

A high spatial resolution study of the extended emission in Seyfert Galaxies

The nuclear and extended infrared emission of the Seyfert galaxy NGC 2992 and the interacting system Arp 245

I. García-Bernetete, C. Ramos Almeida, J. A. Acosta-Pulido, et al., 2015,
MNRAS, 449, 1309



EWASS 2015, La Laguna (Spain)

ULL | Universidad
de La Laguna

The central engines AGN

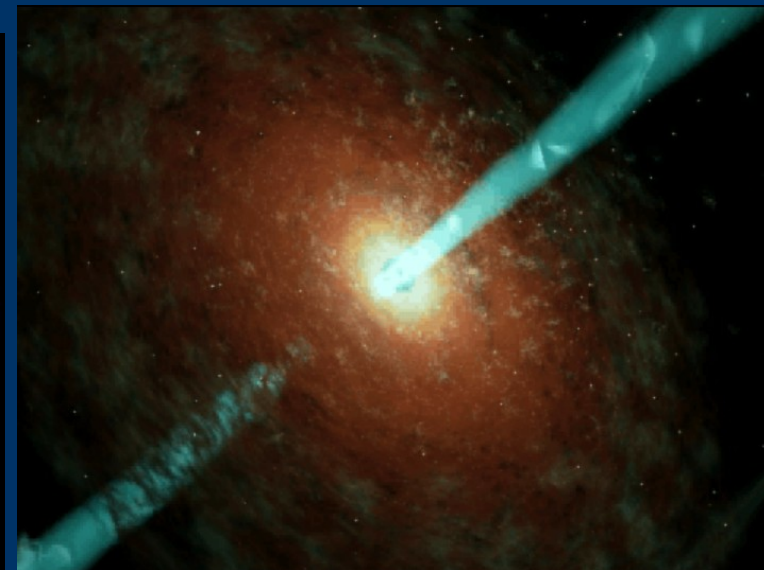
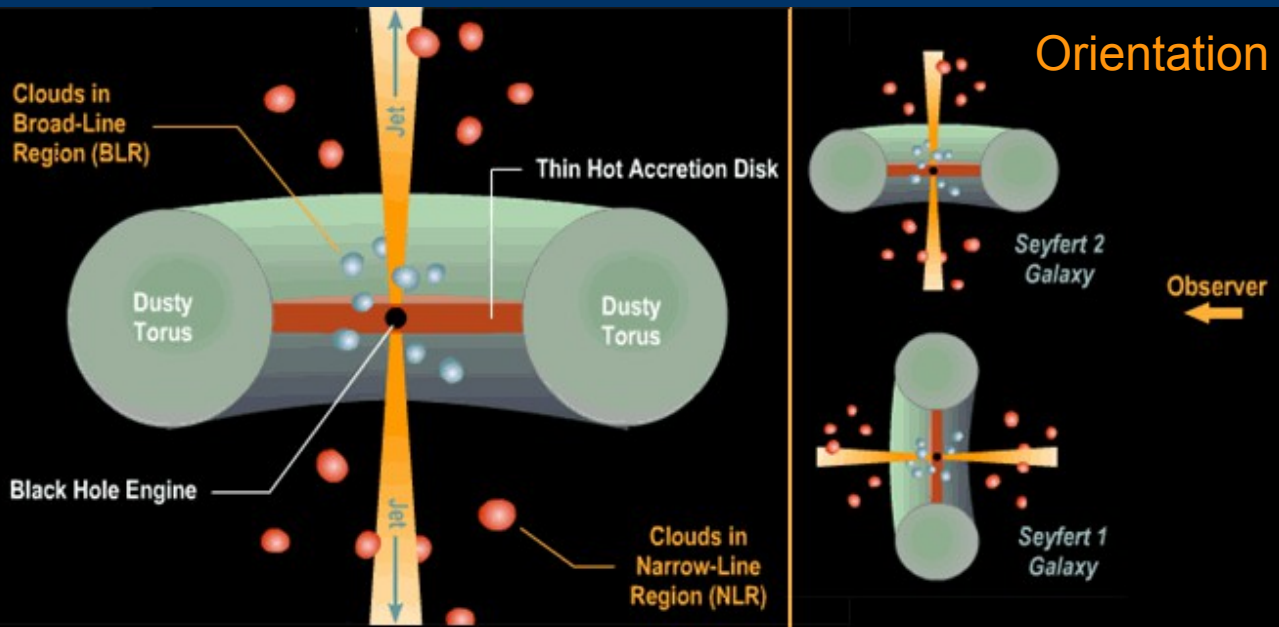
- Unified Model (Antonucci 1993)

The AGN type depends on orientation

- Seyfert torus size \sim few pc

(Tristram et al. 2009; Burstcher et al. 2013)

- The torus absorbs the intrinsic AGN radiation and re-emits it in the IR, peaking in the MIR



Credit: W. Steffen (UNAM)

