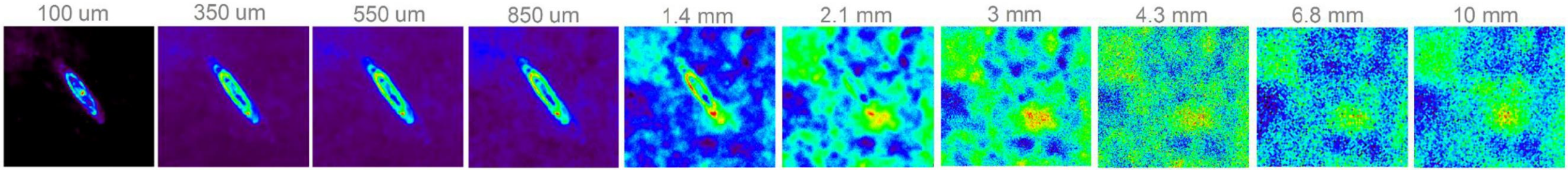


The Andromeda galaxy as seen from IRAS and Planck

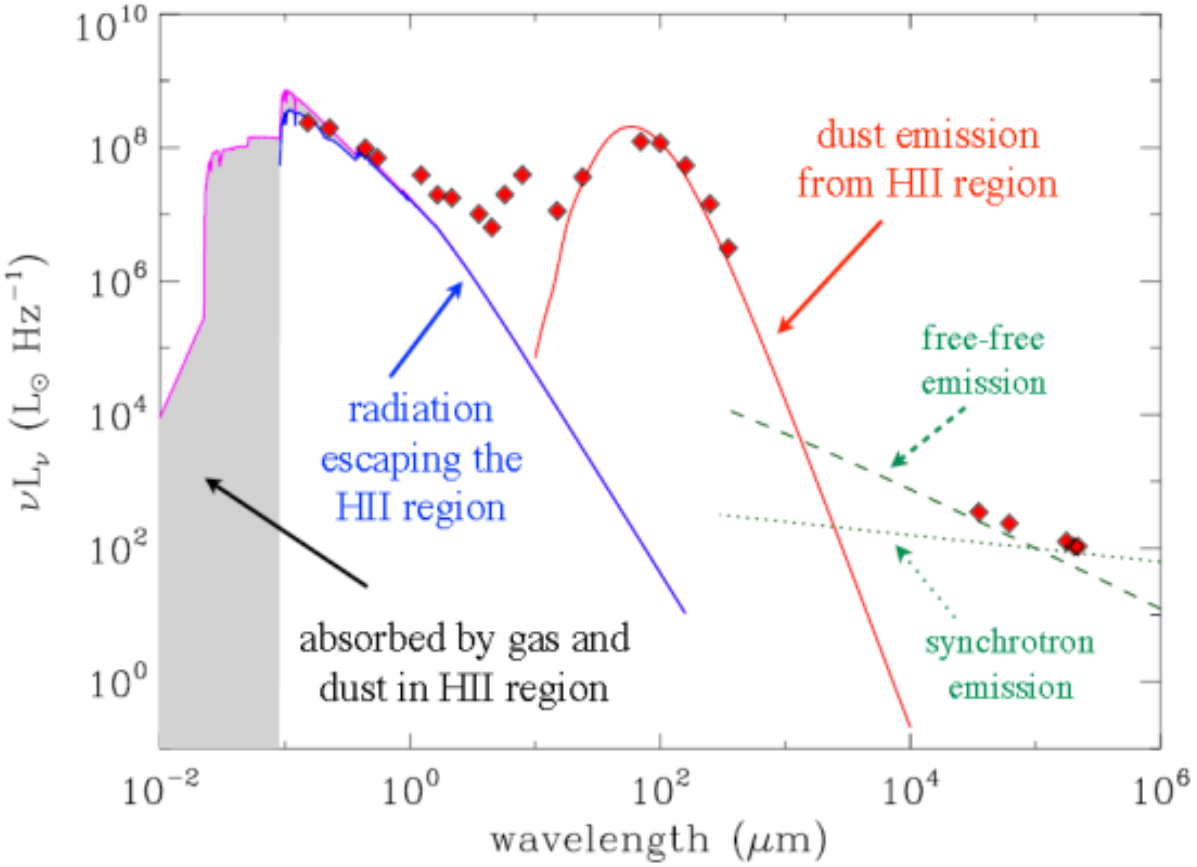
Microwave gas and dust emission in a sample of nearby galaxies with IRAS and Planck

Lucie CORREIA – Caroline BOT – Axel RYMAR - Jérémy CHASTENET – Katharina LUTZ – Roberta PALADINI

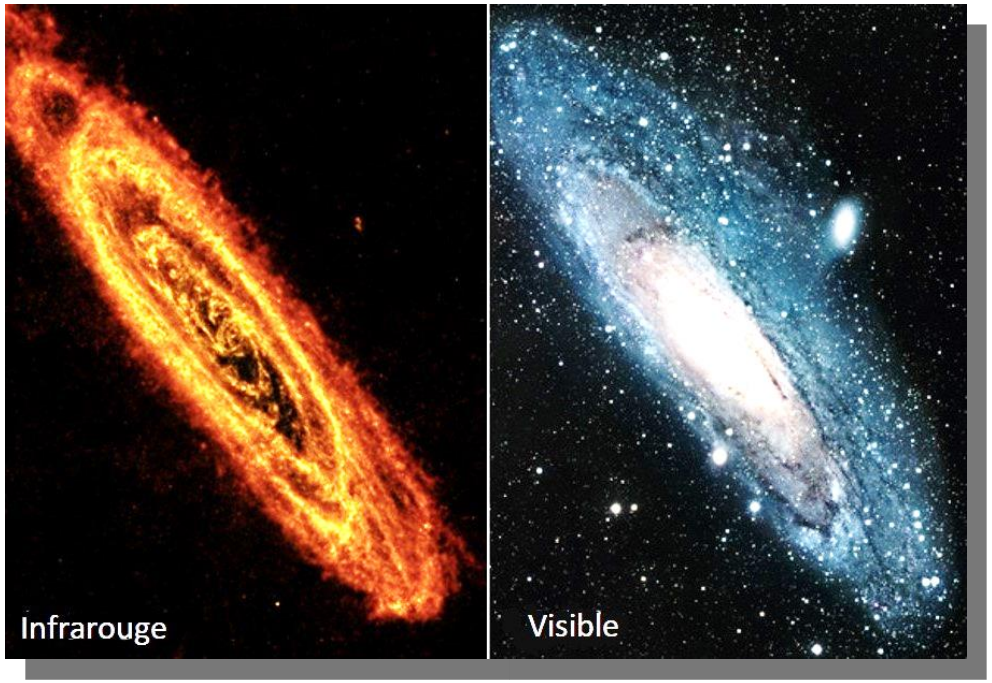
Observatoire astronomique de Strasbourg | ObAS

Dust in galaxies

Dust plays a fundamental role in the evolution of galaxies



Source: Eufrasio, R et al.

