

**Gas, Dust, and Star Formation in Galaxies:
From the Local to far Universe
Platanias, May 2015**

*Biases linked with resolution
effects and the lack of
wavelength coverage*

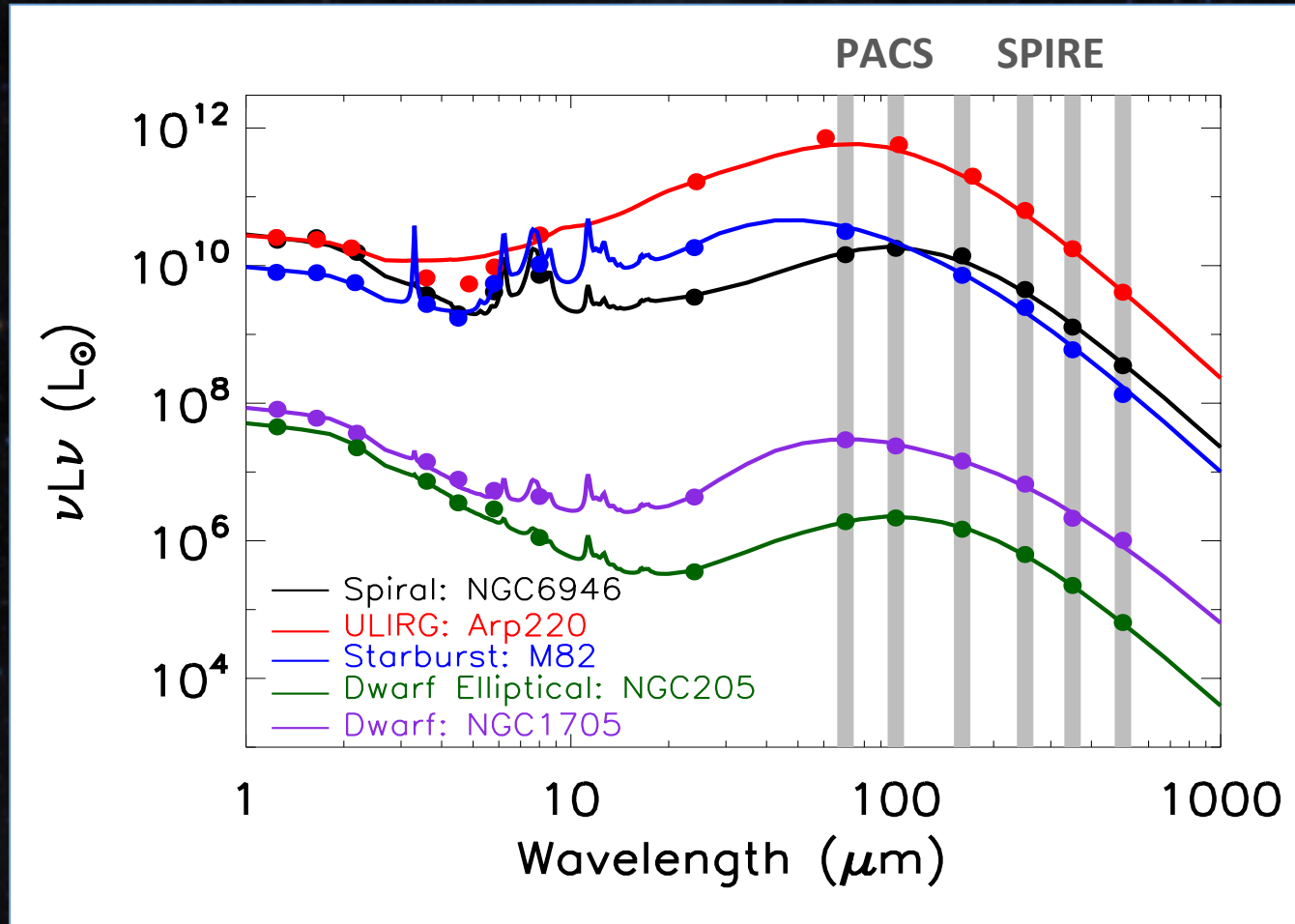
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Herschel : A new vision on local galaxies

Gain in wavelength coverage



Herschel : A new vision on local galaxies

Gain in spatial resolution

From 70 μ m to 500 μ m

Resolution 5.2'' to 36''

