

# Arcetri extragalactic group

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## *OAA Staff:*

Simone Bianchi  
Edvige Corbelli  
Sperello di Serego  
Carlo Giovanardi  
Leslie Hunt  
Filippo Mannucci  
Guido Risaliti  
Marco Salvati  
Guidetta Torricelli  
Paolo Tozzi (share OAT)  
Stefano Zibetti

## *OAA Post-docs:*

Giovanni Cresci  
Laura Magrini  
Ciro Pappalardo  
Eleonora Sani  
Veronica Sommariva

## *UniFi:*

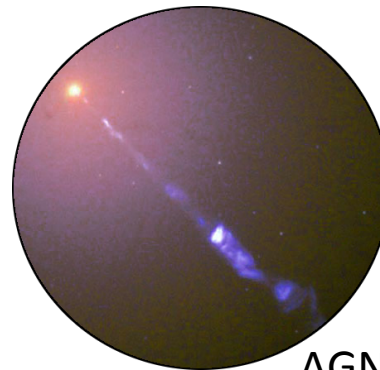
Alessandro Marconi  
Paola Pietrini

## *PhD students:*

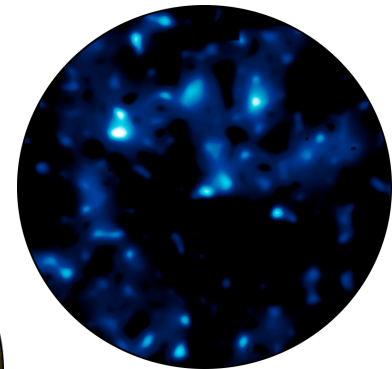
Simona Bovinelli  
Mauro Sirigu



Local  
Universe



AGN



Cosmology  
and high  
redshift

# The Local Universe

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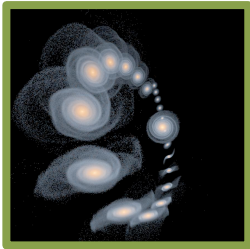
*Three themes pervade our research:*

✓ *How do the disks in spiral galaxies form and how do they form stars?*

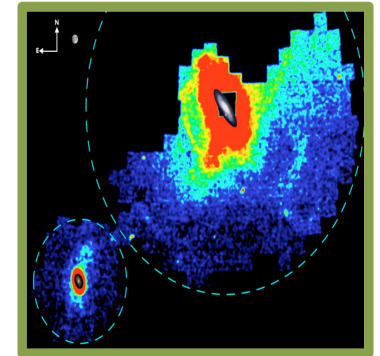
✓ *What is the influence of environment (galaxy clusters and groups) on galaxy properties?*

✓ *How do dust and metallicity govern star formation?*

- Dark matter and dynamics in the Local Group
- Lessons from M33: The onset of star formation - from giant to tiny clusters
- The ISM in early-type galaxies: The environmental influence and formation scenarios
- The Herschel Virgo Cluster Survey: HeViCS
- Key Insights to Nearby Galaxies - Far-infrared Survey with Herschel: KINGFISH
- MOlecules and DUSt at LOw metallicity: MODULO
- DUSTY-PhotZ: A spectral energy distribution library to probe star formation in the infrared
- Stellar masses



# Dark Matter and Dynamics in the Local Group



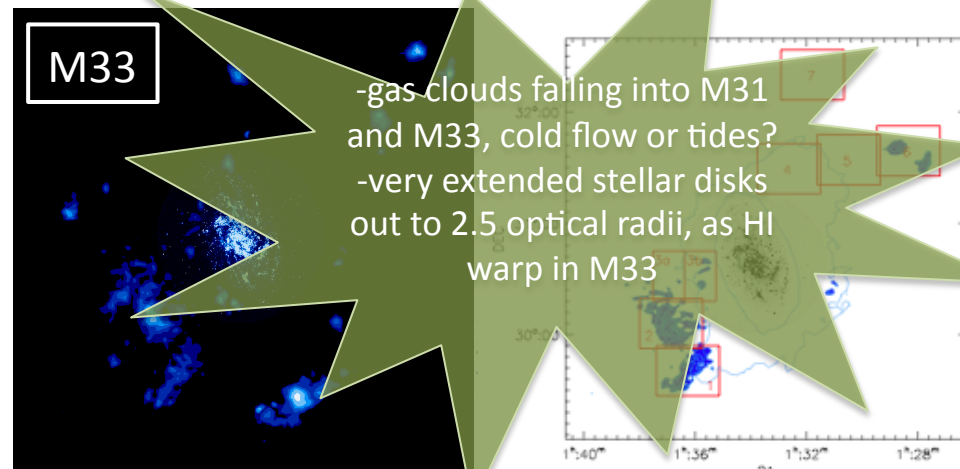
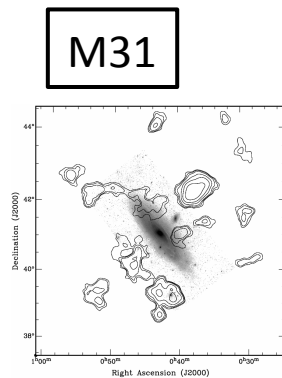
☑ - done    ☐ - more work in progress