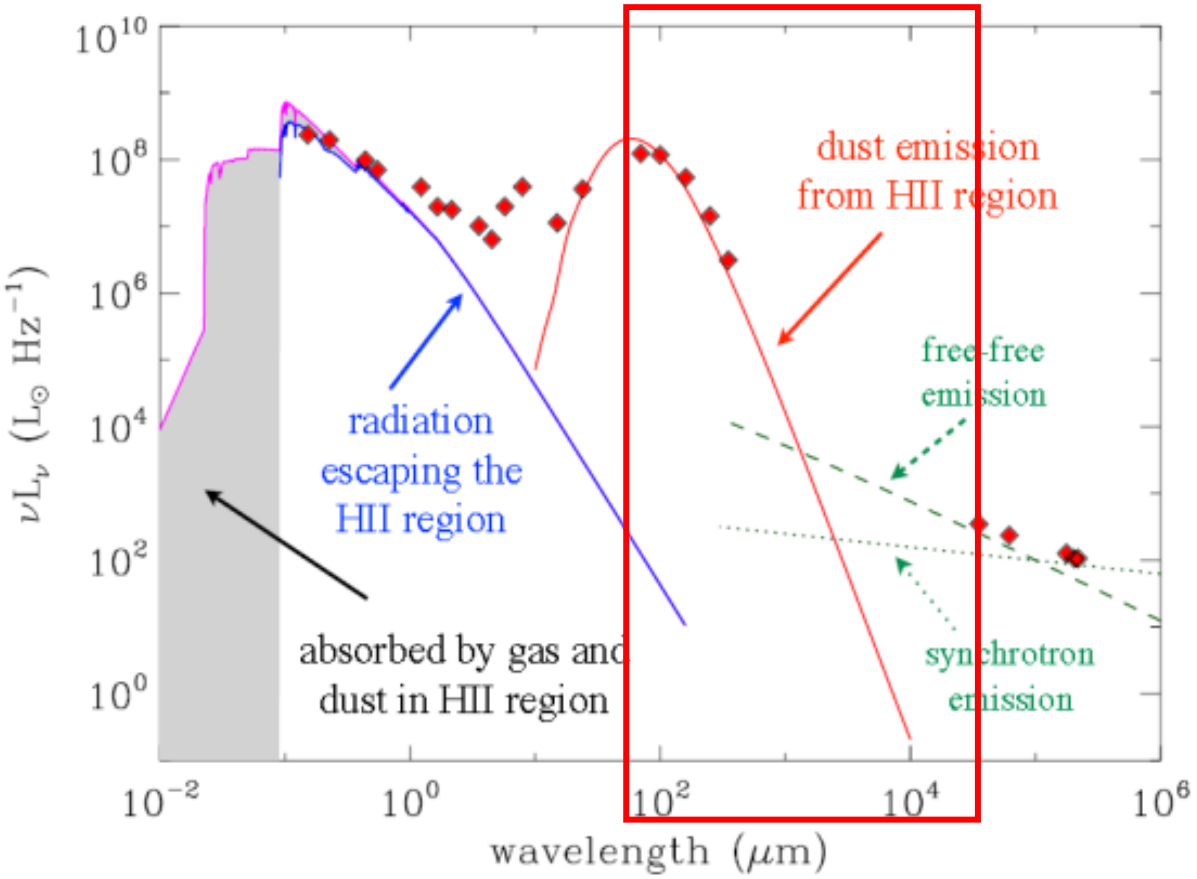


Credits: Robert Gendler (visible), ESA(infrared)

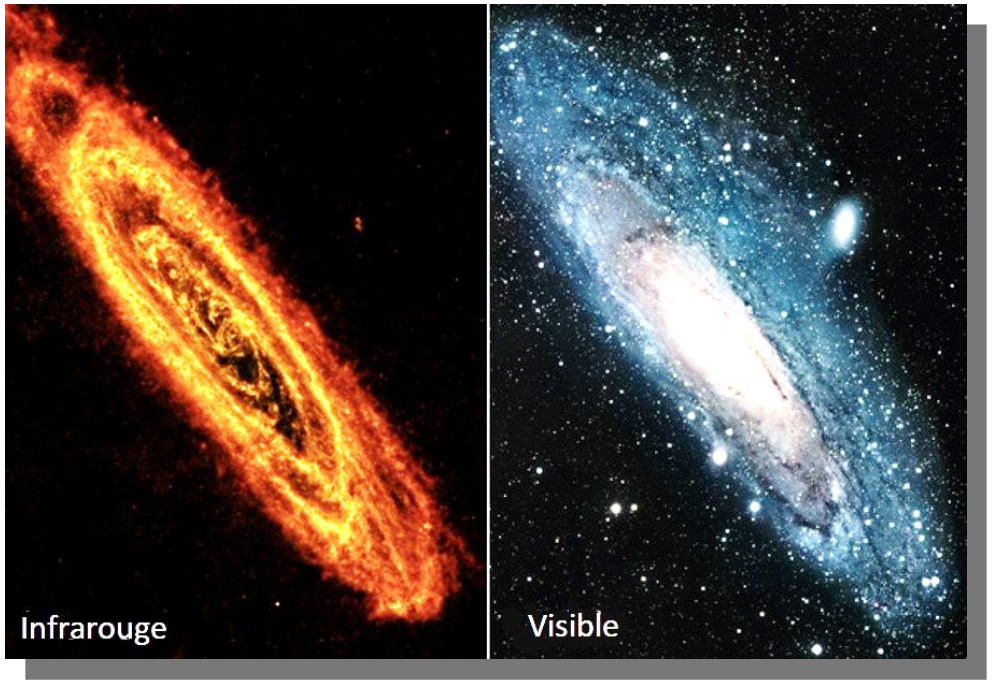
Mass, composition and temperature of dust obtained from the analysis of infrared to millimeter emission

Dust in galaxies

Dust plays a fundamental role in the evolution of galaxies



Source: Eufrasio, R et al.



Credits: Robert Gendler (visible), ESA(infrared)

Mass, composition and temperature of dust obtained from the analysis of infrared to millimeter emission

Observations in the sub-mm & mm

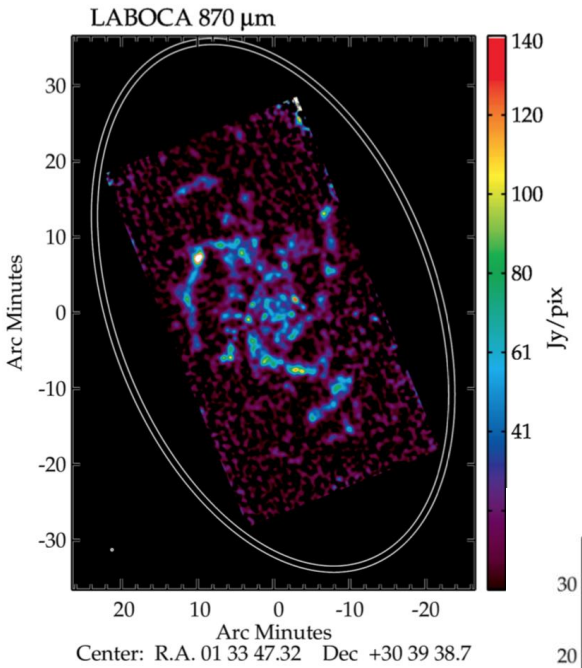
Ground-based observations

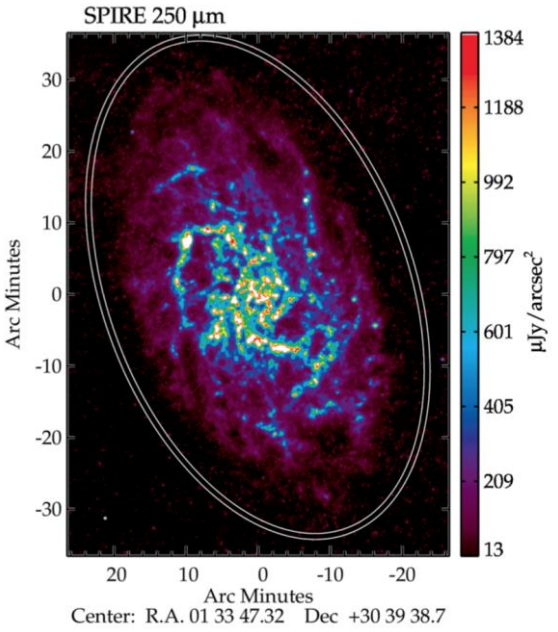
- JCMT/SCUBA, APEX, IRAM/NIKA2
- Pro: good resolution
- Cons: large scale filtering