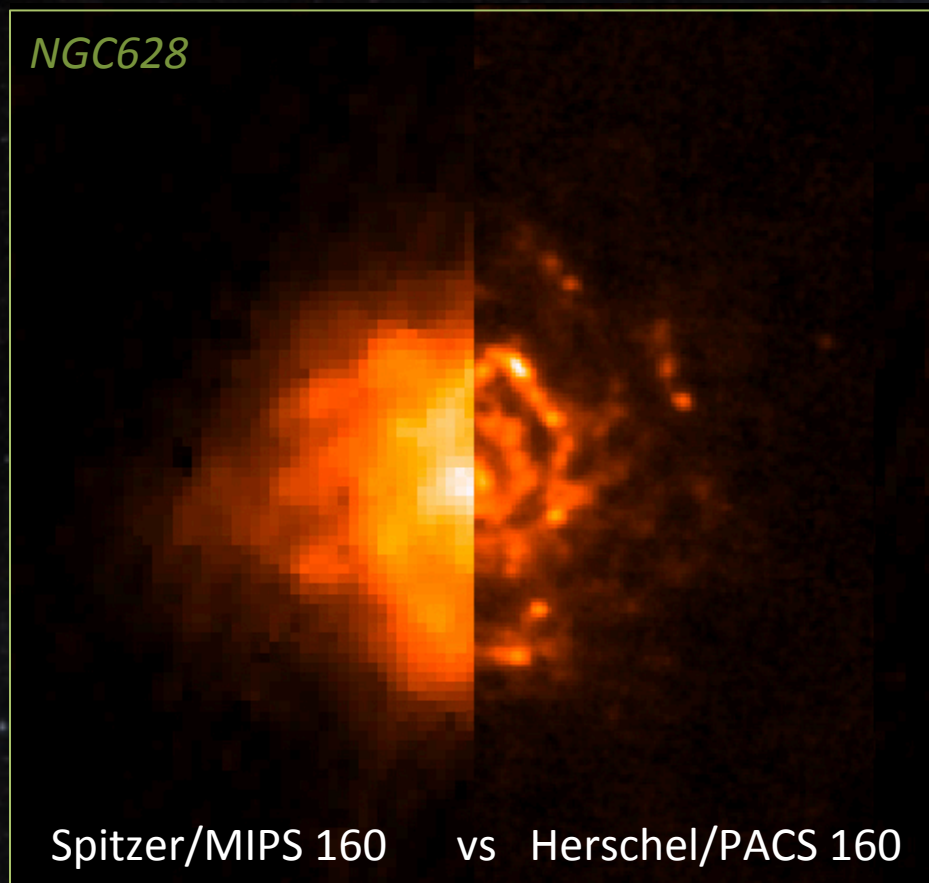


Large Magellanic Cloud

1.3 pc to 8.7 pc

A galaxy at 10Mpc

250 pc to 1.7 kpc



Content

I - Dust properties

- Masses

- Emissivities

II - Star formation rates

III - New calibrations

Content

I - Dust properties

- Masses

- Emissivities

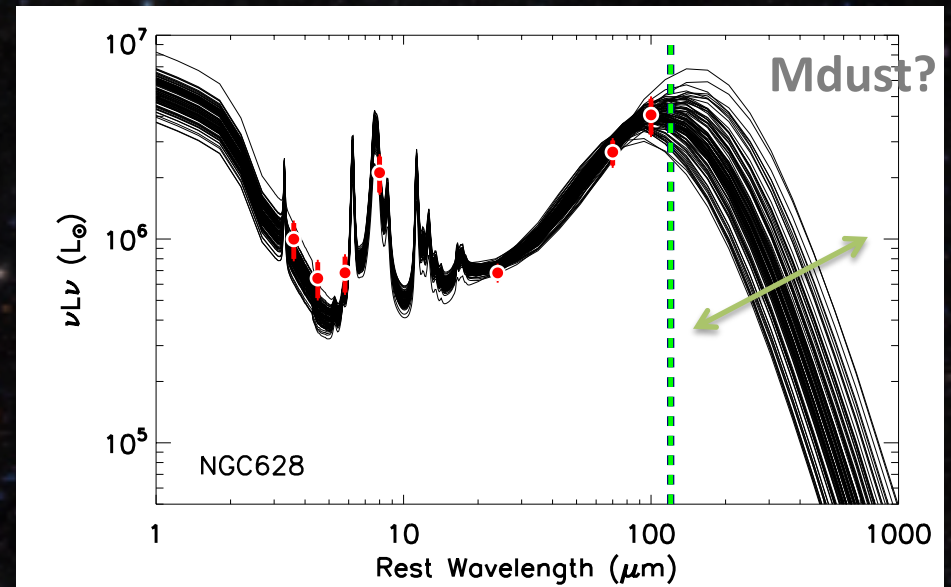
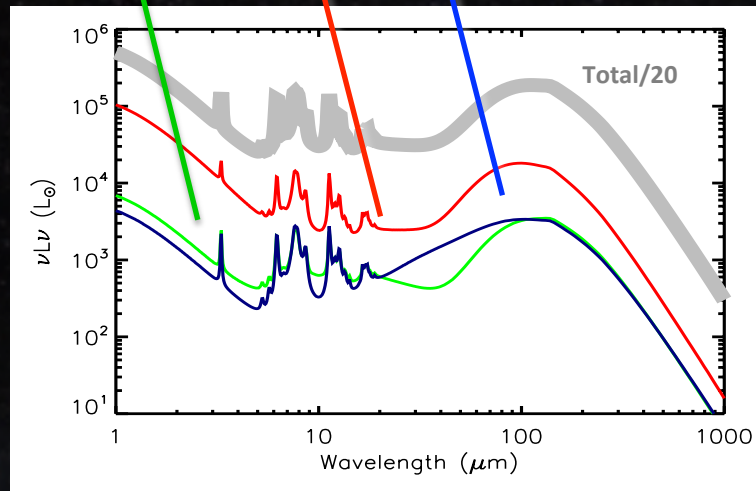
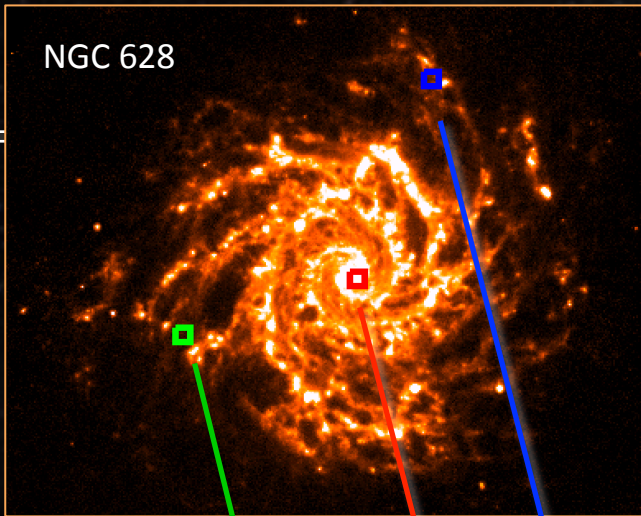
II - Star formation rates