## 1. The interaction between M31 and M33

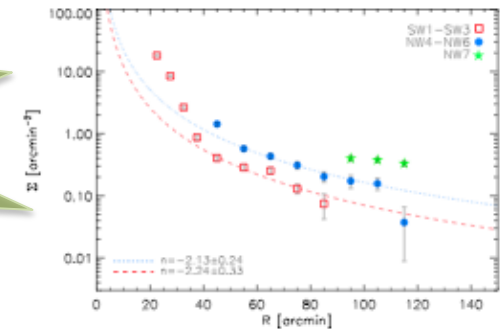
(*E. Corbelli, C. Giovanardi, M. Grossi + A. Burkert*)

☑ - deep HI & optical surveys (Arecibo, Subaru, LBT)

☐ - numerical simulations



-gas clouds falling into M31 and M33, cold flow or tides?  
-very extended stellar disks out to 2.5 optical radii, as HI warp in M33



## 2. The dark halo of M31

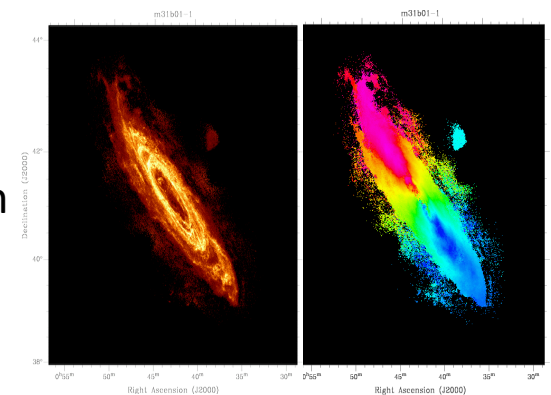
(*E. Corbelli, S. Lorenzoni - tesi specialistica, + R. Braun et al.*)

☑ - WSRT-largest HI datacube, the disk rotation + M31 satellites motion  
Most extended rotation curves ever made !!

## 3. The dark halo of M31 - $\Lambda$ CDM & MOND test

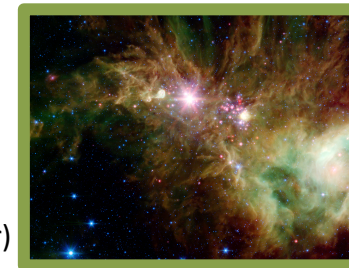
(*E. Corbelli, C. Giovanardi, S. Zibetti, + D. Thilker, P. Salucci*)

☐ - VLA-HI datacube,  $M/L(R)$  from SED, stronger constraints on DM and cosmology





# The onset of SF: from giant to tiny clusters



Staff: *E. Corbelli, C. Giovanardi, L. Hunt*

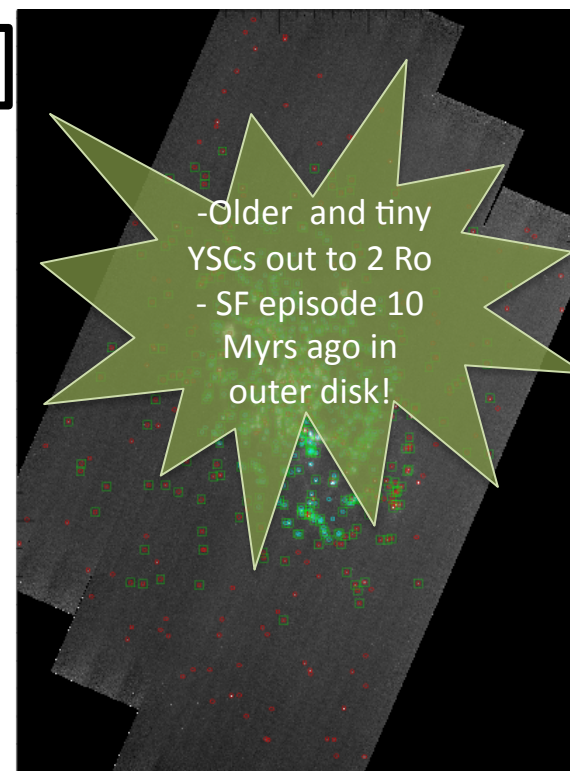
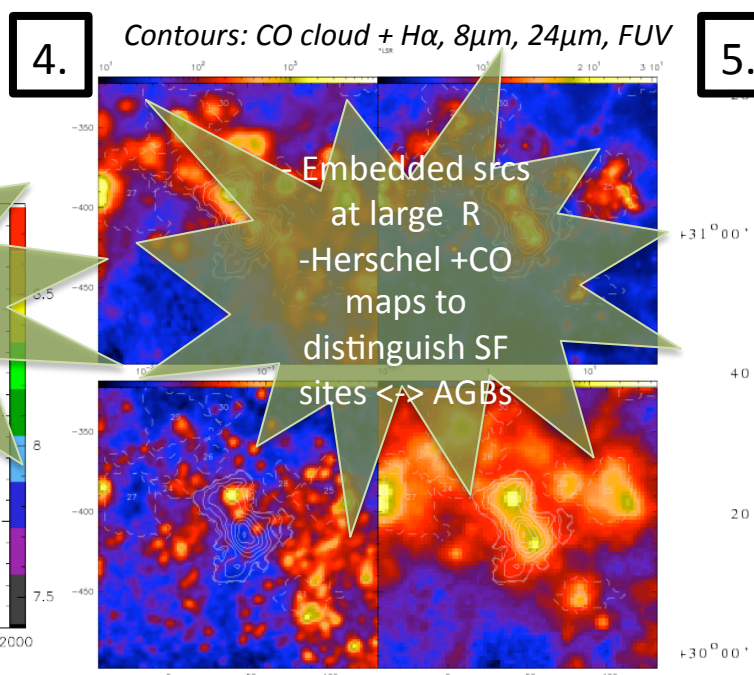
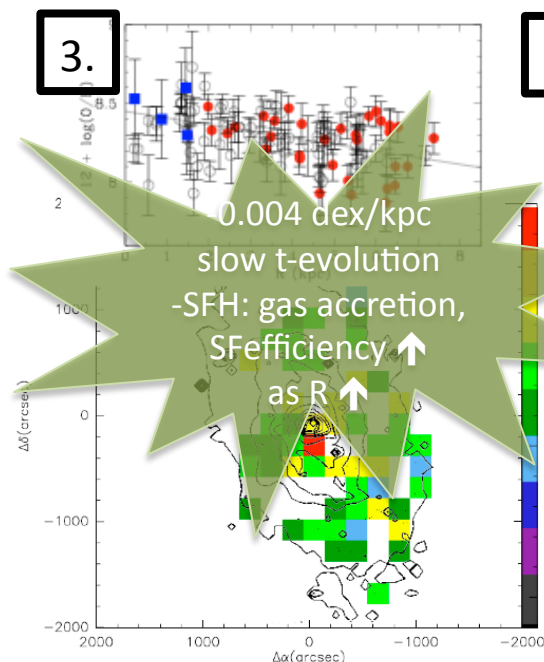
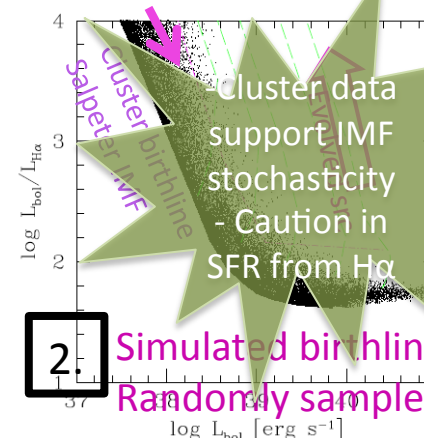
Post-Doc (2006-2010): *S. Verley* (2yrs), *M. Grossi* (2yrs, Sperello share), *Saurabh* (1yr)

