

# Star formation and AGN activity in the most luminous LINERS in the local universe




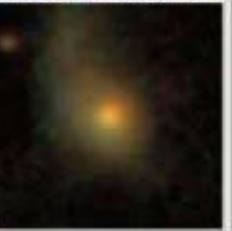
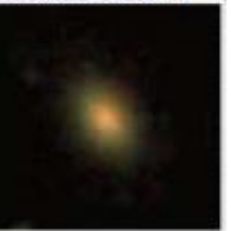
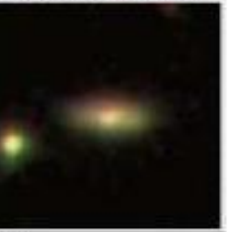




Mirjana Pović, et al

MNRAS 2016

<https://arxiv.org/pdf/1607.03915v1.pdf>

# LINERS

- LINERs – Low Ionization Nuclear Emission Line Regions
- AGN – Active Galactic Nuclei
- LINERs are about 2/3 of local AGN
- Two types:
  - Type I – both broad and narrow emission lines
  - Type II – only narrow emission lines

F01 J030959.83+001758.3	F02 J074144.3+211057	F03 J084524.02+391443.5	F04 J083823.91+460241.2	F06 J093956.8+345604.4
				
F07 J091256.06+465201.5	F09 J112216.38+544142.3	F12 J120926.68+110156.7	F13 J121520.55+053201	F14 J120037.52+043149.4
				
F15 J133525.14+455327.8	F16 J170330.7+205058.1	F17 J171814.47+641735.6	F19 J210450.52+002131.4	F20 J221312.46+131941.8
				
F21 J225122.06-065722.9	F22 J235249.11+140244.3	F23 J003707.81+002436.5	F24 J013455.38-064238.7	B01 J033410.54+010612
				

# Motivation

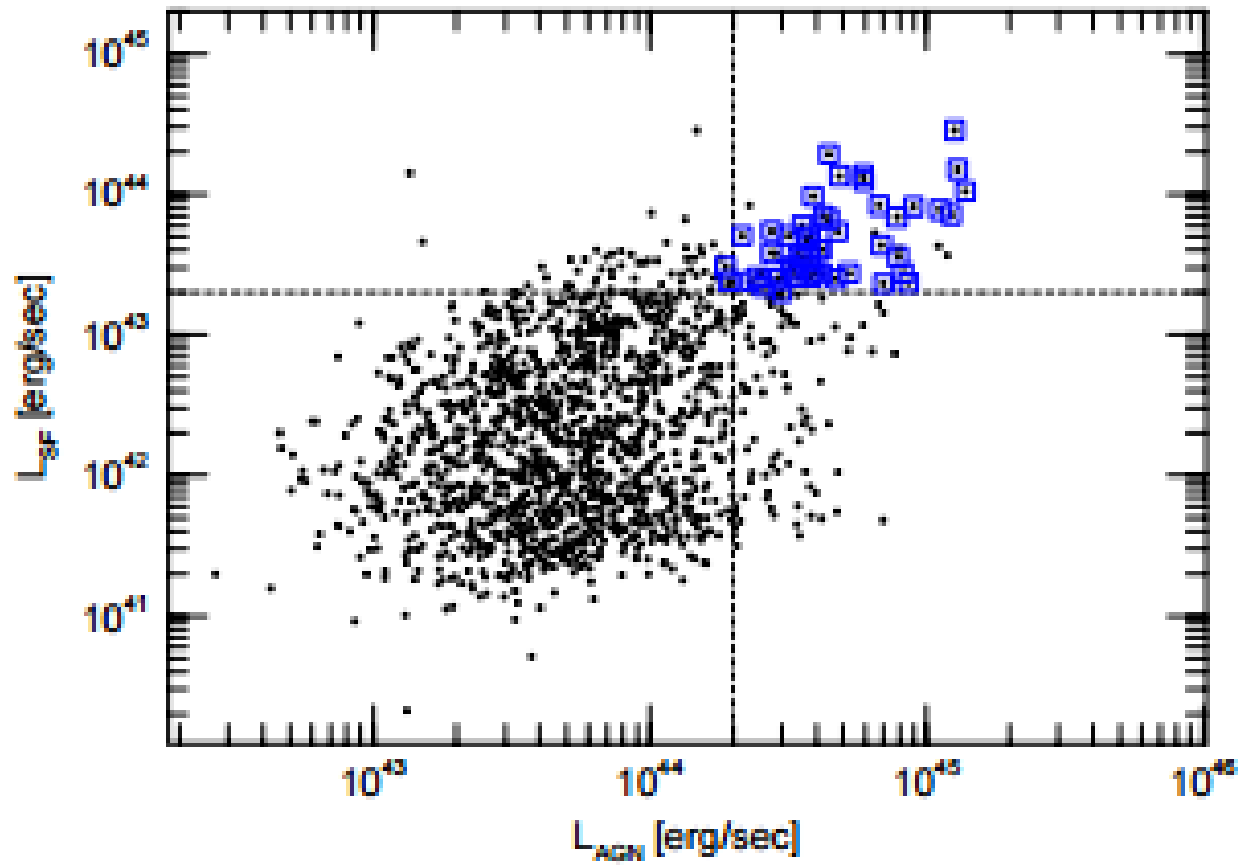
- Most studied LINERS are in galaxies with a low Star Formation Rate (SFR)
- Tommasin et al. (2012) looked at higher SFR LINERS at redshift of  $z=0.3$ 
  - Found 2 mags brighter than other LINERS, exceeding expectations from Far Infrared (FIR) measurements
- Want similar study at more redshifts