The central engines AGN

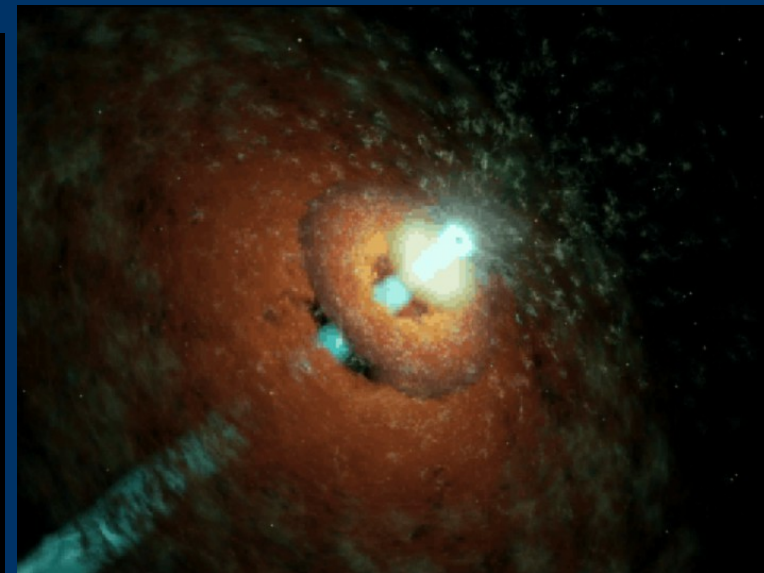
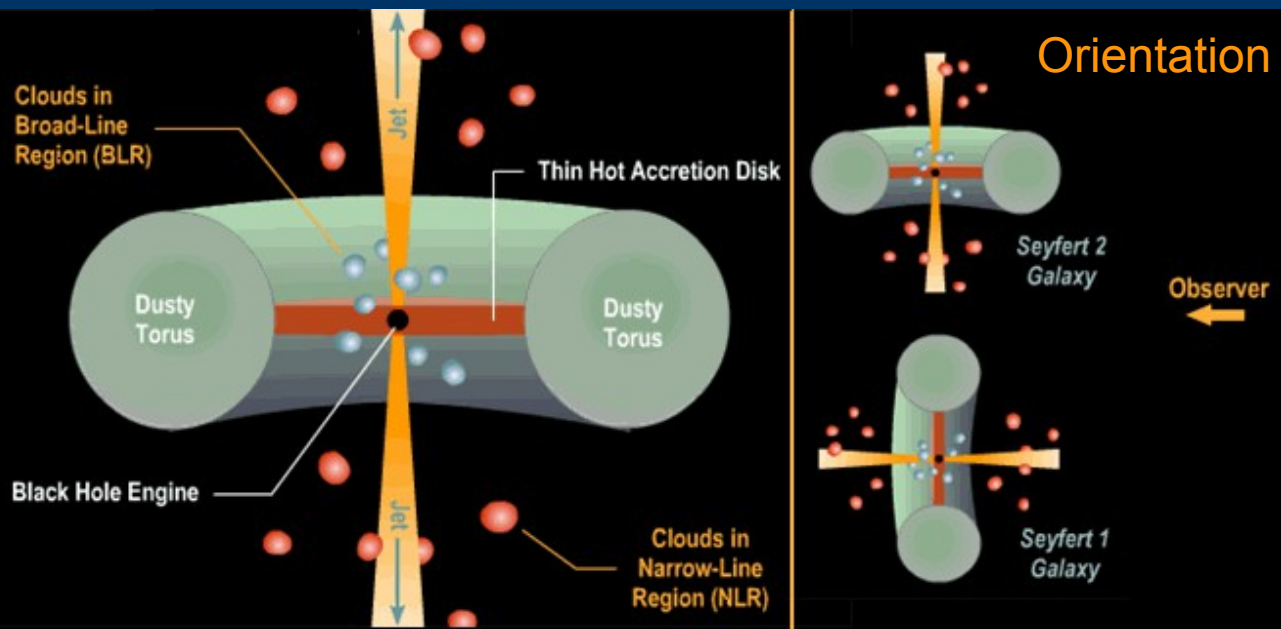
- Unified Model (Antonucci 1993)

The AGN type depends on orientation

- Seyfert torus size \sim few pc

(Tristram et al. 2009; Burstcher et al. 2013)

- The torus absorbs the intrinsic AGN radiation and re-emits it in the IR, peaking in the MIR



Credit: W. Steffen (UNAM)

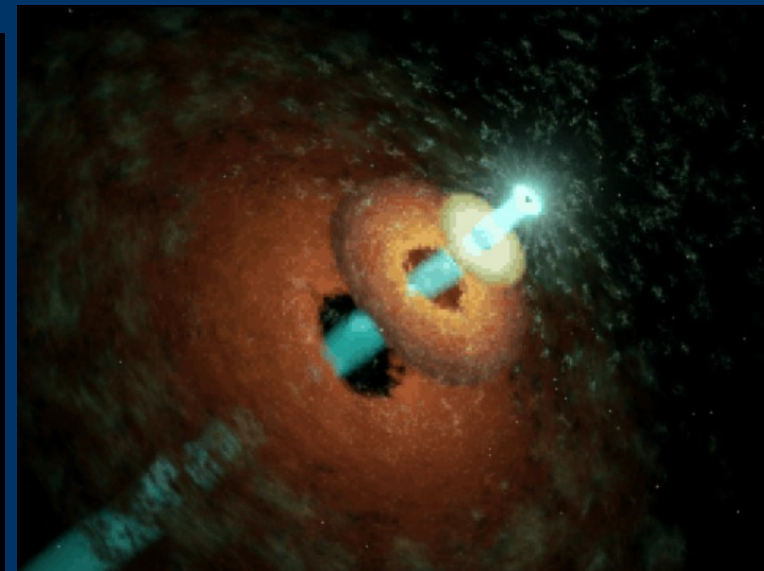
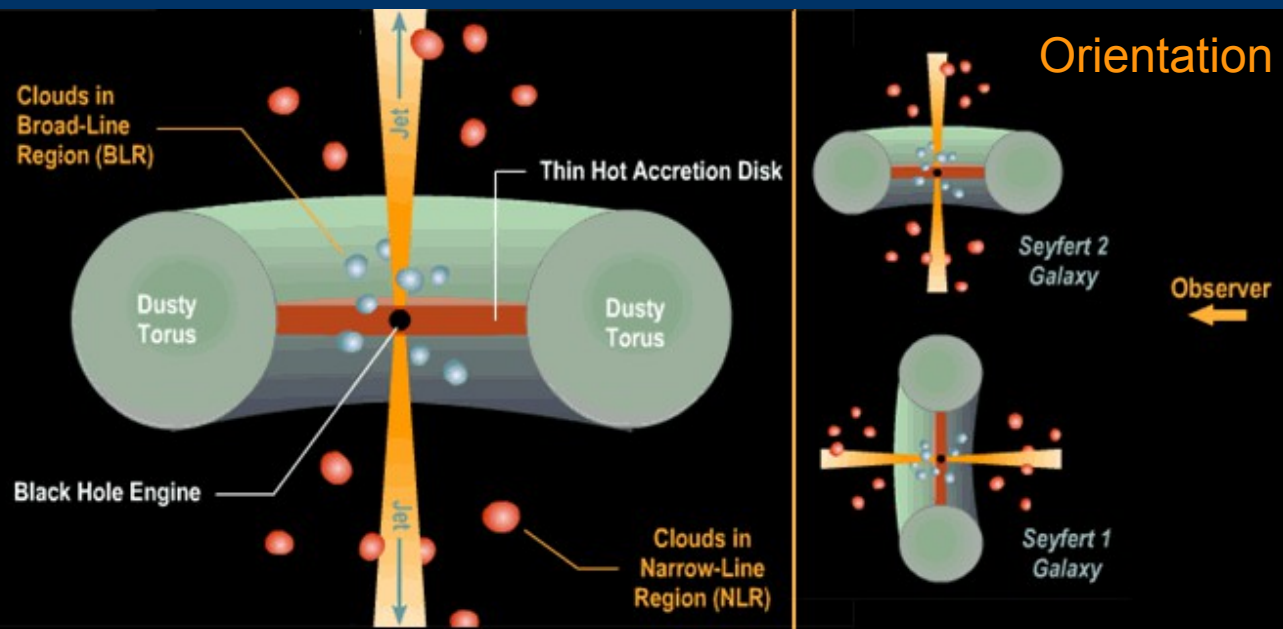
The central engines AGN



- Unified Model (Antonucci 1993)

The AGN type depends on orientation

- Seyfert torus size \sim few pc
(Tristram et al. 2009; Burstcher et al. 2013)
- The torus absorbs the intrinsic AGN radiation and re-emits it in the IR, peaking in the MIR



Credit: W. Steffen (UNAM)

