

Star Formation Rate of Local Galaxies

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References



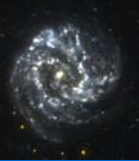
- “*Ultraviolet-to-Far-Infrared Properties of Local Star-Forming Galaxies*”,
Schmitt et al., 2006, ApJ, 643, 173
- “*Observations of High Redshift Universe*”,
Ellis, 2007, astro-ph/0701024



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Diagnostics of Star Formation Rate

- Rest-frame ultraviolet continuum ($\lambda \sim 1200 - 1500 \text{ \AA}$)

$$SFR(M_{\odot}yr^{-1}) = 1.4 \cdot 10^{-28} L_{\nu}(ergs s^{-1} Hz^{-1})$$

- Nebular emission lines

$$SFR(M_{\odot}yr^{-1}) = 7.9 \cdot 10^{-42} L(H\alpha)(ergs s^{-1})$$

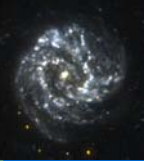
$$SFR(M_{\odot}yr^{-1}) = 1.4 \pm 0.4 \cdot 10^{-41} L(OII)(ergs s^{-1})$$

- Far infrared emission ($10 - 300 \mu\text{m}$)

$$SFR(M_{\odot}yr^{-1}) = 4.5 \cdot 10^{-44} L_{FIR}(ergs s^{-1})$$

- Radio emission

$$SFR(M_{\odot}yr^{-1}) = 1.1 \cdot 10^{-28} L_{1.4}(ergs s^{-1} Hz^{-1})$$



Local Star Forming Galaxies

- **Sample**

- 41 star forming galaxies coming from a multiwavelength observation project (Schmitt et al., 2006, *ApJS*, 164, 52)

- **Ultraviolet (1600 Å) — *HST* STIS**

- **H α — ground-based telescopes and *HST* archival data**

- **Radio (8.46, 4.89, 1.4 GHz) — VLA**

- In all above three bands monochromatic luminosities are used.

- **Infrared — *ISO* and *IRAS***

- In infrared band, luminosities are integrated between 8 μm and 1 mm under the two temperature model of spectral energy distribution (SED).

