The mm-to-cm Spectral Energy Distribution of spiral galaxies

Synergies between NIKA2 and SRT instruments

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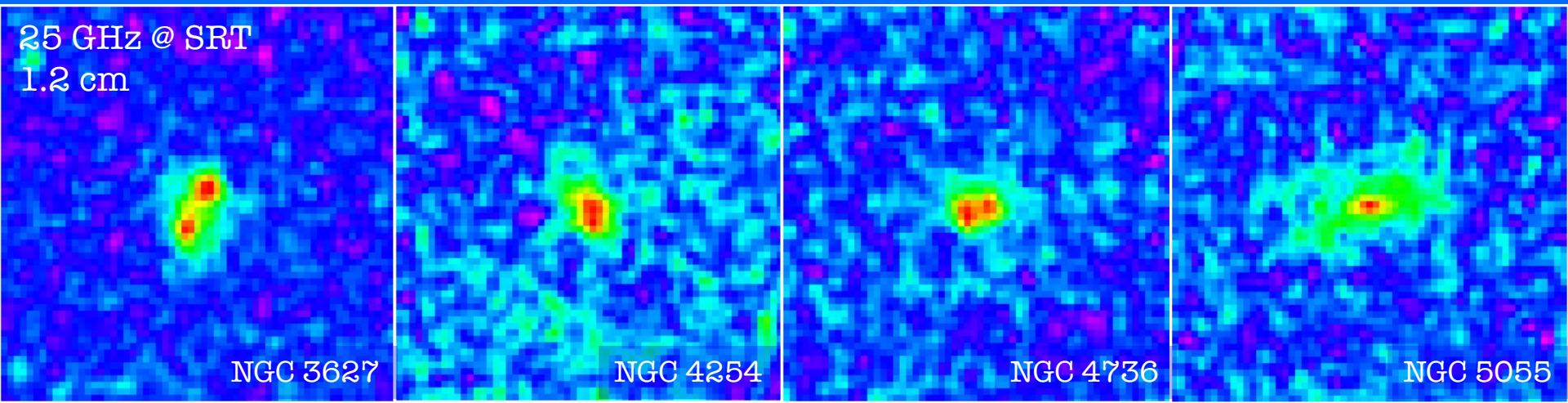
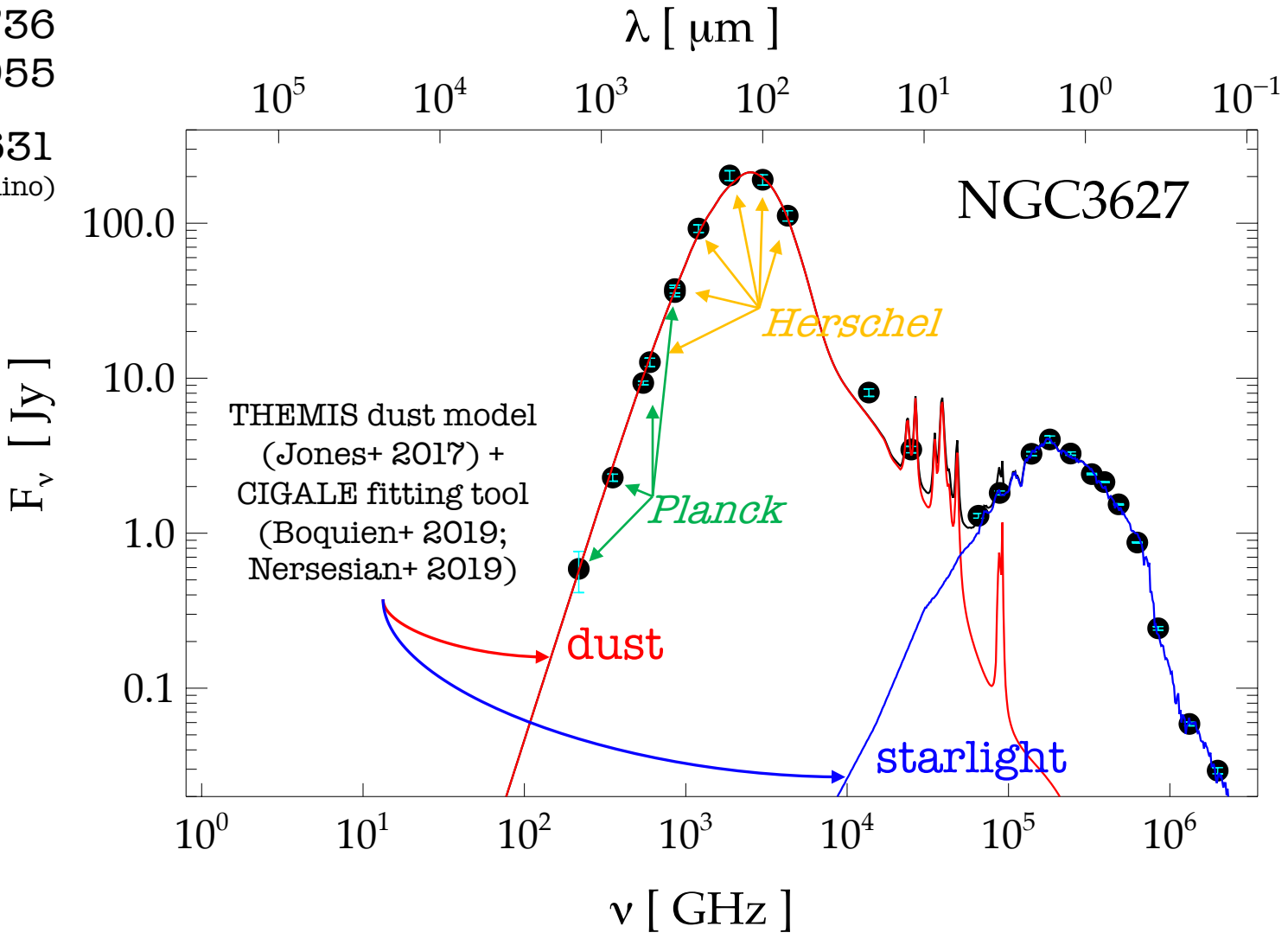


The targets:
NGC 3627
NGC 4254
NGC 4736
NGC 5055

NGC 4631
(P.I. Paladino)

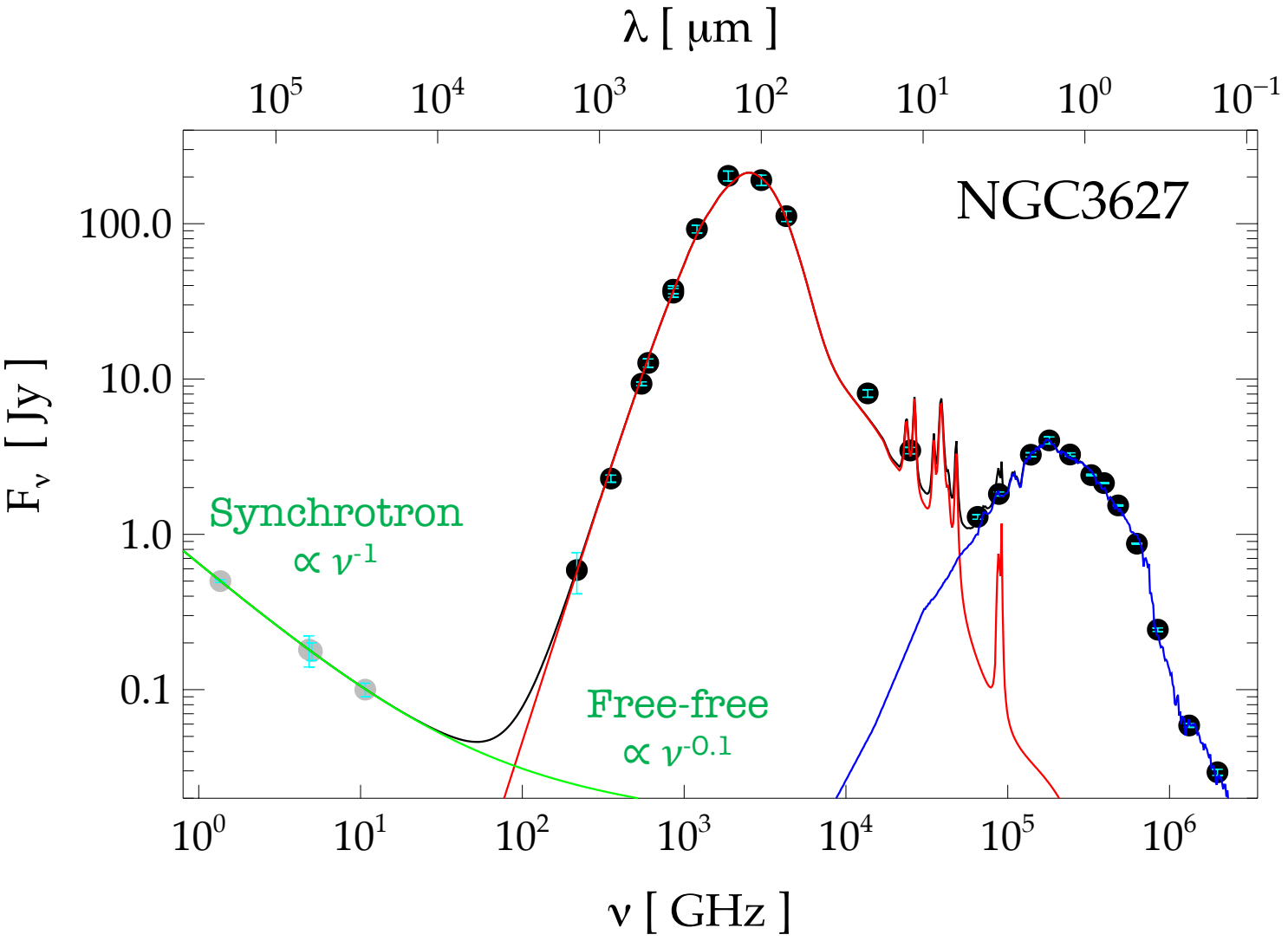
The SED from DustPedia (Davies+ 2017, Clark+ 2018)

