Far-IR Colours and SEDs of Nearby Galaxies

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Herschel Extragalactic Working Group:

Auld R., Baes M., Barlow M., Bendo G., Bock J., Bradford M., Castro-Rodriguez N., Chanial P., Charlot S., Clements D., Cooray A., Cormier D., Cortese L., Davies J., Dwek E., Eales S., Elbaz D., Galametz M., Galliano F., Gear W., Glenn J., Gomez H., Griffin M., Hony S., Isaak K., Lebouteiller V., Levenson L., Lu N., Madden S., O'Halloran B., Okumura K., Oliver S., Page M., Panuzzo P., Papageorgiou A., Parkin T., Perez Fournon I., Pohlen M., Rangwala N., Rigby E., Roussel H., Rykala A., Sacchi N., Sauvage M., Schulz B., Schirm M., Smith M., Spinoglio L., Srinivasan S., Stevens J., Trichas M., Symeonidis M., Vaccari M.,

Vigroux L., Wilson C., Wozniak H., Wright G., Zeilinger W.

Herschel Virgo Cluster Survey (HeViCS):

Davies J. (P.I.), Baes M., Bendo G., Bianchi S., Boehringer H., Bomans D., Clemens M., Corbelli E., Cortese L., Dariush A., Dye S., Eales S., Fadda D., Garcia-Appadoo D., Gavazzi G., Giovanardi C., Grossi M., Hughes T., Hunt L., Jones A., Madden S., Pierini D., Pohlen M., Putman M., Sabatini S., Smith M., di Serego Alighieri S., Vlahakis C., Xilouris E., Zibetti S.

SEDs as probes of galaxy evolution

-important tools for determining the energetic budget of any extragalactic source

- useful for tracing dust extinction (stellar light absorbed by dust is re-emitted in the infrared) ⇒ determining the intrinsic stellar SED ⇒ reconstruct the star formation history

- useful for tracing the presence of an AGN

- useful to calibrate k-corrections

- z=0 critical reference for high z studies of unresolved sources

- necessary for determining M_{dust}, critical parameter in the study of the physics of the ISM

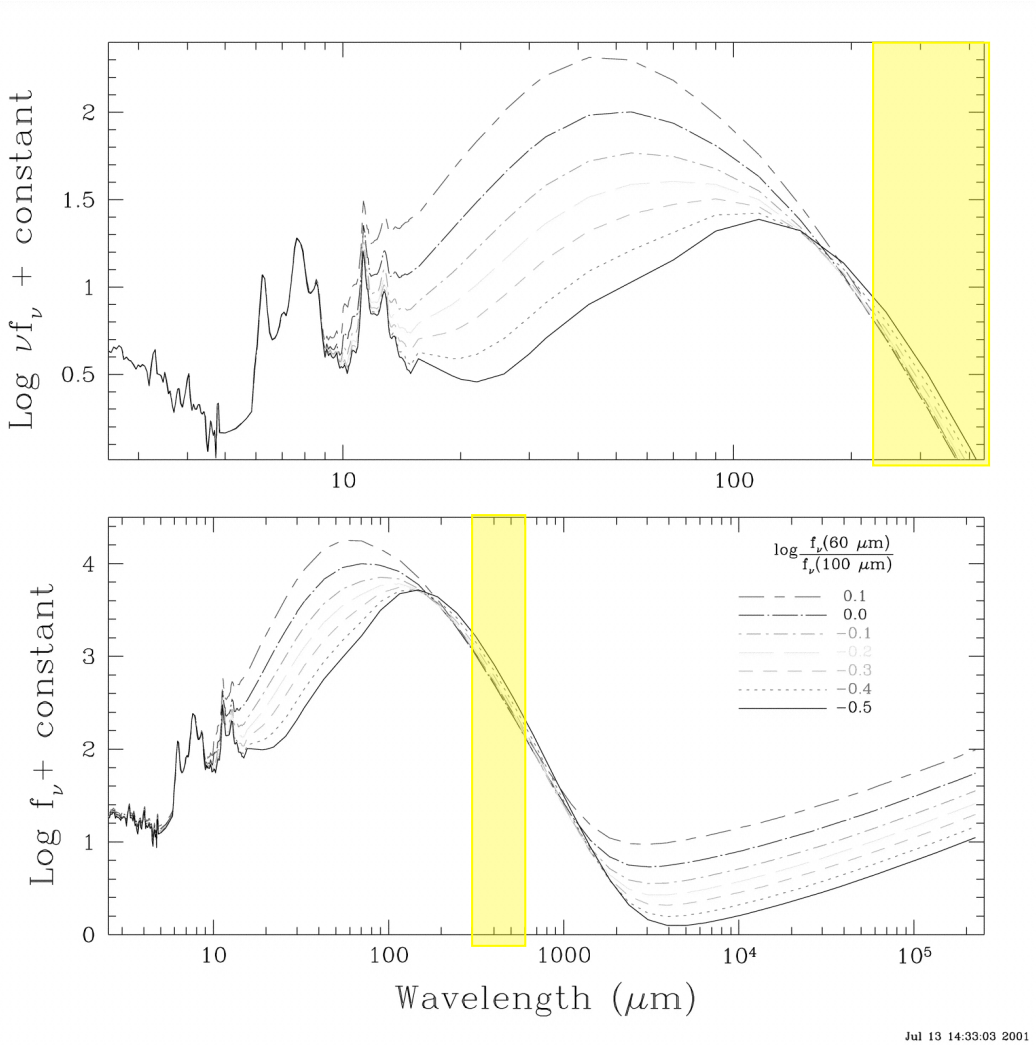
SEDs in the literature

Available for single galaxies or templates but limited to $\lambda<170$ mic & $\lambda>850$ mic

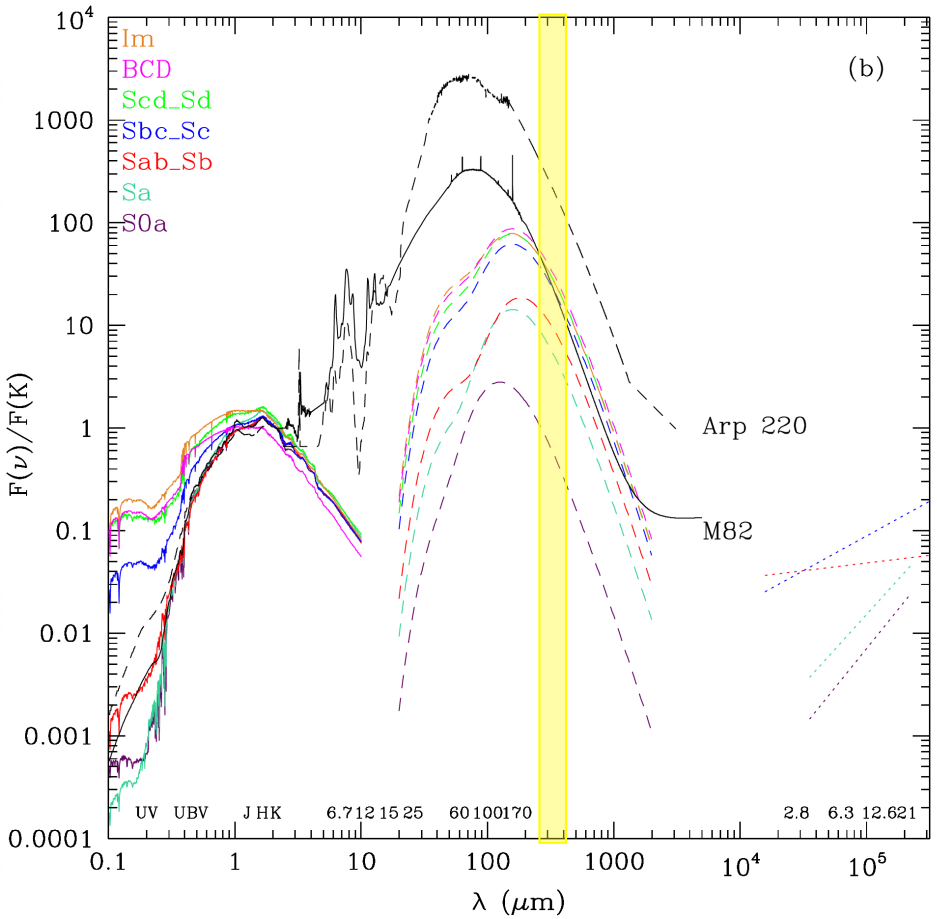
SPIRE covers this spectral range particularly important for detecting the emission of the cold dust component dominant in mass at z=0 (and the warm dust heated by the youngest stellar populations at high z)