III - New calibrations

Biases in dust masses

Linked with the lack of spatial resolution

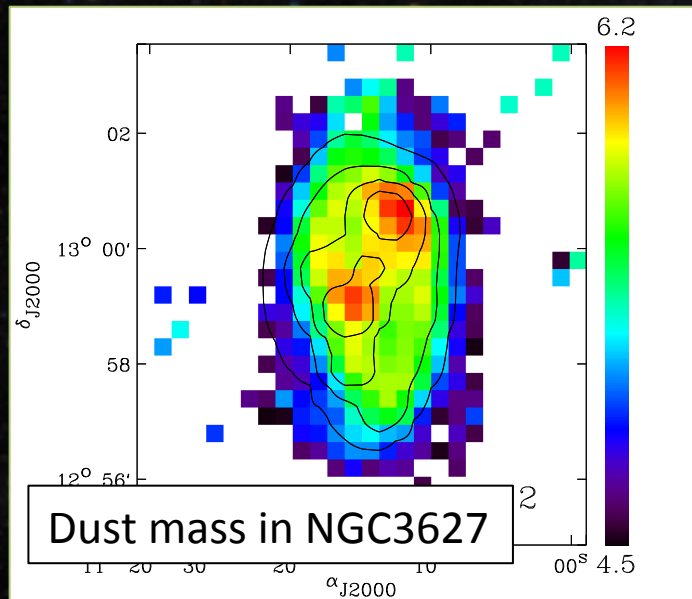
... and with an incomplete wavelength coverage



Non linearity of the SED models

→ Total mass $\neq \sum$ local masses

Some studies and results



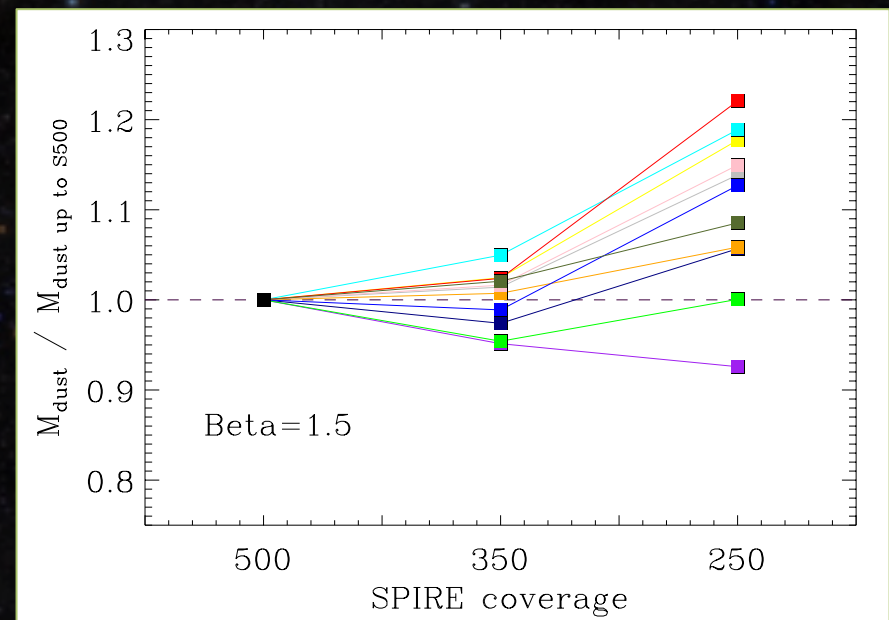
Galamez et al, 2012
KINGFISH galaxies

Comparison with wavelength coverage

Result: Large discrepancies
No systematics

Comparison global vs local masses

Result:
from 0 to 40% of missing mass



Some studies and results

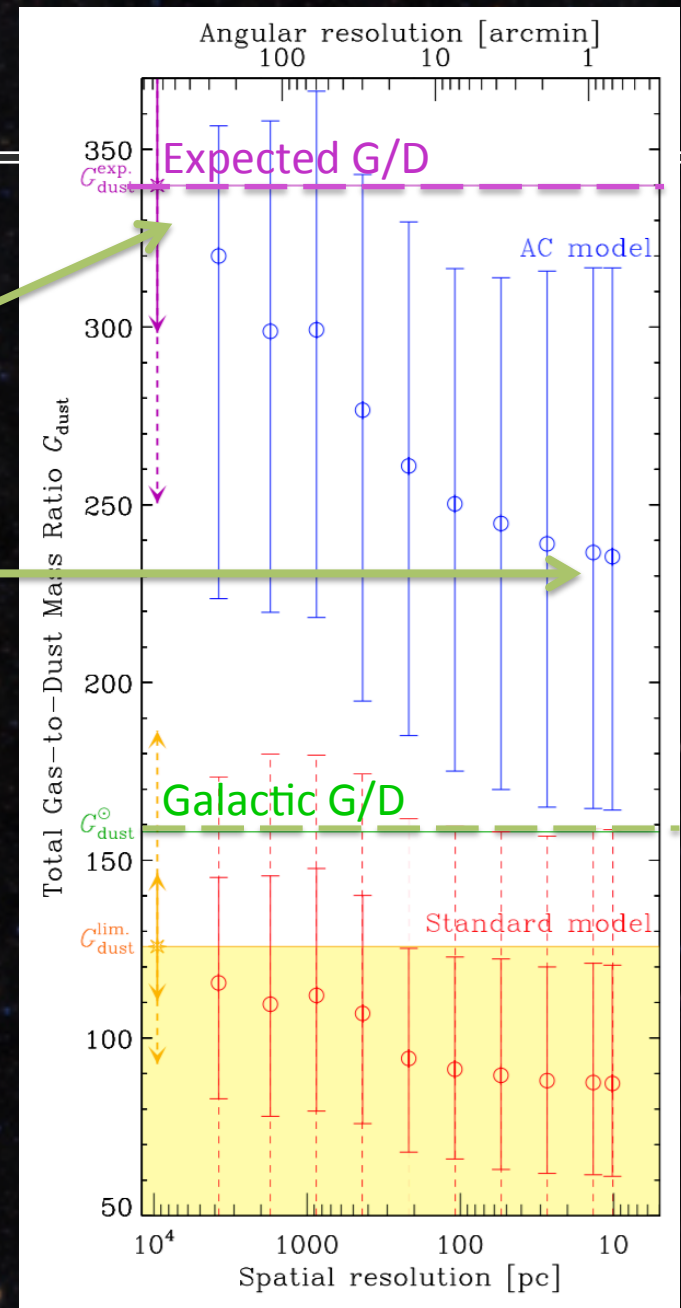
In a strip across the LMC

Increase by 50% of the dust mass when the working resolution increases

Take away messages

It is a non negligible effect !