# Sample

- Choose LINERS from Sloan Digital Sky Survey, which is best at redshifts of  $z=0.04$  to  $z=0.11$
- Divide LINERs into classes by AGN Luminosity (LAGN) and star formation luminosity (LSF), after correcting for reddening by extinction
  - Call LINERs with  $\log \text{LAGN} > 44.3$  erg/s LLINERs (Luminous LINERs)
  - Call LLINERs with  $\log \text{LSF} > 43.3$  erg/s MLLINERs (Most Luminous LINERs)



# MLLINERS



# Data Collection - Optical

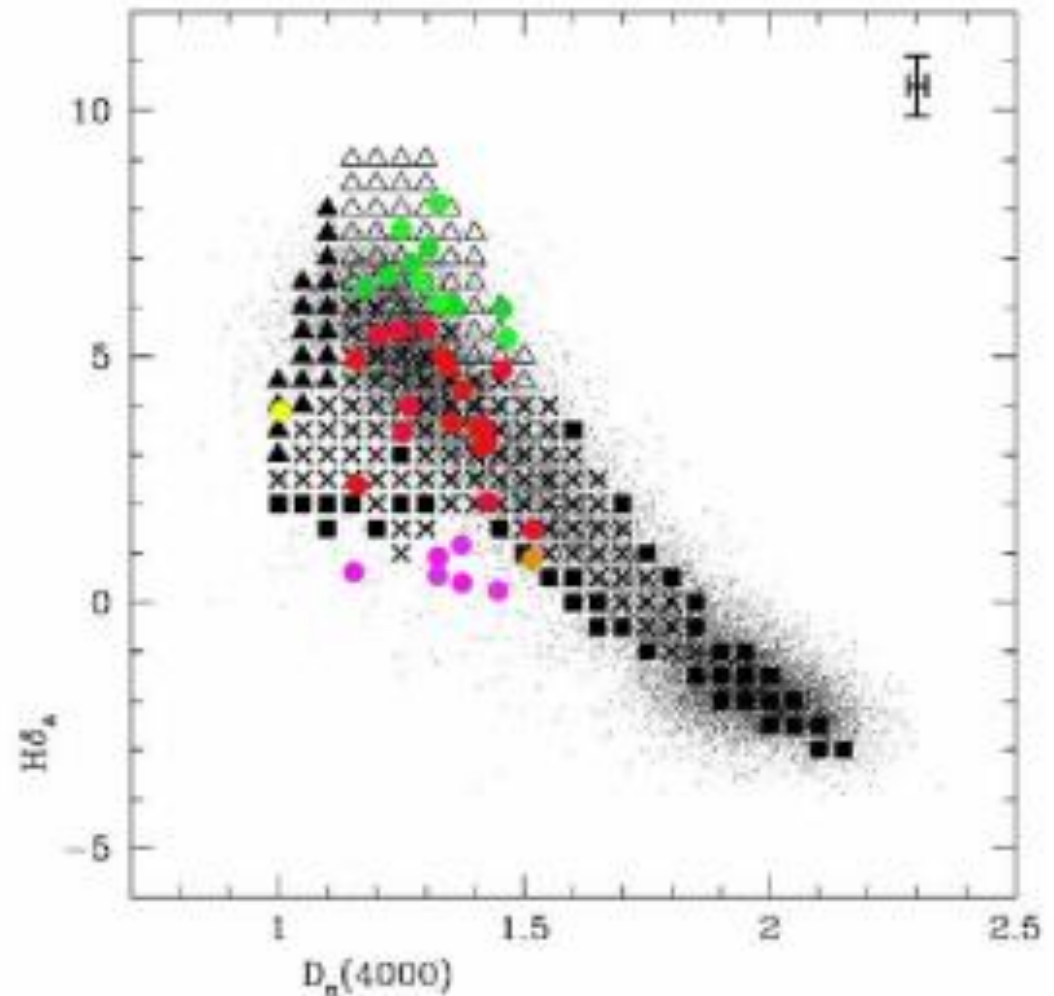
- Used Cassegrain Twin Spectrograph at Calar Alto Observatory and Andalucia Faint Object Spectrograph and Camera at the Nordic Optical Telescope
- Used data with the higher Signal to Noise Ratio for each source
- Standard background subtraction
- Three people were asked to call each galaxy elliptical, spiral, or peculiar

