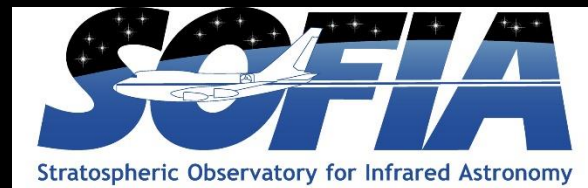


Mapping PAH sizes in NGC 7023 with SOFIA

By Bavo Croiset
Supervisors: A.G.G.M. Tielens,
O. Berné,
A. Candian



Overview

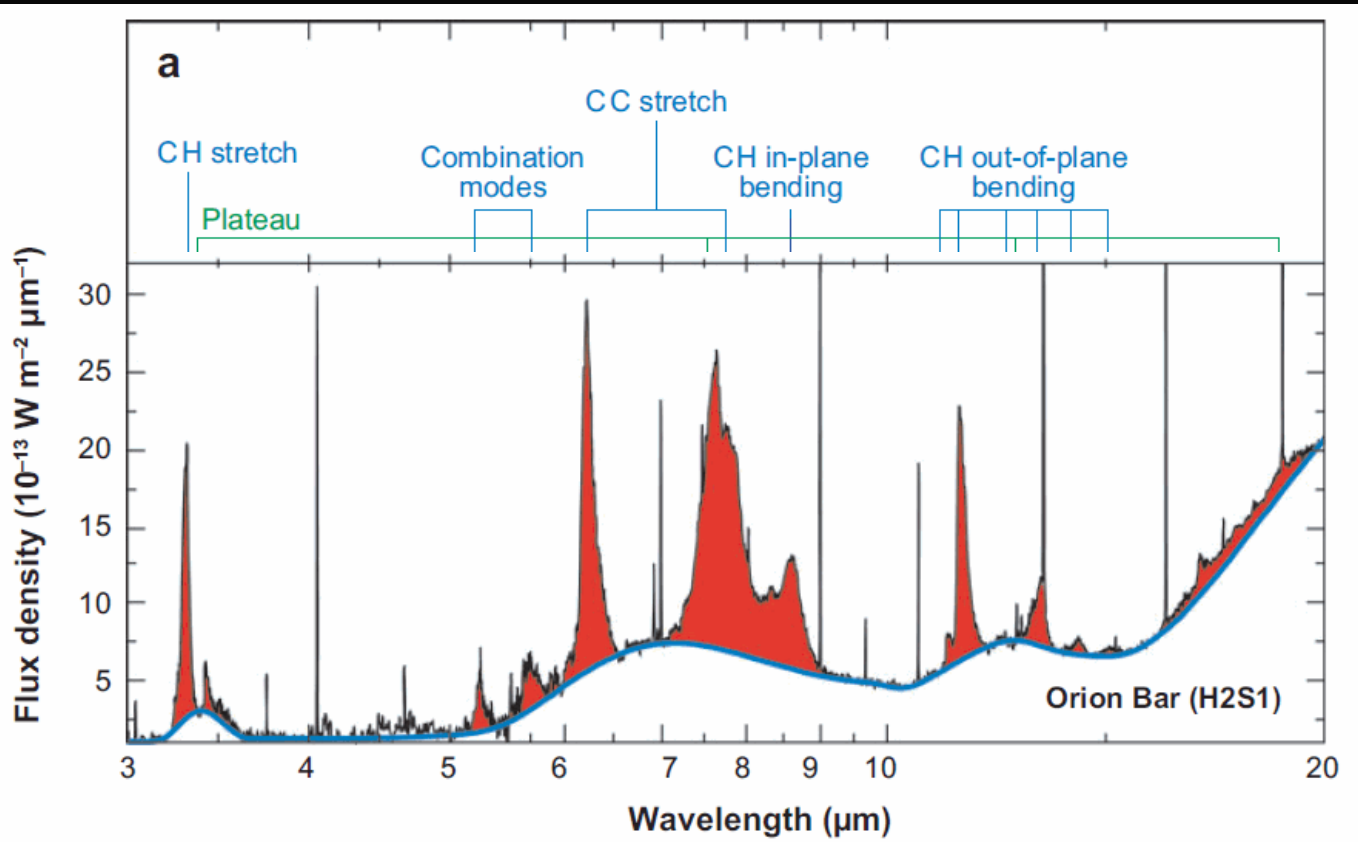
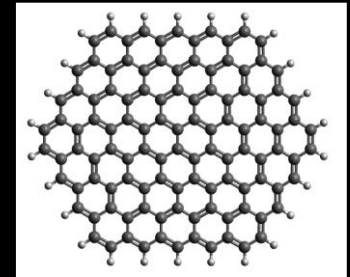
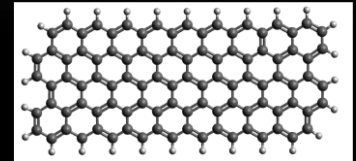
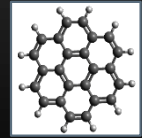
- Introduction
- NGC 7023
- Instruments
- Images
- PAH size emission model