SEDs in the literature

Dale_Helou 2002



Boselli et al 2003

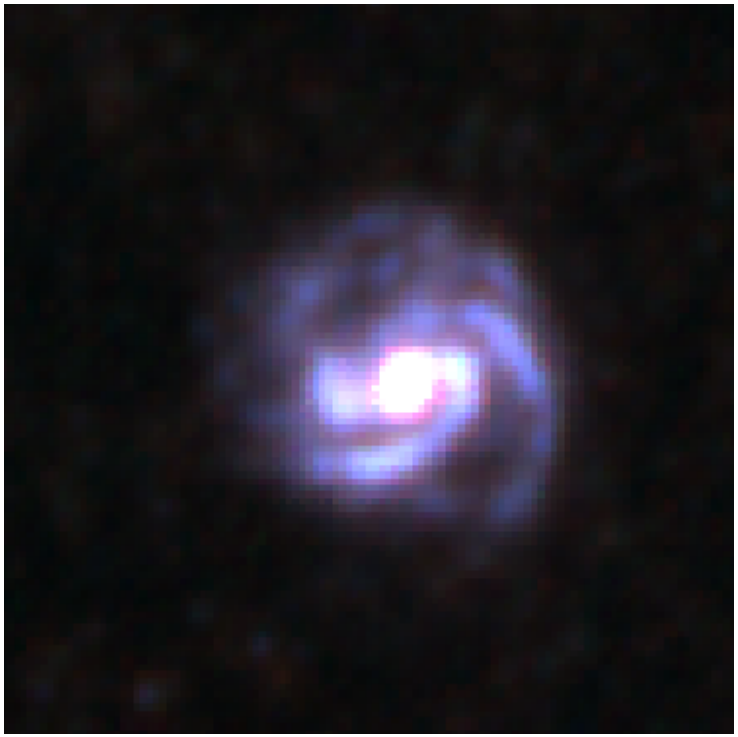


SEDs of galaxies observed in the SDP

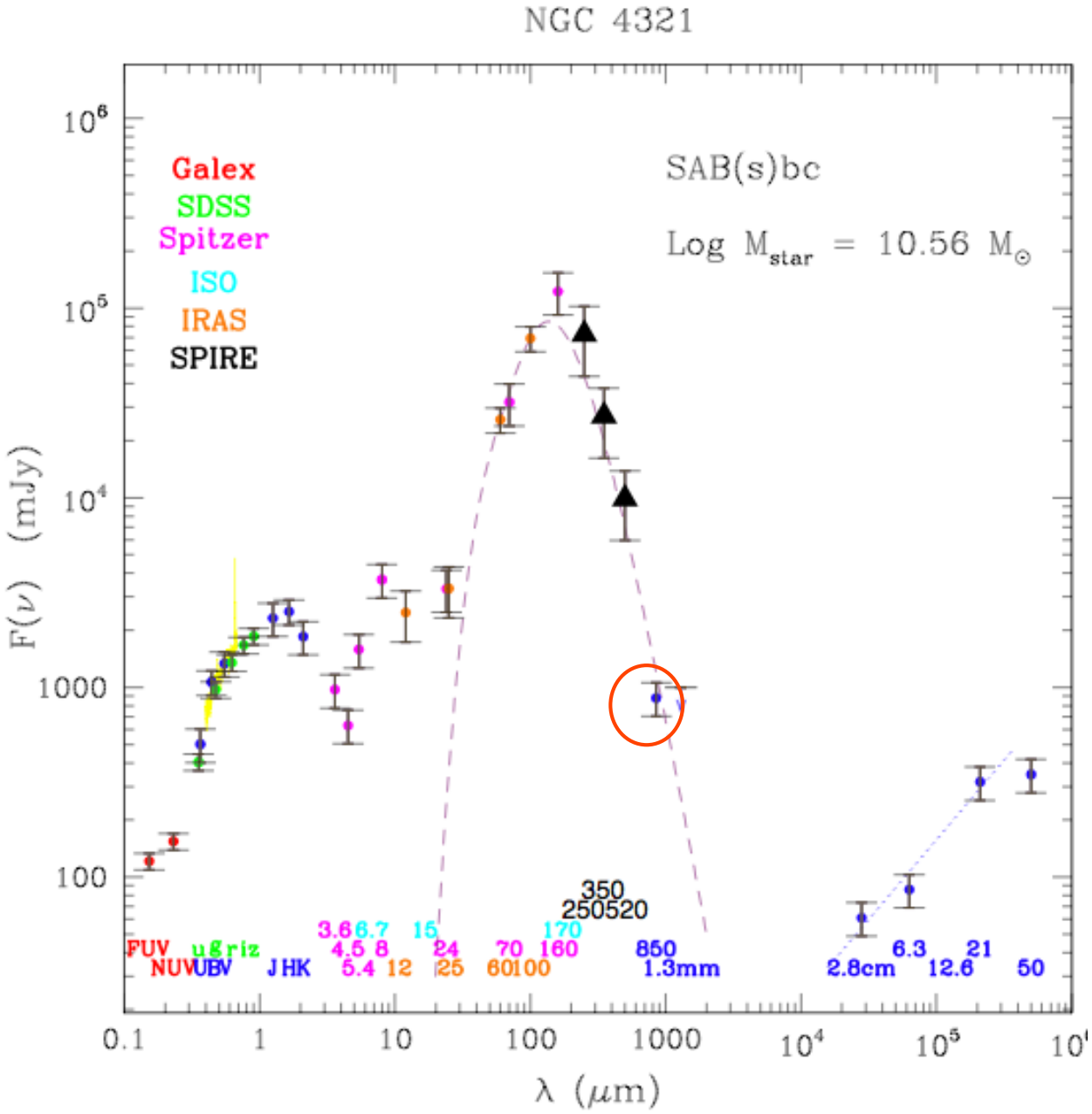
Data taken from the
Herschel Reference Survey (HRS; Boselli et al 2010b) and the Herschel Virgo Cluster Survey (HeViCS; Davies et al 2010)

Analysis based on 51 objects:
33 Virgo members
3 isolated objects
13 background objects
(+ M81 and M82 from the VNGS)