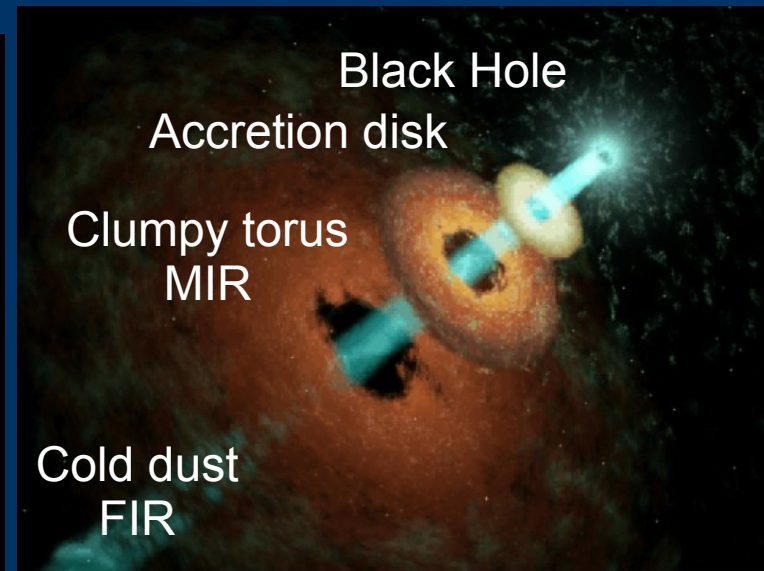
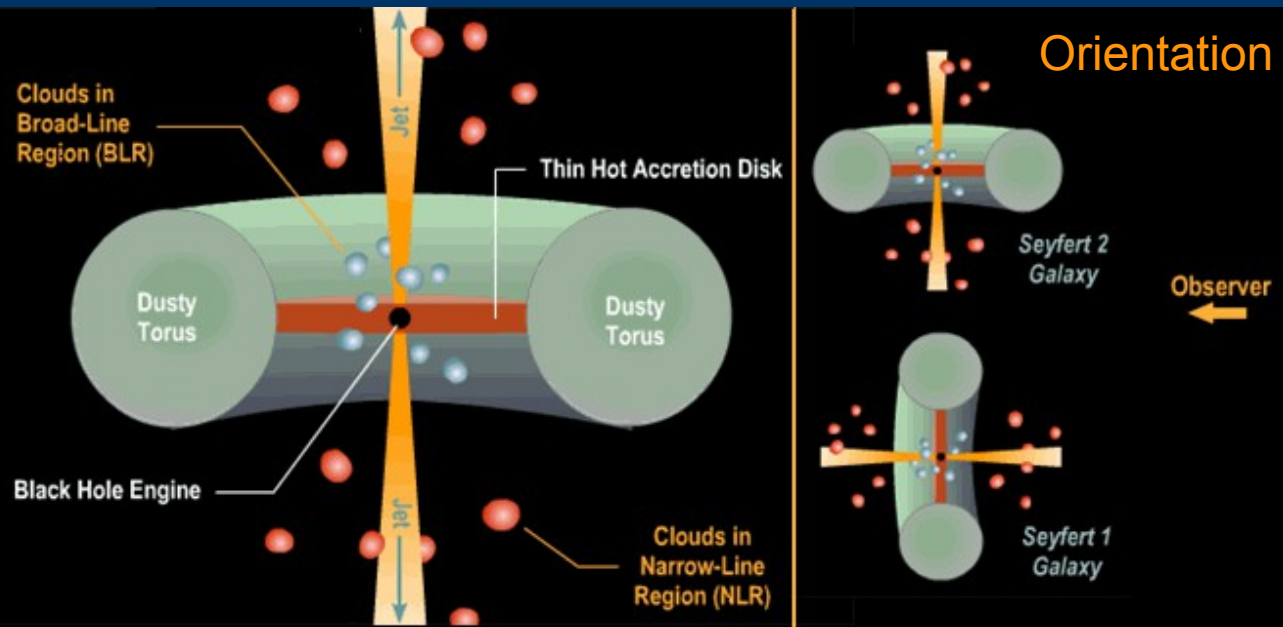
The central engines AGN



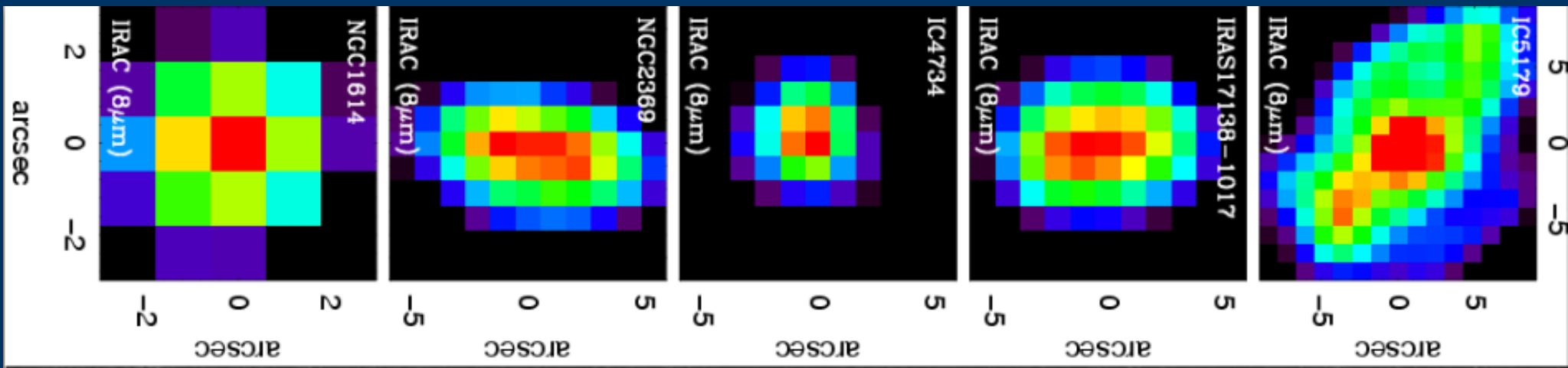
- Unified Model (Antonucci 1993)

The AGN type depends on orientation

- Seyfert torus size ~ few pc
(Tristram et al. 2009; Burstcher et al. 2013)
- The torus absorbs the intrinsic AGN radiation and re-emits it in the IR, peaking in the MIR