Croiset et al., 2016 , A&A, 590, A26

PAH emission

- Polycyclic Aromatic Hydrocarbon



Tielens (2008)

PAH emission

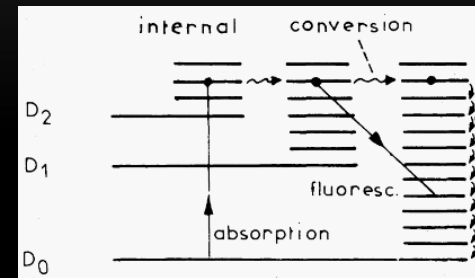
“11.2/3.3 μm proportional to PAH size”

- Absorption UV
- Vibrational emission
- Typical vibrational modes:
 - C-H 3.3 μm , neutral
 - C-H 8.6 μm , ionized
 - C-H 11.2 μm ,

(stretch)

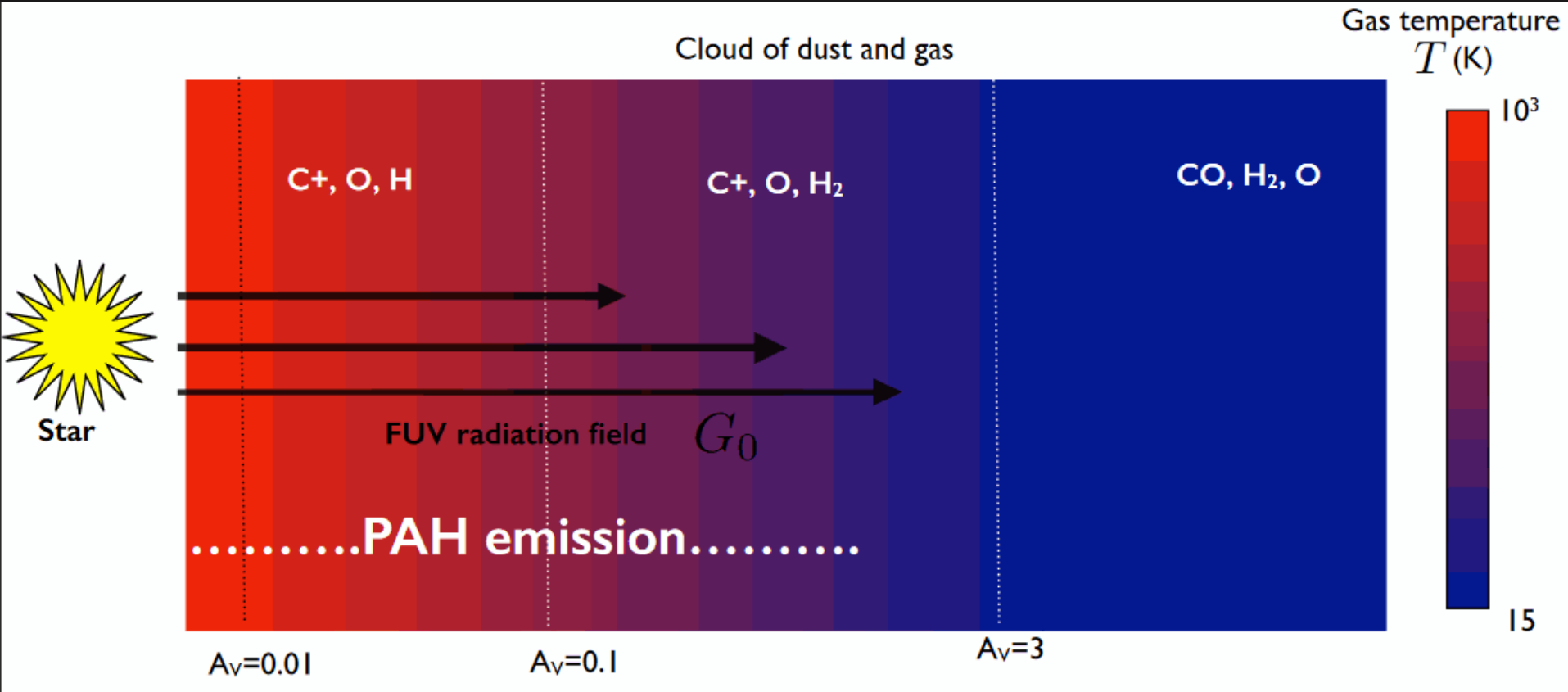
(in plane bending)