http://dustpedia.astro.noa.gr/



SED fits: M_{dust}, ISRF, fraction of small grains, SFR and fraction of dust heating
(Nersesian+ 2019, Galliano+ 2021)

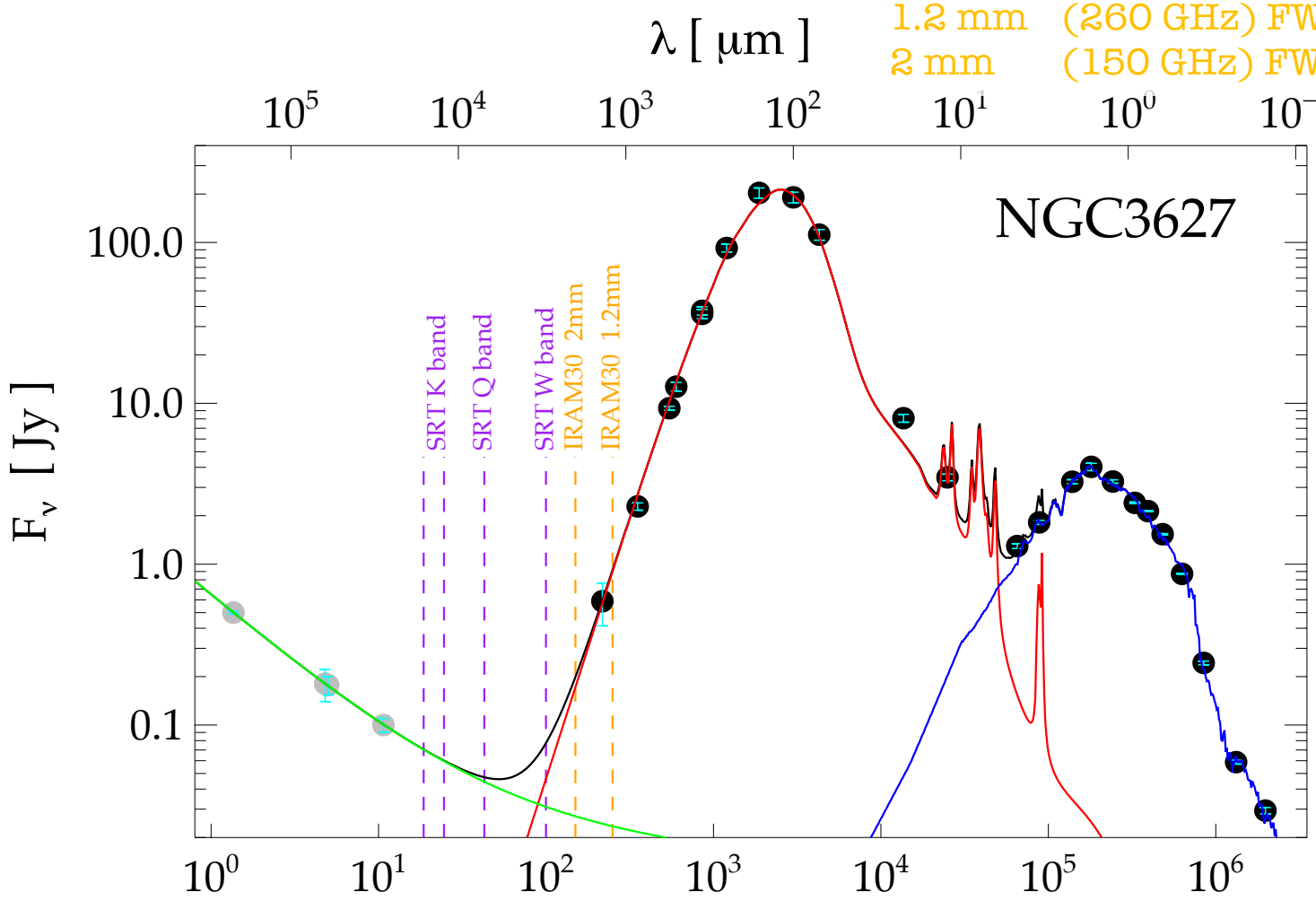
The Mid-Radio continuum from KINGFISHER (Tabatabaei+ 2017)



Non thermal and thermal radiation provide dust-free SFRs

NIKA2 and instruments at the 64m Sardinia Radio Telescope

NIKA2 @ IRAM 30m
1.2 mm (260 GHz) FWHM=12"
2 mm (150 GHz) FWHM=18"



K-band 7-feed receiver
[18,26] GHz
1.2 cm, FWHM=45"
(Orfei 2010) **Available!**

Q-band 19-feed receiver
[33,50] GHz
7 mm, FWHM=28"
(Orfei+ 2020)

Autumn-2022?

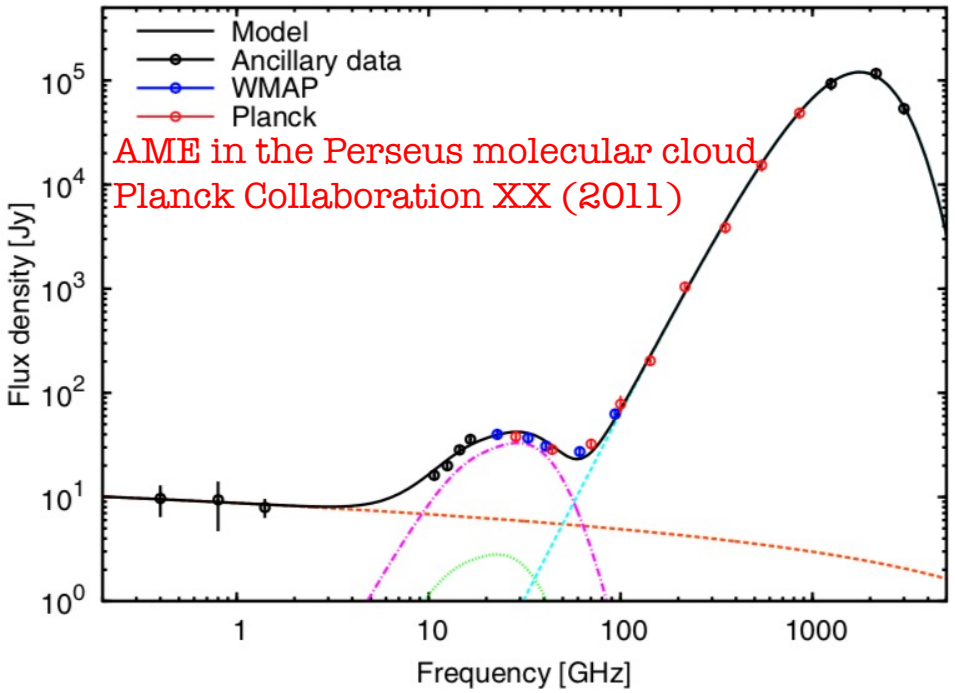
MISTRAL camera
W band [77,103] GHz
3 mm, FWHM=13"
(D'Alessando's talk)