# Data Collection - Infrared

- Used Photo Detector Array Camera and Spectrometer at Herschel Space Observatory
- Removed low quality detections, according to IRAS tables



# Data Analysis

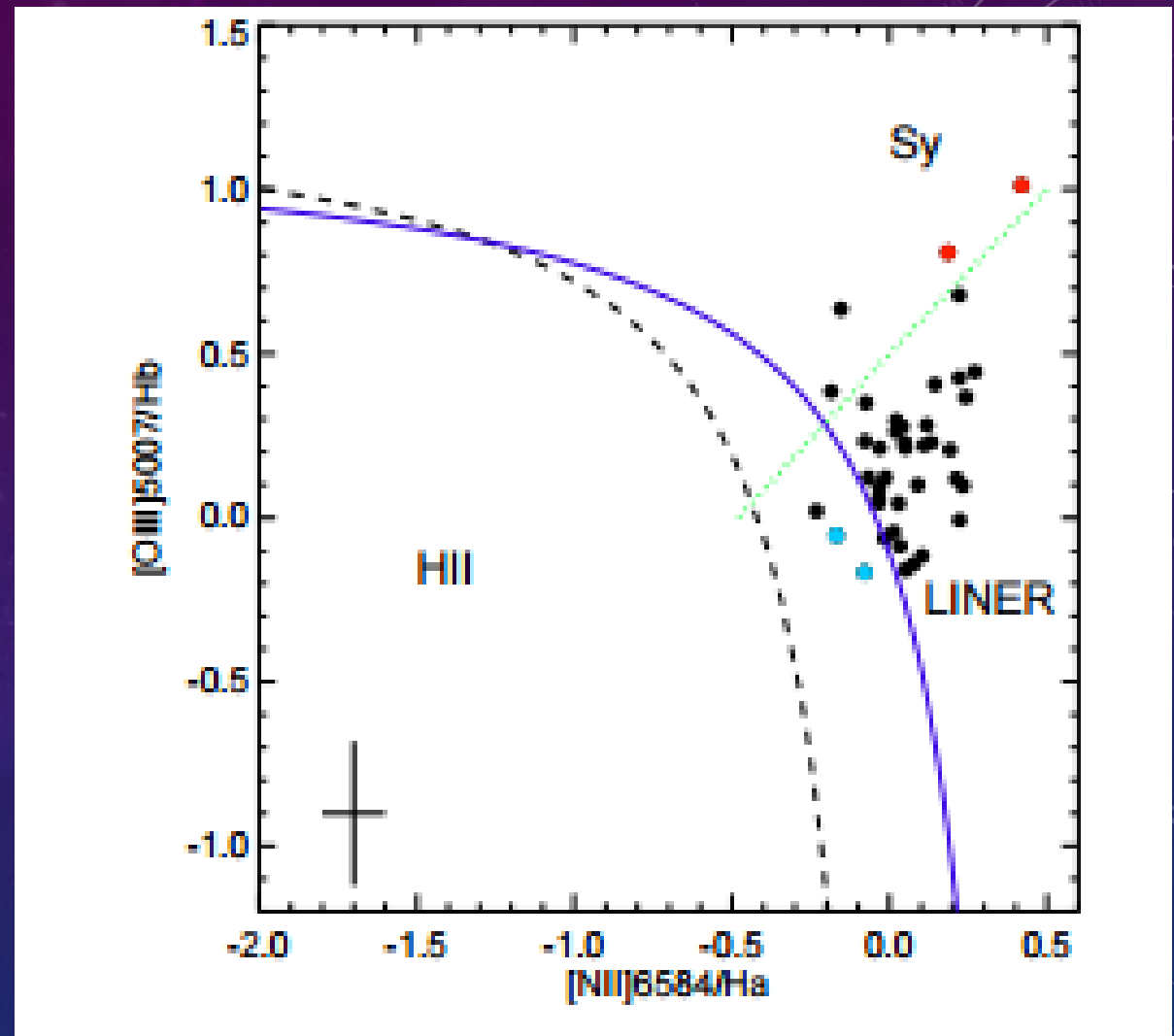


- Dn4000 and H $\delta$  strengths – SFR and consistency check (using Spearman's rank coefficient)
- Solid triangles have recent SF bursts, open triangles have older SF bursts, squares have continuous SF