Collaborators: *L. Magrini, F. Palla, B. Elmegreen, J. Braine*

☑ - done    ☐ - more work in progress

*M33 Database: UV-GALEX, Optical, H $\alpha$ , NIR-MIR-Spitzer, FIR-Herschel, HI, CO*

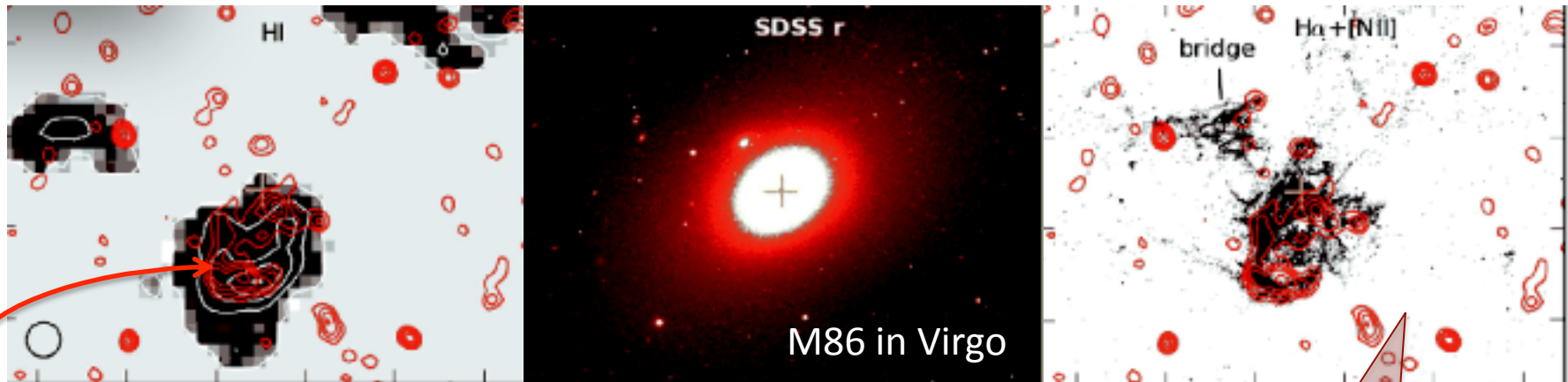
1. ☑ - The SFR and the K-S law: integrated, radial and local variations
2. ☐ - The IMF (stochastic-truncated) and the cluster birthline
3. ☑ - Metallicity gradient, metallicity maps
4. ☐ - IR sources and the CO map: embedded SF sites & AGBs
5. ☑ - Young Stellar Clusters: LF, ages, masses inner and outer disk



# The ISM in early-type galaxies (ETGs): Clues to formation scenarios

OAA: S. di Serego, C. Giovanardi, M. Grossi (post-doc, 2yrs share Edvige)

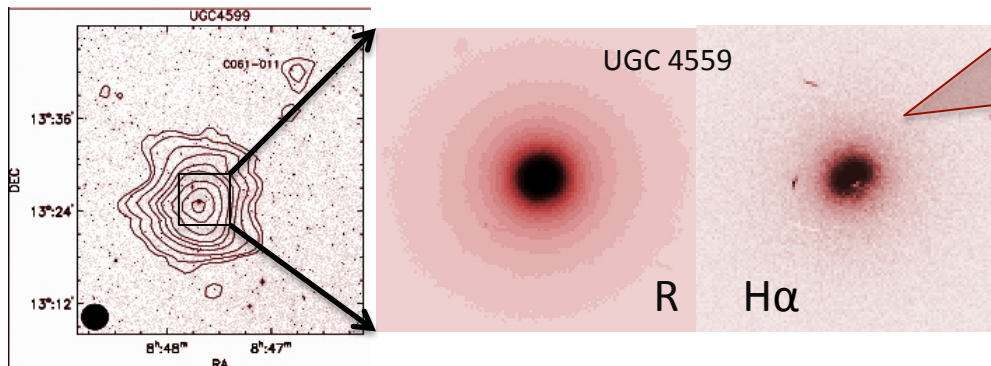
Collaborators: Riccardo Giovanelli, Martha Haynes, ...