(out of plane bending)



Leger, d'Hendecourt, Defourneau (1989)

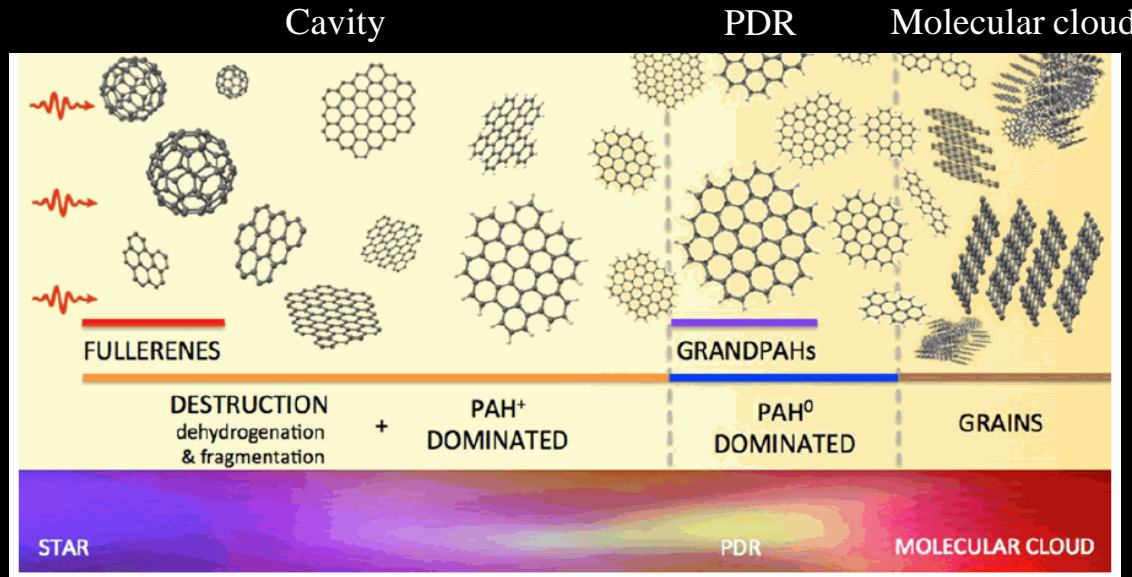
Photo Dissociation Region



Tielens & Hollenbach (1985)