Anomalous Microwave Emission (AME)

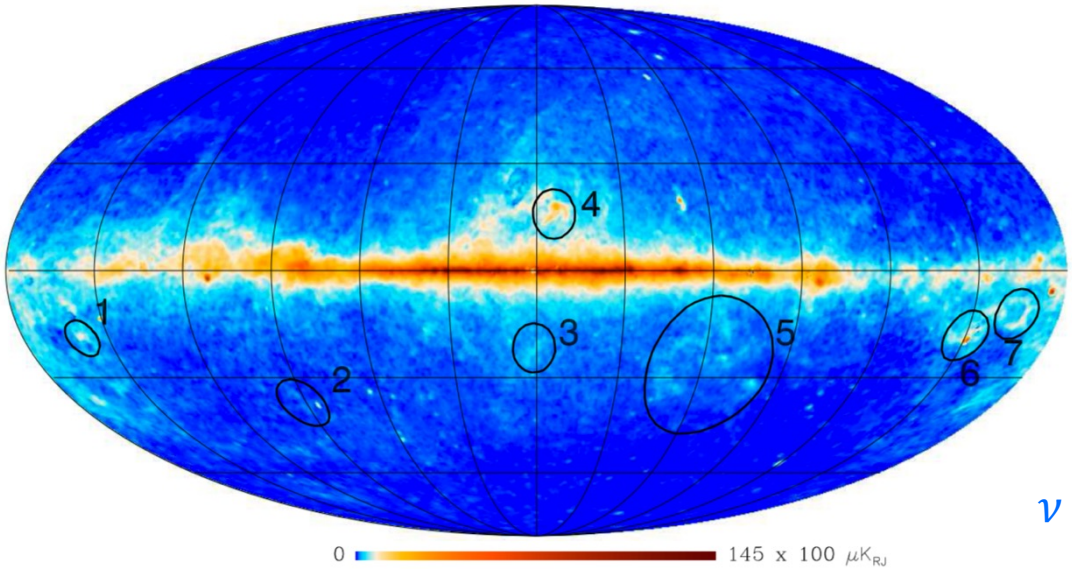
Emission at 30 GHz in the Milky Way, in excess of synchrotron, free-free and dust emission.

AME correlates with dust emission at larger frequencies

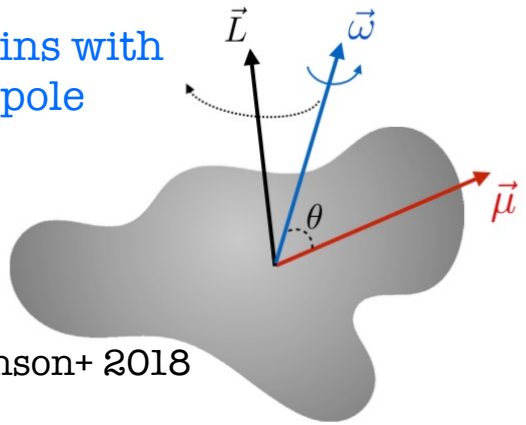
Detected in various environments



AME all-sky map at 23 GHz
Planck Collaboration Int. XXII (2015)