**SPIRE (with HeViCS):** dust stripped away in Virgo, similarly to HI

**HI (with ALFALFA):** 9 of 389 ETGs (2%) detected in Virgo, 15 of 62 (24%) detected in low-density environments

**Hα (from TNG):** comparison with HI in progress



Dense environments (clusters) strip away ISM (gas and dust), possibly quenching star formation

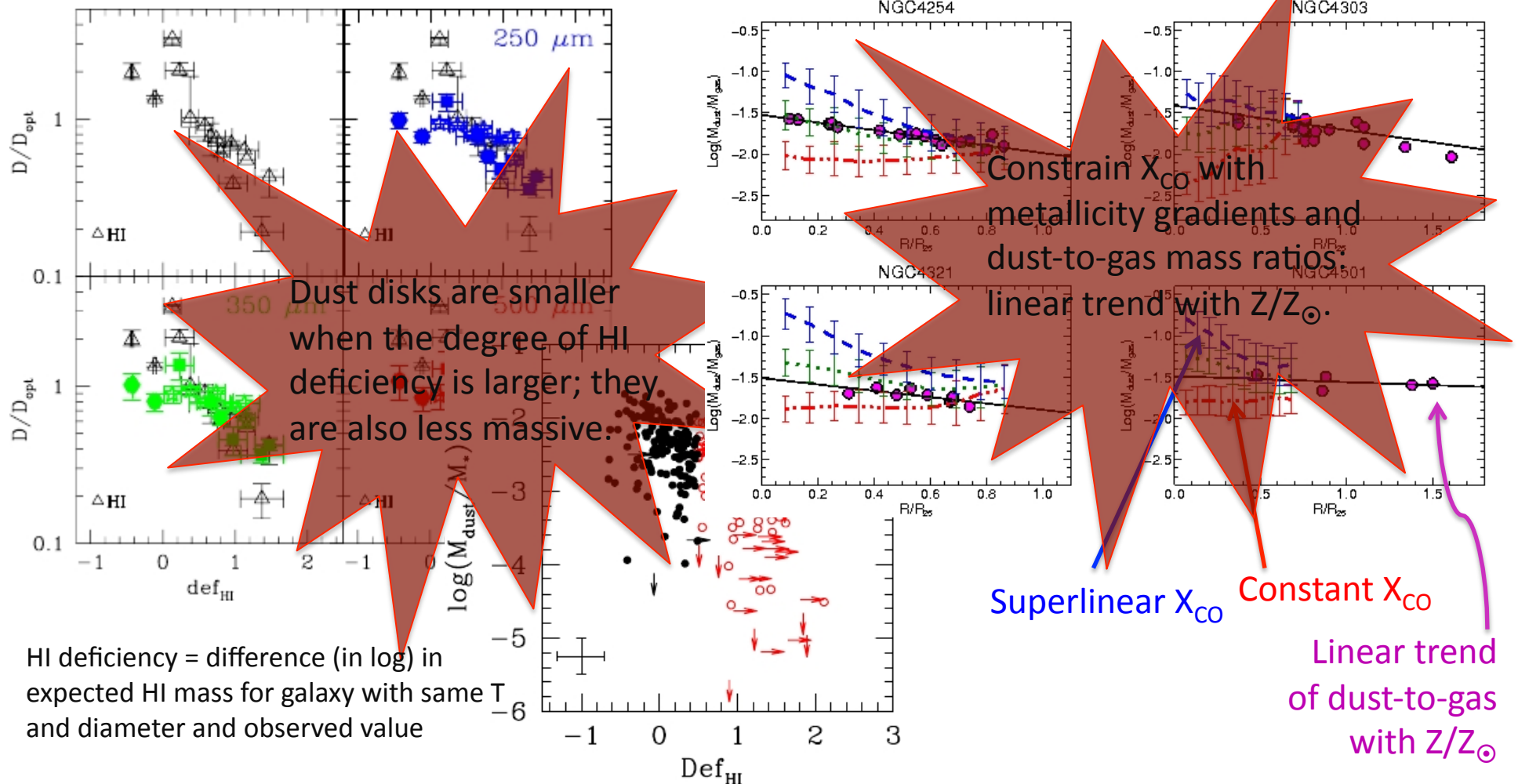
# The Herschel Virgo Cluster Survey: HeViCS

OAA: S. Bianchi, E. Corbelli, S. di Serego, C. Giovanardi, L. Hunt, S. Zibetti

Post-docs: L. Magrini (1 yr), C. Pappalardo (1.9 yr)

Funding: ASI 2011 (personnel, travel, H/W)