Photo Dissociation Region

unstable VSG evaporate → compact PAH at PDR surface
→ PAH broken down



Andrews et al., (2015)

NGC 7023 (Iris nebula)

- Reflection Nebula
- Distance: 320 pc
- Herbig Be Star system



Hubble NGC 7023 North PDR (1995)

NGC 7023 (Iris nebula)

“H₂ 2.12 μm traces the PDR surface”



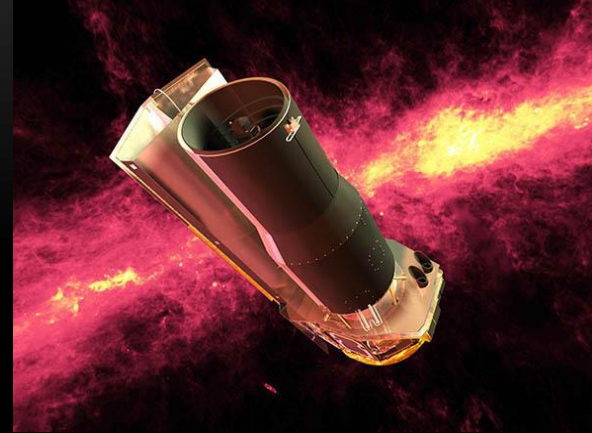
Hubble NGC 7023 (1995) & CFHT 2.12 μm

Instruments



NASA SOFIA

- FLITECAM: $3.3 \mu\text{m}$