Local Star Forming Galaxies

- Calibrations for star formation rates

$$\text{SFR}(\text{H}\alpha) = (7.9 \times 10^{-42})L(\text{H}\alpha),$$

$$\text{SFR}(\text{UV}) = (1.4 \times 10^{-28})L_{\nu}(1600),$$

$$\text{SFR}(\text{IR}) = (4.5 \times 10^{-44})L(\text{IR}),$$

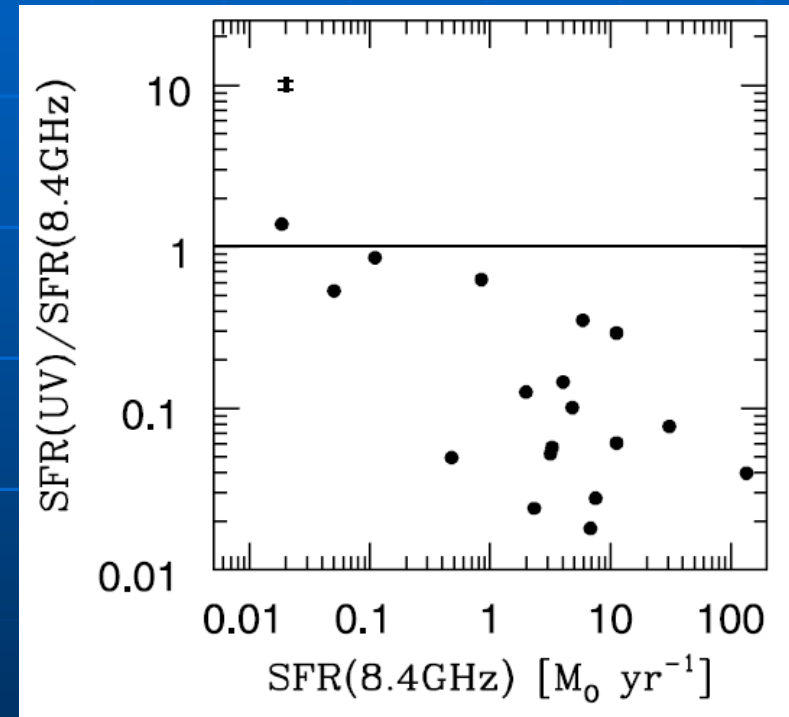
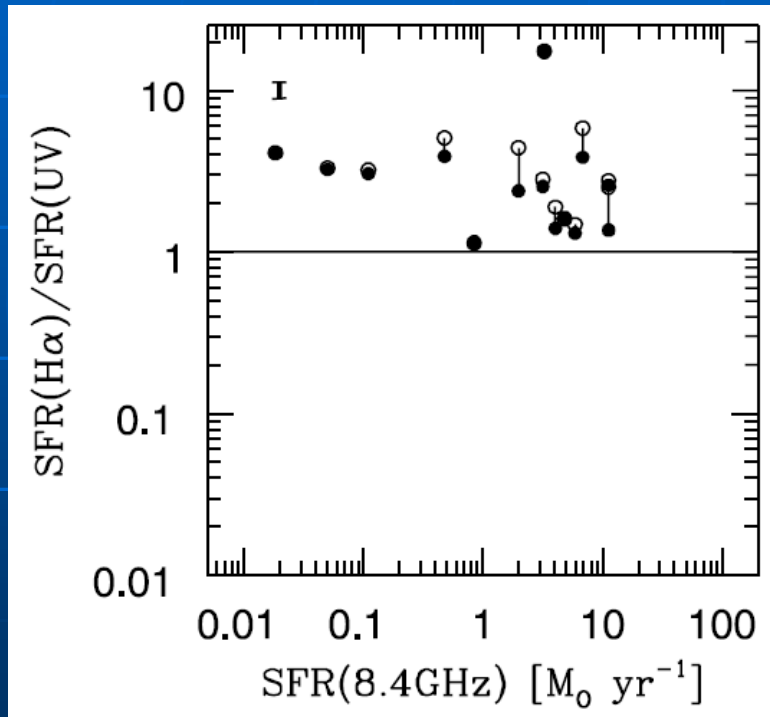
$$\text{SFR}(\text{radio}) = 10^{-20}L_{\nu}/(8.55\nu^{-0.8} + 1.6\nu^{-0.1}),$$

Definition of $\text{SFR}(\text{BOL}_{\text{SB}})$.