Spinning grains with an electric dipole

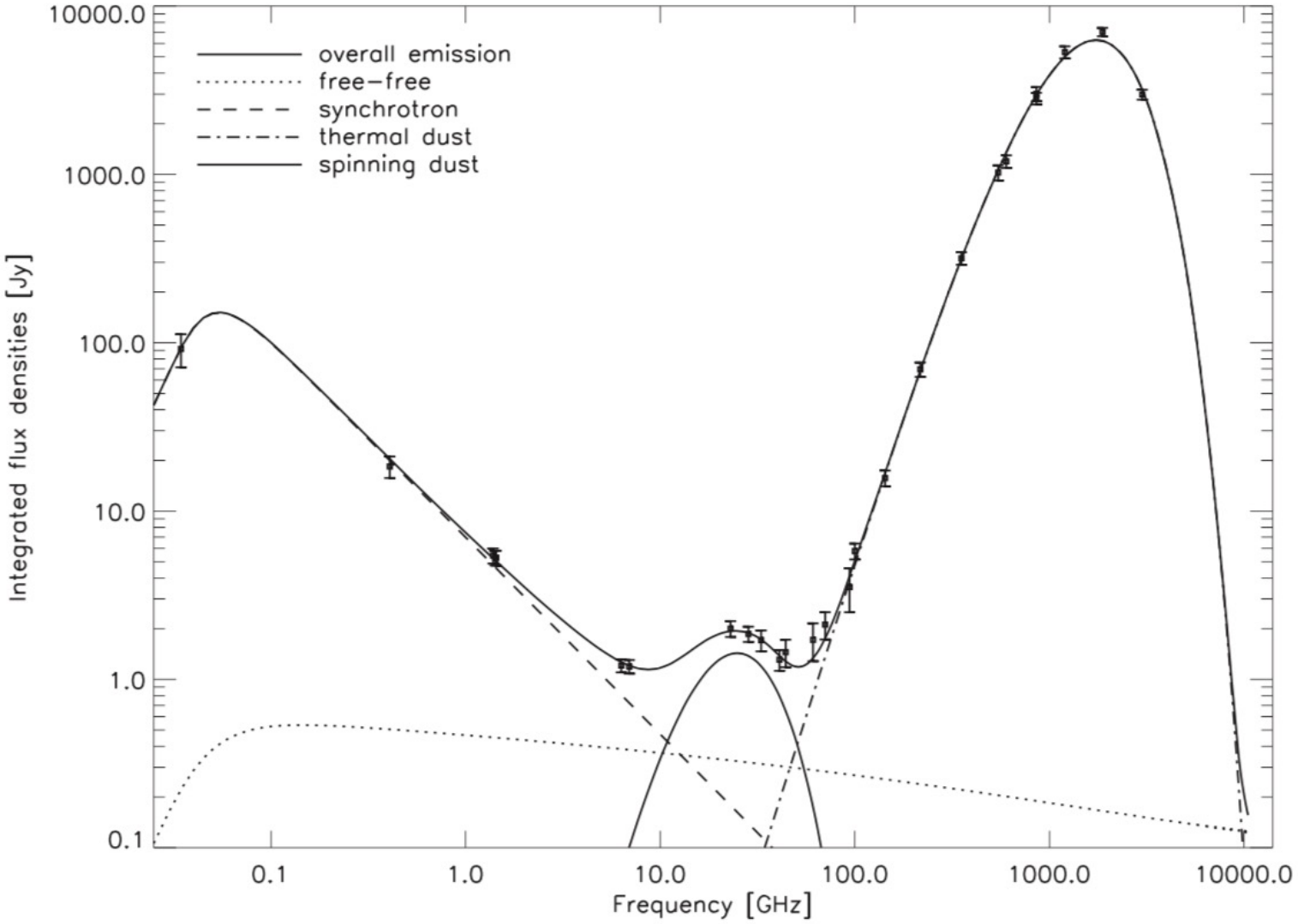


Dickinson+ 2018

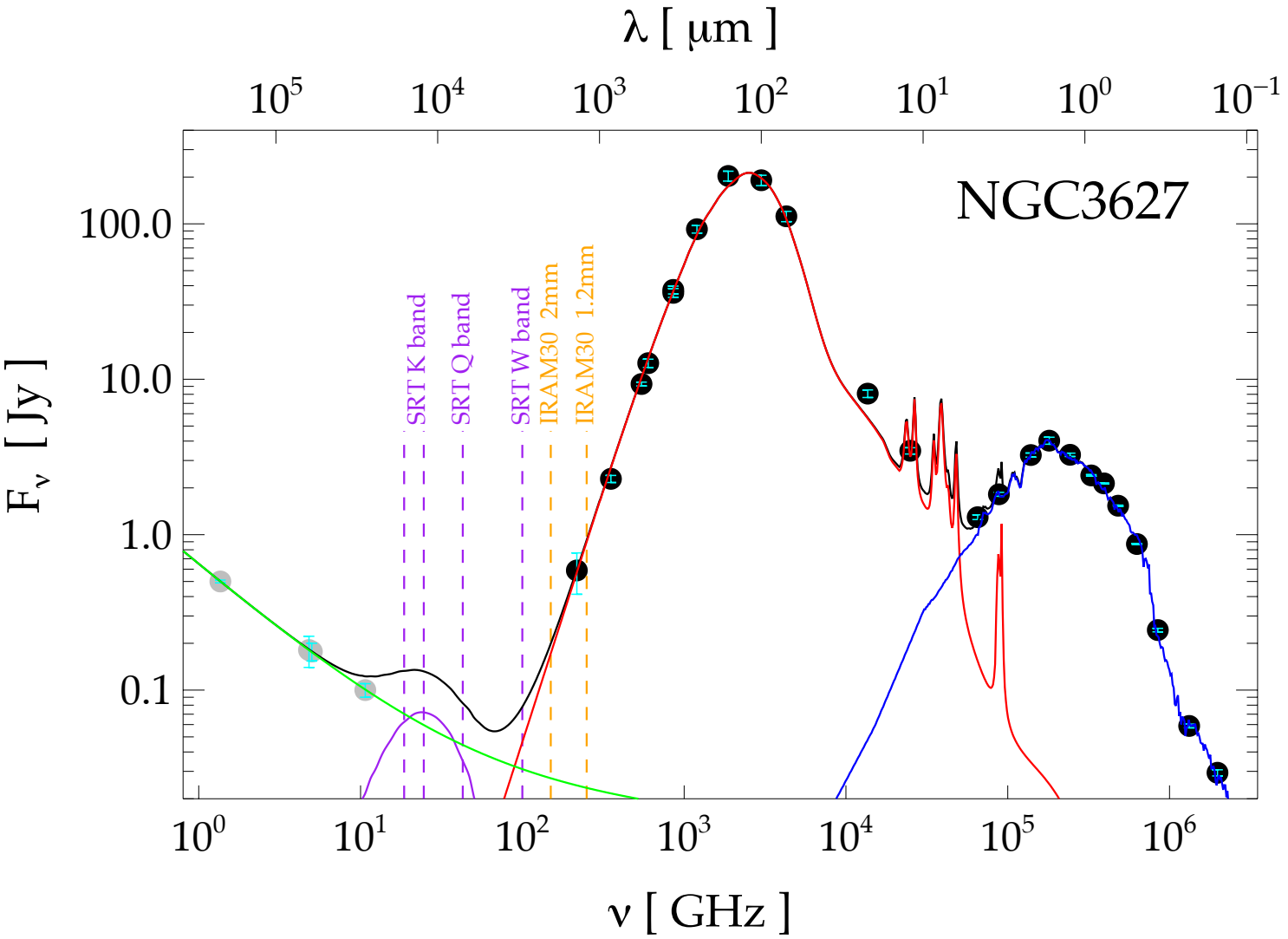
$\nu = \omega/2\pi \simeq 30$ GHz ⇒ $a \lesssim 1$ nm

AME in the global SED of M31

Battistelli+ 2019



$$\frac{F_{AME}(30\ GHz)}{F_{dust}(3000\ GHz)} \simeq 1/3000$$ AME emissivity



SRT observation at 18.6 GHz (1.6 cm) and 24.6 GHz (1.2 cm)

7-feed K-band receiver & SARDARA backend

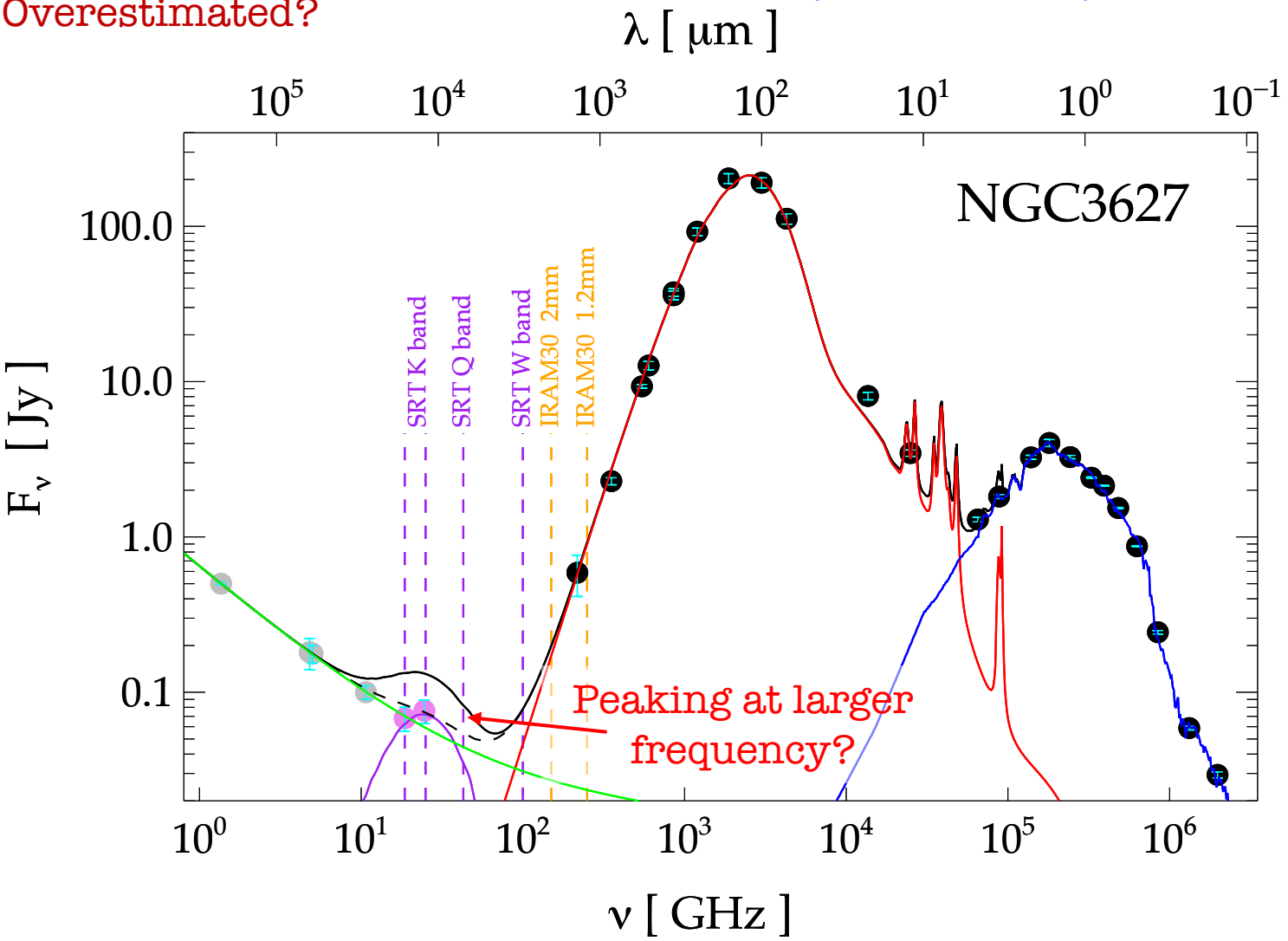
1st semester 2021

$$\frac{F_{AME}(30\ GHz)}{F_{dust}(3000\ GHz)} \simeq 1/3000$$

Overestimated?