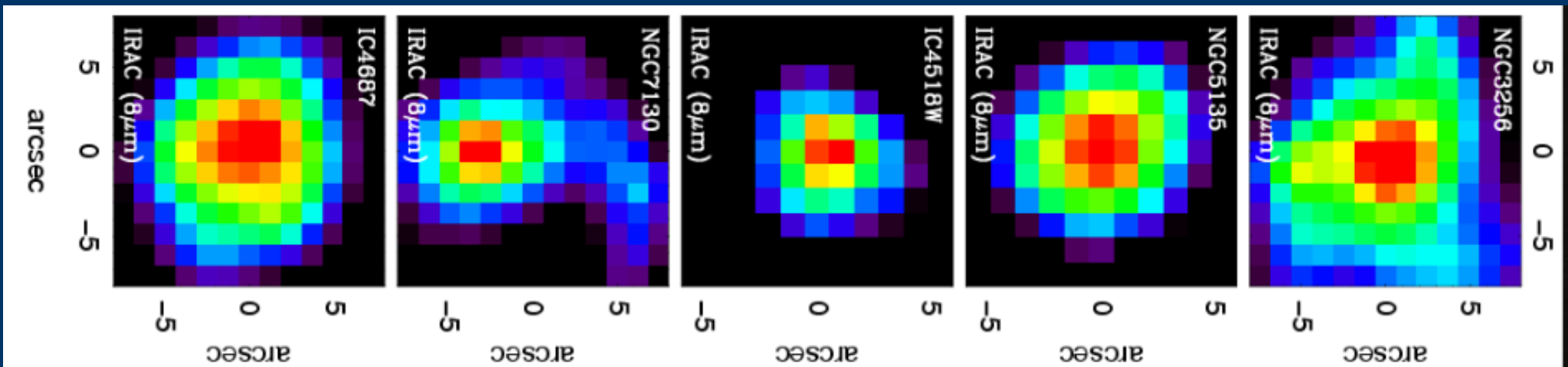


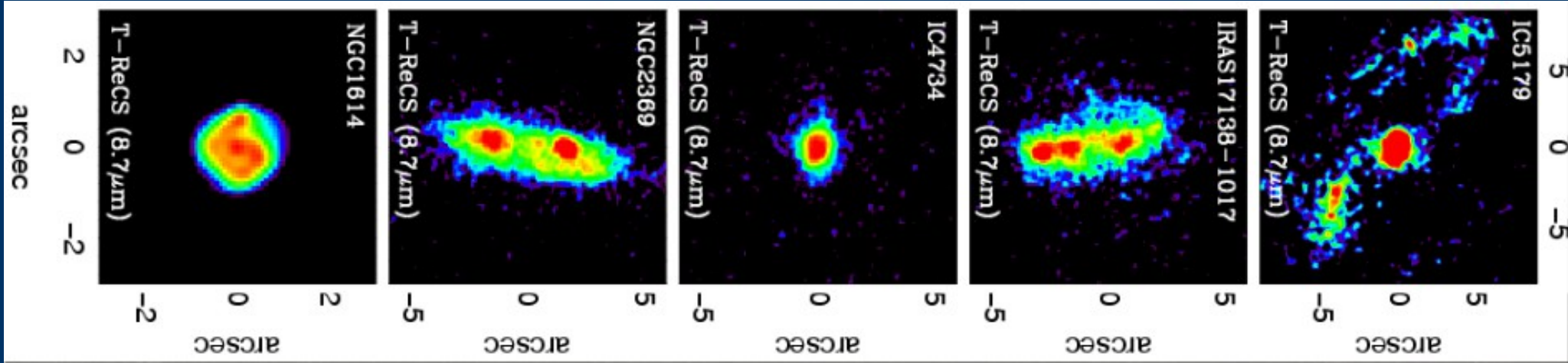
Credit: W. Steffen (UNAM)



Mid-IR imaging: space (Spitzer/IRAC) vs. ground (Gemini/T-ReCS) observations

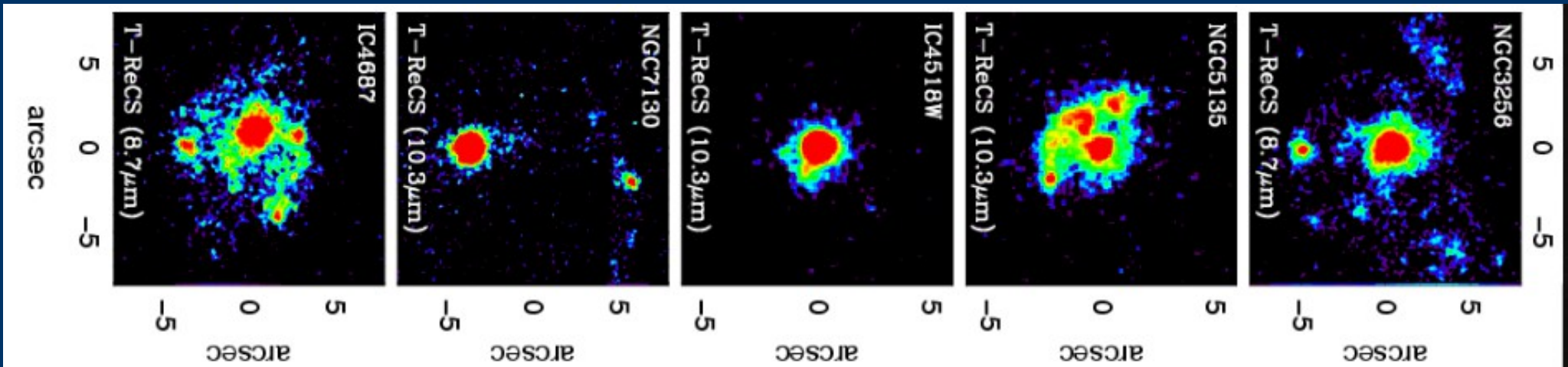
Díaz-Santos (2009, PhD)





