Cluster: Luminosity Weighted Ages

Poggianti+01 (Smail+01)
At $z=0.37$ ($\Delta t=4$ Gyr):

- Spectral-Density Relation Established
- $\sim 70\%$ Early-types (Bright)
- Merging Happens

Galaxy Evolution on Group Scales is Critical
SG1120: Outlook

Multi-wavelength Survey:
Chandra X-ray imaging
HST/ACS F814 mosaic
BVRJKs, g’r’ mosaics
Spitzer 24 μm map
VLT & Magellan spectroscopy

Evolving (Coma) Cluster Galaxies:
Color-Magnitude Relation: Red Sequence? Scatter?
Luminosity Functions
Environmental Trends (SFR, Morphology, AGN)
Large Scale Structure (photo-z’s)
Scaling Relations (Fundamental Plane, Tully-Fisher)