— integrating SED between UV and B bands, then adding infrared luminosity

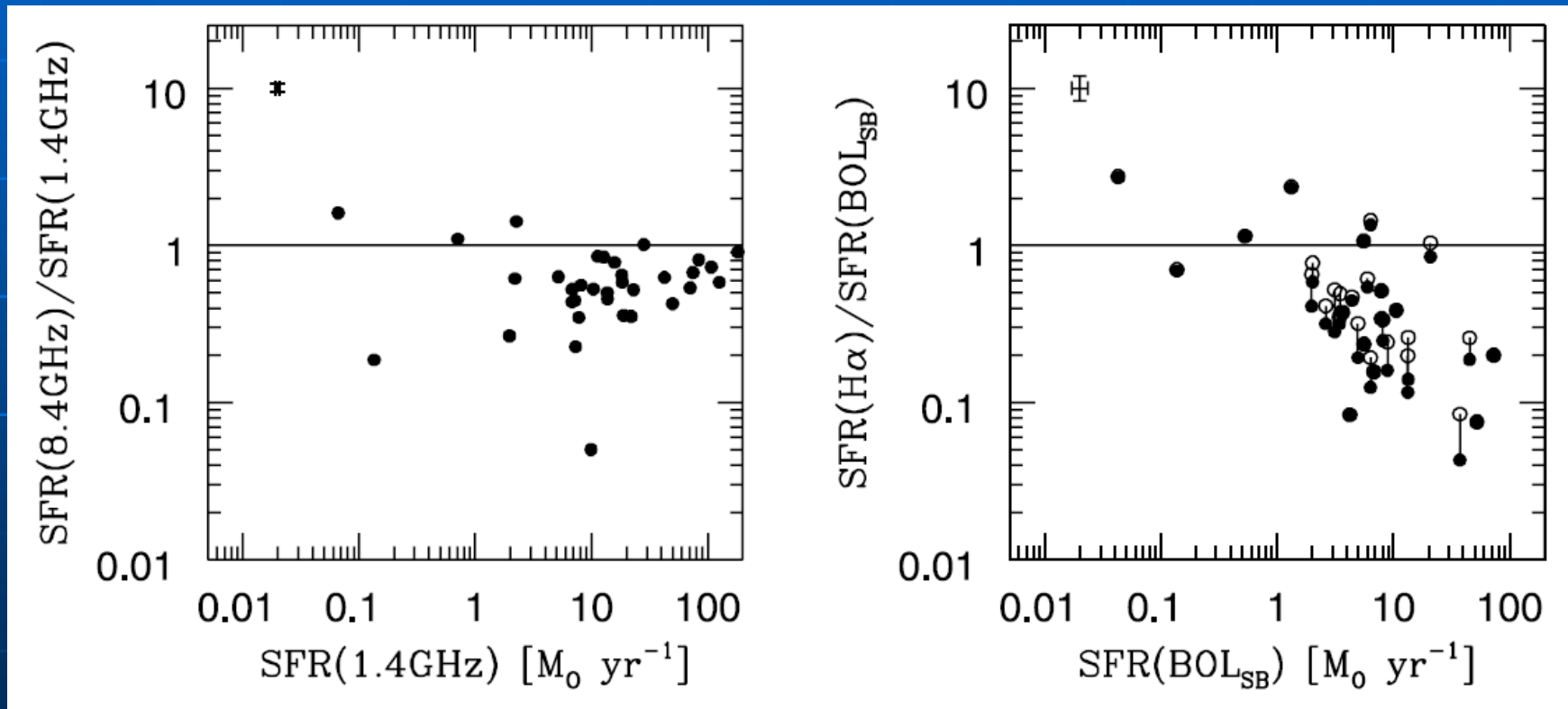
Local Star Forming Galaxies

- Comparison between different diagnostics
- Matched Apertures (local) — effects of extinction