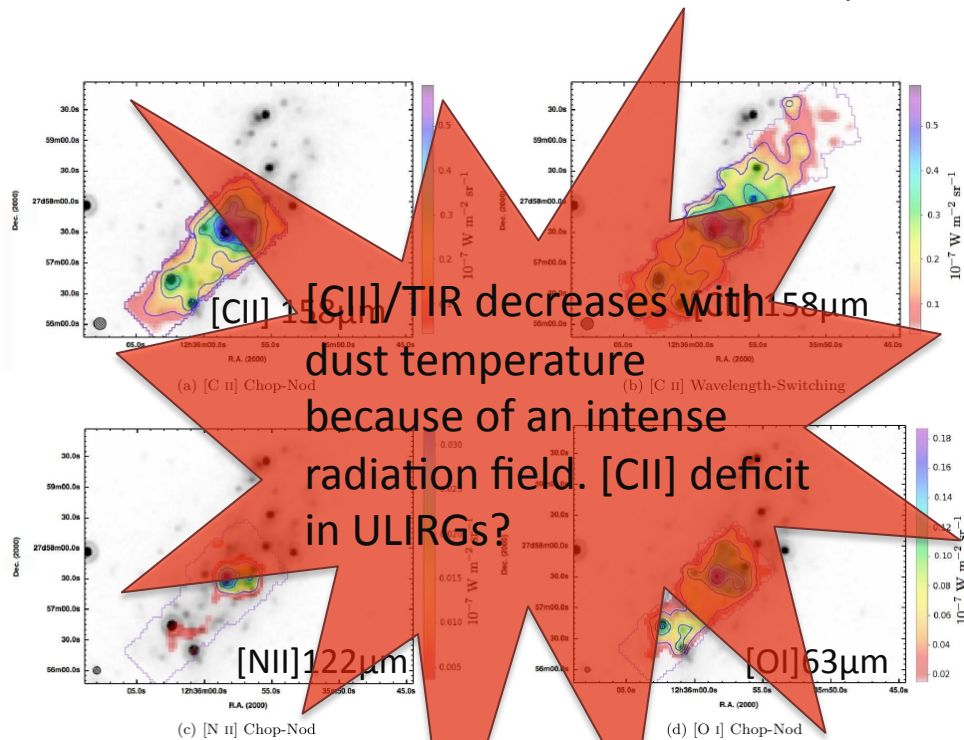
Collaborators: Jon Davies, Maarten Baes, George Bendo, ...



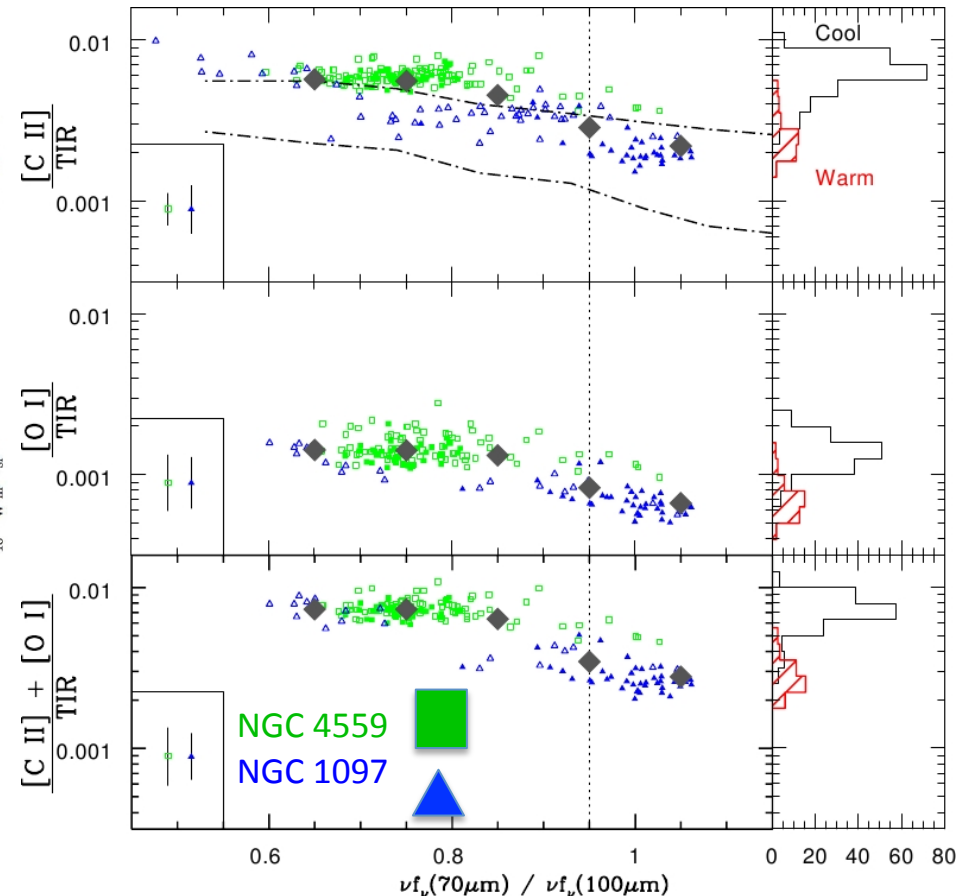
# Key Insights to Nearby Galaxies - Far-infrared Survey with Herschel: KINGFISH

OAA: L. Hunt, S. Zibetti

Collaborators: Rob Kennicutt, Daniela Calzetti, George Helou, ...



