

Local environments of [U]LIRGs

Małgorzata (Goha) Bankowicz

Astronomical Observatory
of the Jagiellonian University

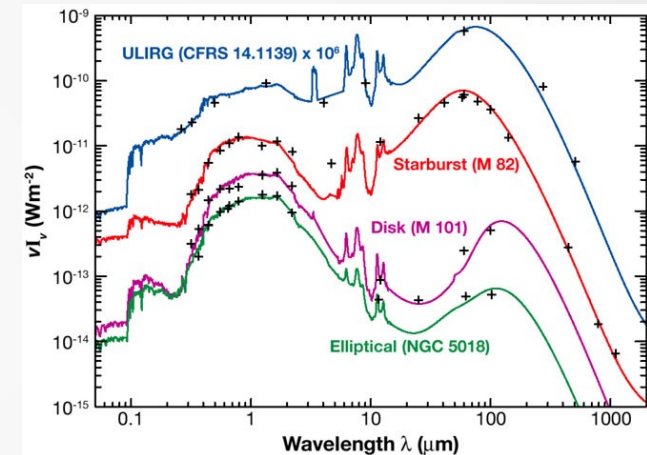
59 Cracow School of Theoretical Physics 2019

Zakopane
15.06.2019



[U]LIRGs

- [Ultra] Luminous InfraRed Galaxies ([U]LIRGs) – infrared bolometric luminosities
 - $10^{11} - 10^{12} L_{\odot}$ (LIRG),
 - $10^{12} - 10^{13} L_{\odot}$ (ULIRG).



Galliano 2004

- the peak emission is located in the infrared part of the spectrum

[U]LIRGs

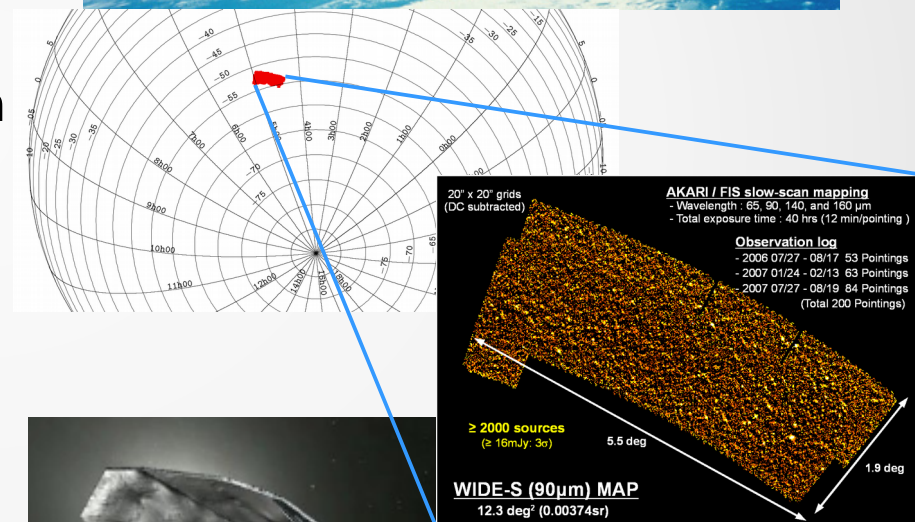
- ✓ possibly merging galaxies
- ✓ rare in local Universe
- ✓ dust rich
- ✓ extremely intense star formation
- ✓ 30-70% of local [U]LIRGs are AGNs
- ✓ possible relation between intense SFR and AGN
- ✓ perfect laboratories to study different factors controlling star formation in galaxies (AGN, mergers etc.)

Environment of [U]LIRGs – inconclusive knowledge

- Merger probability depends on the environment.
- If mergers are a trigger of ULIRGs activity:
 - Does environment play a role in activation of [U]LIRGs?
 - How correlated are environments of [U]LIRGs and environments of AGNs in general?
 - Are there more dusty AGN/[U]LIRGs in more dense environments than undusty AGN?
 - Environmental influence on the luminosity of [U]LIRGs?