Mid-IR imaging: space (Spitzer/IRAC) vs. ground (Gemini/T-ReCS) observations

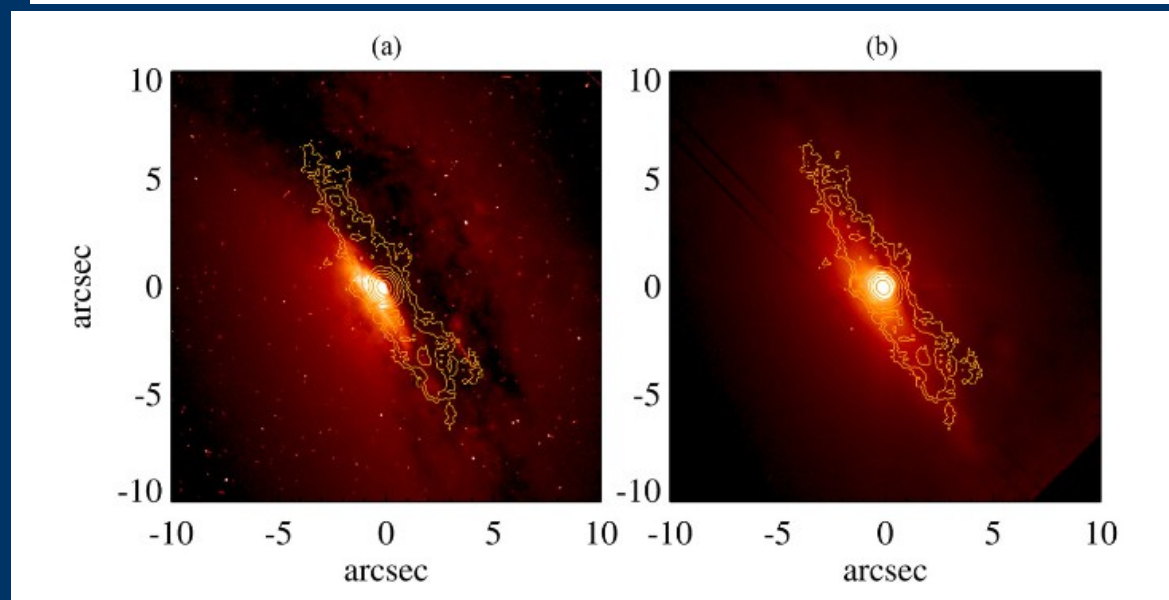
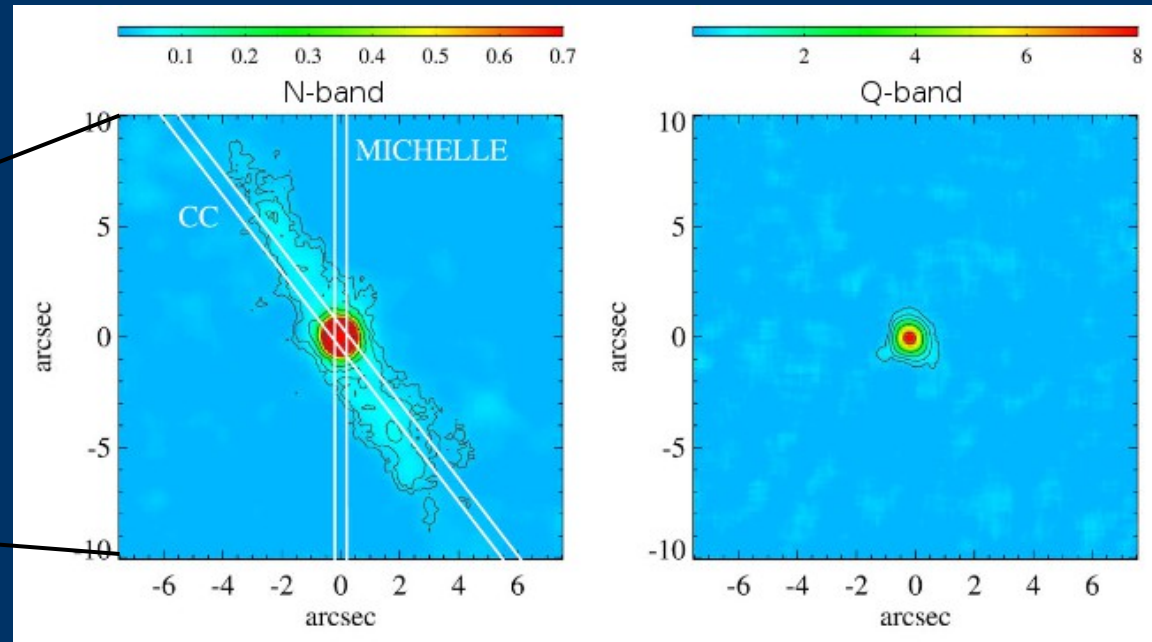
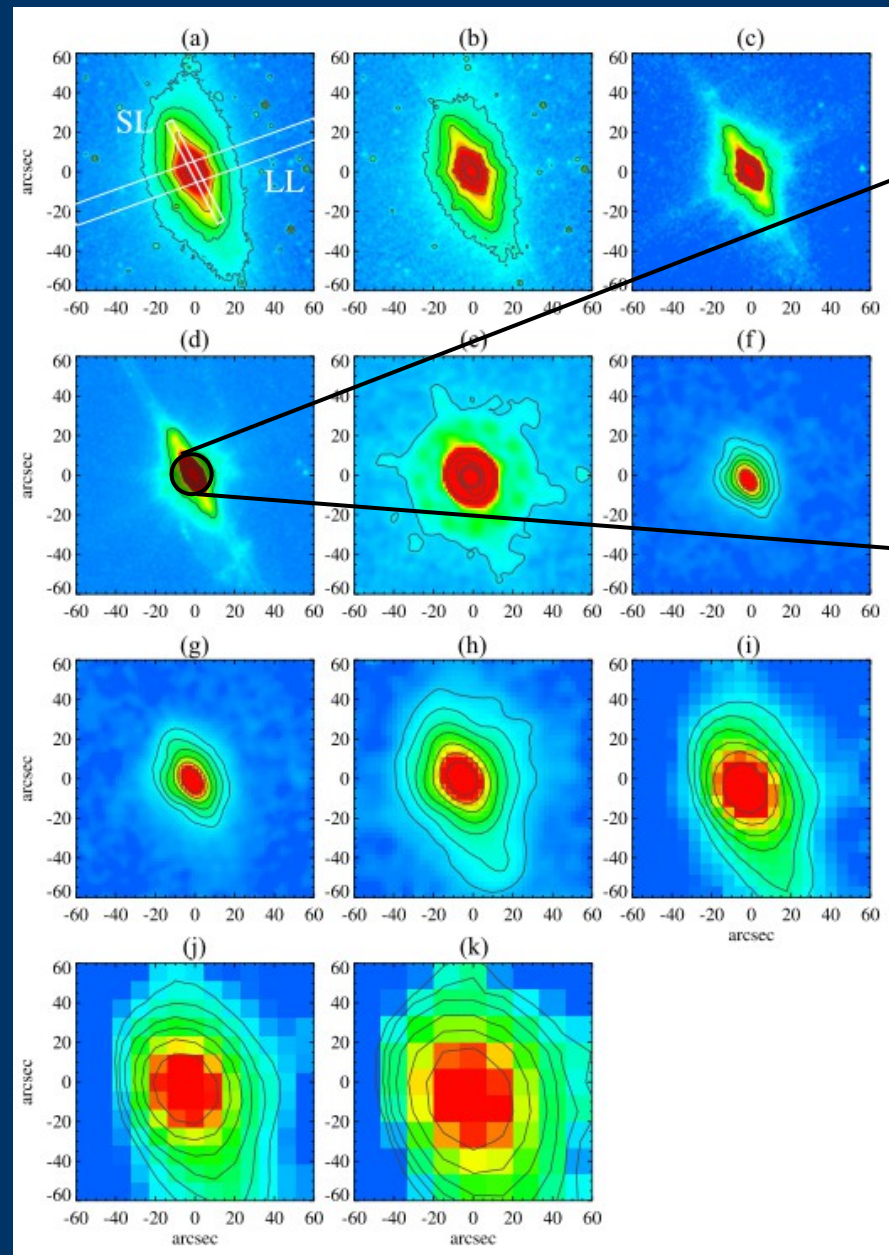
Díaz-Santos (2009, PhD)