Dependence of emissivity on T_{dust} (Tibbs+ 2012)

18 K (MW and M31) vs 25 K



SRT observation at 18.6 GHz (1.6 cm) and 24.6 GHz (1.2 cm)

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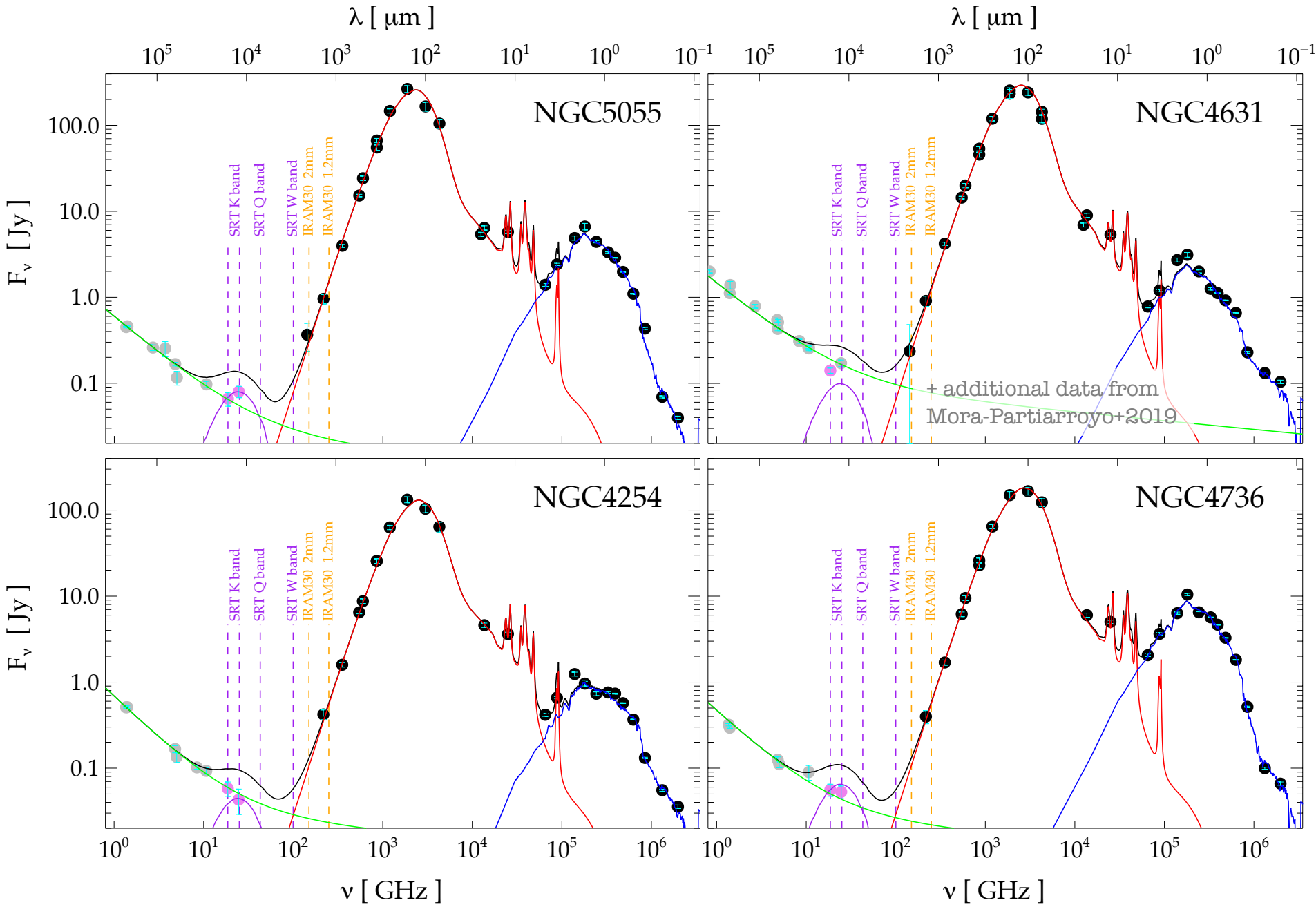
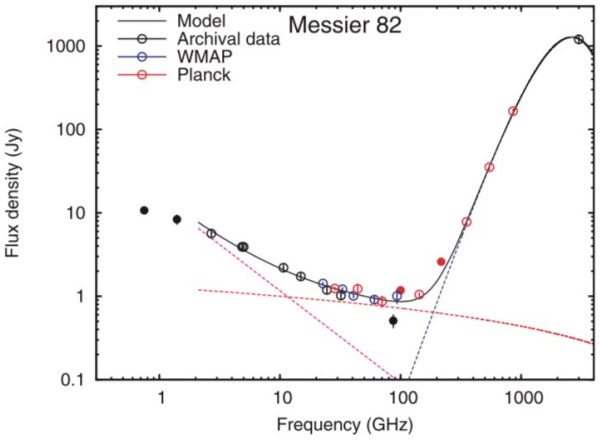
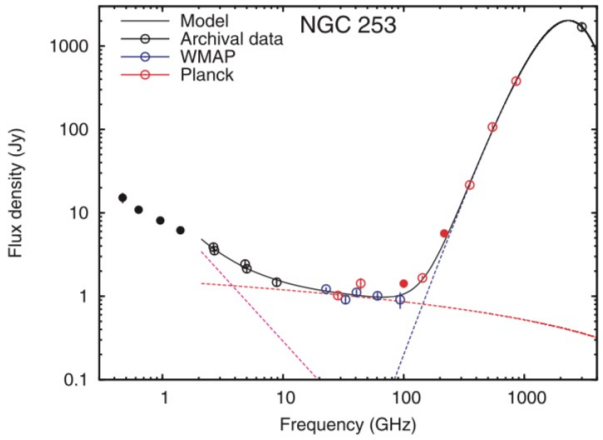
1st semester 2021

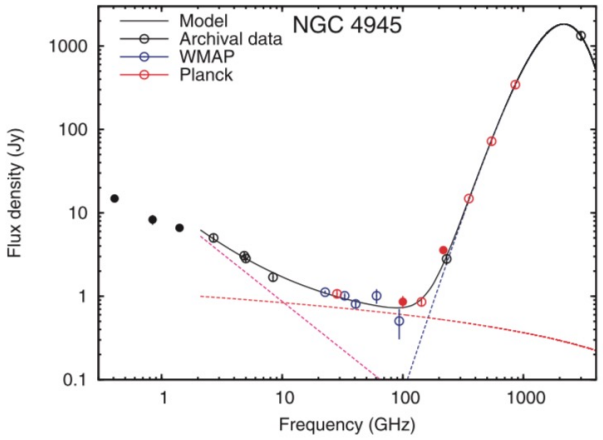
AME or no AME?


λ [μm]
NGC5055
NGC4631
NGC4254
NGC4736
SRT K band
SRT Q band
SRT W band
IRAM30 2mm
IRAM30 1.2mm
+ additional data from
Mora-Partiarroyo+2019
F_ν [Jy]
ν [GHz]

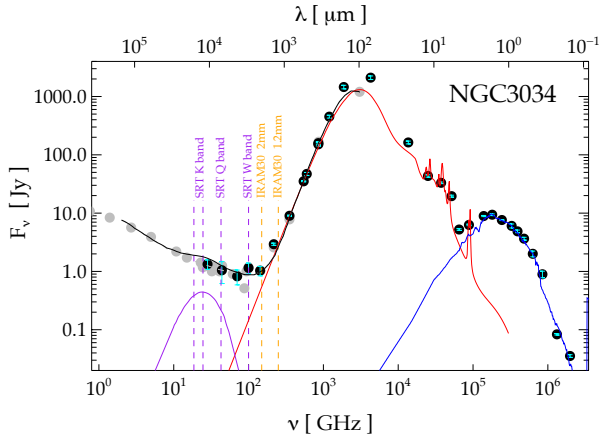
Other AME non detections (Peel+ 2011)