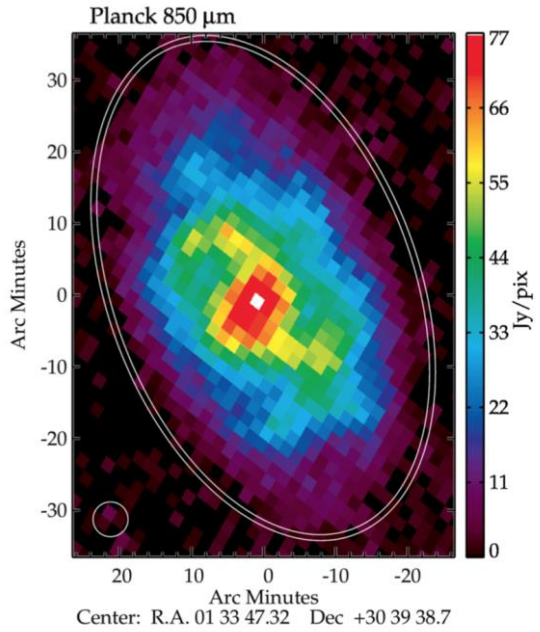
CMB related missions

- Planck (+ ACT, SPT, …)
- Pro: all sky (large regions) available
- Cons: low resolution

We need both together







M33, Hermelo et al. 2016

Observations in the sub-mm & mm

Ground-based observations

JCMT/SCUBA, APEX, IRAM/NIKA2, …

Pro: good resolution

Cons: large scale filtering

We need both together

CMB related missions

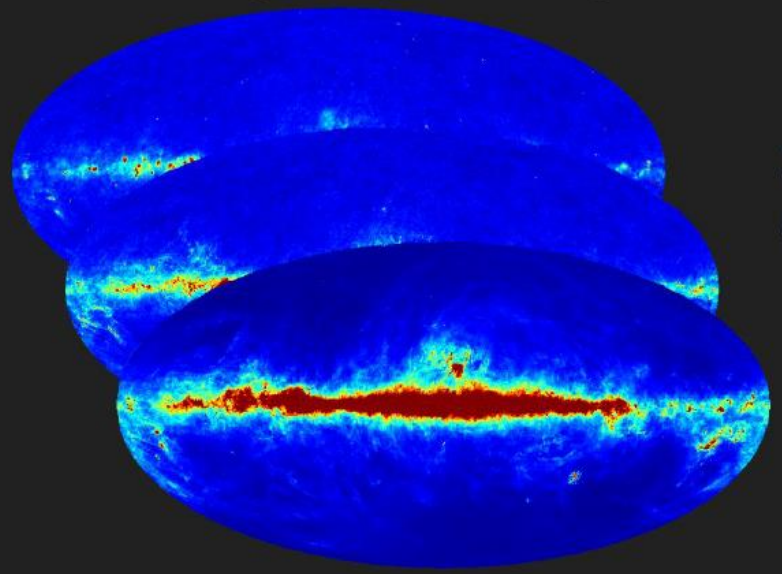
- Planck (+ ACT, SPT, …)
- Pro: all sky (large regions) available
- Cons: low resolution

Goal of this project:
obtain a sample of IRAS + Planck SEDs of nearby galaxies and model dust emission up to cm wavelengths at low resolution

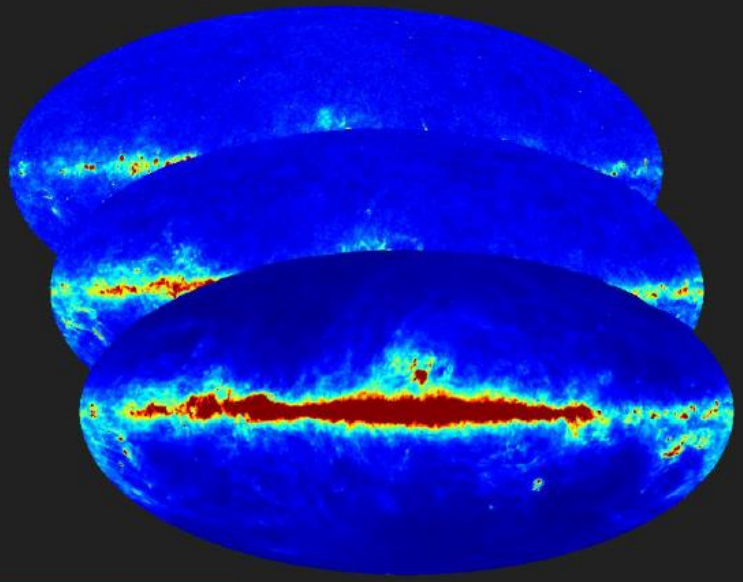
Galaxy sample: same 21 galaxies as NIKA2 IMEGIN key project

Data processing

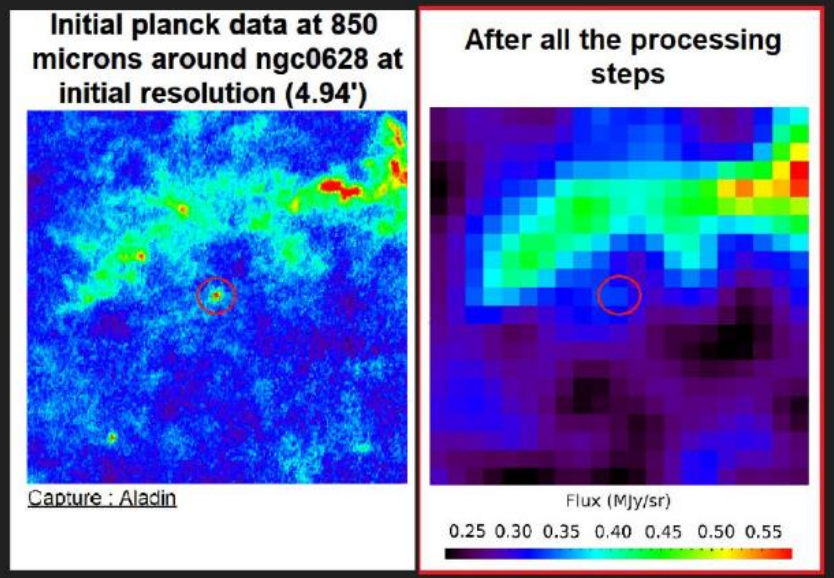
1) Conversion of IRAS and Planck sky maps in MJy/sr



2) Convolution at 32.29'