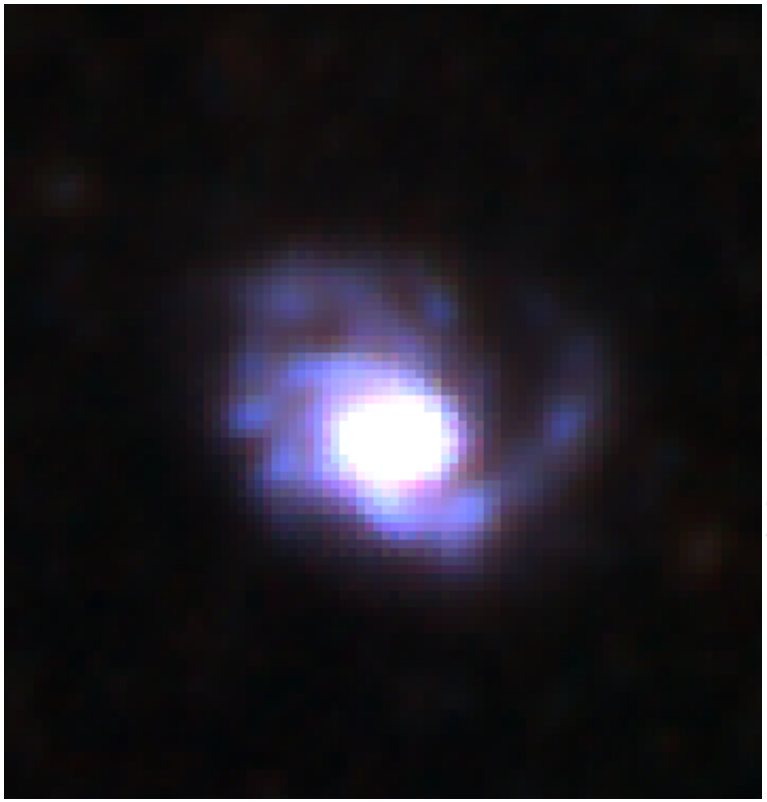
Normal spiral galaxy: M100



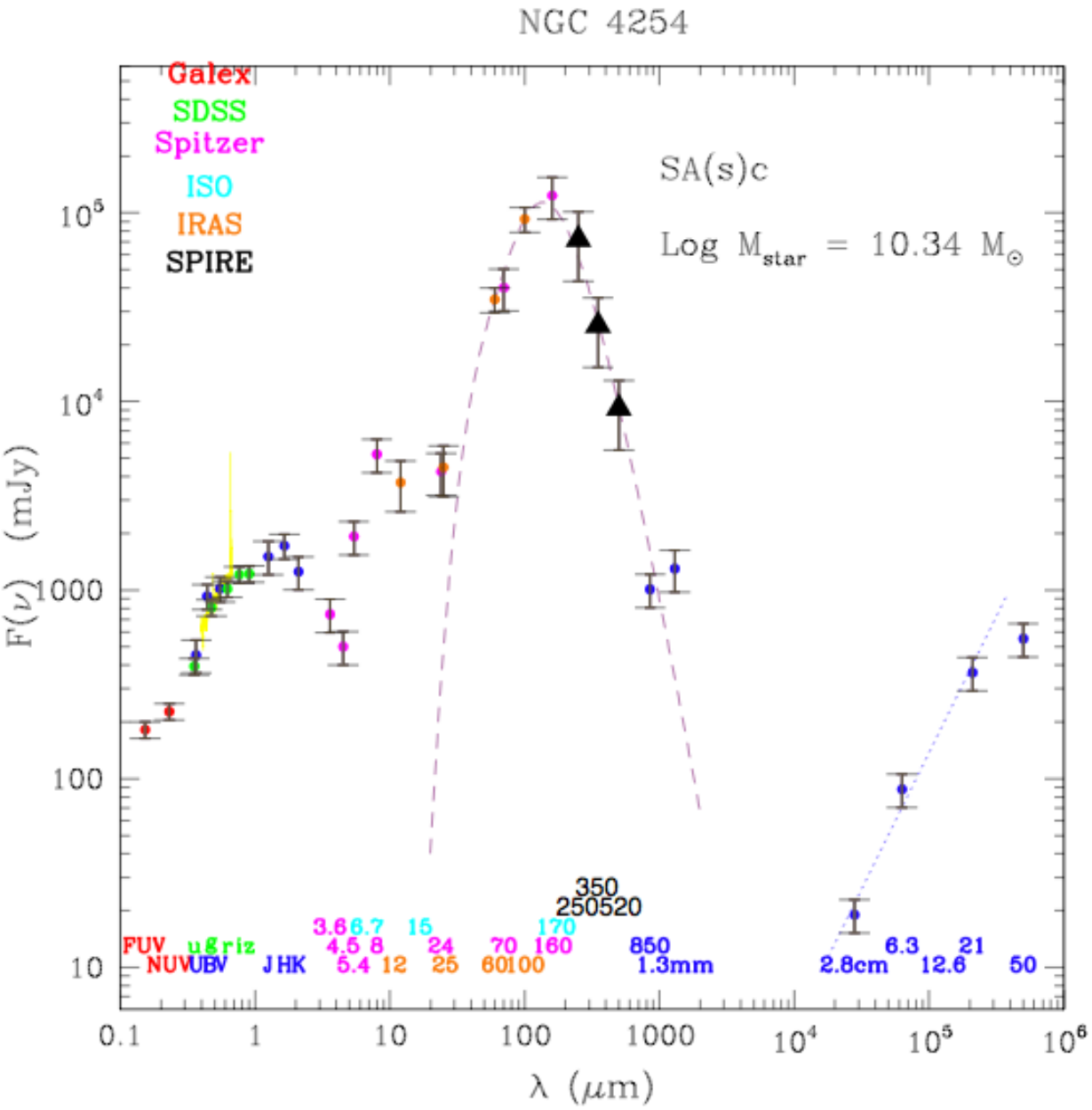
Pohlen et al. 2010



Normal spiral galaxy: M99



Pohlen et al 2010