# Data Analysis

- Nuclear spectra (central area spectra) corrected for reddening with pystarlight
- Used SNR and extinction to measure mass of stars and light-weighted mean ages of MLLINERs

## Data Analysis

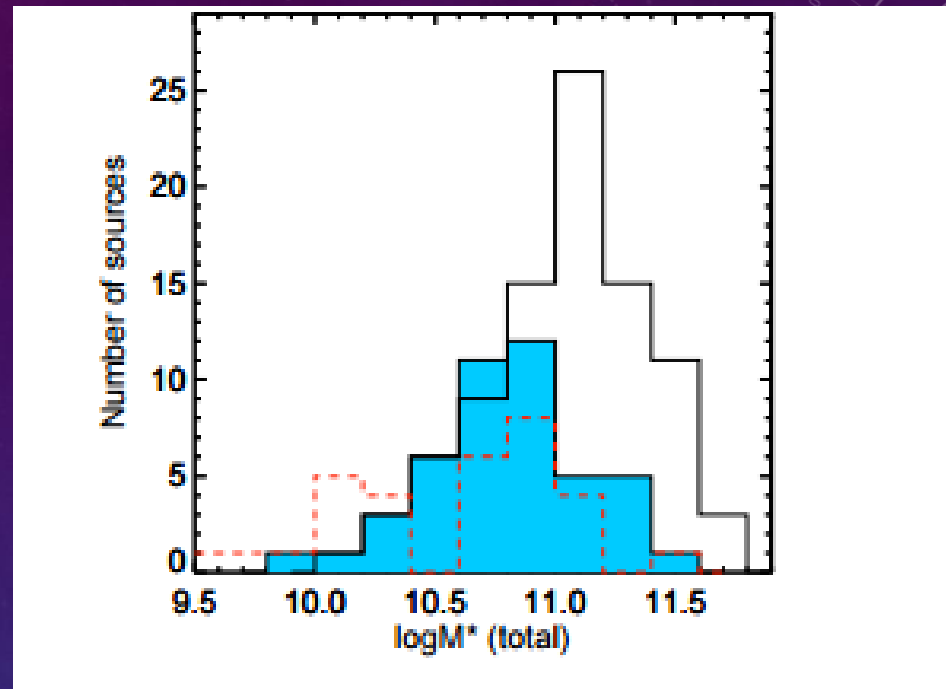


- Measured emission lines and H $\alpha$  equivalent width
- Used BPT to remove likely Seyferts from consideration