PACS spectroscopy:  
[C II] is the most important cooling line for the ISM



# MOlecules and DUSt at LOw metallicity: MODULO

OAA: S. Bianchi, D. Galli, L. Hunt (ex-OAA: P. Caselli, R. Maiolino, R. Schneider, L. Testi)

Post-docs, students: L. Magrini, R. Valiante, S. Bovinelli

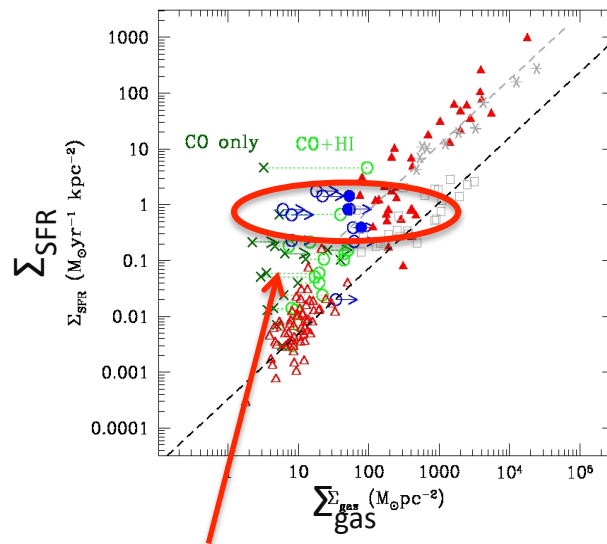
Funding: ISSI Bern 2010-2011 (living expenses, <http://www.issibern.ch/teams/modulo>)

PRIN-INAF 2010-2012 (PI Maiolino: travel, H/W)

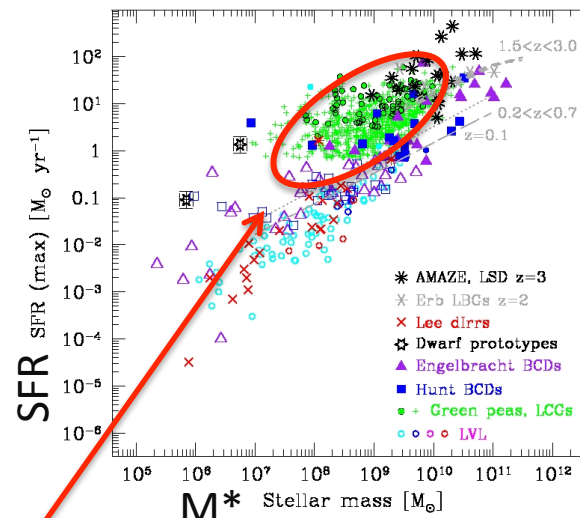
Collaborators: Francoise Combes, Santiago Garcia-Burillo, Christian Henkel, Karl Menten, ...

Approved proposals: ALMA Cycle 0, IRAM ~100hr, APEX ~60hr, Spitzer Cycles 0+5, Herschel Cycle 2

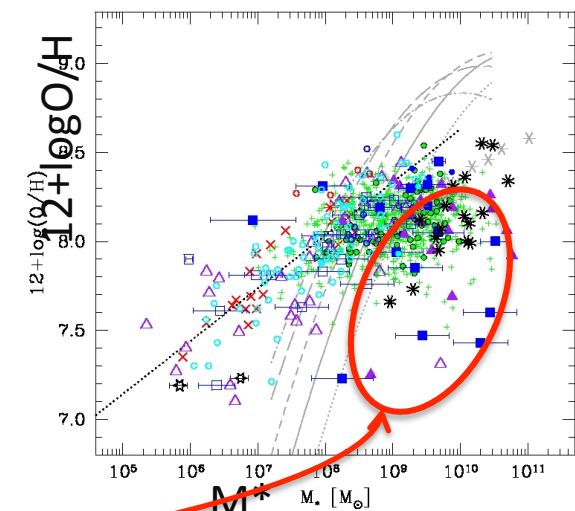
Kennicutt-Schmidt Law



SF "main sequence"



Mass-metallicity relation



Low-metallicity starbursts: where is their molecular gas?

Apply chemical evolution models with varying initial conditions (compact/dense vs. extended/tenuous)