Needs to be more systematically quantify



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II - Star formation rates

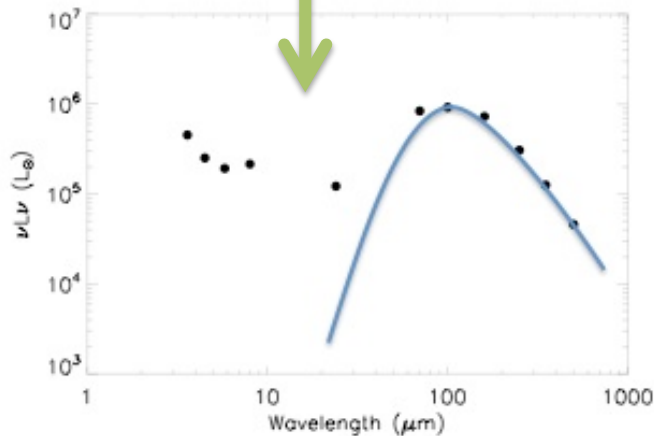
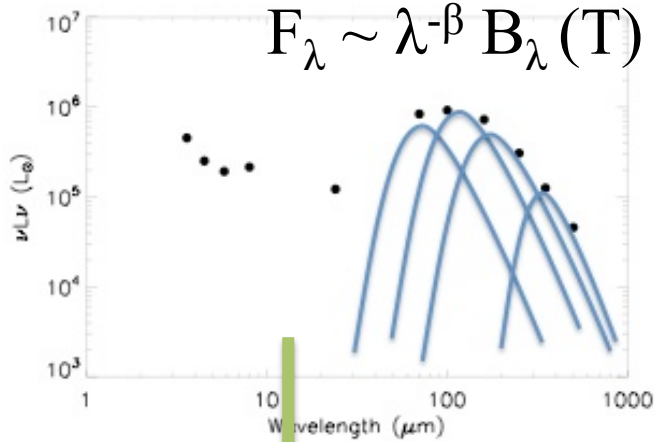
III - New calibrations

Biases in the emissivity

Linked with the lack of spatial resolution

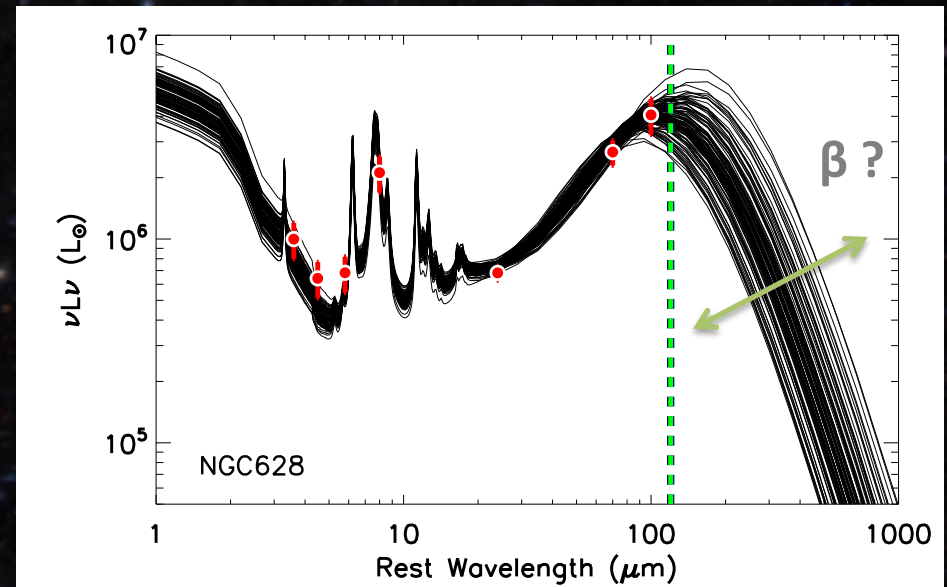
... and with an incomplete wavelength coverage