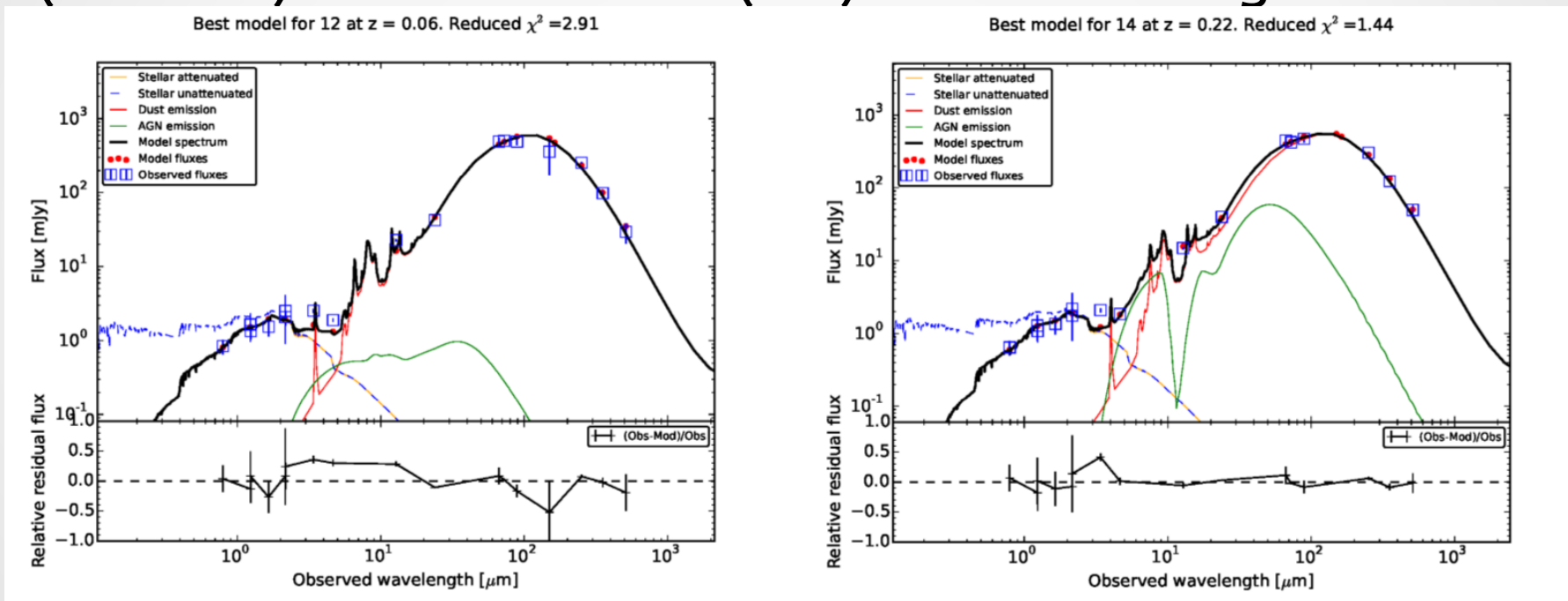
Data

- AKARI Deep Field South (ADF-S) around South Ecliptic Pole
- AKARI → Japanese IR satellite,
 - developed by members of JAXA/ISAS, with contribution from ESA
 - 68.5 cm telescope cooled to 6 K
 - the wavelength range:
1.7 μm - 180 μm
- ADF-S data enriched with Herschel data used



Data

- SED (Spectral Energy Distribution) fitting with the CIGALE (FUV-FIR) and CMCIRSED (FIR) for 69 ADF-S galaxies



SED examples of ULIRG (right panel) and normal SF galaxy (left panel)

Malek & Bankowicz et al. 2017

Local environment

- Two available surveys covering ADF-S field at optical range:
 - ✓ Digital Sky Survey – scans of photometric plates in 3 filters: B_j , R , IR , up to 23, 22 and 19.5 mag
 - ✓ Dark Energy Survey (DES) – g , r , i , z , Y photometry at range 23.52, 23.10, 22.51, 21.81 and 20.61 mag with data lower limit at 15 magnitude in each filter
- DES deeper but with lesser brighter objects → lacking data at lower redshift
- DSS covers full redshift depth but it is not as deep as DES

Local environment

- We measured projected local density around [U]LIRGs using the n-th neighbour method