# Data Analysis

- SFR rates
  - STARLIGHT
  - Dn4000
  - FIR luminosity

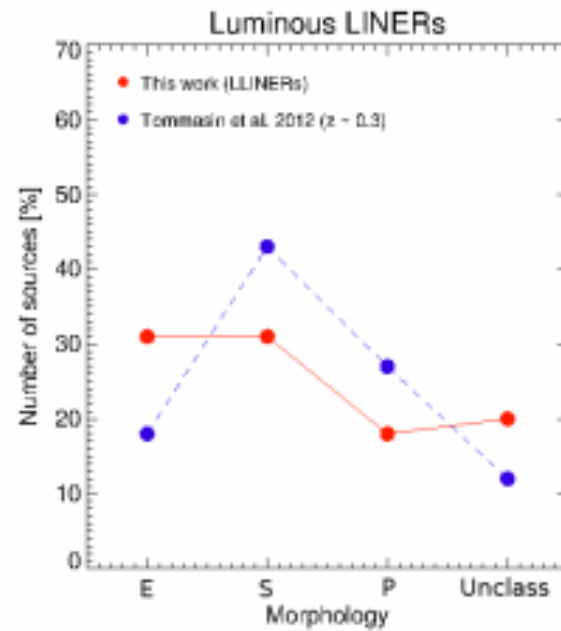
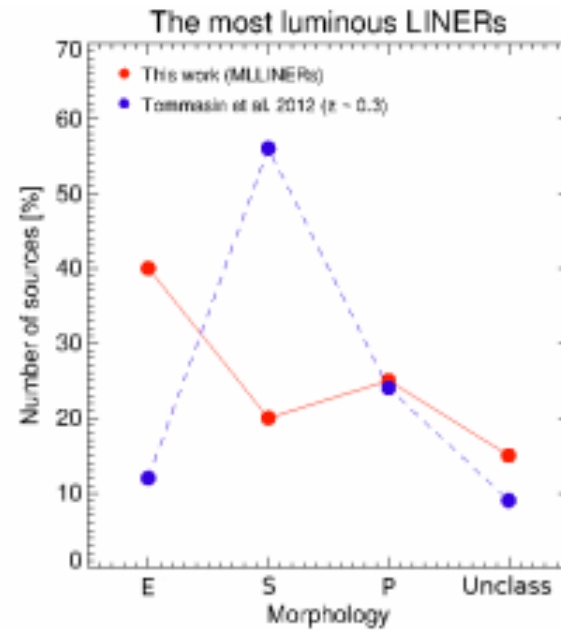
## Results - Mass



- Median MLLINER stellar mass is  $1.52 \times 10^{10}$  solar masses
- Kolmogorov-Smirnov test indicates different distribution from Tommasin (red)

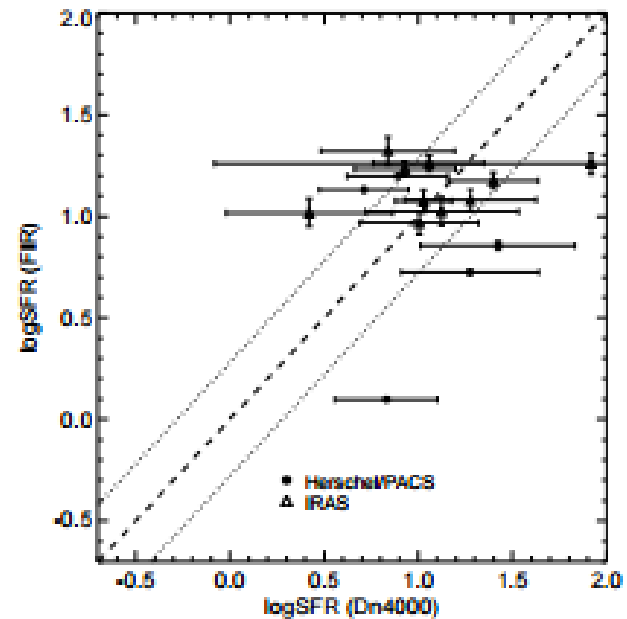
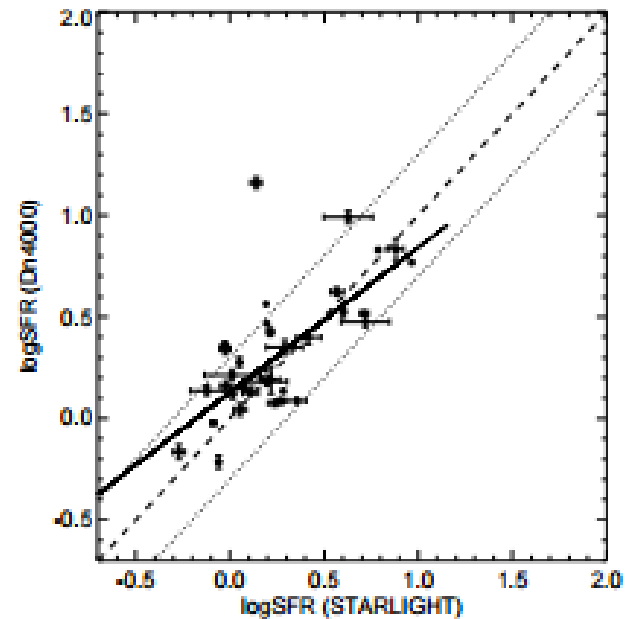