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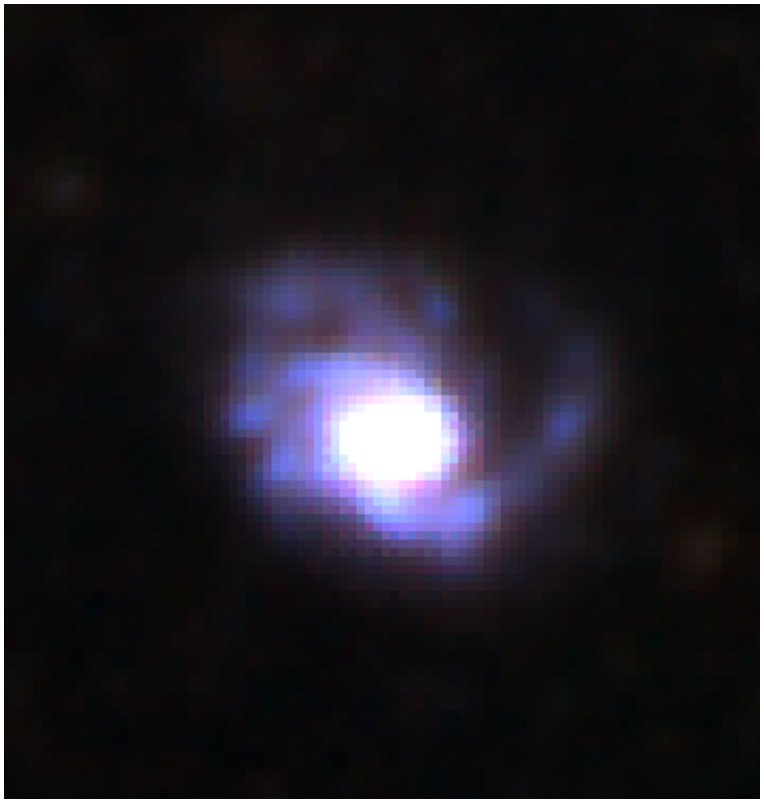
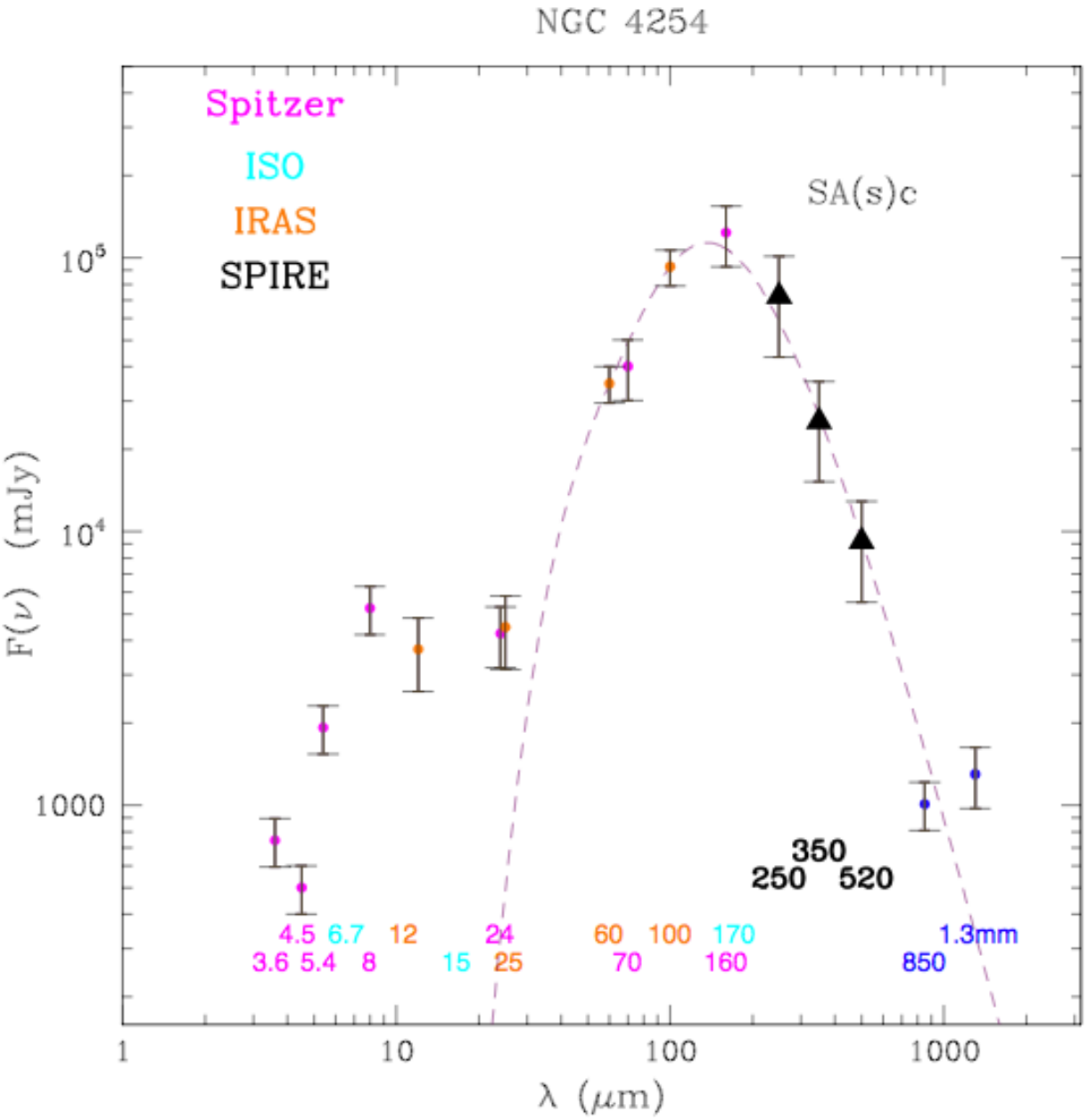
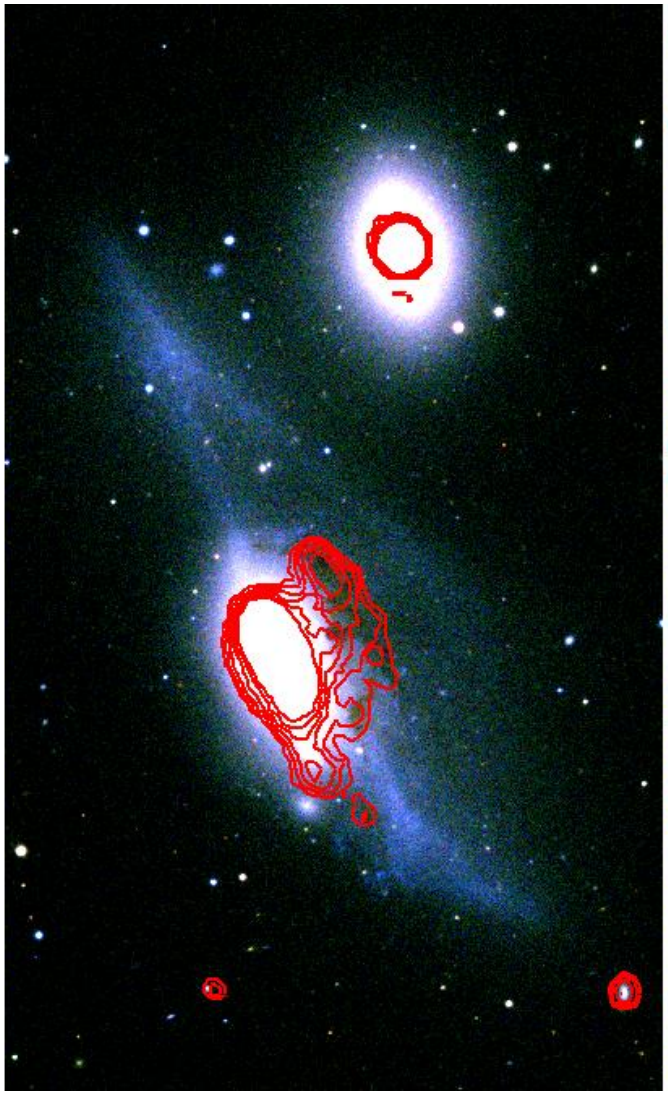