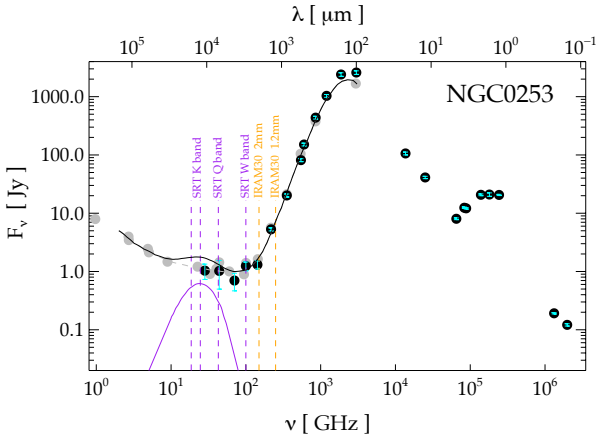


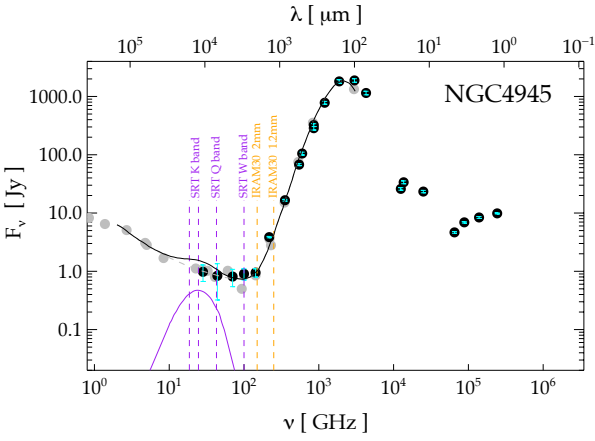




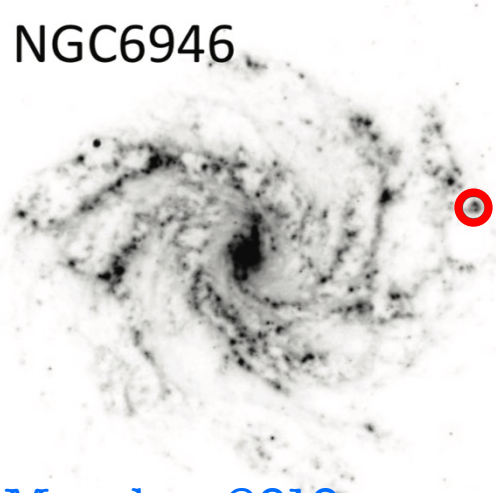
Predictions based on the MW AME emissivity



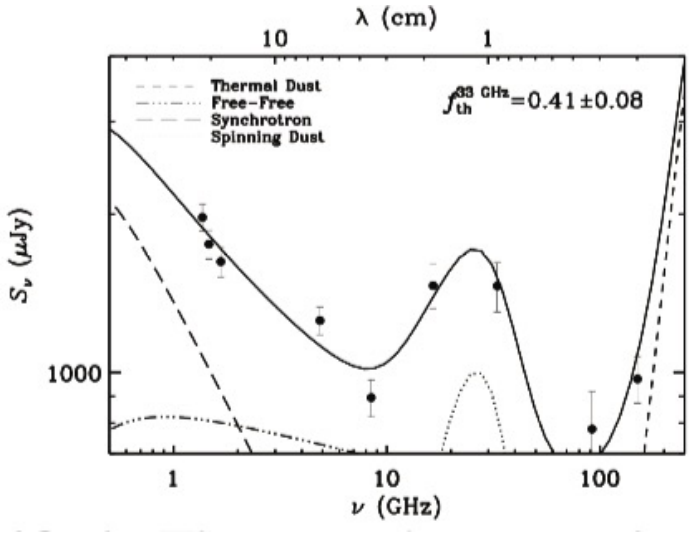


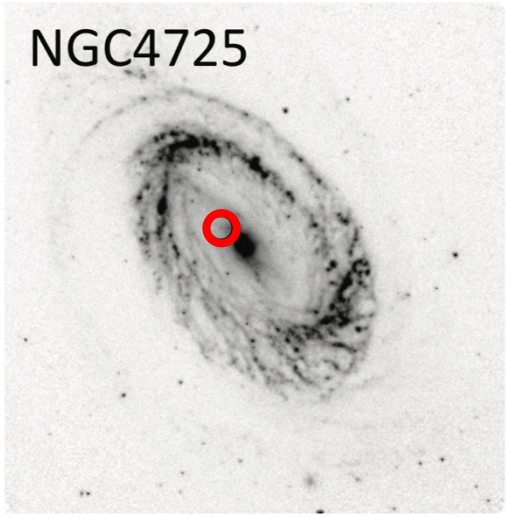


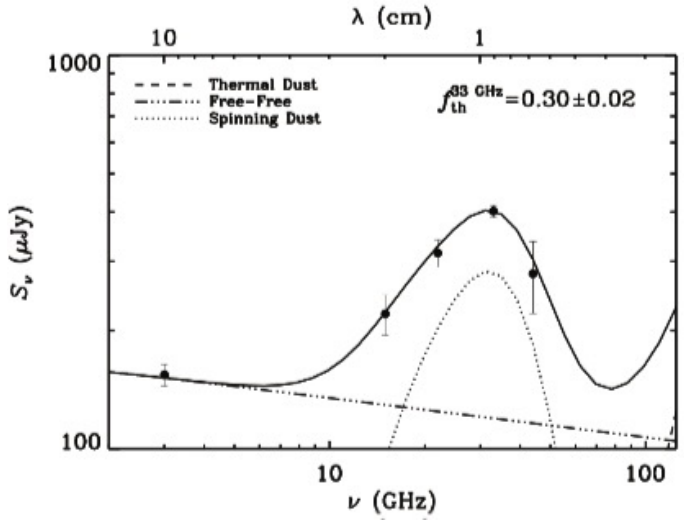
Where was AME detected?