## Results - Morphology

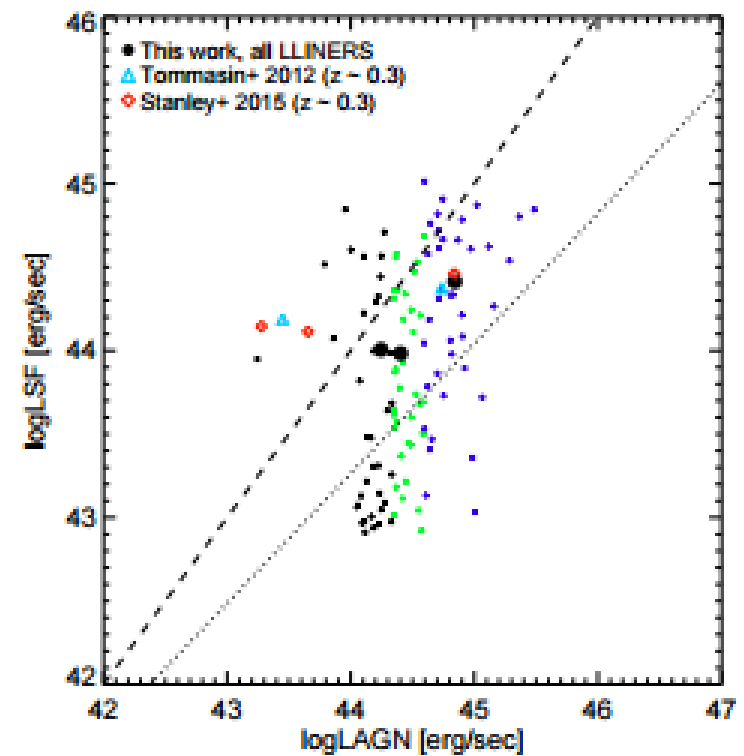
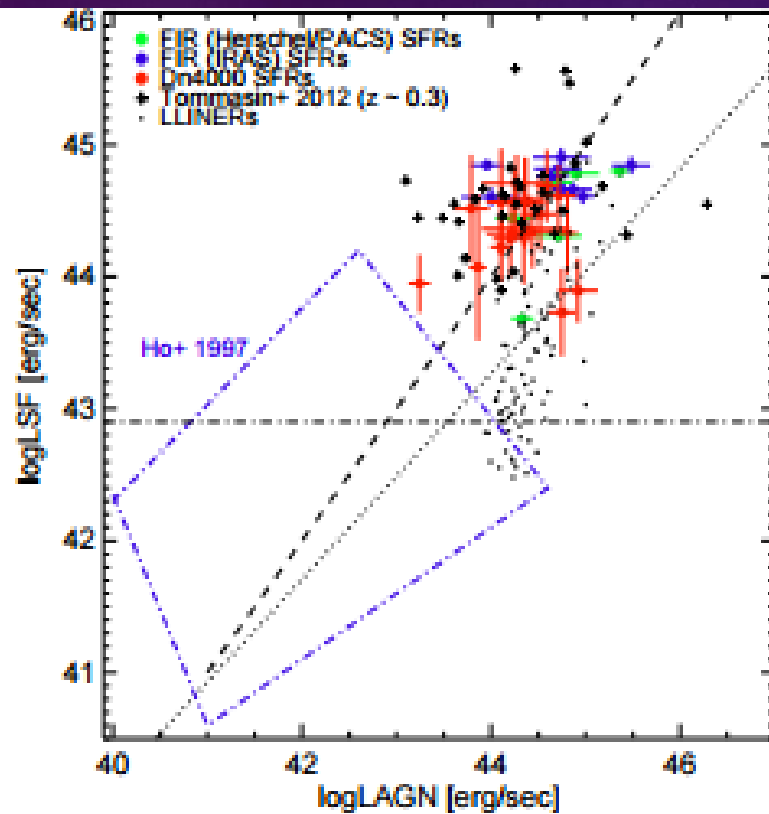