# MOlecules and DUst at LOw metallicity: MODULO

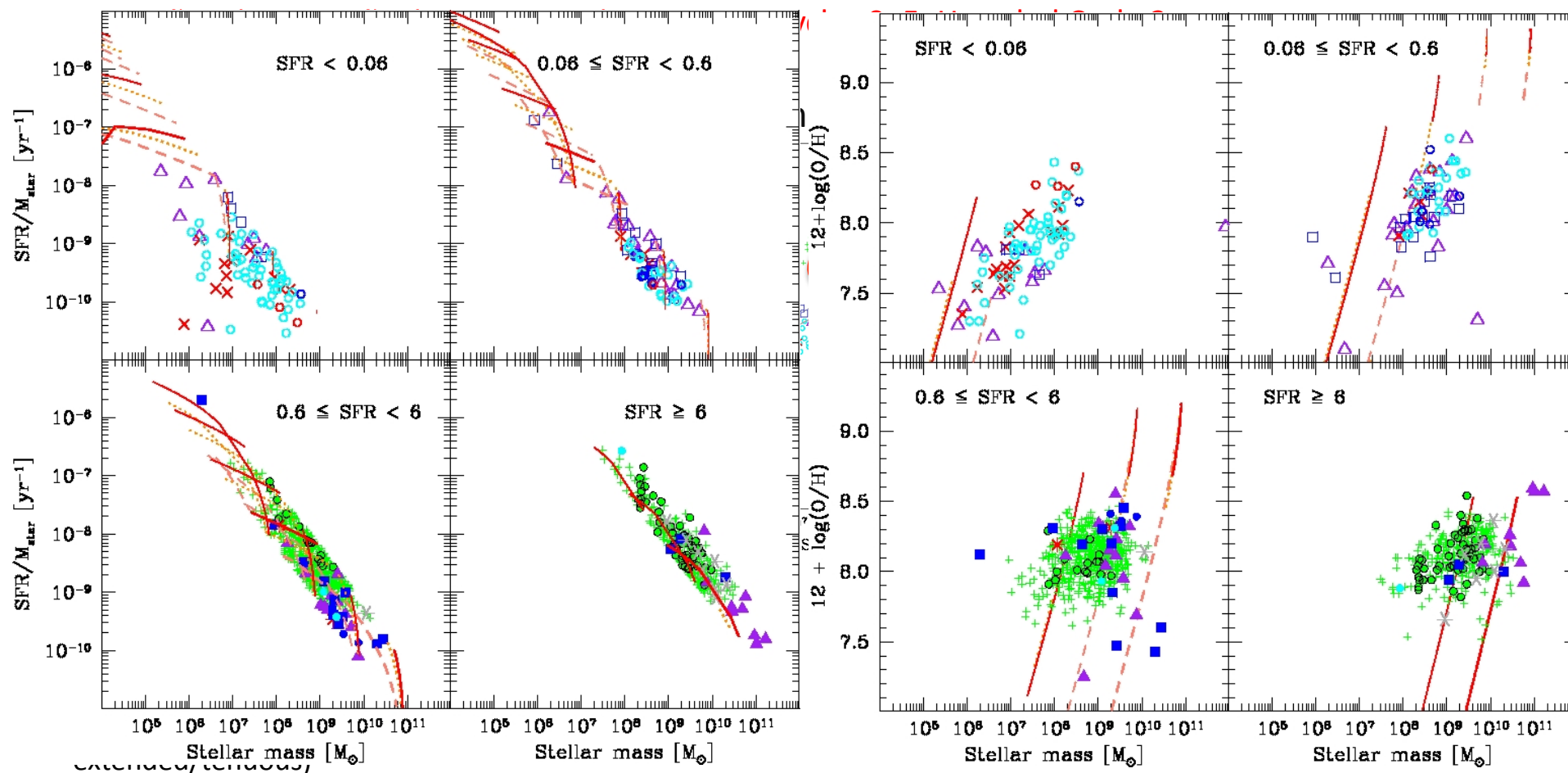
OAA: S. Bianchi, D. Galli, L. Hunt (ex-OAA: P. Caselli, R. Maiolino, R. Schneider, L. Testi)

Post-docs, students: L. Magrini, R. Valiante, S. Bovinelli

Funding: ISSI Bern 2010-2011 (living expenses, <http://www.issibern.ch/teams/modulo>)

PRIN-INAF 2010-2012 (PI Maiolino: travel, H/W)

Collaborators: Francoise Combes, Santiago Garcia-Burillo, Christian Henkel, Karl Menten, ...



# DUSTY-PhotZ: A spectral energy distribution library to probe star formation in the infrared

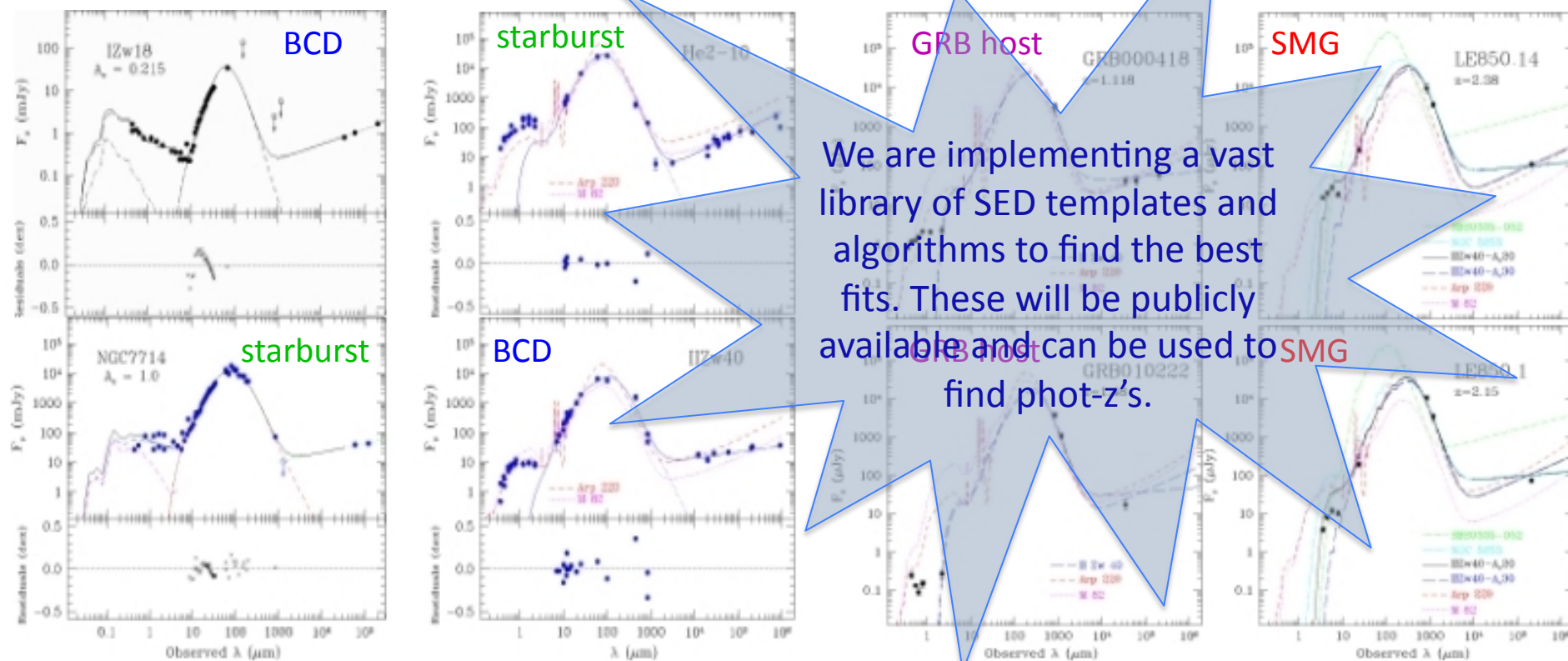
OAA: S. Bianchi, L. Hunt (ex-OAA: R. Maiolino)