The infrared emission of the Seyfert 2 galaxy NGC 2992

Spitzer and Herschel

Gemini and Hubble

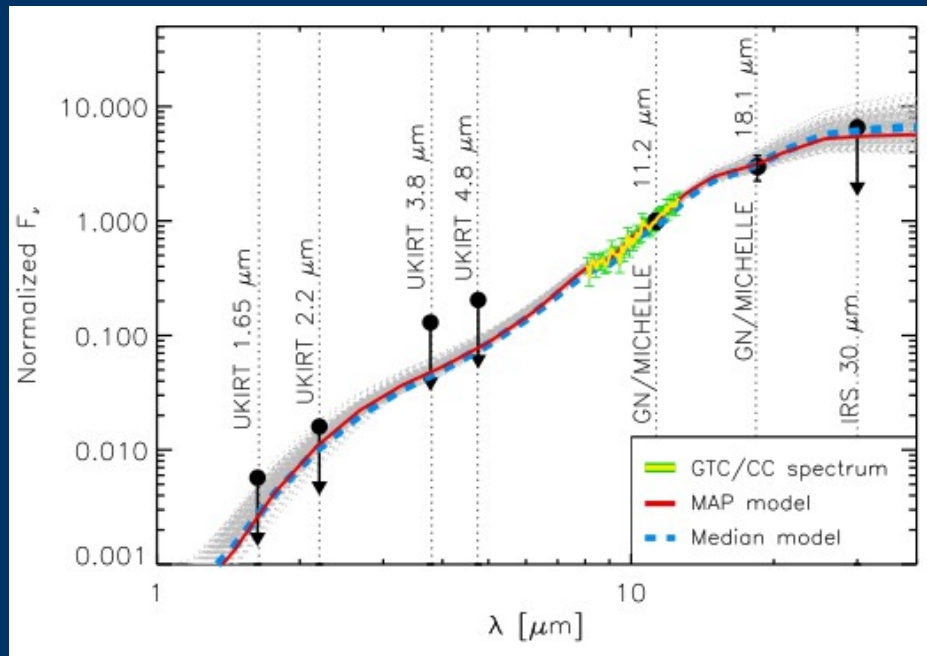


NGC 2992: infrared photometry

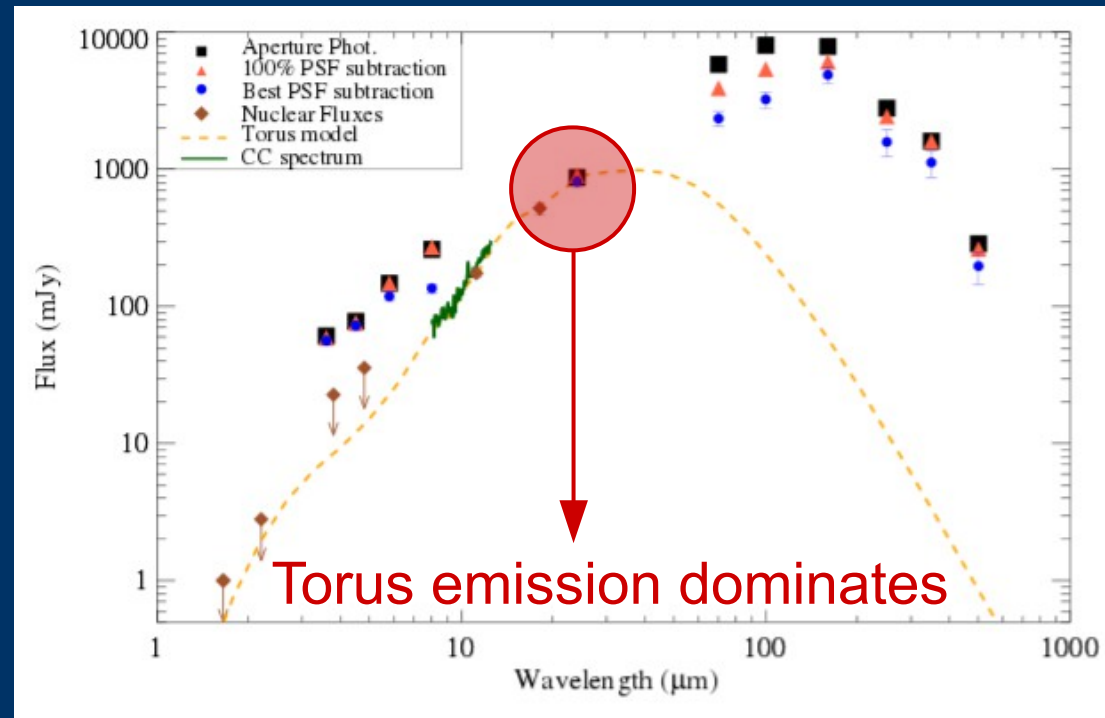
Recovering nuclear information from low angular resolution data

Nuclear IR SED modelling with clumpy torus models

- Different methods to try to recover the nuclear information from arcsecond resolution data:



Apert. Photometry & Scaled PSF subtraction.