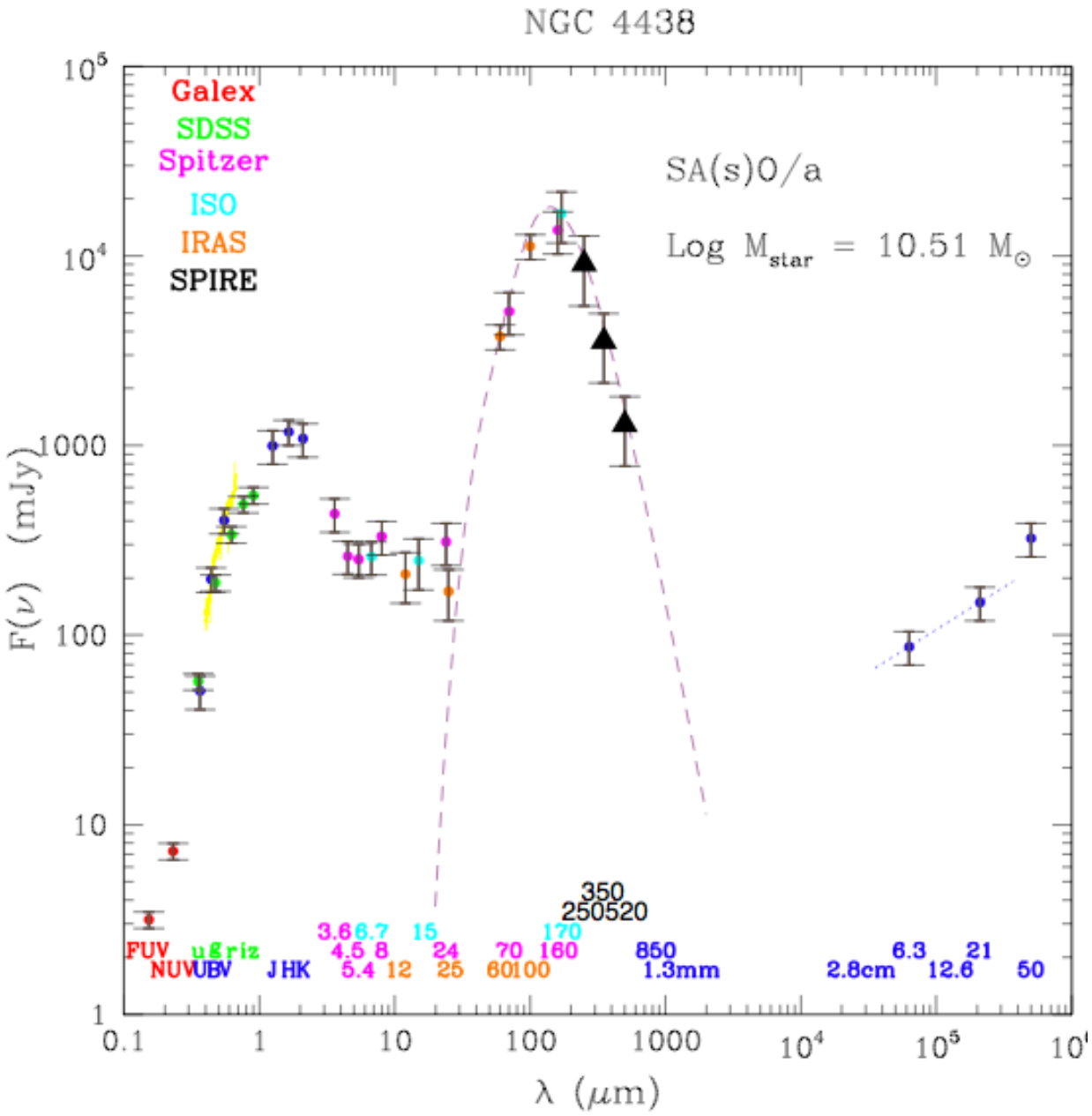
Pohlen et al 2010



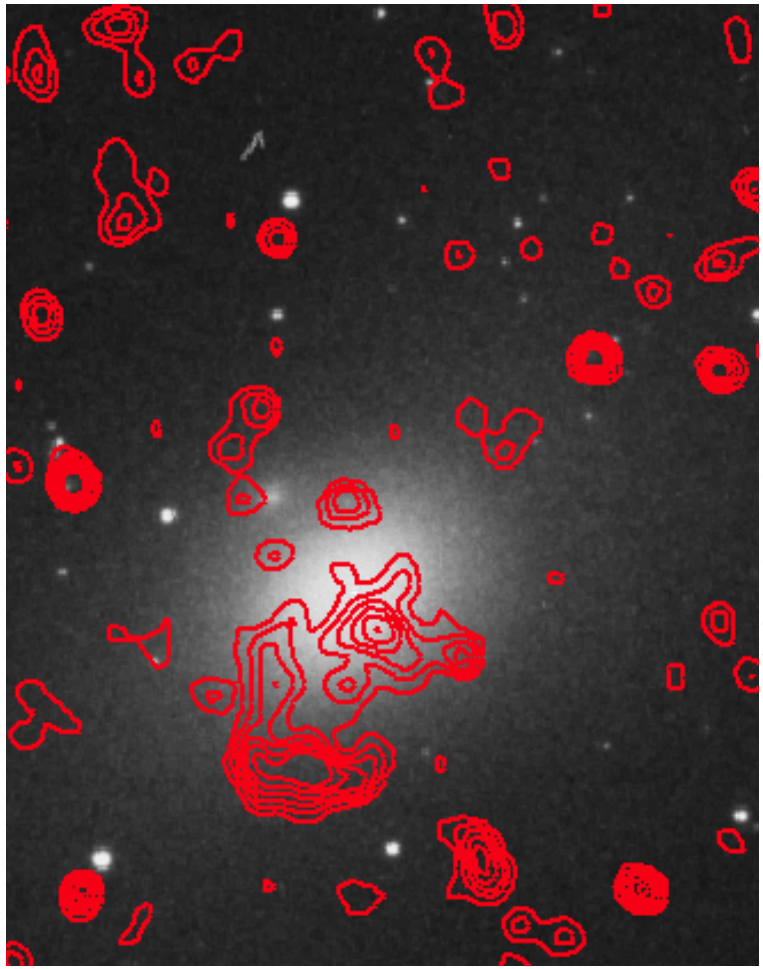
Interacting galaxy: NGC 4438-4435



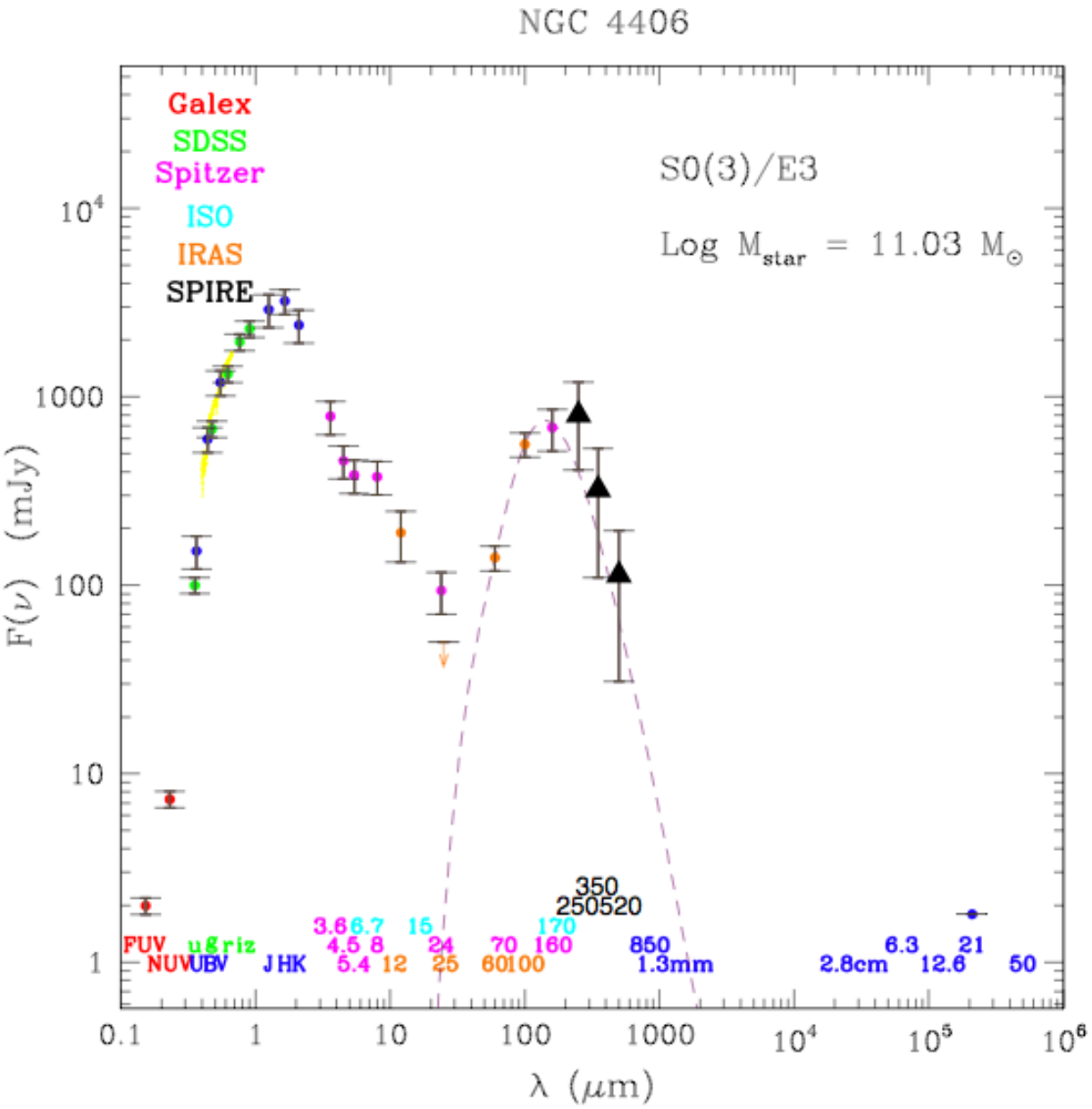
Cortese et al 2010



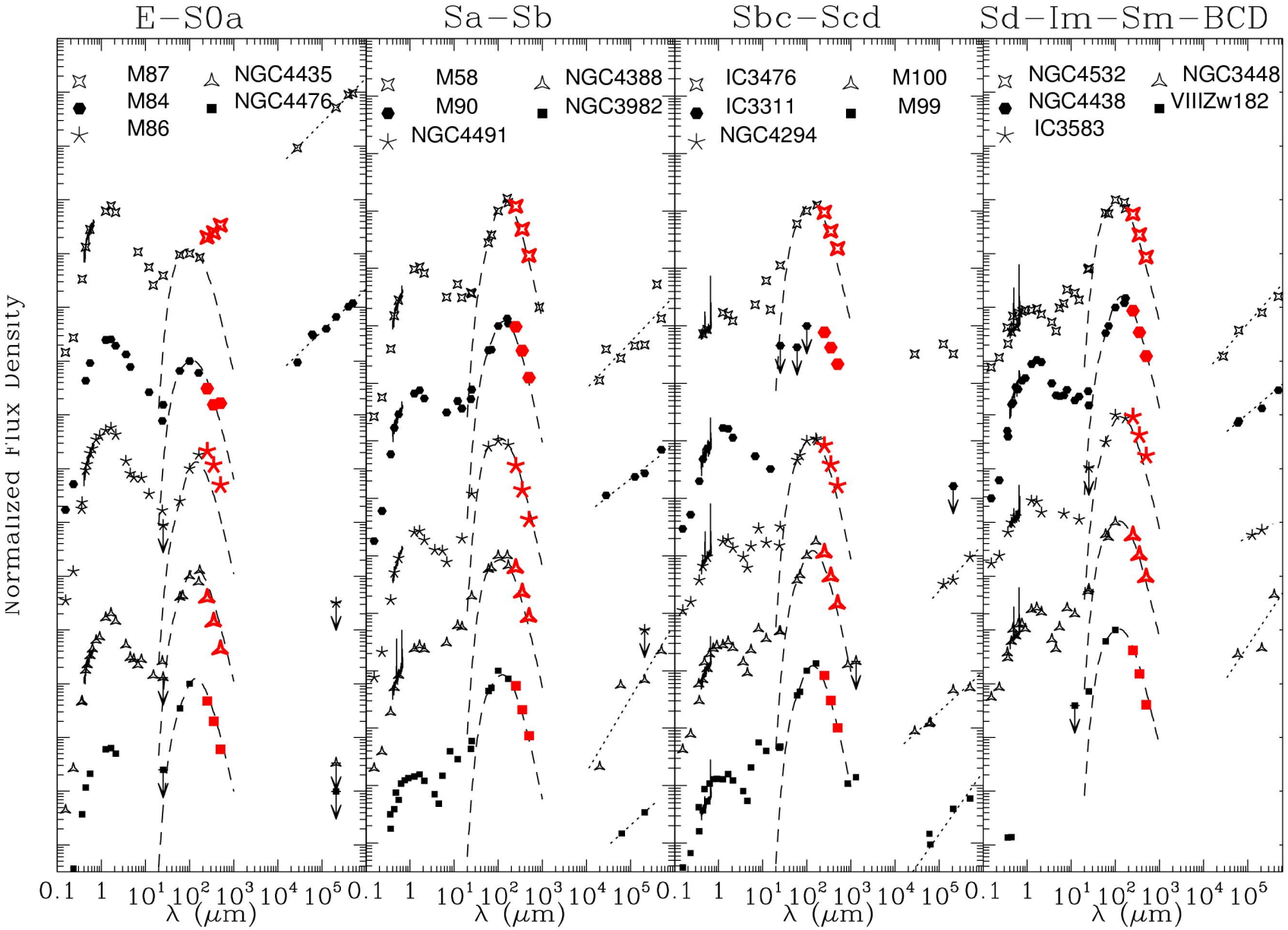
Elliptical galaxy: M86