$$F_{\lambda} \sim \lambda^{-\beta} B_{\lambda}(T)$$



Population mixing

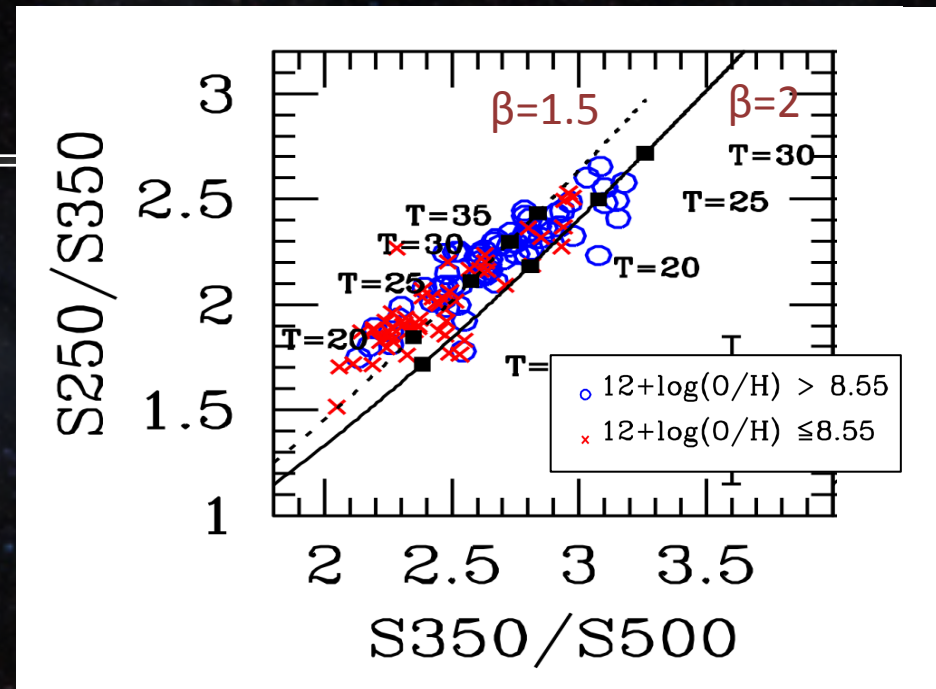
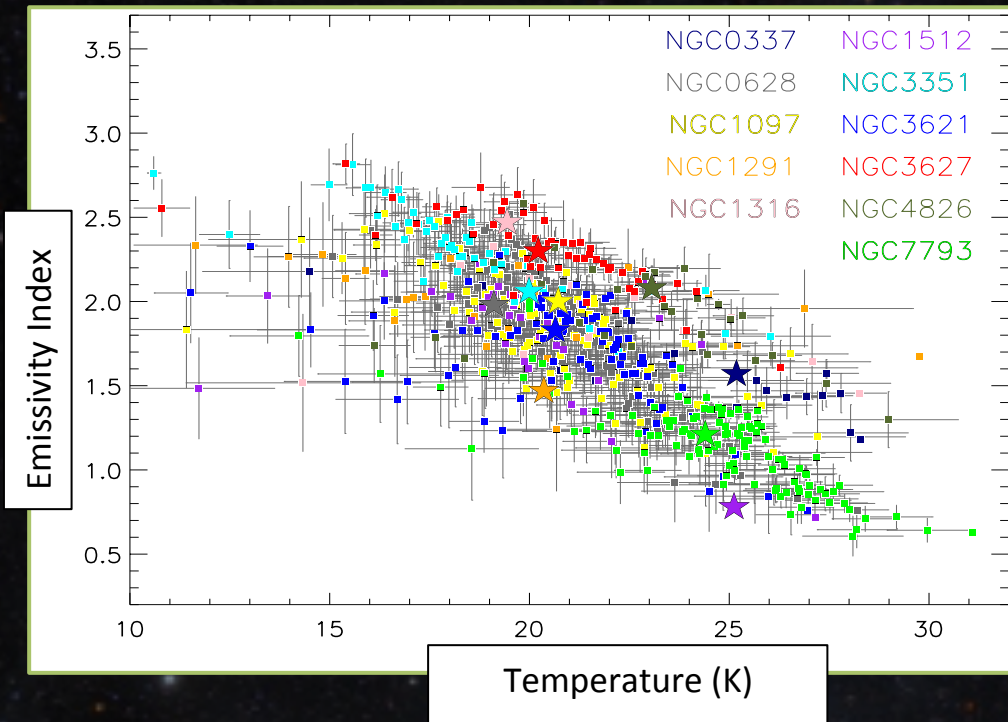
→ Access to an effective emissivity rather than to the intrinsic emissivity



Emissivity variations

From galaxy to galaxy ...

Galametz et al, 2012
KINGFISH sample

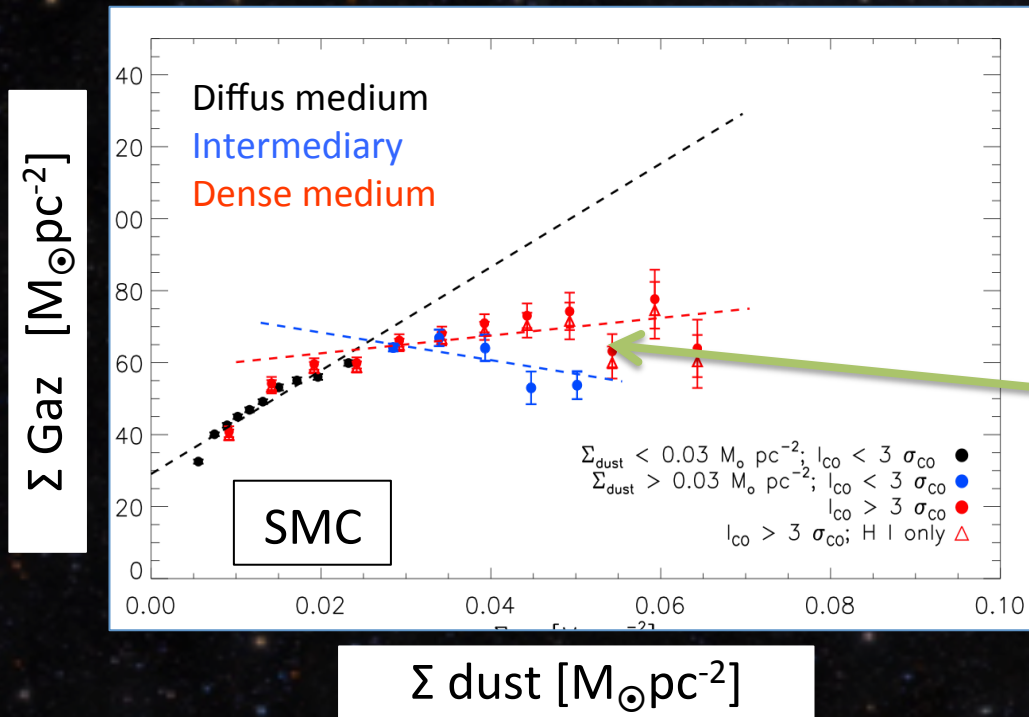


Boselli et al, 2012
HRS sample

... See also *Auld et al, 2012* for the
Herschel Virgo Cluster Survey

... and within one galaxy

Emissivity variations



In the LMC / SMC

Variations in the grain emissivity with density

→ Dust aggregates / coagulation

Roman-Duval et al, 2014

Take away message

Applying a (random) emissivity index value is dangerous !