- FORCAST: $11.2 \mu\text{m}$



NASA SPITZER

- IRAC $8.0 \mu\text{m}$



CFHT

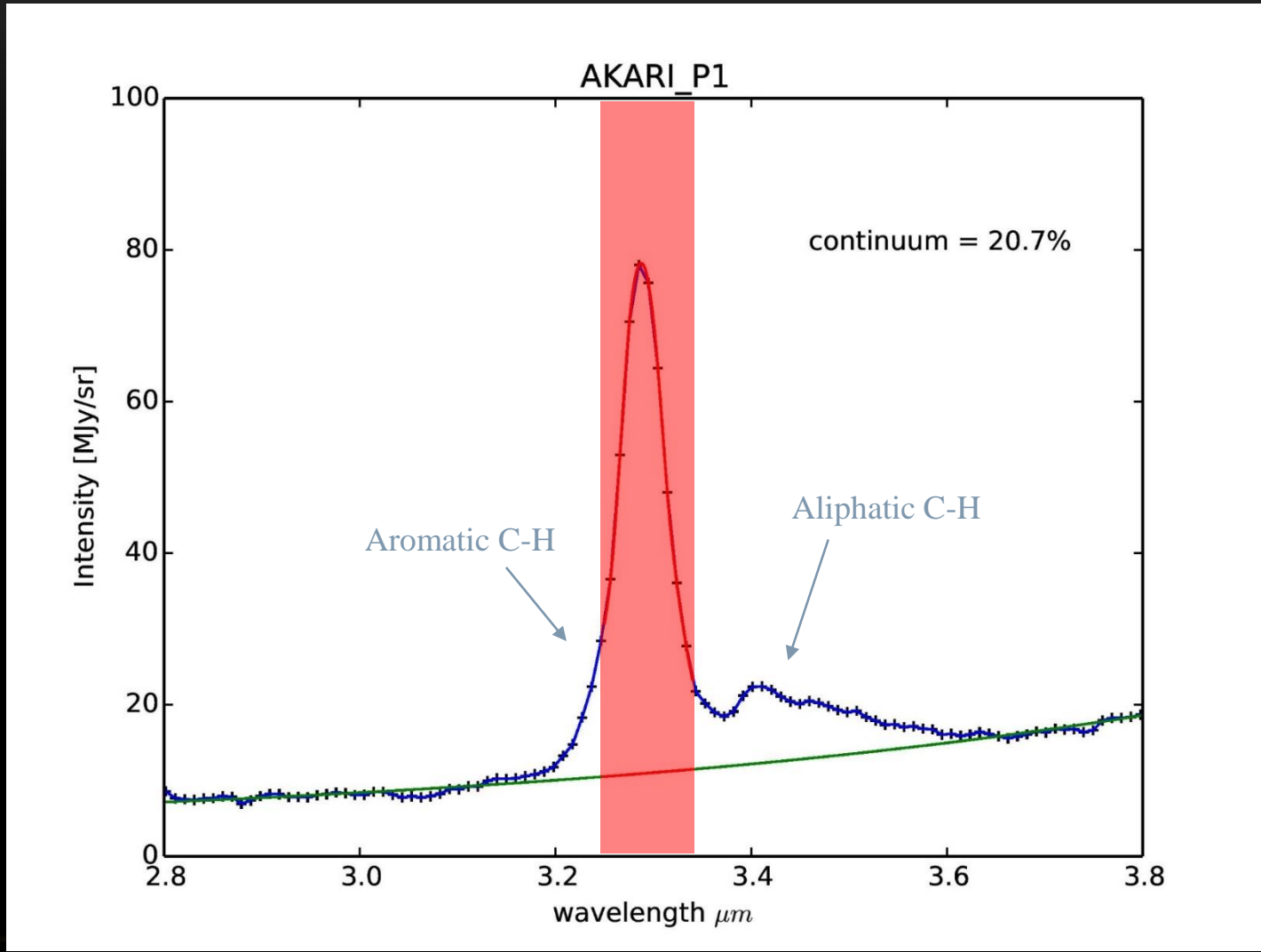
- MIDAS: $2.12 \mu\text{m}$



NASA HST

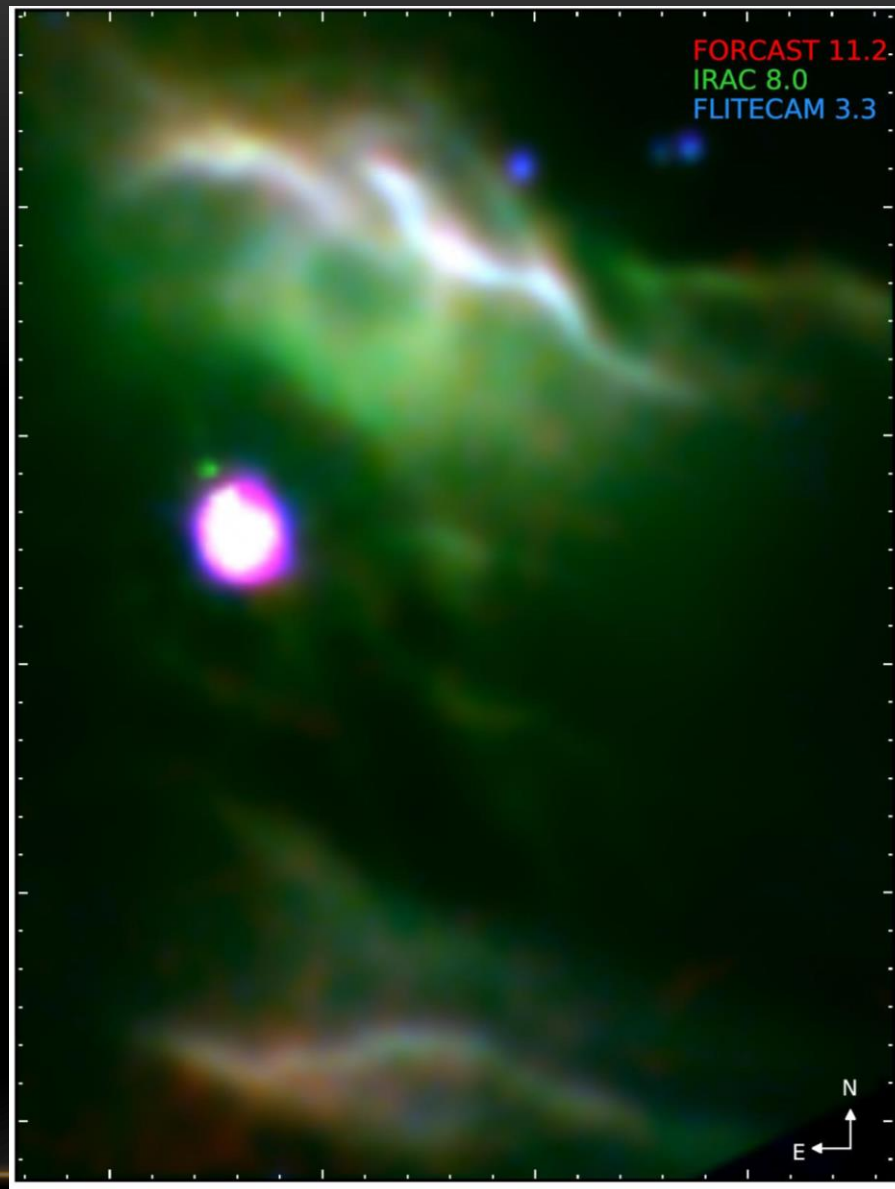
- NICMOS: ERE