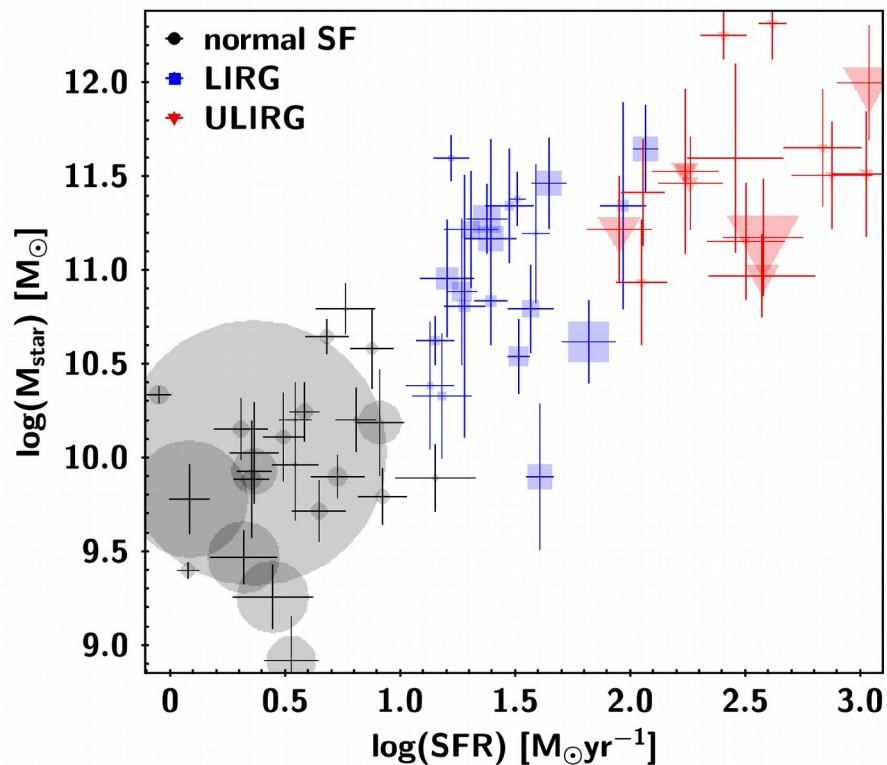
local density in a sphere based on the distance to the n-th neighbour

$$\delta = \frac{\sigma_n}{\bar{\delta}_z}$$

mean galaxy density at a given redshift

- Environment density based on Digital Sky Survey (DSS) optical data with photo-z estimated by EAZY code (Brammer et al. 2008)