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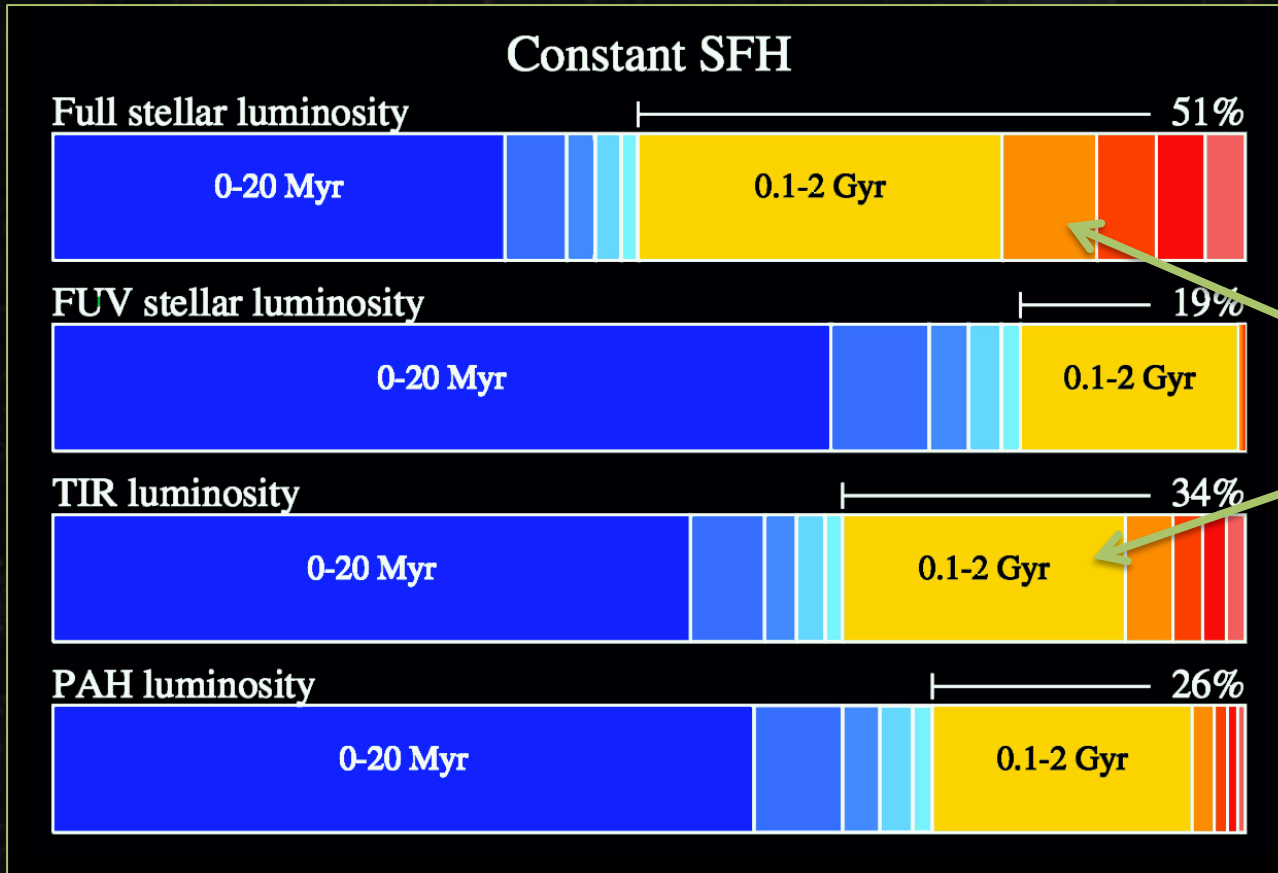
Biases in the star formation estimates

Dust emission = a star formation tracers

$$\text{SFR} = f(\text{H}\alpha, 24\mu\text{m})$$

$$\text{SFR} = f(70\mu\text{m})$$

$$\text{SFR} = f(L_{\text{TIR}})$$



... however, a significant fraction of the dust emission is **not** associated with star formation

... See also Bendo et al.