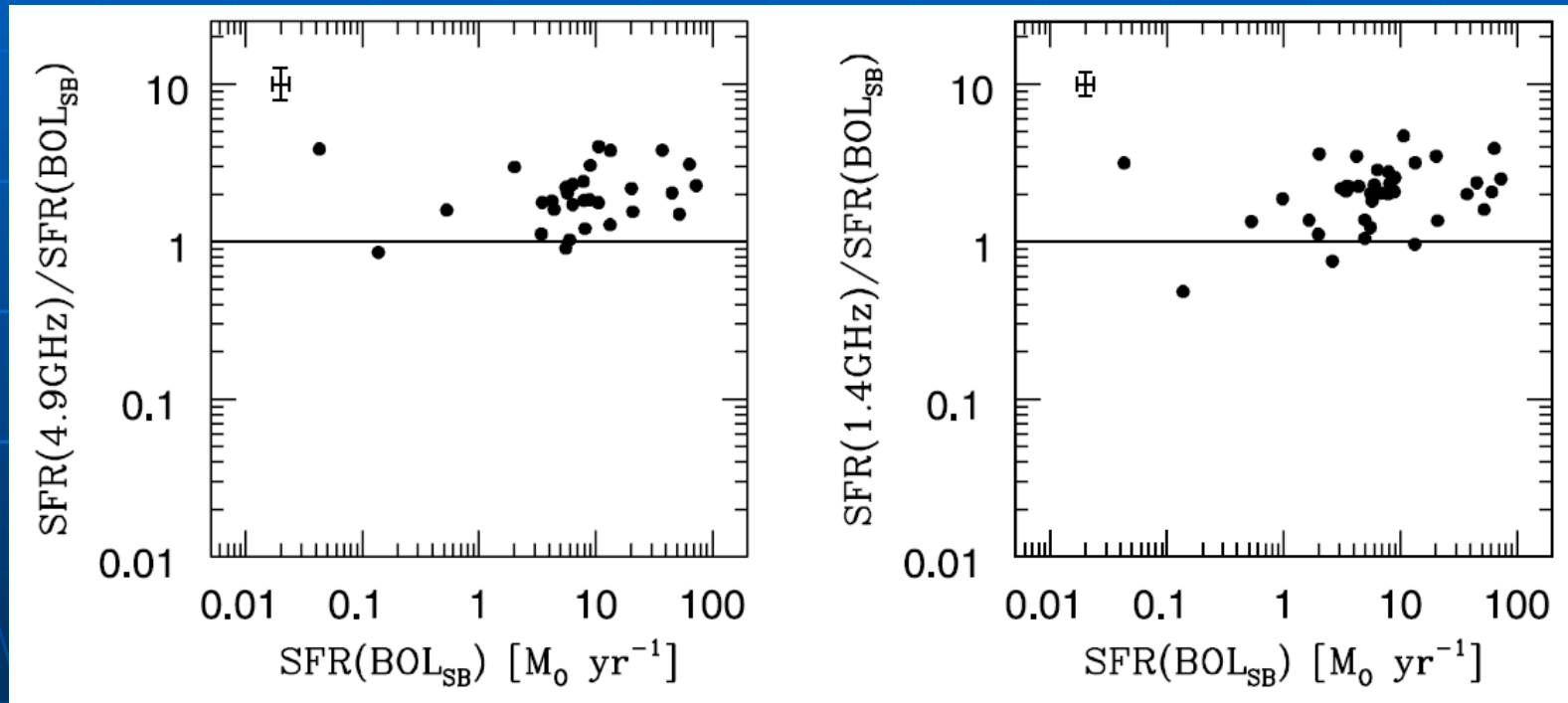
Local Star Forming Galaxies

- Comparison between different diagnostics
- Integrated Apertures (global) — observation limit and effects of extinction



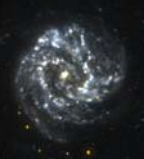
Local Star Forming Galaxies

- Comparison between different diagnostics
- Discrepancy between radio and bolometric — overestimation of radio relation