Instruments



AKARI, Pilleri et al., 2015

Images

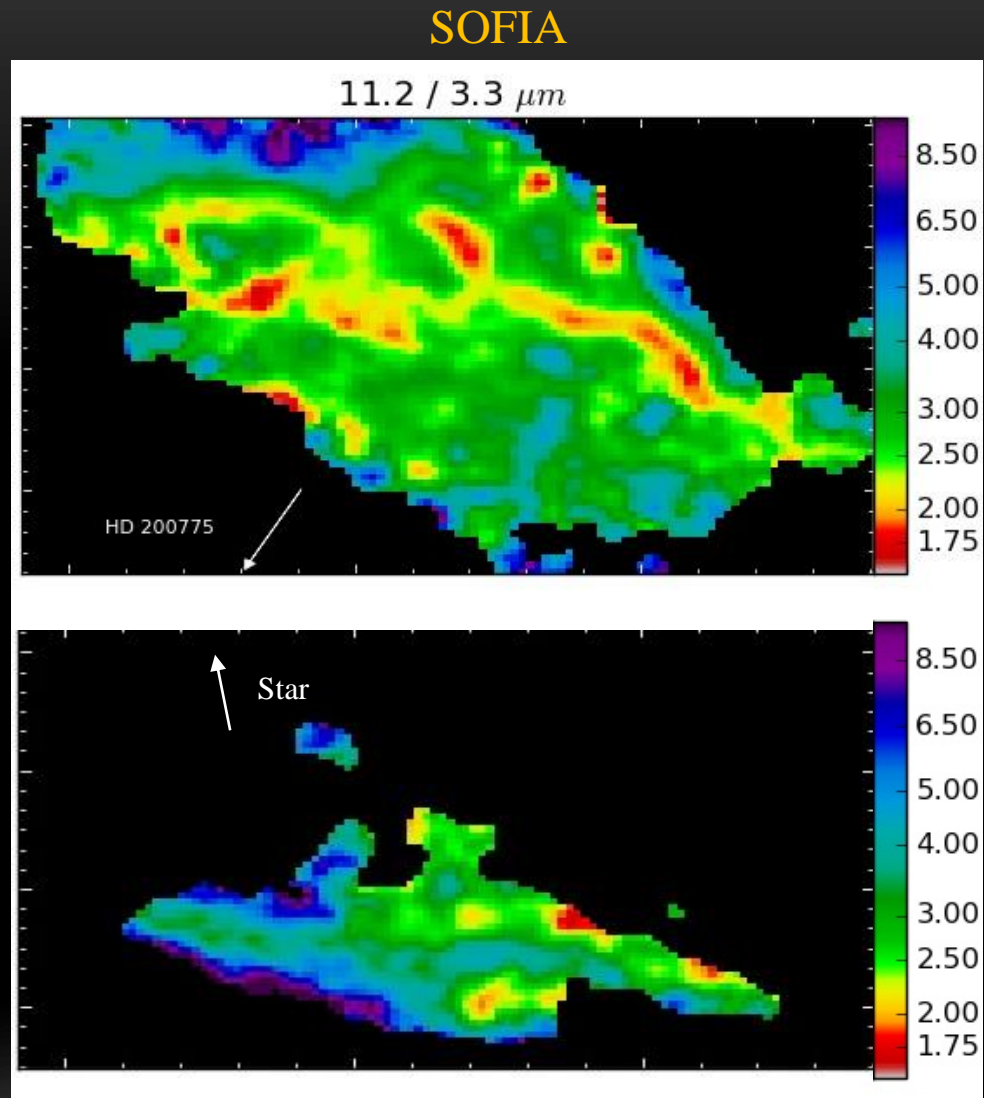


Croiset et al., 2016

Images

North PDR

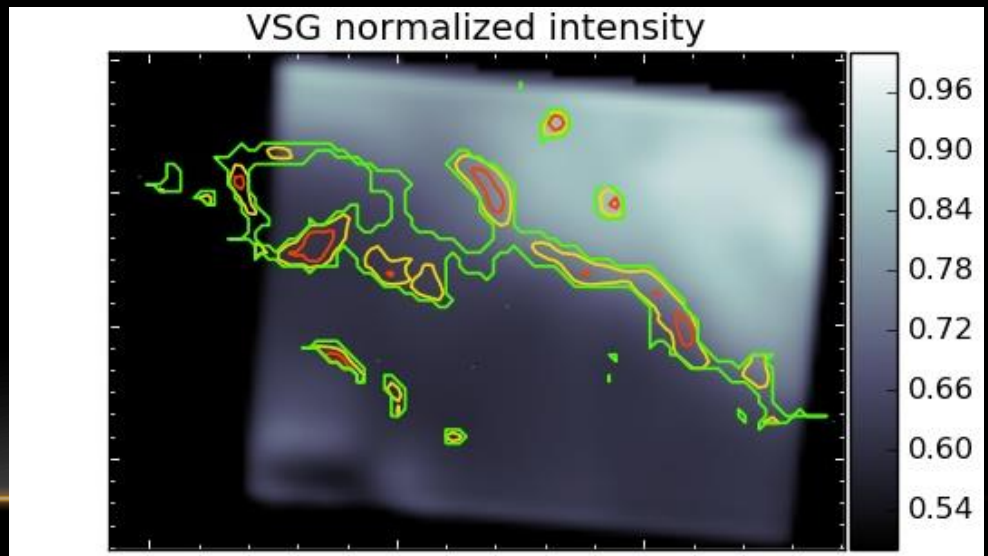
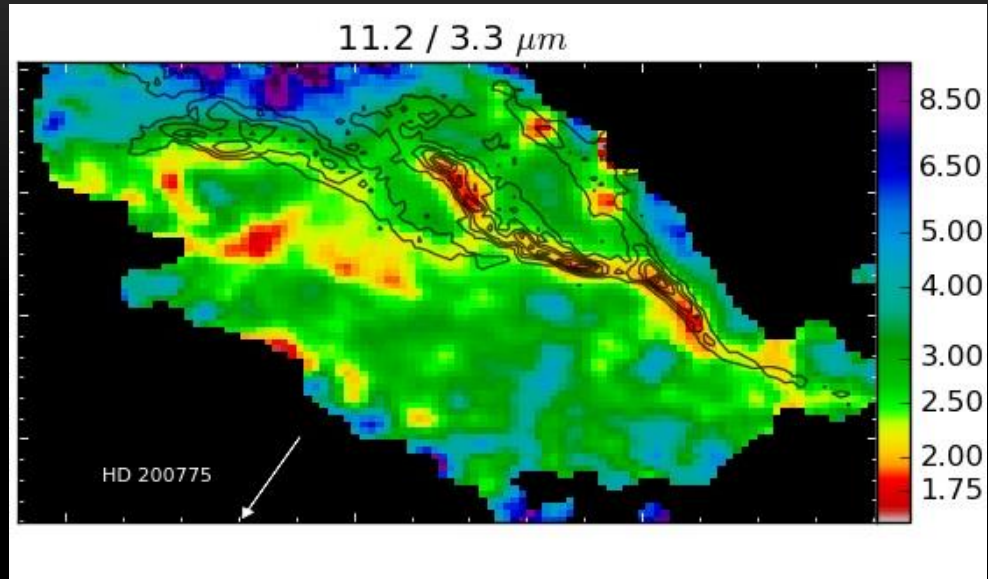
South PDR