Deriving calibration coefficients

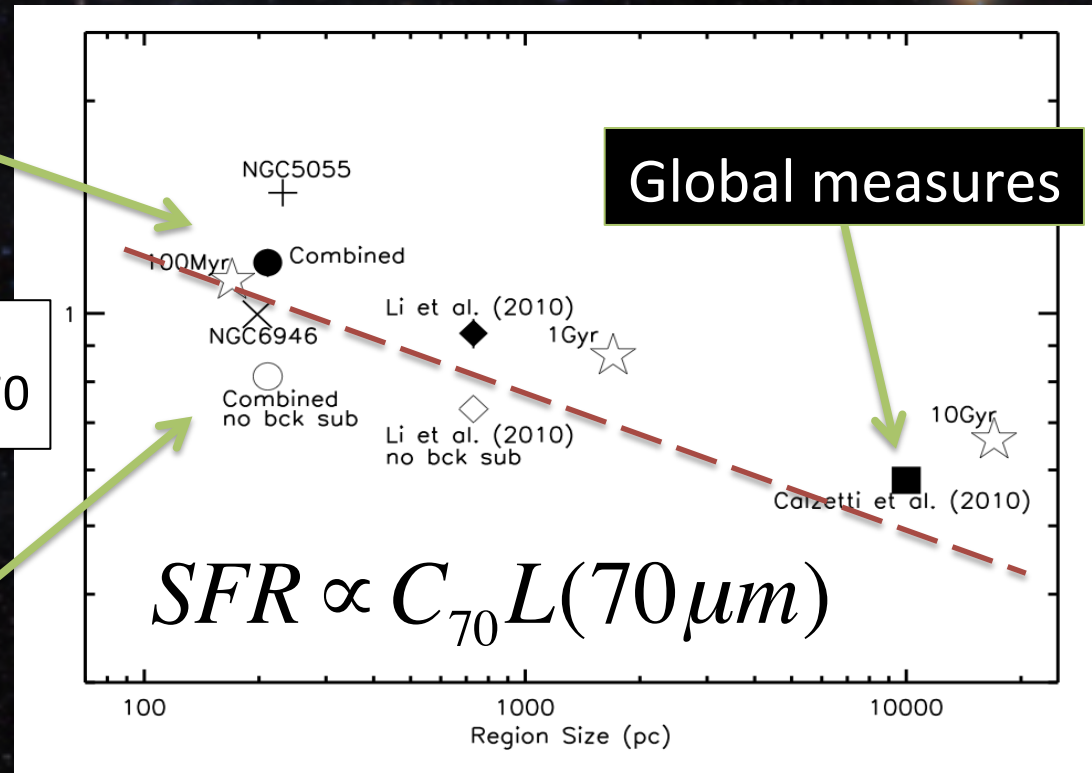
HII regions
Back. subtracted

Coefficients are
dependent of the
region physical size

HII regions
No back. subtracted

C_{70}

Li et al 2013



Take away message

Be aware of the 'diffuse' emission not related to star formation

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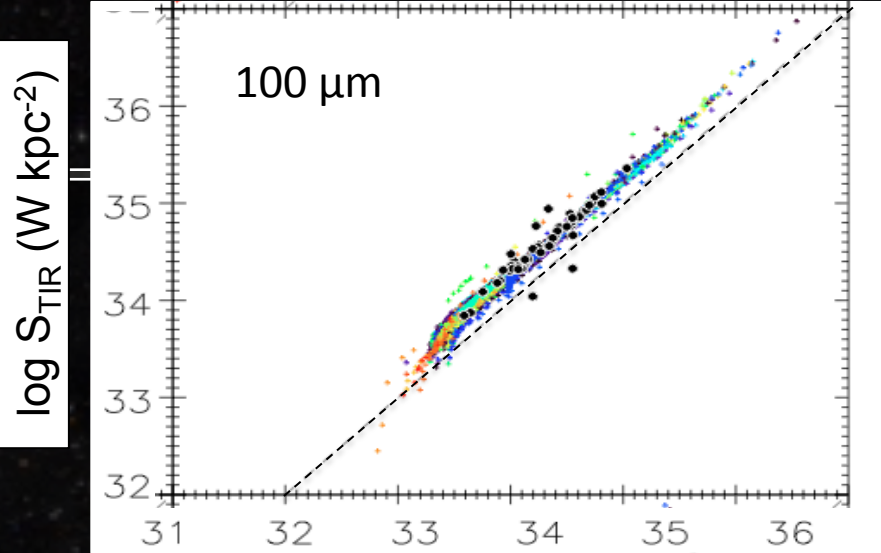
- Emissivities

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Calibrations of IR

→ Nearby galaxies allow us to produce predictive tools to overcome the lack of wavelength coverage

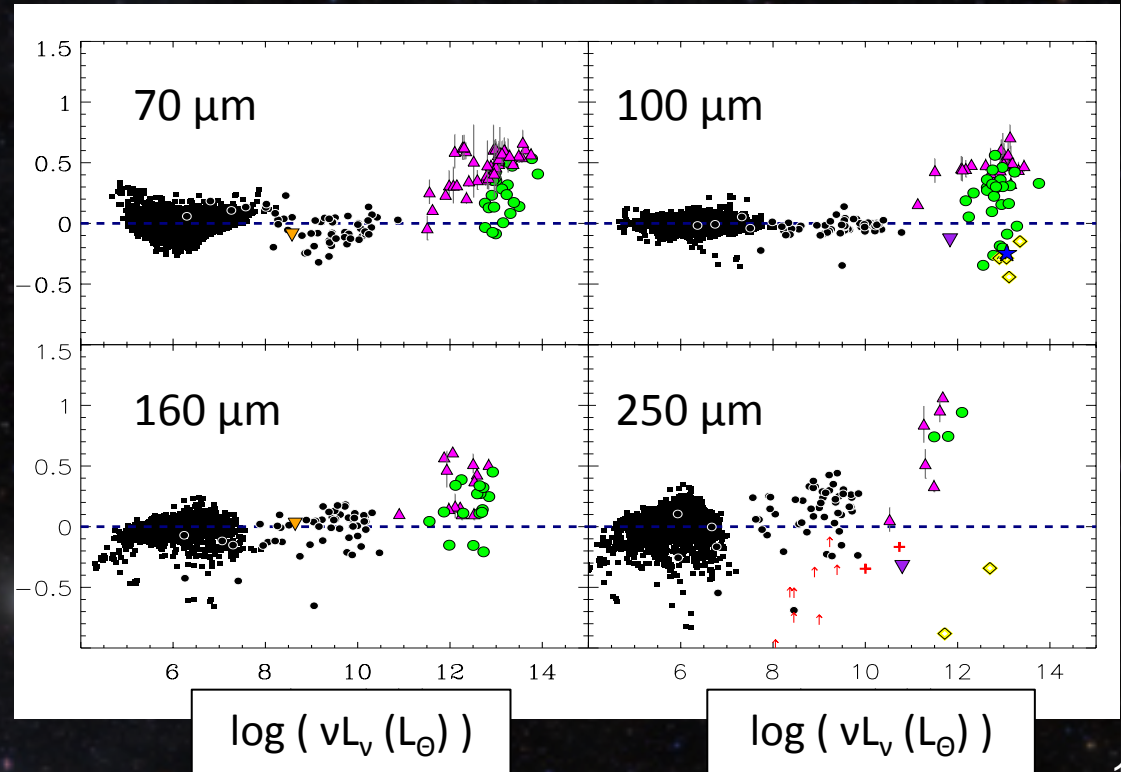


$\text{Log } \nu S_{\nu} \text{ (W kpc}^{-2}\text{)}$

Galametz et al. 2013b

Magnelli et al., 2012
 Wu et al., 2012
 Eisenhardt et al., 2012
 Le Floc'h et al., 2012
 Rangwala et al., 2011

