Connecting Environment and Galaxy Evolution: 
Star Formation and Gas in Compact Groups

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In the footsteps of galaxies
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**Importance of Environment**

**Field**
- More Spirals
- Secular evolution is the norm
- Significant star formation
- Neutral-gas rich
- E’s have hot gas

**Clusters**
- More Ellipticals
- Interactions & mergers common
- Little to no star formation
- Neutral-gas poor
- Tend to have hot gas
The CG Environment

Compact Groups

- More Ellipticals
- Interactions & mergers common
- Lots to little star formation
- Range in neutral gas abundances
- Hot gas only associated with individual galaxies
Star Formation in Compact Groups

* Some CGs show abundant star formation (Iglesias-Páramo 99; Gallager+10)

* However, %E is higher than field (Lee+04; Deng+08; Coenda+12)

* E’s in CGs on average older than field (e.g., Proctor+04, Mendes de Oliveira+05; de la Rosa+07; Plauchu-Frayn+12)
Cold Gas in CGs

- Compact groups show wide range of H I content (Verdes-Montenegro+01)
- Distribution of H I also varies
- Content and distribution not necessarily correlated!

A. Heiderman, priv. comm.
A Multi-\(\lambda\) Approach

- X-ray + optical Hot Gas
- HST BVI ACS Stars
- Spitzer IR Warm Dust
- VLA H I + HST Neutral Gas
Hickson CGs

- Hickson 1982
- Photometric survey with spectroscopic confirmation
- 92 spectroscopically-confirmed groups

Redshift Survey CGs

- Barton+ 1996
- Redshift survey; friends-of-friends algorithm
- 89 groups; 15 are also HCGs
Mid-IR Canyon

Compact Groups

Other Environments

Walker+2012
Relationship to Optical CMDs
Optical CMD

Compact Groups

LVL+SINGS

Walker+2013
* Previously have compared with $M_{\text{dyn}}$
Comparison with $M_*$

- HCGs and RSCGs have similar distributions
- No correlation between $M_{\text{HI}}$ and $M_*$
* Divide into HI-Rich, HI-Intermediate, HI-Poor
$$\log\left(\frac{f_{8.0}}{f_{4.5}}\right)$$

$$\log\left(\frac{f_{5.8}}{f_{3.6}}\right)$$

**Active SF**

**Quiescent**

**HI Poor**

**HI Int**

**HI Rich**

**Active SF**

**Quiescent**

**HI Poor**

**HI Int**

**HI Rich**

**Number**

**Mid-IR Color**

$\log(M_{\text{HI}}/M_*) < -2.20$

$-2.20 \leq \log(M_{\text{HI}}/M_*) < -1.45$

$-1.45 \leq \log(M_{\text{HI}}/M_*)$
RSCG 34: NGC 2968

SDSS

Spitzer
RSCG 42: KUG 1131+202A

- **SDSS**
  - ARK303
  - KUG1131+202A
  - UGC6583

- **Spitzer**
  - CGCG 97-026
  - CGCG 97-027

- **Scott+12**
  - CGCG 97-026

Graph showing velocity in km/s with intensity in F (Jy).
RSCG 64: NGC 4613
**Bimodal distribution in mid-IR colorspace**
- Unique to high density, non-preprocessed environment

**Mid-IR transition galaxies fall on optical red sequence**
- In hospitable to low-mass, SF galaxies

**Regardless of distribution of H I:**
- Quiescent galaxies tend to live in H I-poor groups
- Actively SF galaxies more commonly in H I-rich groups

**Rogue galaxies likely due to strong interactions in CGs**
- RSCG 34: NGC 2968
- RSCG 42: KUG 1131+202A
- RSCG 64: NGC 4613