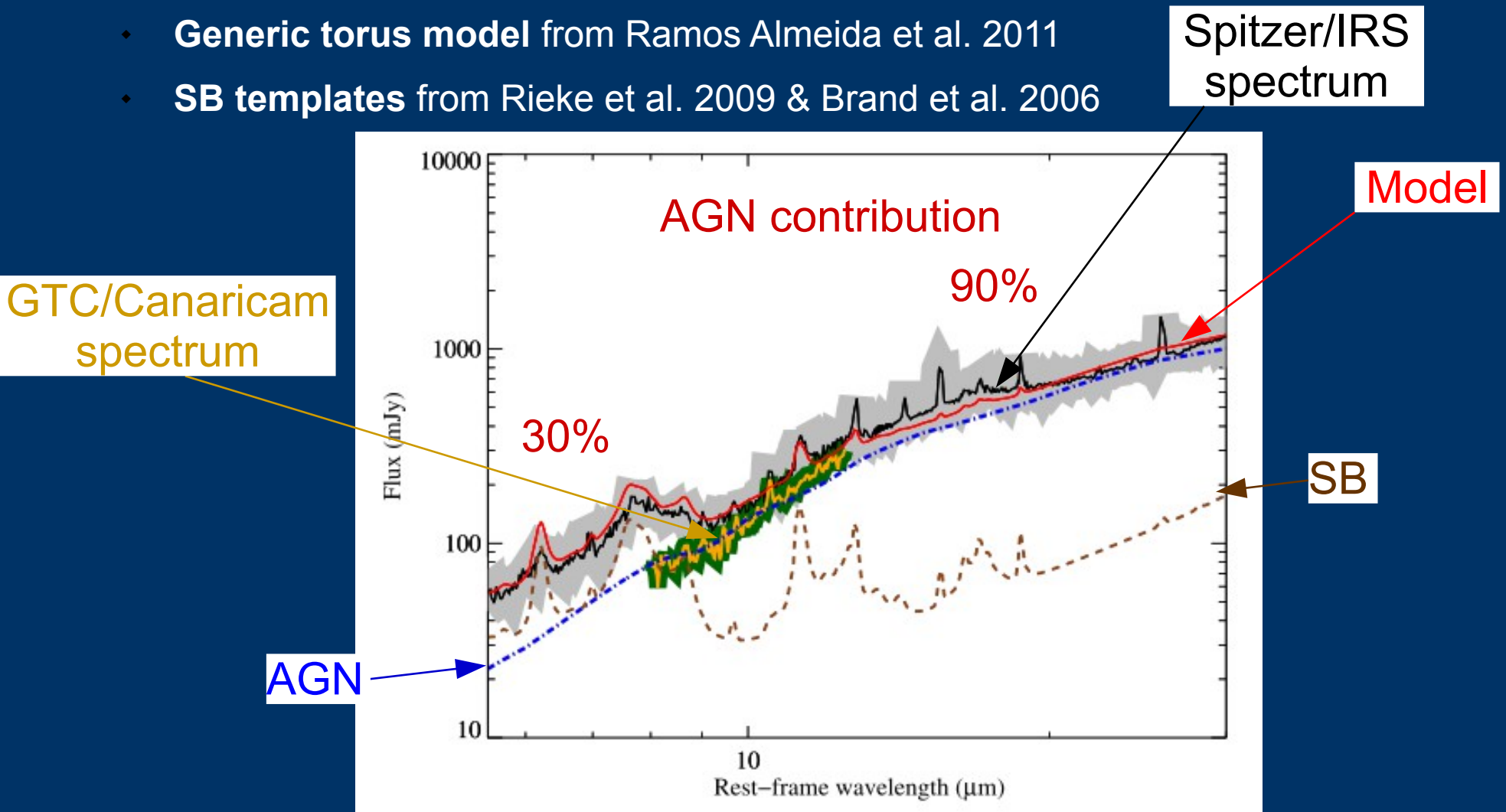


NGC 2992: spectral decomposition of Spitzer spectrum

Recovering nuclear information from low angular resolution data

Decomposition (AGN + SB):

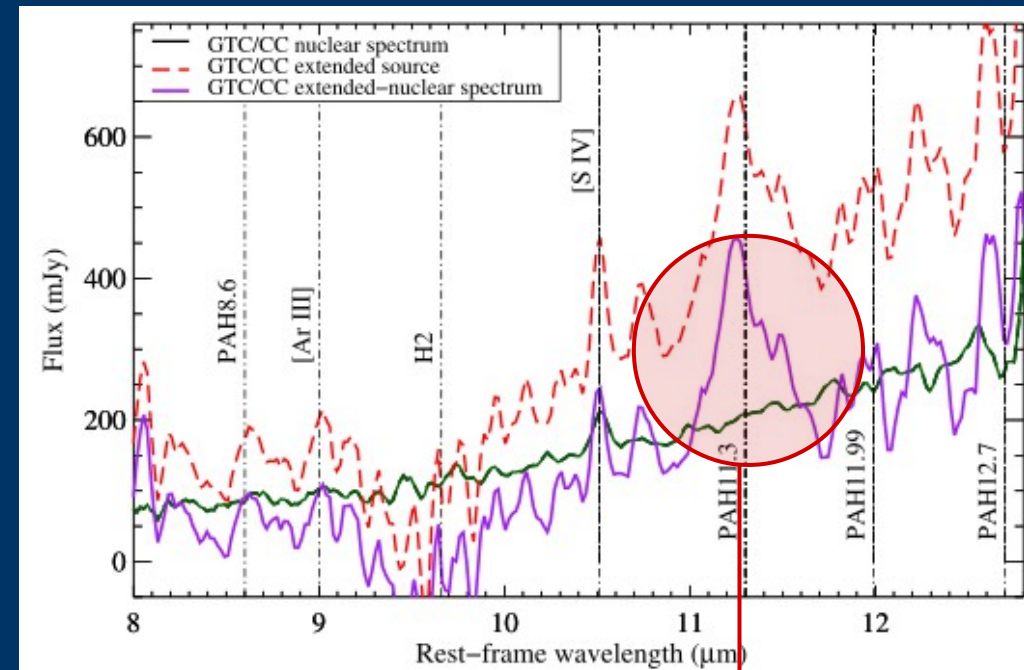
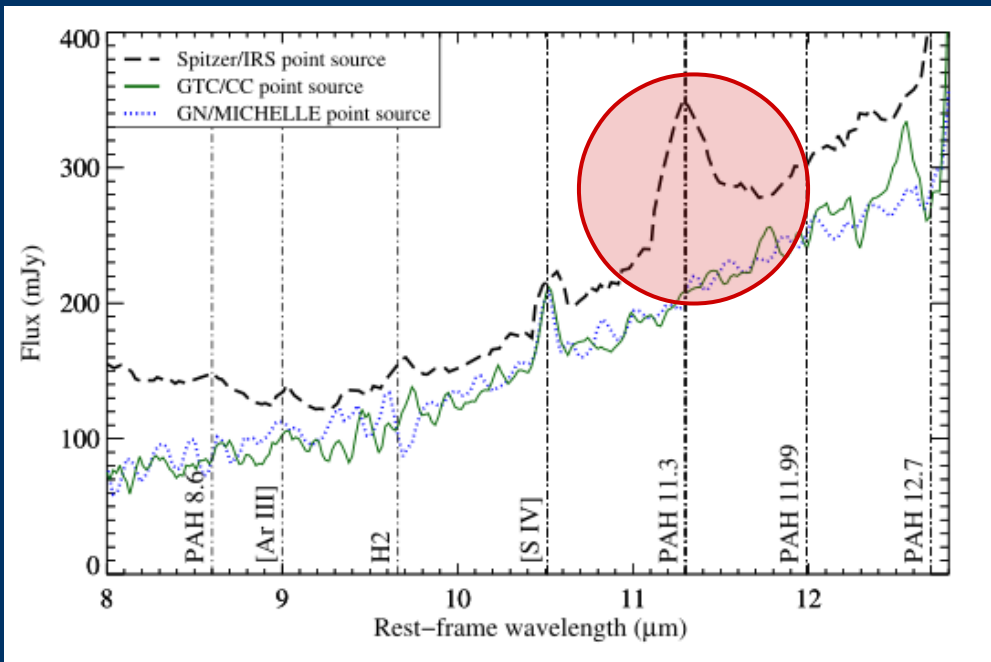
- **Generic torus model** from Ramos Almeida et al. 2011
- **SB templates** from Rieke et al. 2009 & Brand et al. 2006



AGN emission dominates at $\sim 20\text{-}30$ micron !