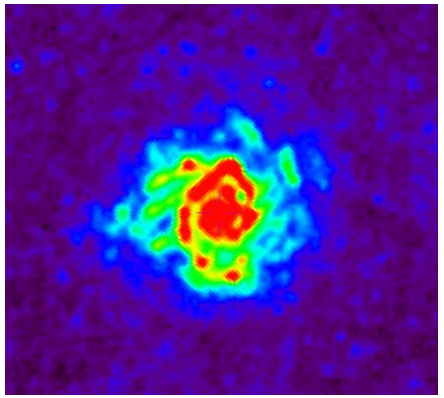


3) Resampling and projection

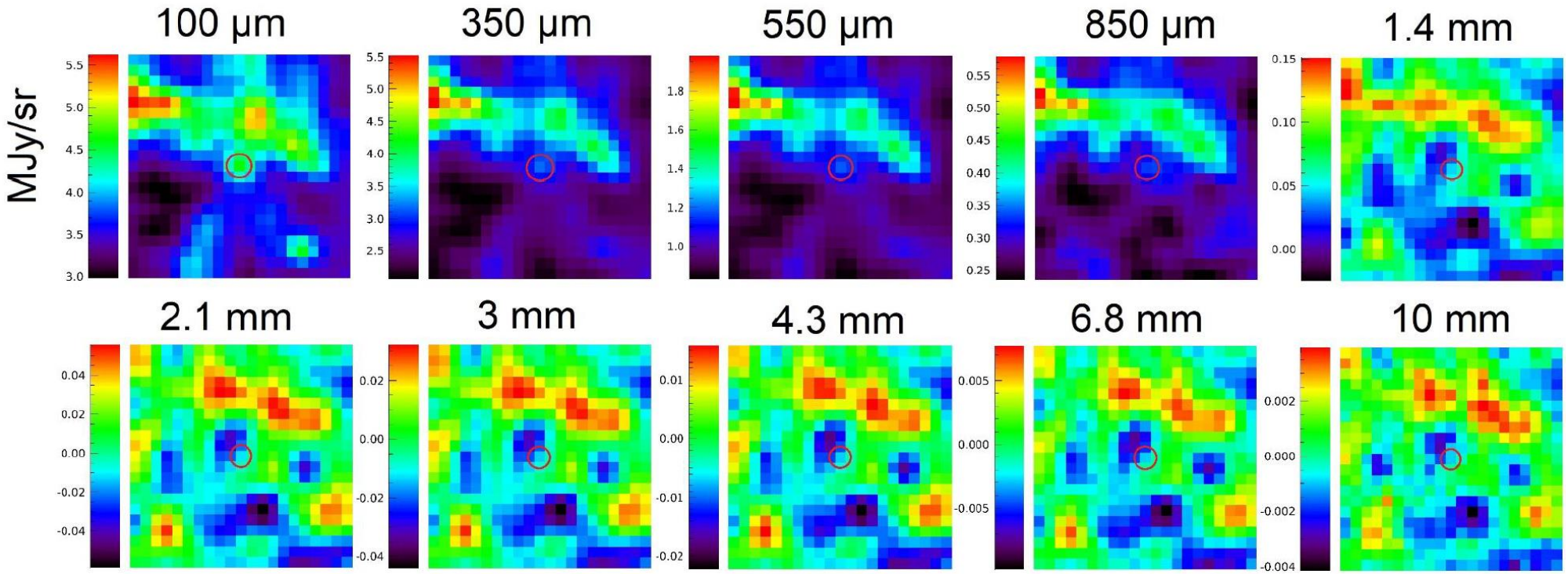


Axel Rymar

NGC0628

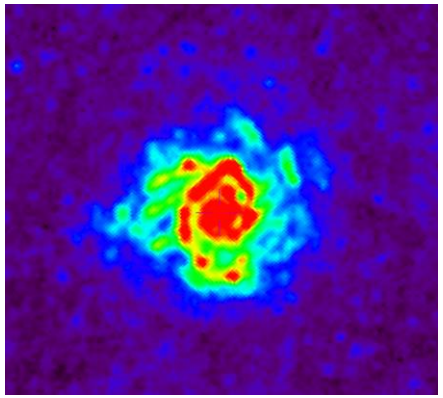


Herschel 500 µm



Foreground (Milky Way) and background (CMB) emission dominate

NGC0628



Herschel 500 μm

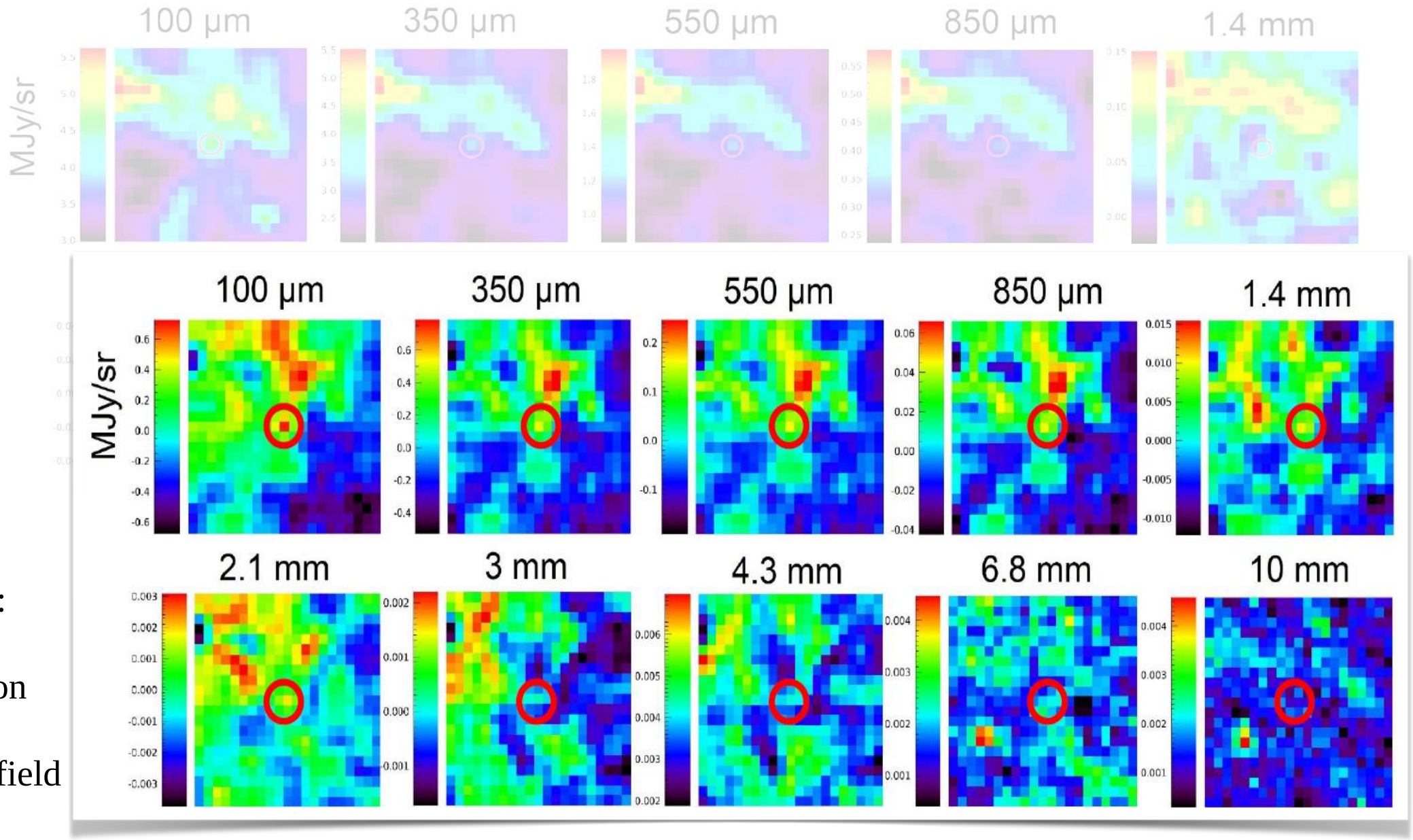
After removing:

-cirrus emission

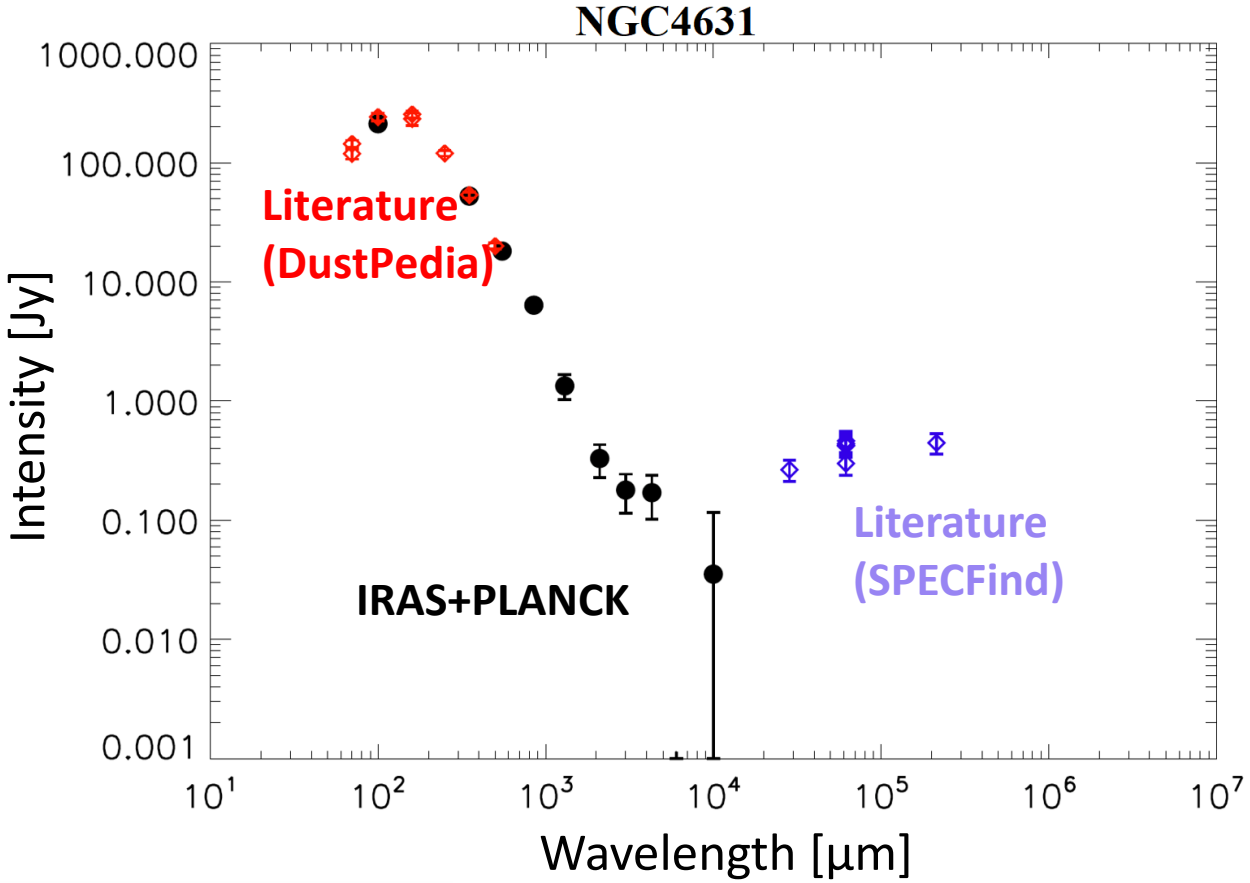
-zodiacal light emission

-CMB fluctuations

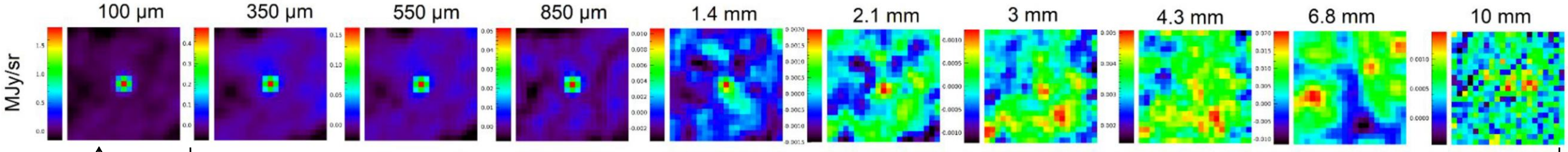
-other galaxies in the field



SEDs and modeling

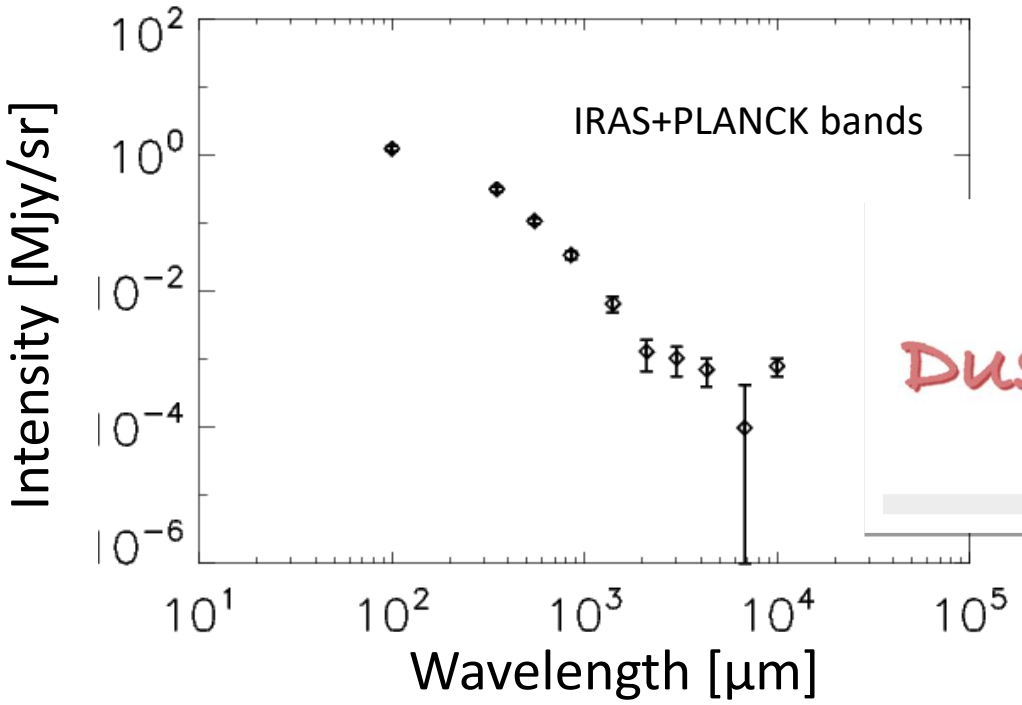


NGC4631

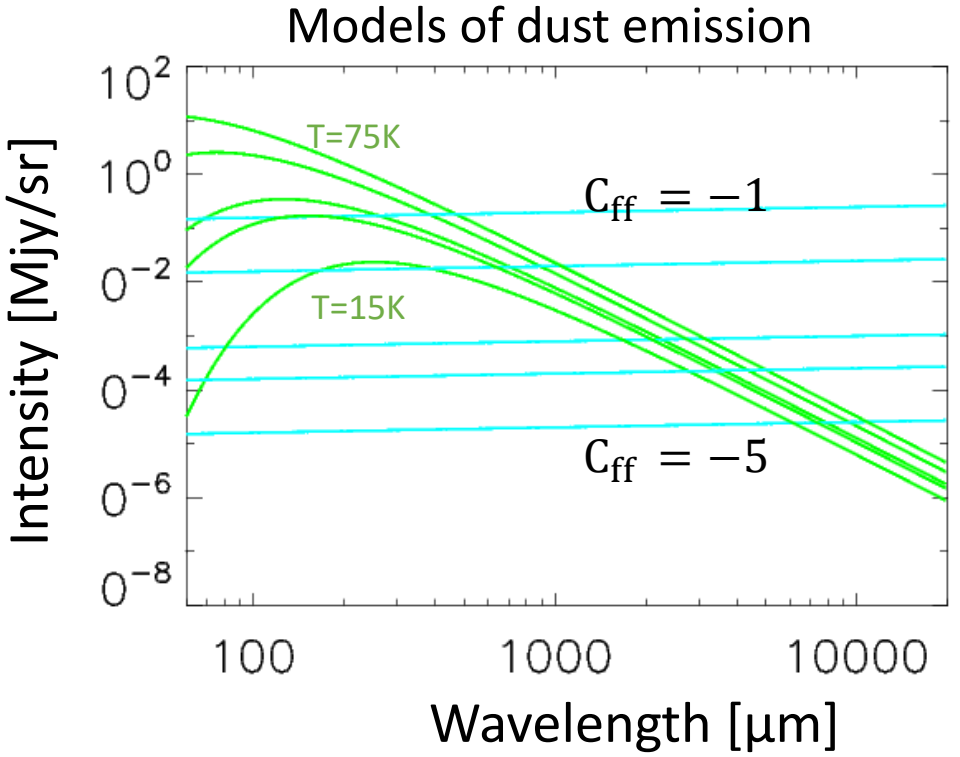


IRAS **PLANCK**

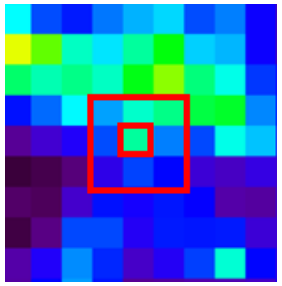
Credits: A. Rymar (2021)