Students: S. Bovinelli

Funding: ASI 2011 (travel, H/W)

NASA ROSES ADP 2011-2014 (personnel, living expenses)

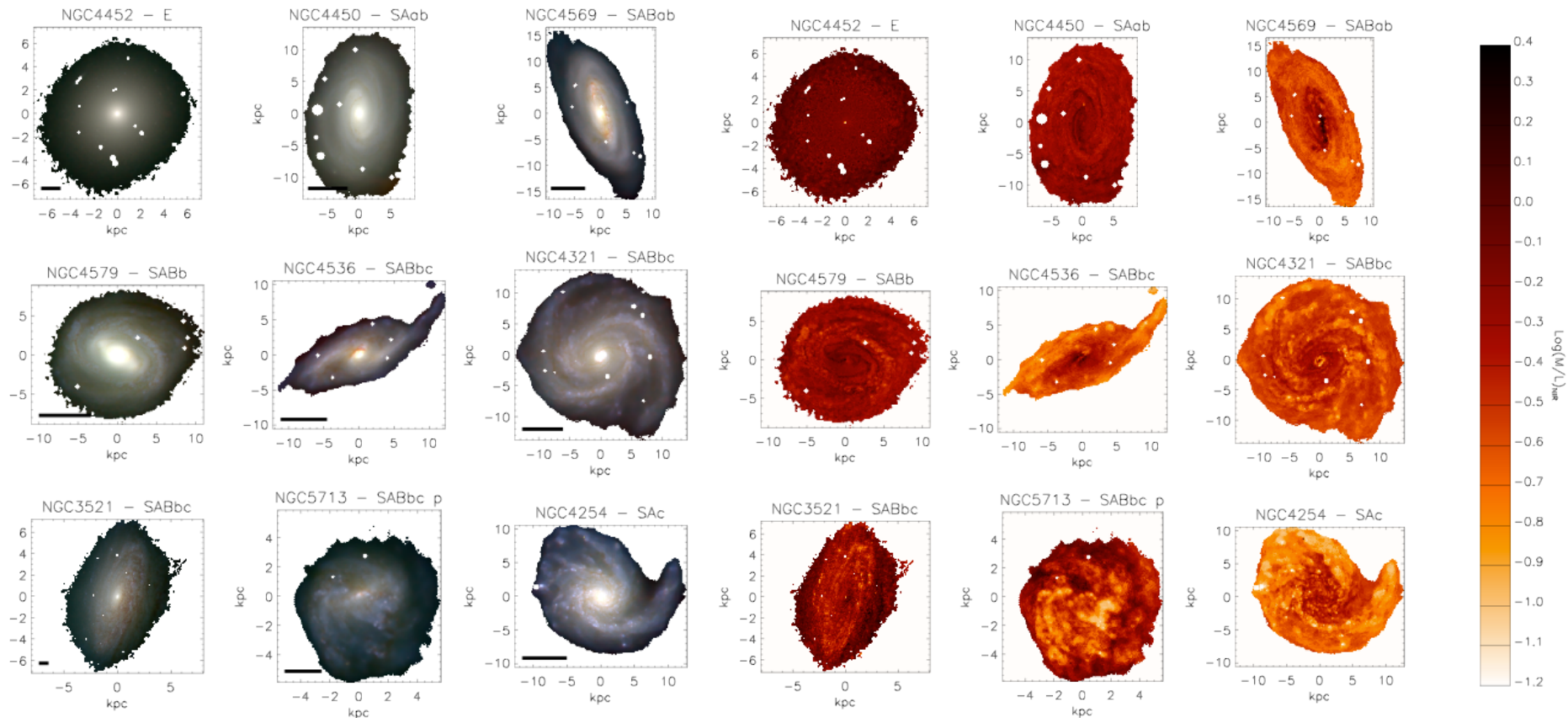
Collaborators: Moshe Elitzur



# Mapping the stellar mass

OAA: S. Zibetti, L. Hunt

Collaborators: S. Charlot, A. Gallazzi



Zibetti, Charlot & Rix (2009)

*giH* true-color images

*M/L*

- Optical and NIR colors (g-i, i-H) constrain at best *M/L*, taking advantage of age/metallicity/dust degeneracy
- New efforts to improve the method with the inclusion of:
  - ✓ dust constraints (in KINGFISH)
  - ✓ spectroscopic determination of stellar population parameters (in CALIFA IFS survey)
  - ✓ new models for the TP-AGB phase
- Test on low-metallicity dwarf galaxies with anomalous colors