Gomez et al 2010



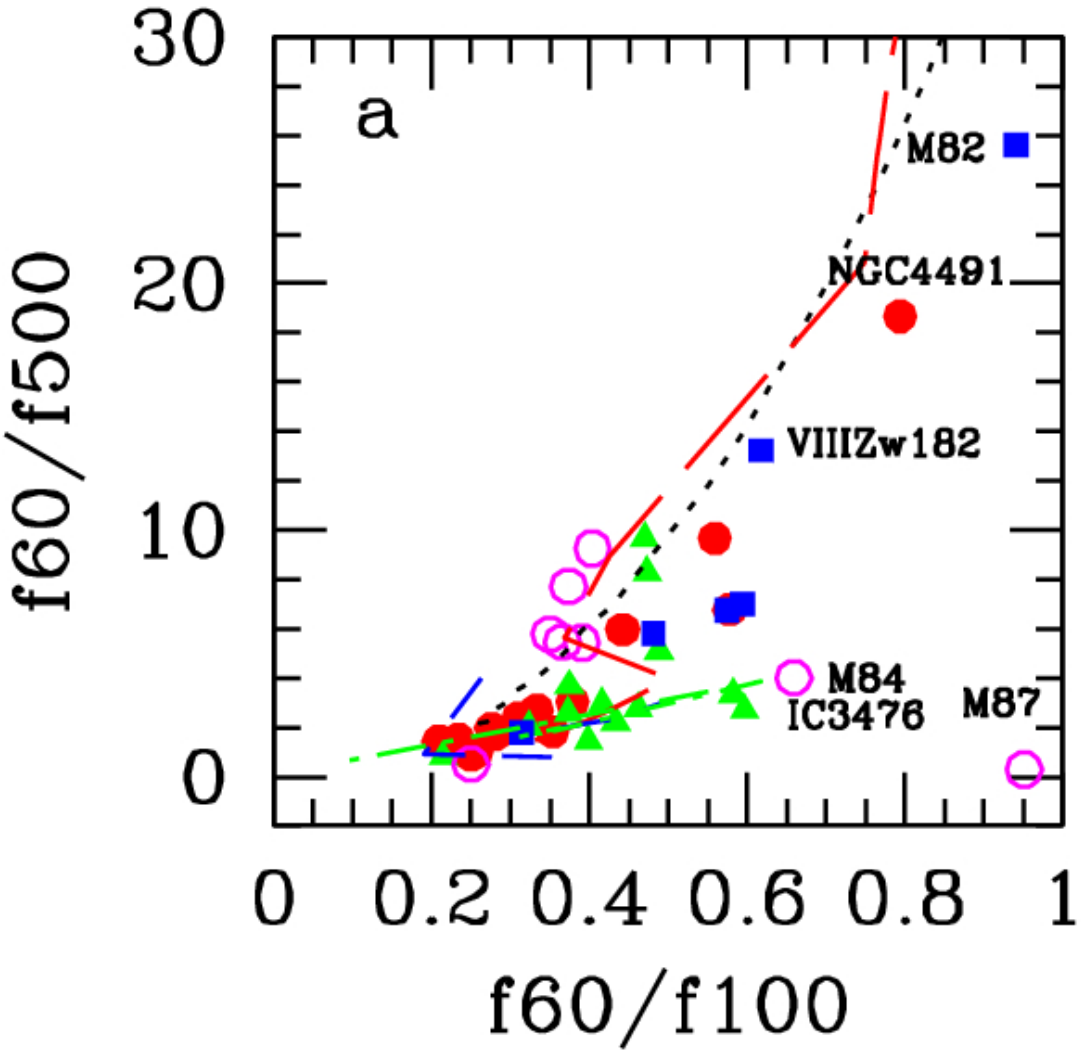
Combined SEDs



Boselli et al 2010b

RED = SPIRE data

Far-IR colour diagrams



Empirical models:

Black dotted line: Dale & Helou 2002

Red dashed line: Chary & Elbaz 2001