Local Star Forming Galaxies

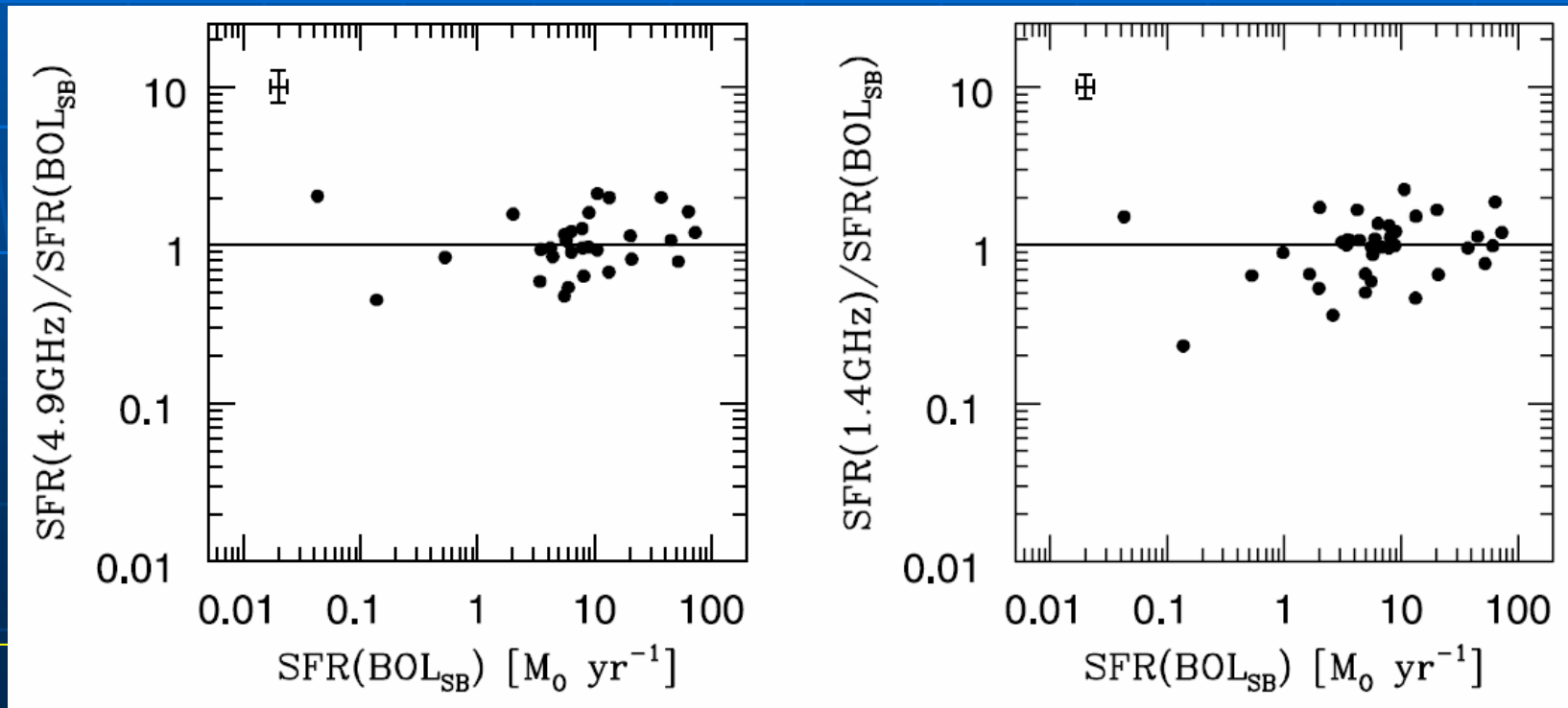


- Comparison between different diagnostics
- New calibration of radio indicator

$$\text{SFR}(1.4 \text{ GHz}) = (6.2 \times 10^{-22}) L_\nu(1.4 \text{ GHz})$$

$$\text{SFR}(4.89 \text{ GHz}) = (1.4 \times 10^{-21}) L_\nu(4.89 \text{ GHz}),$$