Gordon et al. (2014)



Estimation of a covariance matrix from observations
⍰ uncertainties on foreground and background emission subtractions



$$\sigma_{ij}^2 = \frac{\sum_k^N (S_i^k - \langle S_i \rangle)(S_j^k - \langle S_j \rangle)}{N - 1}$$

- Dust emission: modified black body

$$S = \kappa(\beta) \times \Sigma_d \times B(T_d)$$

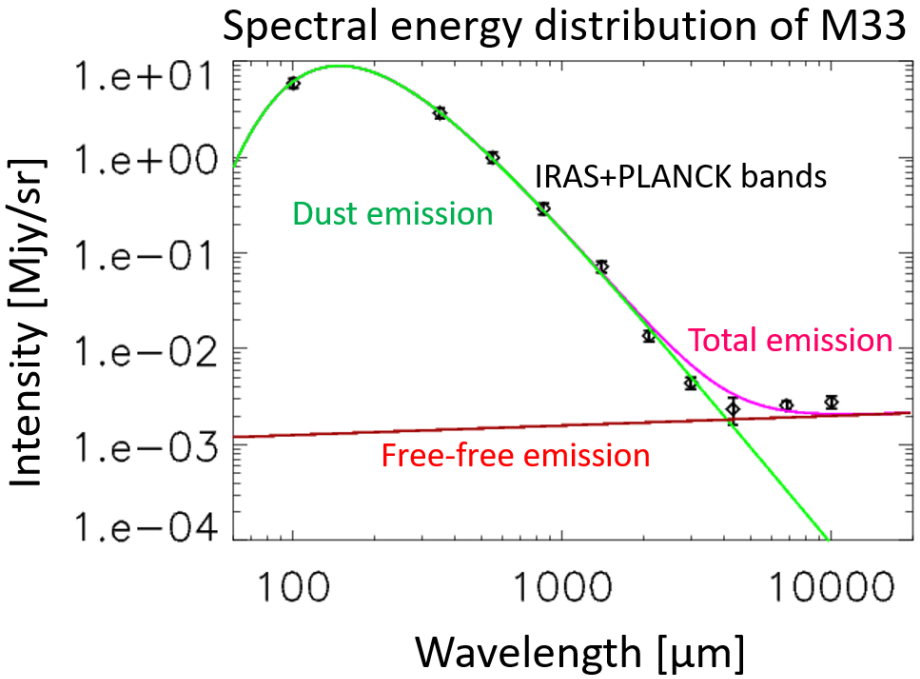
Free parameters: dust mass and temperature, emissivity index β

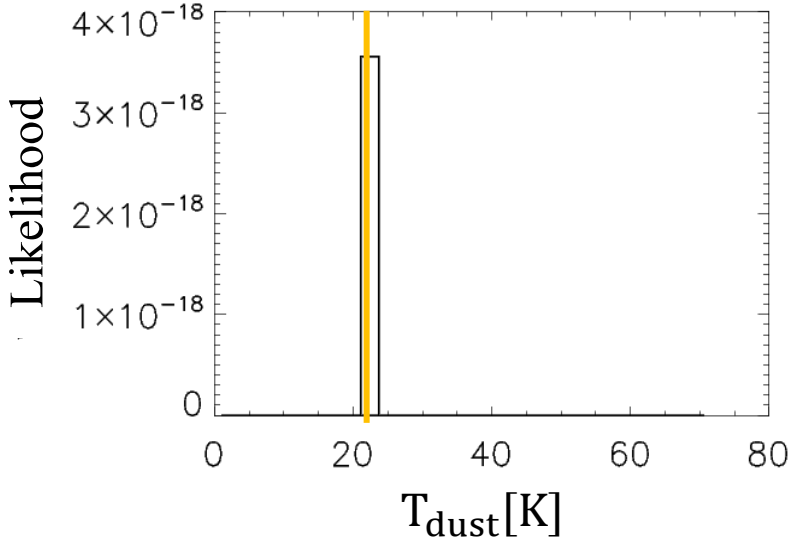
- Free-Free Emission:

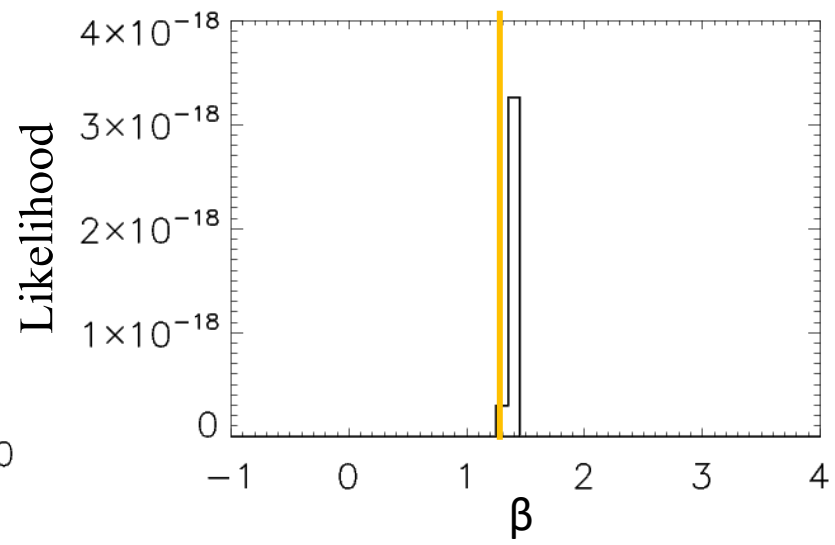
$$S_{ll} = C_{ll} \times \lambda^{0,1}$$

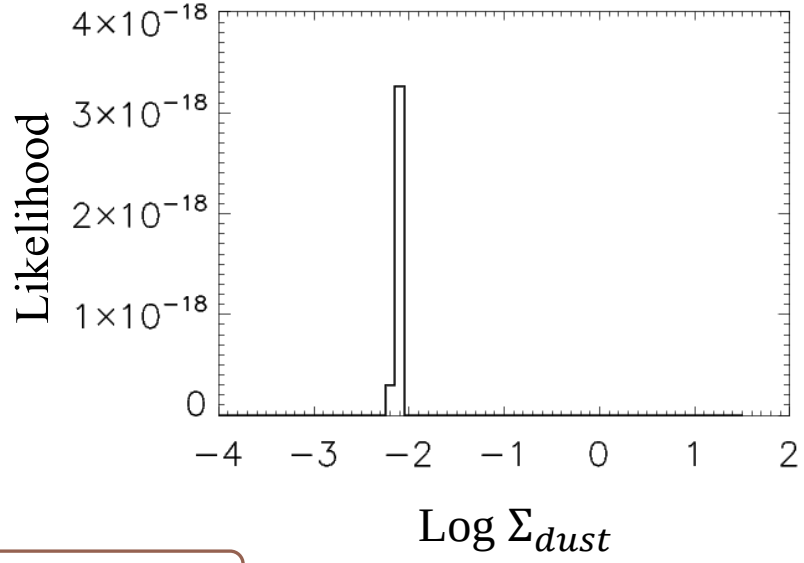
Free parameter: free-free emission coefficient