Blue dashed: Boselli et al 2003 (morphology dependent)

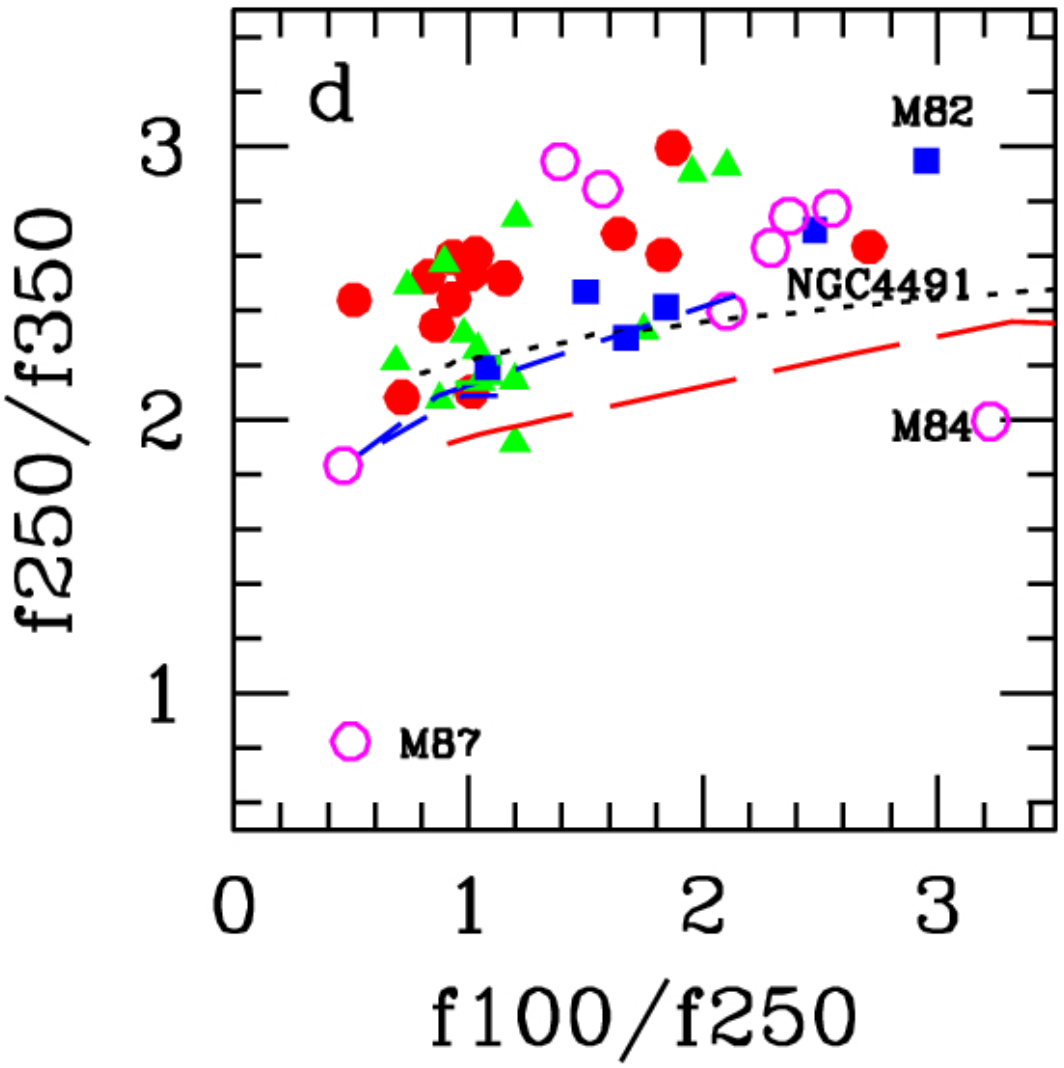
Green dotted-dashed: Boselli et al 2003 (luminosity dependent)

Data:

Magenta open circles: E-S0a
Red filled circles: Sa-Sb
Green triangles: Sbc-Scd
Blue squares: Sd, Im, BCD