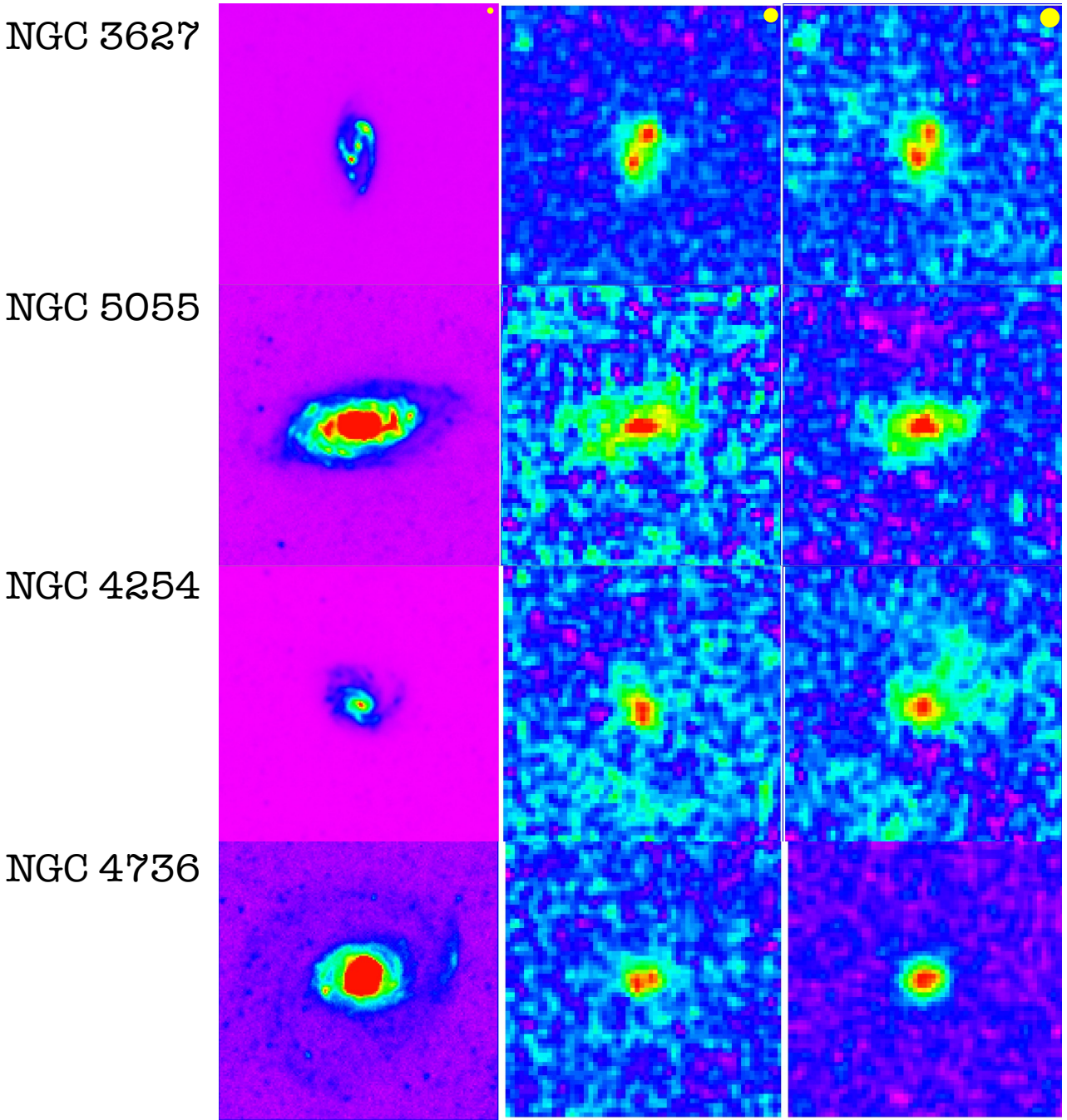
Murphy+ 2010



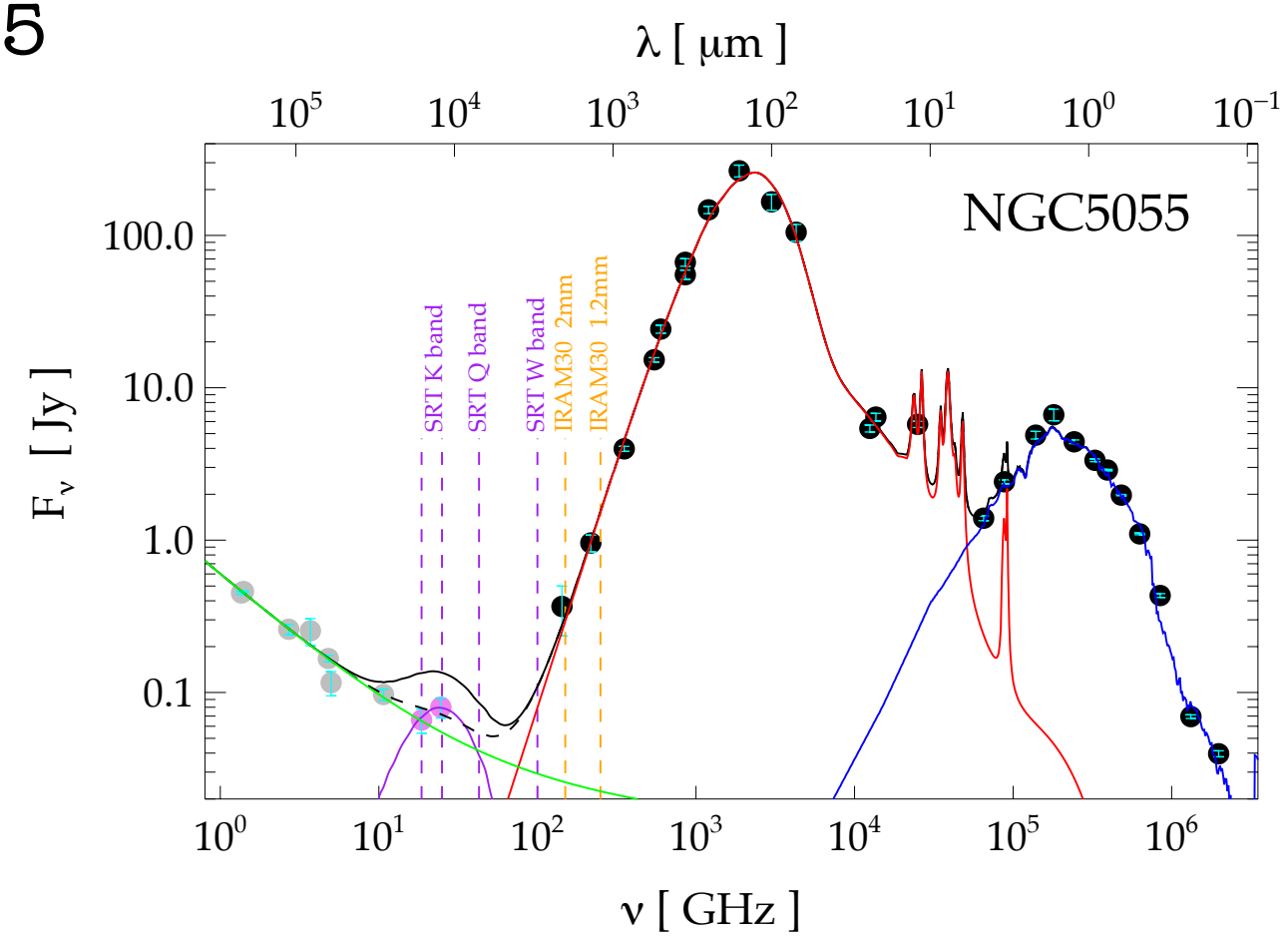


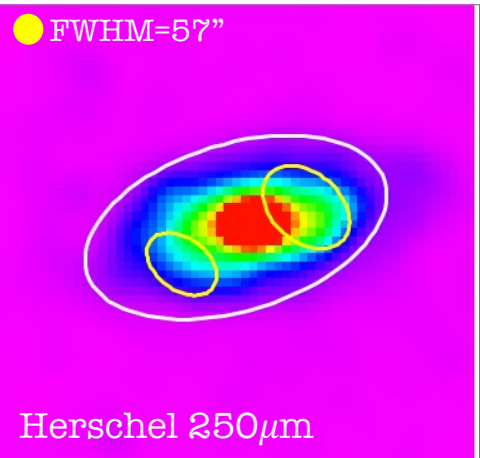


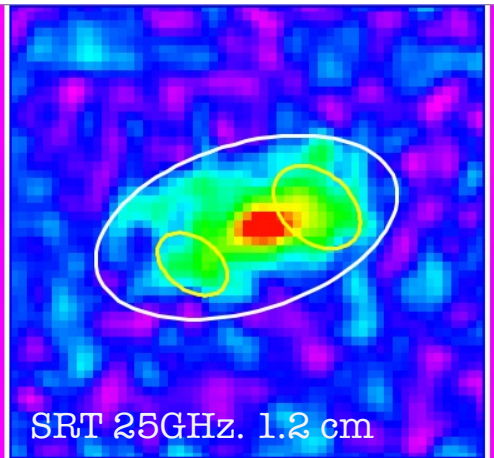
Murphy+ 2018 (but with no associated dust emission; Murphy+ 2020)

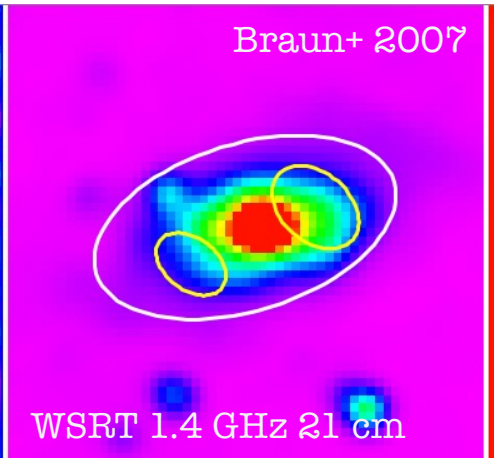

Herschel 250μm
FWHM=18”
SRT 24.6 GHz
FWHM=45”
SRT 18.6 GHz
FWHM=57”
NGC 3627
NGC 5055
NGC 4254
NGC 4736
Our images

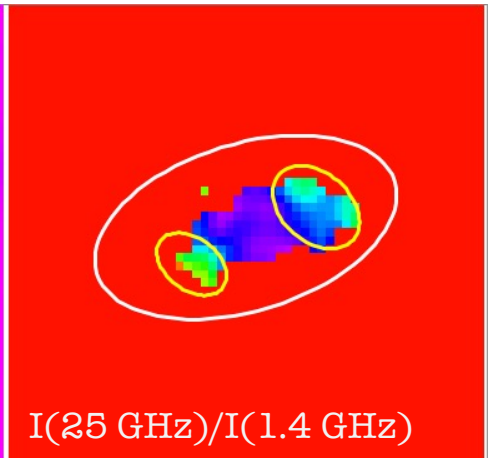
NGC5055


λ [μm]
10^5
10^4
10^3
10^2
10^1
10^0
10^−1
NGC5055
100.0
10.0
1.0
0.1
F_ν [Jy]
SRT K band
SRT Q band
SRT W band
IRAM30 2mm
IRAM30 1.2mm
10^0
10^1
10^2
10^3
10^4
10^5
10^6
ν [GHz]