## Results – Star Formation Rate

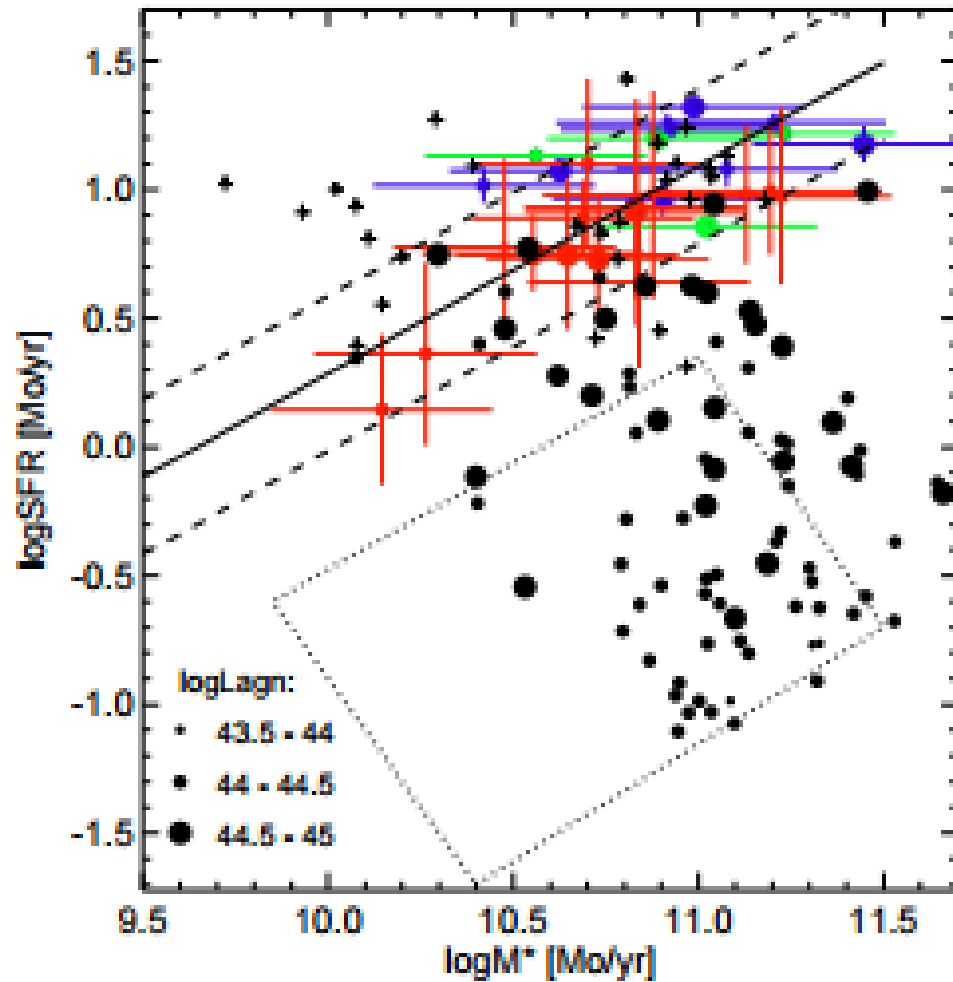
- 9-11 solar masses per year
- STARLIGHT simulation is good fit



# Results - Luminosity



## Results – Main Sequence



- More than 90% of MLLINERs between dashes

# Conclusions

- MLLINERs have more late type and peculiar galaxies than other LINERs
- MLLINERs have higher extinction rates
- MLLINERs have higher SFR, but lower stellar masses
- Tommasin-like LINERs exist at other redshifts
- MLLINERs follow main sequence (LAGN vs LSF)