Boselli et al 2010b

Far-IR colour diagrams



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Boselli et al 2010b

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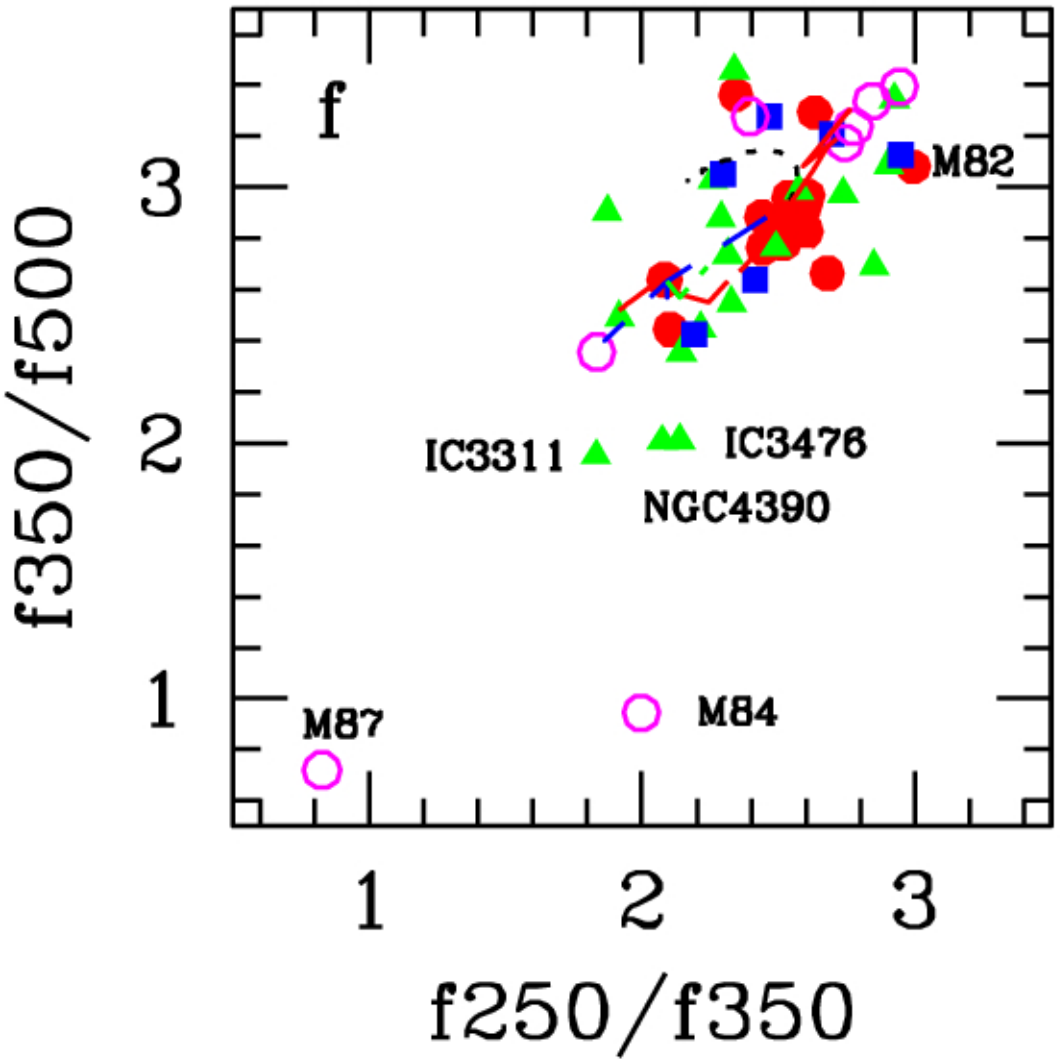

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Boselli et al 2010b

Interpretation

b = birthrate parameter

=

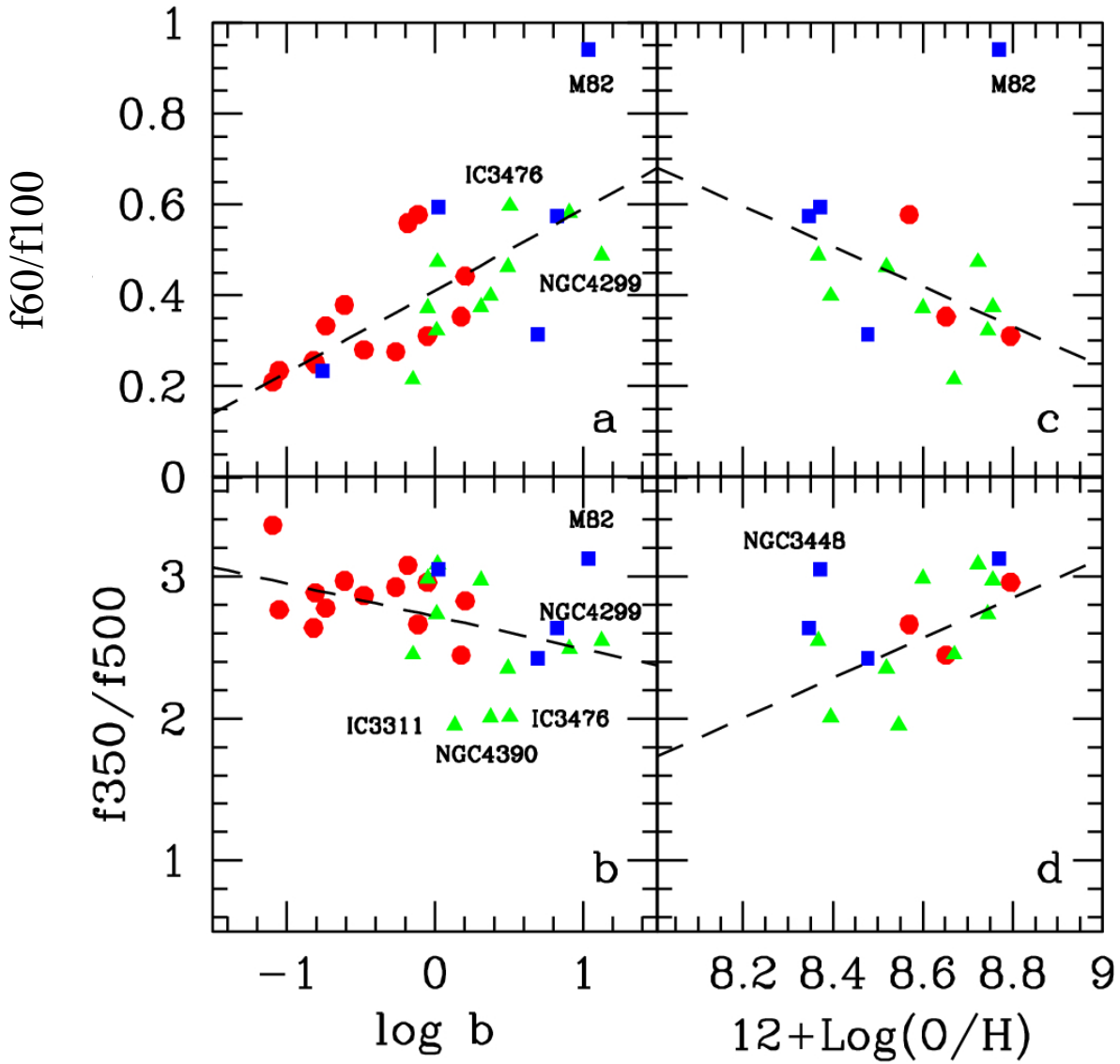
SFR/<SFR>

~

(Hα; UV)/NIR Lum

~

hardness of the UV radiation field/ stellar mass of the old galaxy population



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Boselli et al 2010b

Conclusions

The UV to radio continuum SEDs of nearby galaxies reveal:

a) f60/f500 is a powerful tracer of starburst activity

b) Normal galaxies show a gradual increase in their dust temperature along the Hubble sequence, from Sa to Sc-Im-BCD with the exception of E-S0a, where the dust temperature is higher than in star-forming systems probably because of the different nature of their dust heating sources.

c) SPIRE colours can be used to discriminate thermal from synchrotron emission in radio galaxies.

d) In contrast to the warm dust, the colour temperature f350/f500 index decreases with star formation activity and increases with metallicity.