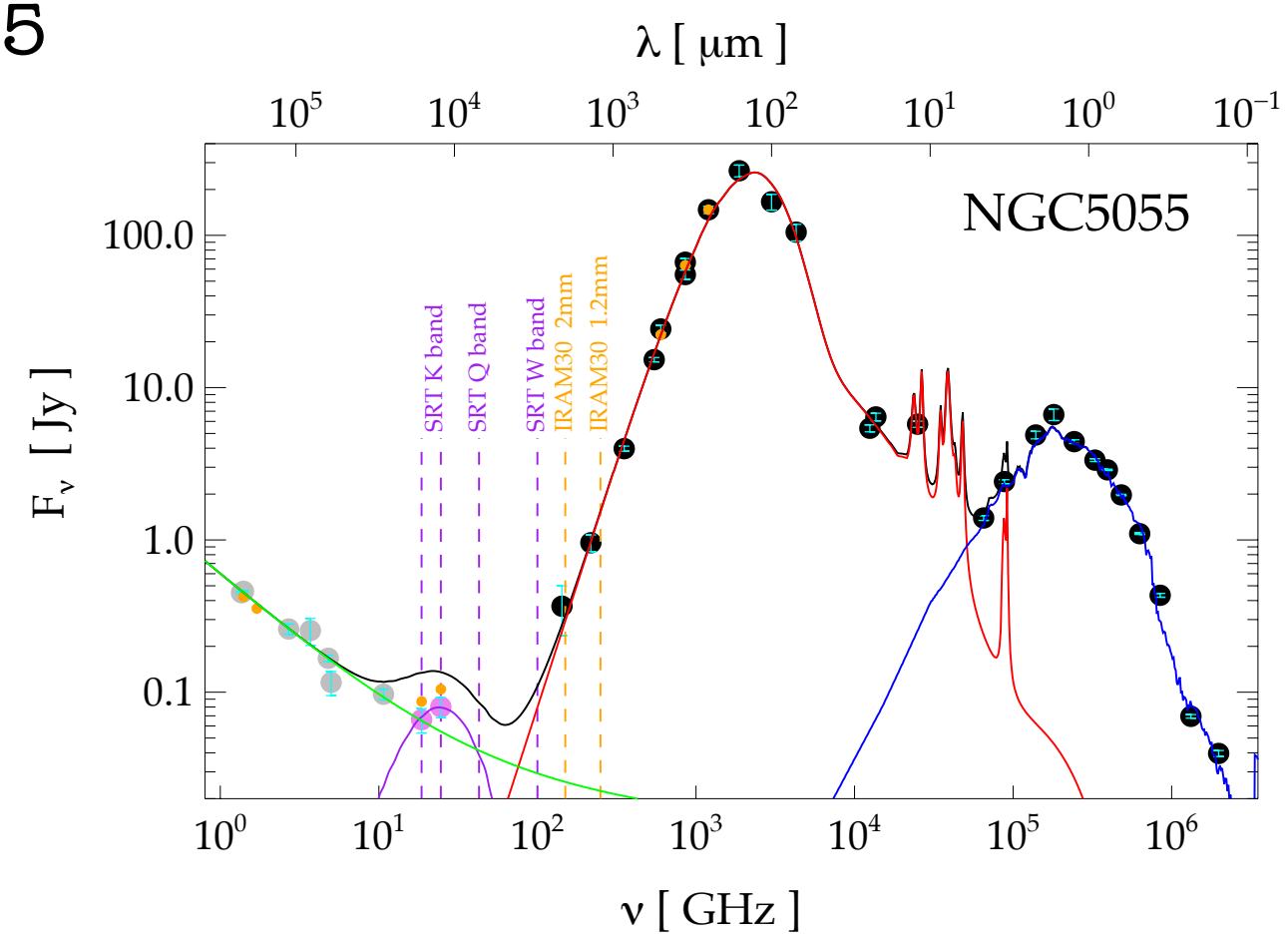

FWHM=57”
Herschel 250μm

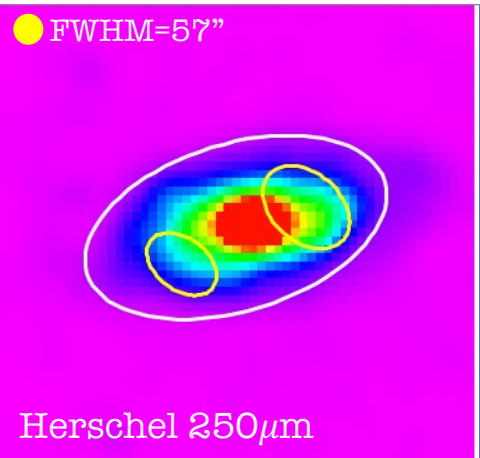

SRT 25GHz. 1.2 cm

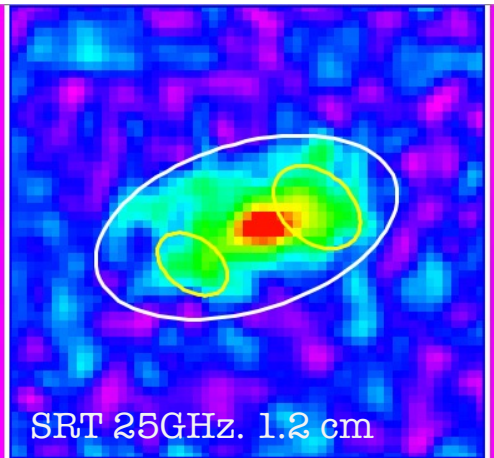

Braun+ 2007
WSRT 1.4 GHz 21 cm

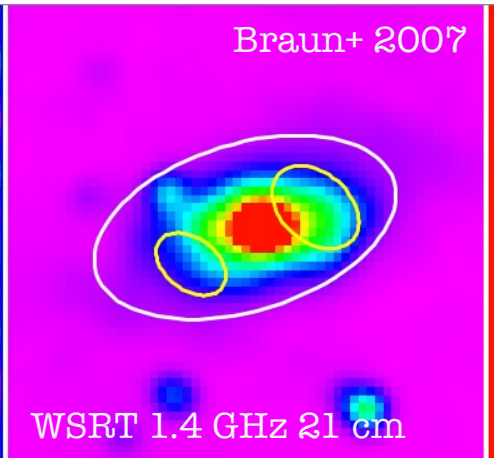

I(25 GHz)/I(1.4 GHz)

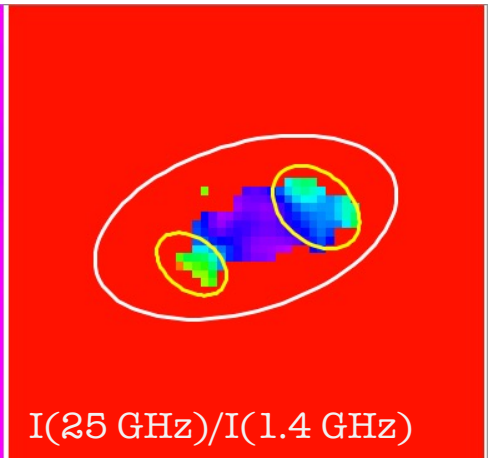
NGC5055


λ [μm]
10^5
10^4
10^3
10^2
10^1
10^0
10^−1
NGC5055
100.0
10.0
1.0
0.1
F_ν [Jy]
SRT K band
SRT Q band
SRT W band
IRAM30 2mm
IRAM30 1.2mm
10^0
10^1
10^2
10^3
10^4
10^5
10^6
ν [GHz]


FWHM=57”
Herschel 250μm


SRT 25GHz. 1.2 cm


Braun+ 2007
WSRT 1.4 GHz 21 cm


I(25 GHz)/I(1.4 GHz)

Summary

- No “ordinary” AME detected at 25 GHz in NGC3627, NGC4254, NGC4631, NGC4736, NGC5055
- An excess for $\nu \geq 25$GHz in NGC3627, NGC4631, NGC5055?
- A stronger excess going outward in NGC5055?

SRT 19-feed Q-Band receiver

- Need to cover the gap in the SED knowledge for $15 < \nu < 250$ GHz
  $1\ \text{mm} < \lambda < 2\ \text{cm}$

SRT W-Band camera

NIKA-2 IMEGIN data