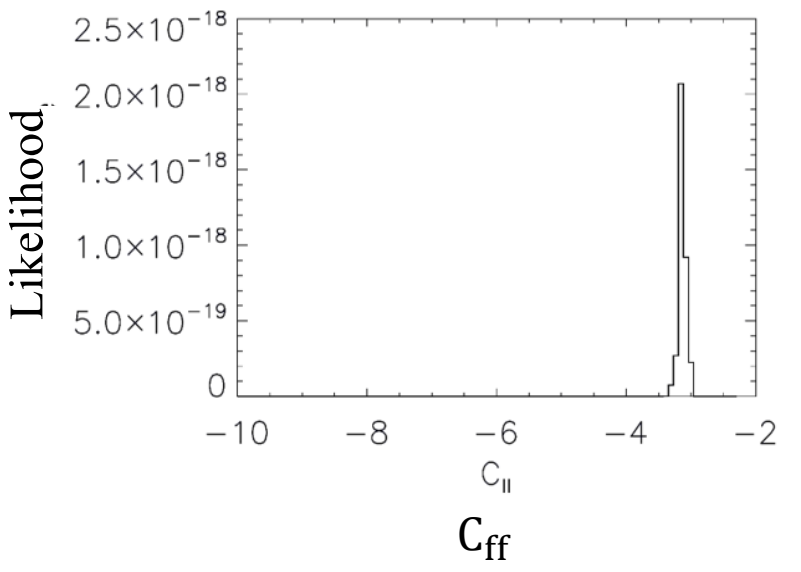
Validation with M33





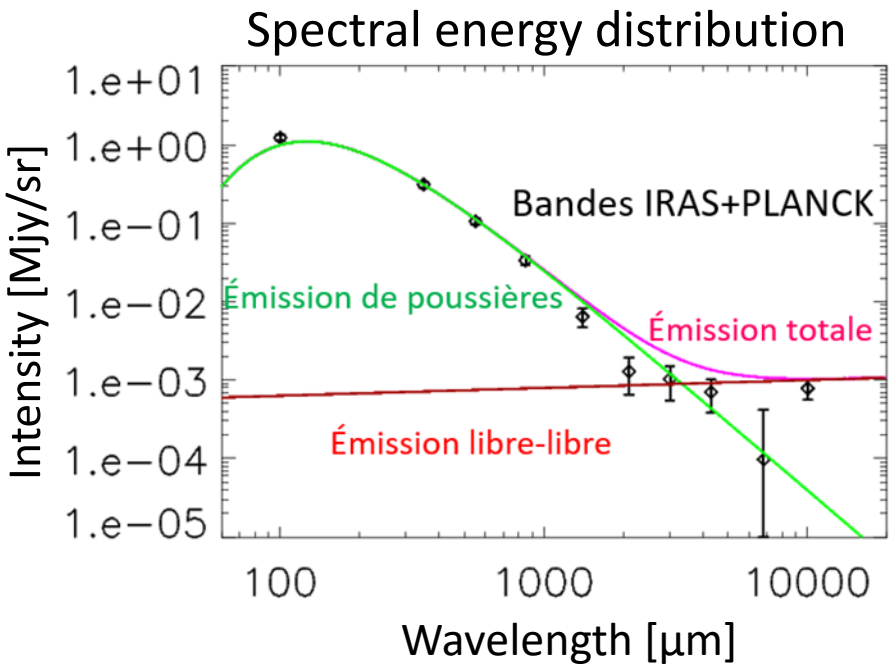


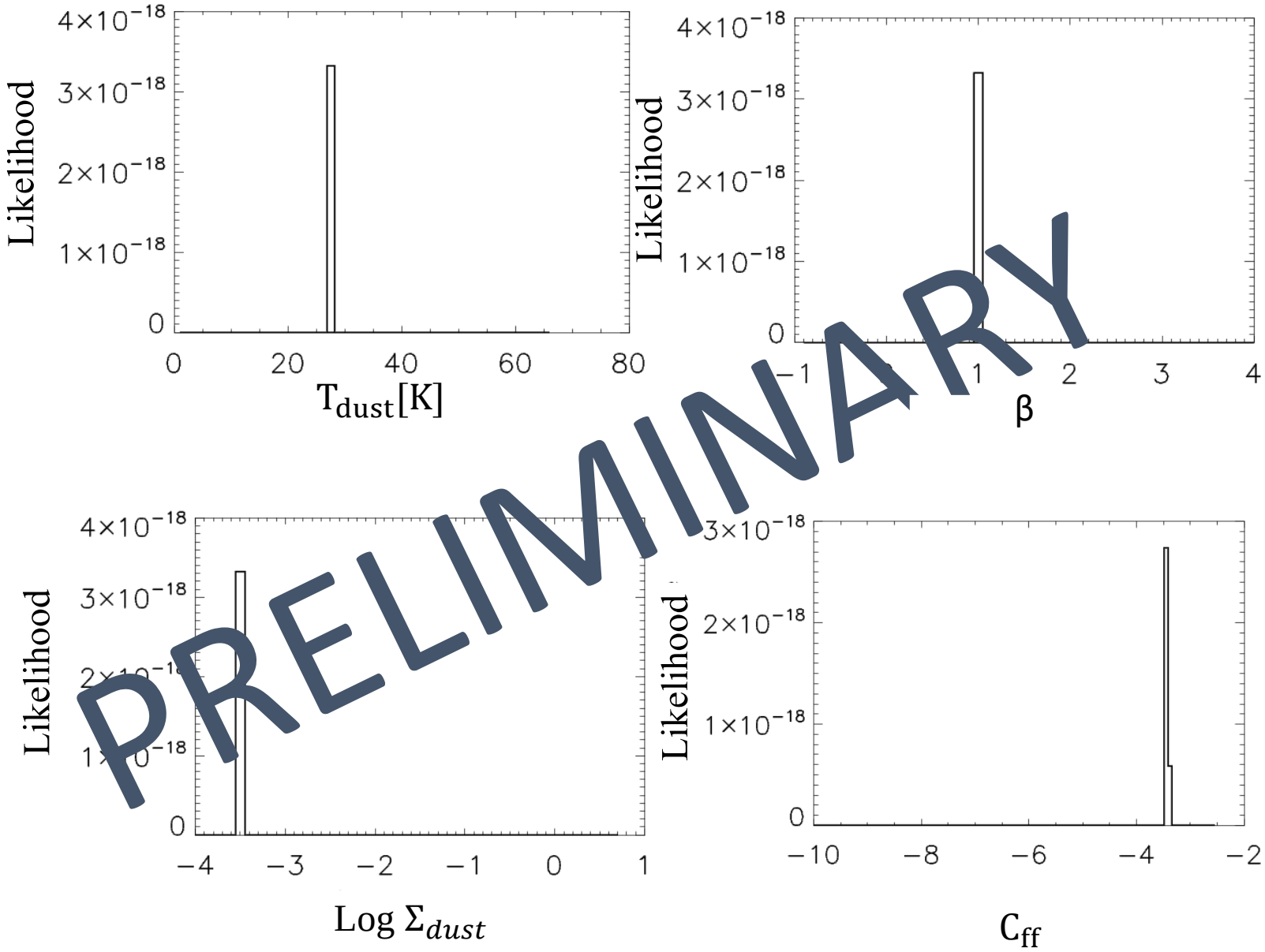




Tibbs et al. (2018): T_{dust}= 21.67 K and β = 1.35

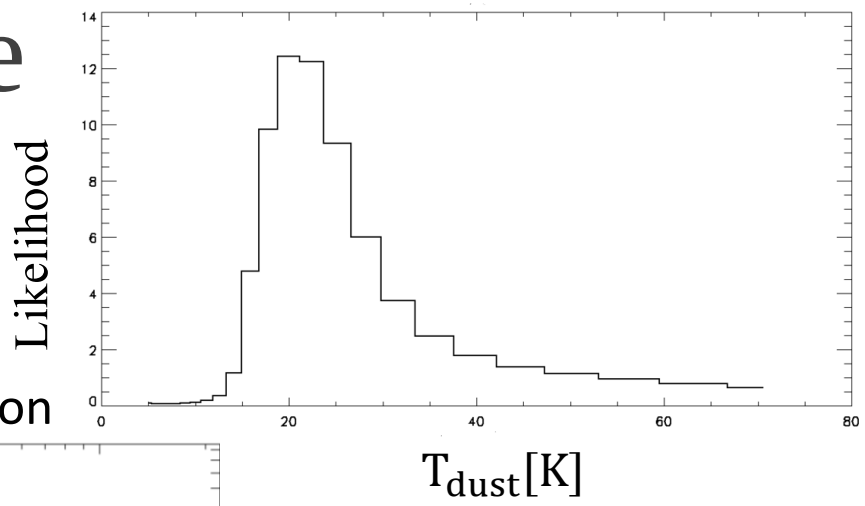
Modeling of the 21 galaxies

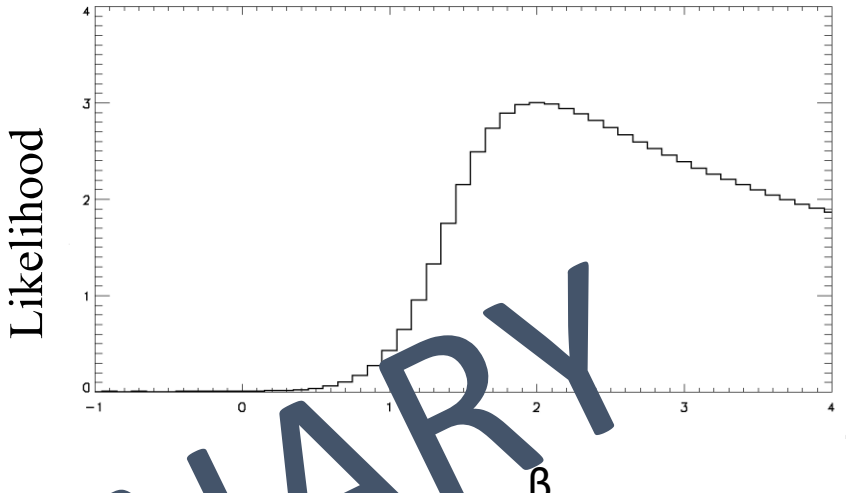




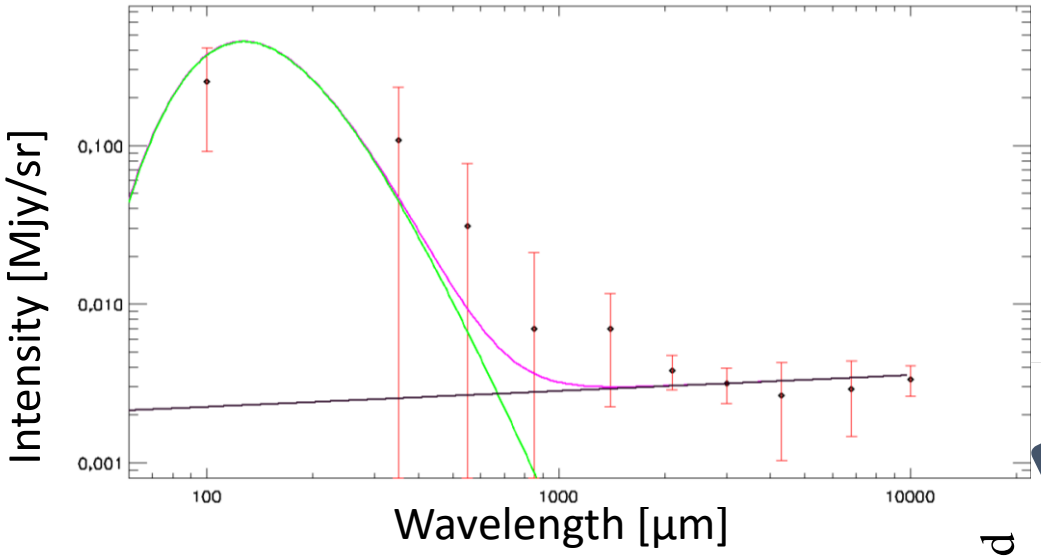
Example: **NGC4631**

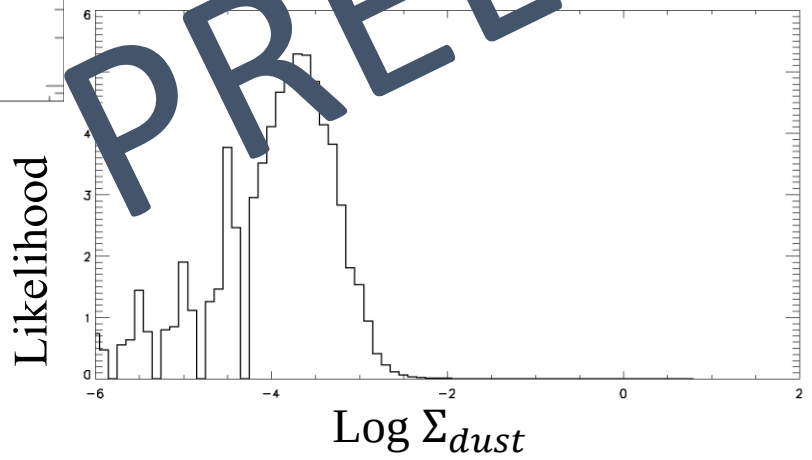
Modeling of the 21 galaxies

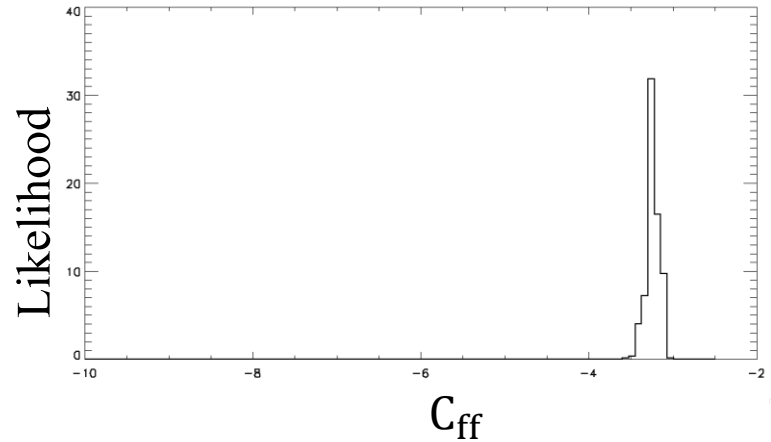




Spectral energy distribution







Example: **NGC4594**

Microwave gas and dust emission in a sample of nearby galaxies with IRAS and Planck

Obtain a sample of IRAS + Planck SEDs of nearby galaxies and model dust emission up to cm wavelengths at low resolution

Galaxy sample: same 21 galaxies as NIKA2 IMEGIN key project

Pros: get diffuse emission, sampling the mm to cm wavelenghts, nearby galaxies seen like distant ones

Set of maps at low (32’ resolution)
Foreground and background subtraction (CMB fluctuations, cirrus, CIB, zody,…)

Now SED modeling … STAY TUNED for results