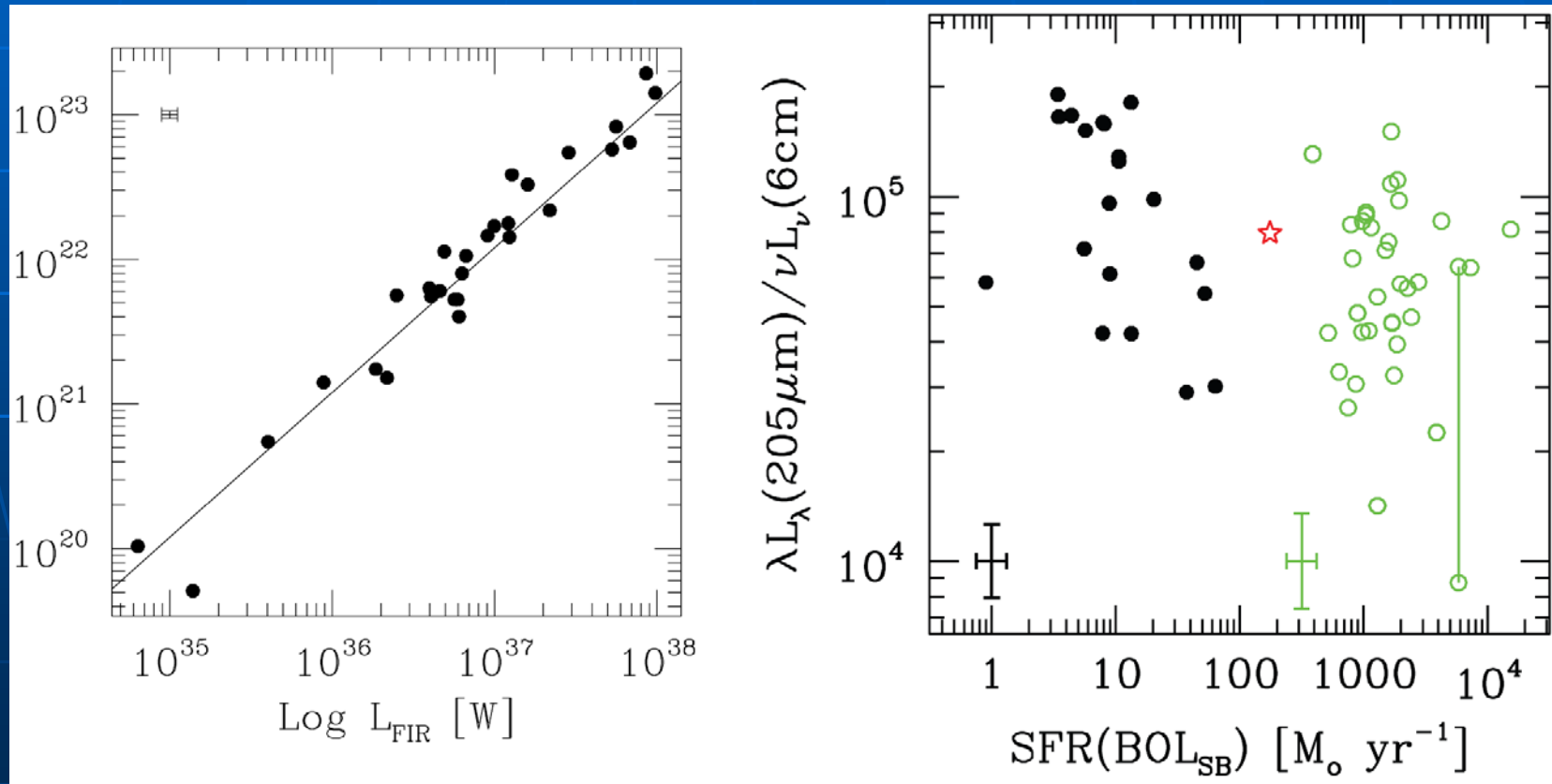
$$\text{SFR}(8.46 \text{ GHz}) = (2.0 \times 10^{-21}) L_\nu(8.46 \text{ GHz}),$$