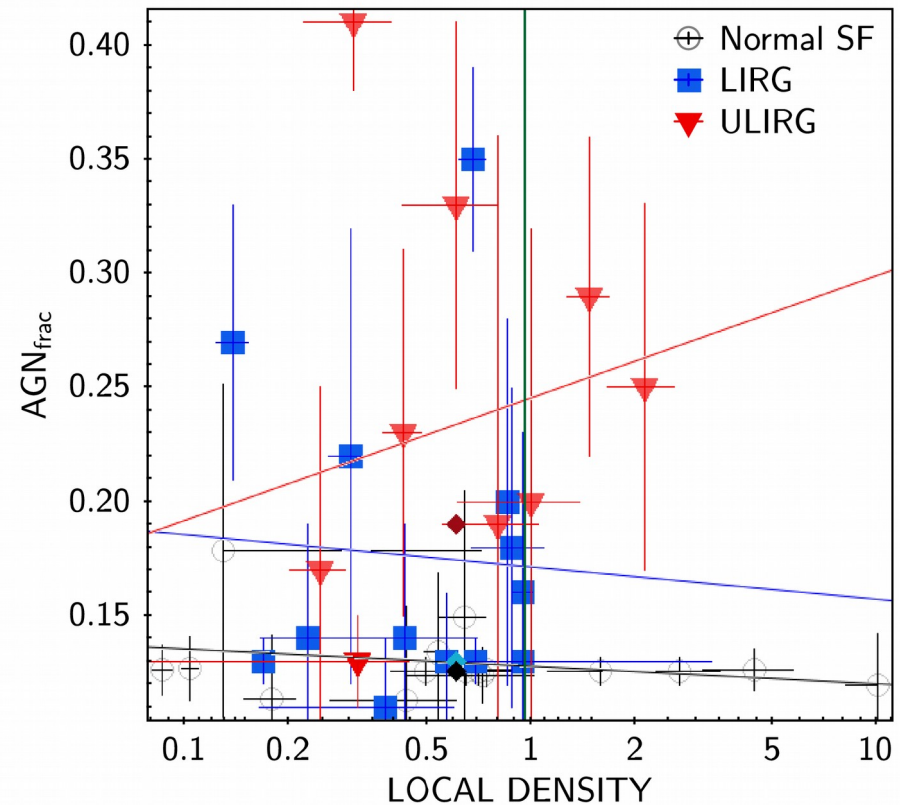
Results



- All ADF-S star forming galaxies are following M_{star} - SFR relation (the main sequence).
- ADF-S FIR-bright star forming galaxies tend to reside in all types of environments
- ULIRGs tend to occupy a narrower range of environments, with moderate local galaxy density.
- M_{star} decreases with increasing density

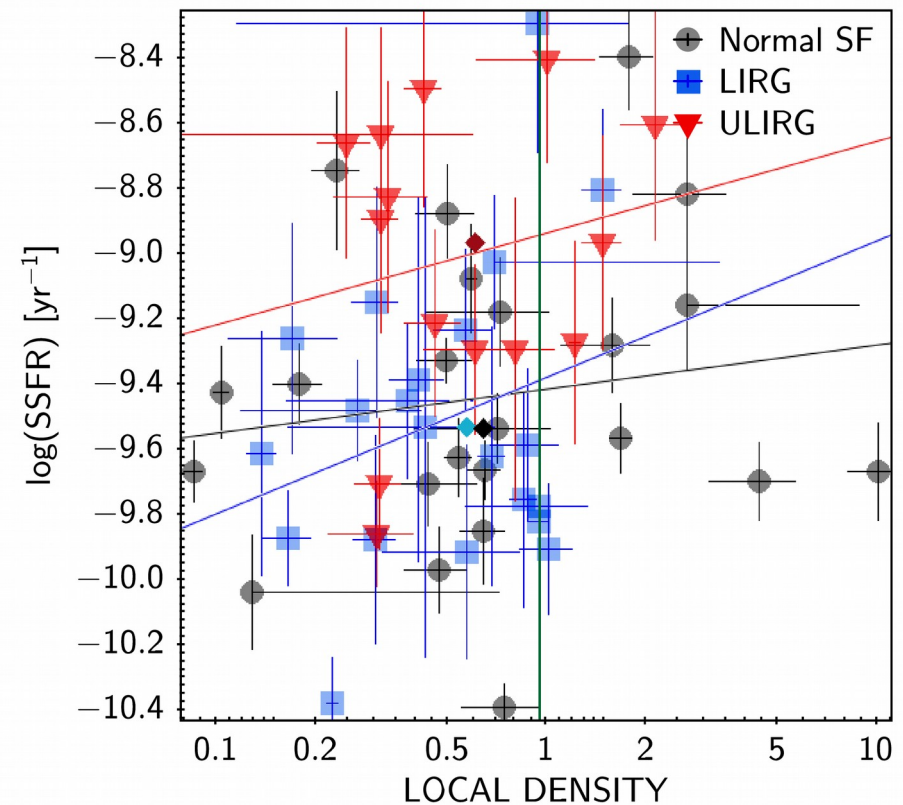
Results

- AGN fraction in ULIRGs increases with local density
- No correlation for LIRGs and normal star forming galaxies in our sample regarding AGN fraction and local galactic density relation.



Results

- Increasing Specific Star Formation Rate with density for all types of FIR-bright star forming galaxies



Summary

- FIR-bright star forming galaxies tend to occupy all types environments
 - ULIRGs tend to occupy a narrower range of environments, with moderate local galaxy density.
- All ADF-S star forming galaxies are following the the main sequence
- Physical properties of ULIRGs depend on the environment stronger than properties of other star forming galaxies, with their AGN activity and specific star formation rate rising with the increasing local galaxy density.
- ➔ This confirms that intergalactic interactions in dense but not extreme environments may play a role in activation and properties of ULIRGs.