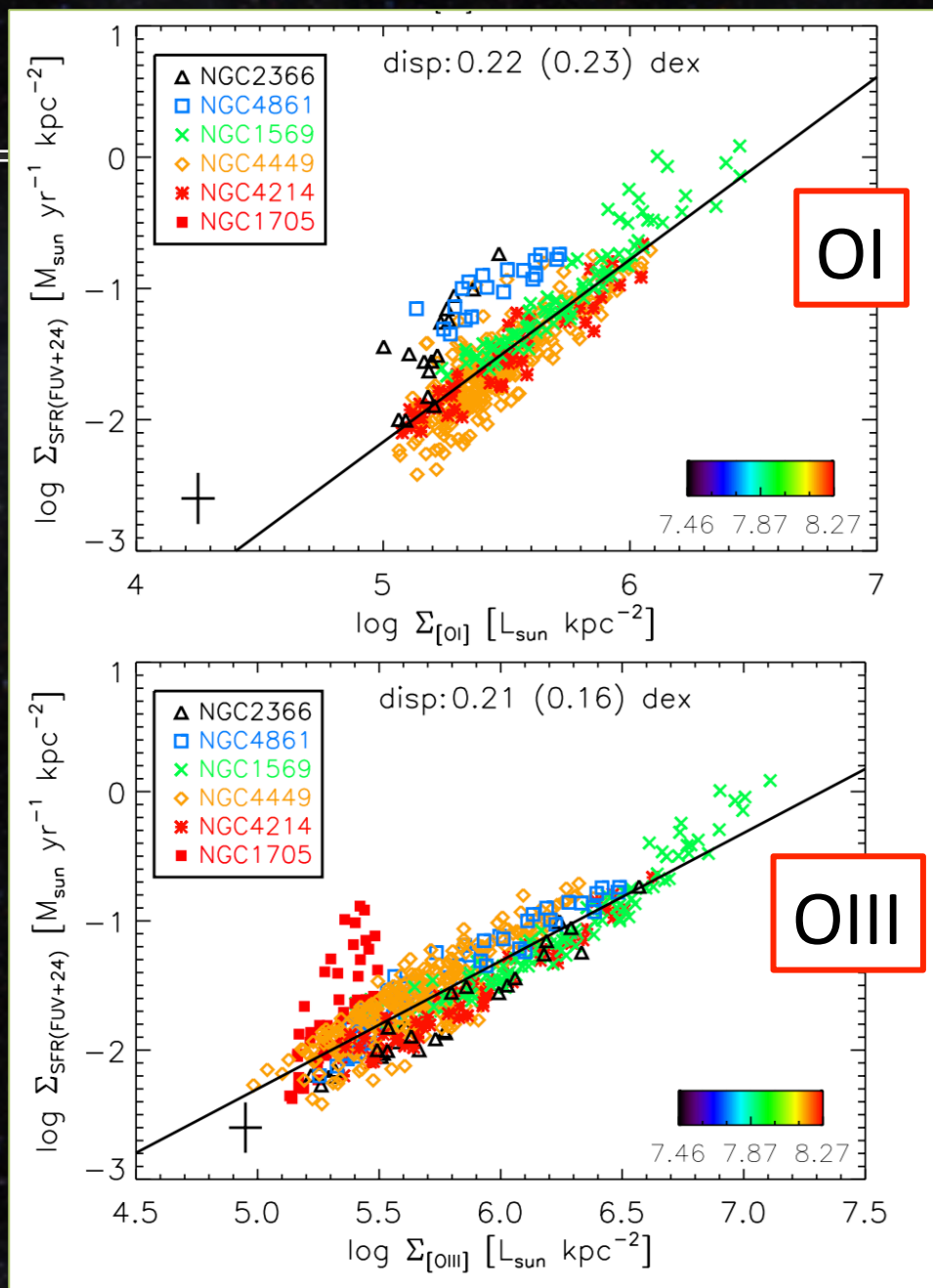
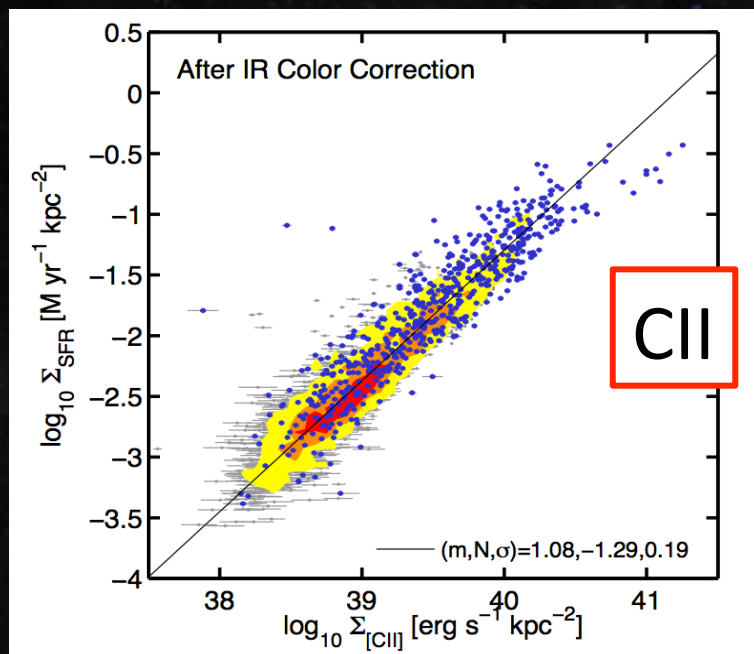
$\log (L_{\text{TIR}} \text{ predicted})$
 $L_{\text{TIR}} \text{ literature}$



New calibrators

→ FIR fine-structure lines can be used to reliably trace the SFR

- [CII] 158 μm ,
- [OI] 63 μm ,
- [OIII] 88 μm ...



Conclusions

- Lack of resolution and of wavelength coverage
 - ➔ Non negligible effects!
- Major consequences on the dust emissivities or masses, thus on the parameters derived from the dust
 - ➔ Need to be more systematically quantified
- Diffuse emission not related to star formation
 - ➔ Understand the recipe before using it