Comparing to High Redshift Galaxies

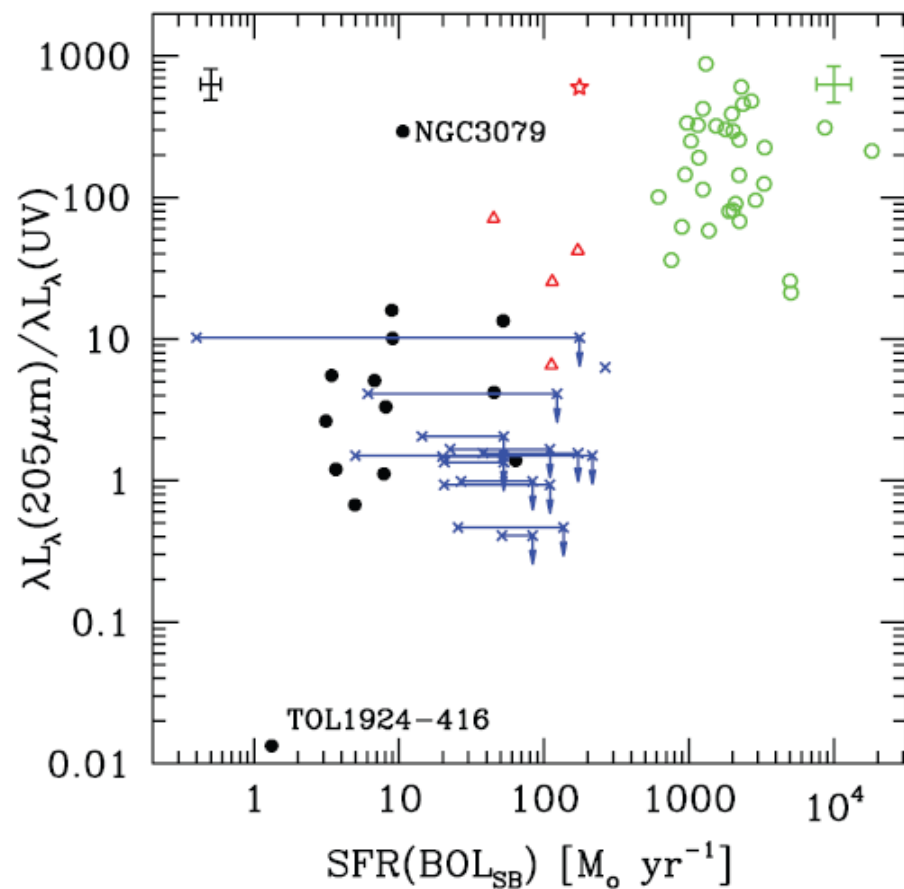
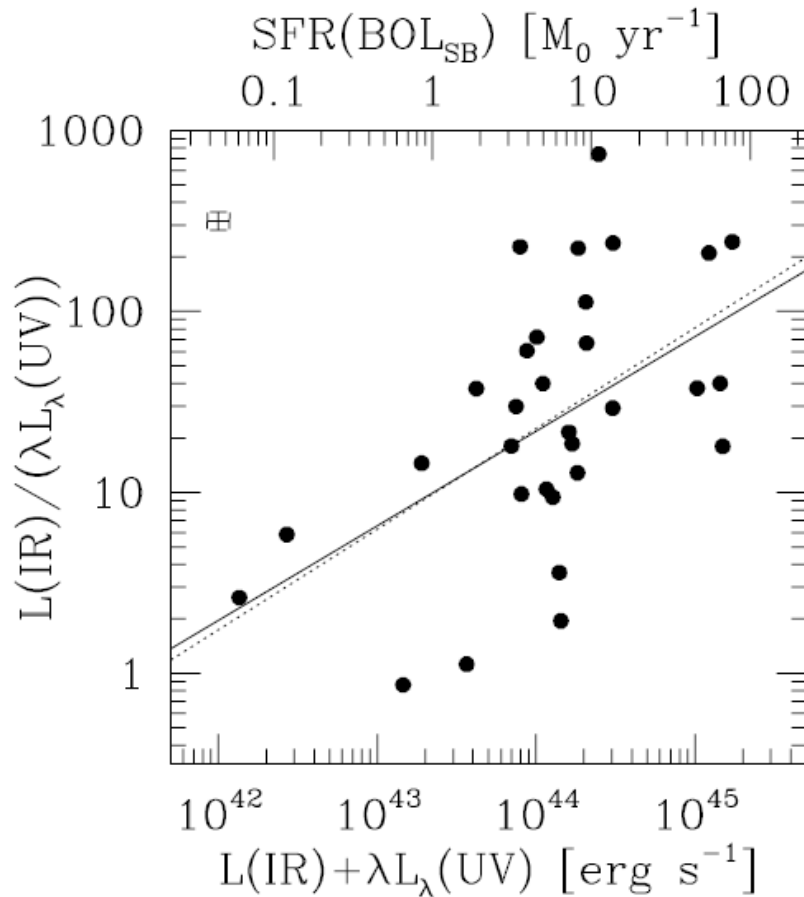
- Sample of High Redshift Galaxies

Arp 220, another 4 ULIGs, 13 LBGs, 31 SCUBA sources ($z \sim 2-3.5$)
—— both rest-frame UV and rest-frame $\sim 200 \mu\text{m}$ measurement available



Comparing to High Redshift Galaxies

- Results
- More actively star-forming galaxies also tend to be more dust opaque





Summary & Discussion



- 4 diagnostics for star formation rate — UV, H α , IR, Radio
- Dust extinction affects the estimation of star formation rate.
- More actively star-forming galaxies also tend to be more dust opaque