GTC/CanariCam MIR spectra of NGC 2992

- ◆ Nuclear spectra (~ 60 pc)
 - ◆ No SF or PAH features diluted by the AGN continuum.
- ◆ Extended emission spectra (~ 900 pc)
 - ◆ PAH features!!

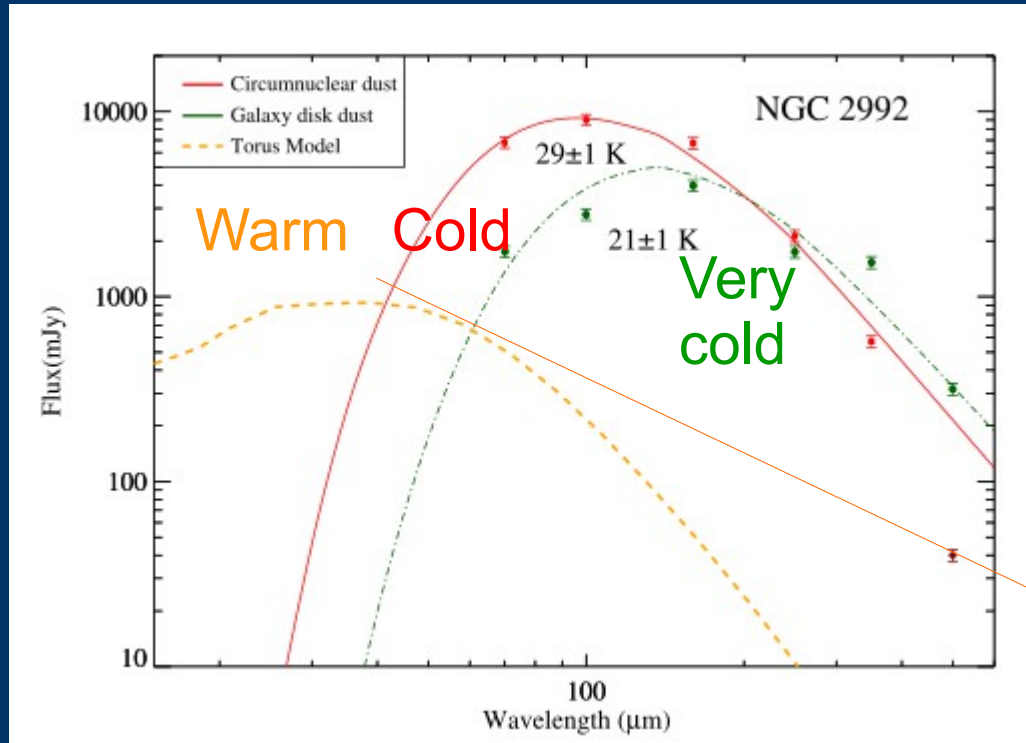


Size of the region probed by Spitzer/IRS ~ 640 pc

Dust heated by SF

Arp 245 interacting system

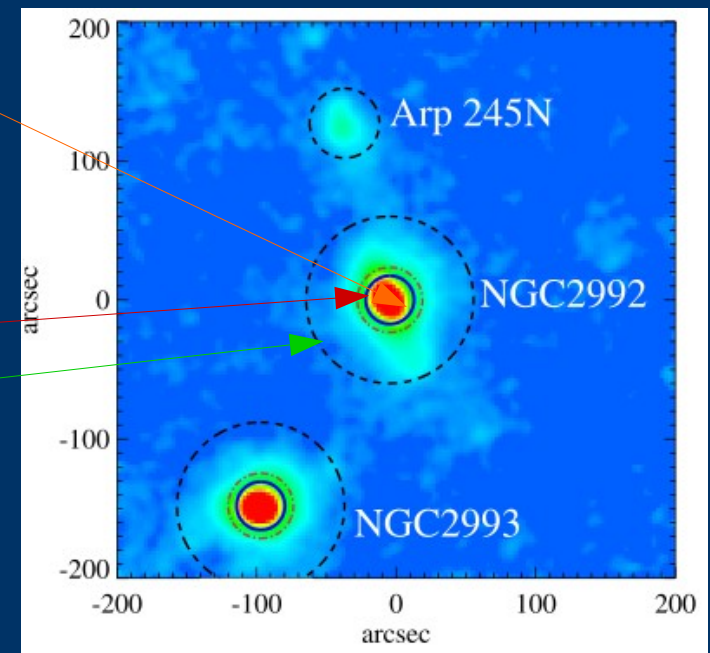
Physical parameters of the circumnuclear dust emission derived from Spitzer and Herschel data



	Temperature (K)	M_{dust} ($10^6 M_{\odot}$)	SFR ($M_{\odot} \text{ yr}^{-1}$)
NGC 2992 (a)	29 ± 1	7.6 ± 1.3	2.5 ± 0.4
NGC 2992 (b)	21 ± 1	19.6 ± 2.7	0.7 ± 0.1
NGC 2993 (a)	33 ± 1	4.7 ± 0.8	3.7 ± 0.6
NGC 2993 (b)	22 ± 1	14.9 ± 2.0	0.8 ± 0.1
Arp 245N	19 ± 1	3.2 ± 1.1	~ 0.03

(a) Circumnuclear dust

(b) Galaxy disk dust



Very similar dust masses, temperatures and SFRs for NGC 2992/2993

Conclusions

- We reproduced the nuclear IR SED of NGC 2992 with clumpy torus models and derived its torus properties.
- We recovered the nuclear emission from low angular resolution data:
 - Photometry: nuclear fluxes in the range $\sim 20-30$, where the torus emission dominates.
 - Spectroscopy: flux and spectral shape.
 - The torus emission dominates at $\sim 20-30$.
- The GTC/CanariCam nuclear spectrum reveals NO/DILUTED PAH emission in the central ~ 60 pc of NGC 2992.
- Dust emission properties of Arp 245 system using dust models
 - We derived very similar dust masses, temperatures and SFRs for both spiral galaxies.

I. García-Bernete, C. Ramos Almeida, J. A. Acosta-Pulido, et al., 2015, MNRAS, 449, 1309

Conclusions

- We reproduced the nuclear IR SED of NGC 2992 with clumpy torus models and derived its torus properties.
- We recovered the nuclear emission from low angular resolution data:
 - Photometry: nuclear fluxes in the range $\sim 20-30$, where the torus emission dominates.
 - Spectroscopy: flux and spectral shape.
 - The torus emission dominates at $\sim 20-30$.
- The GTC/CanariCam nuclear spectrum reveals NO/DILUTED PAH emission in the central ~ 60 pc of NGC 2992.
- Dust emission properties of Arp 245 system using dust models
 - We derived very similar dust masses, temperatures and SFRs for both spiral galaxies.

I. García-Bernete, C. Ramos Almeida, J. A. Acosta-Pulido, et al., 2015, MNRAS, 449, 1309

Thank you!

Email: igarcia@iac.es