Images

PAH

Very Small Grains



PAH emission-size model

Extinction
Crosssection PAH
Photon energy emitted

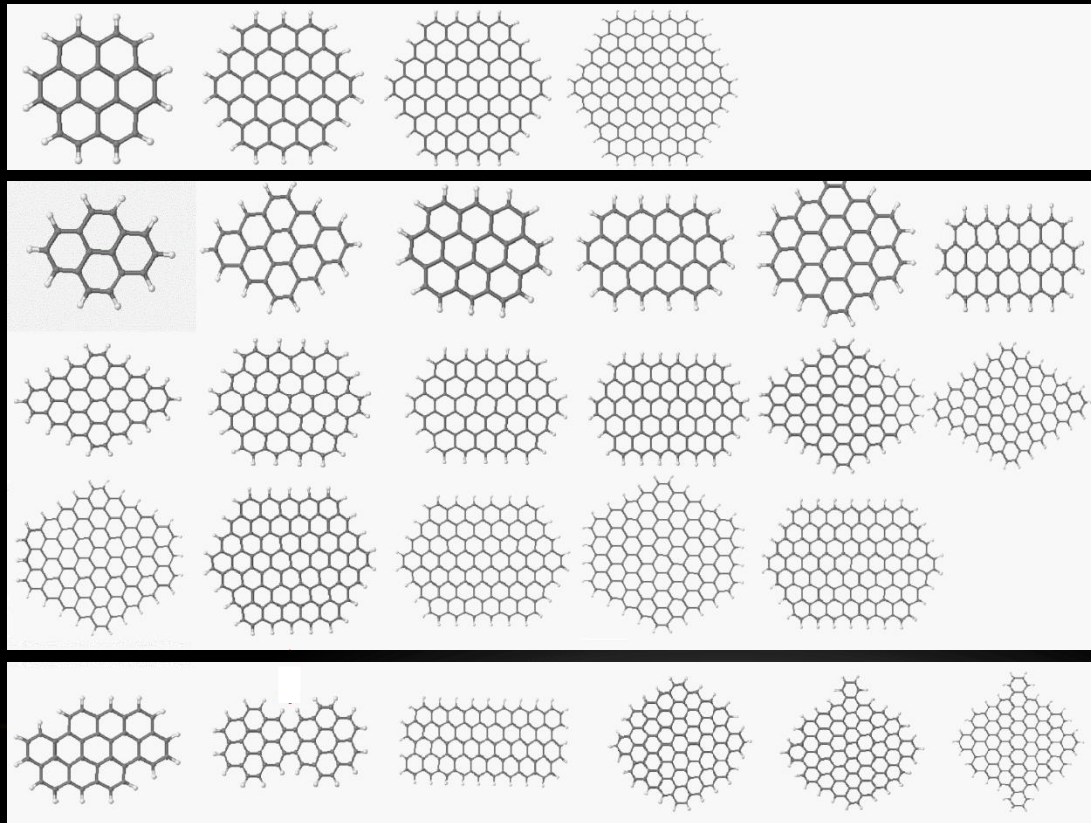
} Avg. photon energy absorbed by the PAH

- NASA Ames PAH IR spectral database
- Spectra of 27 different PAHs

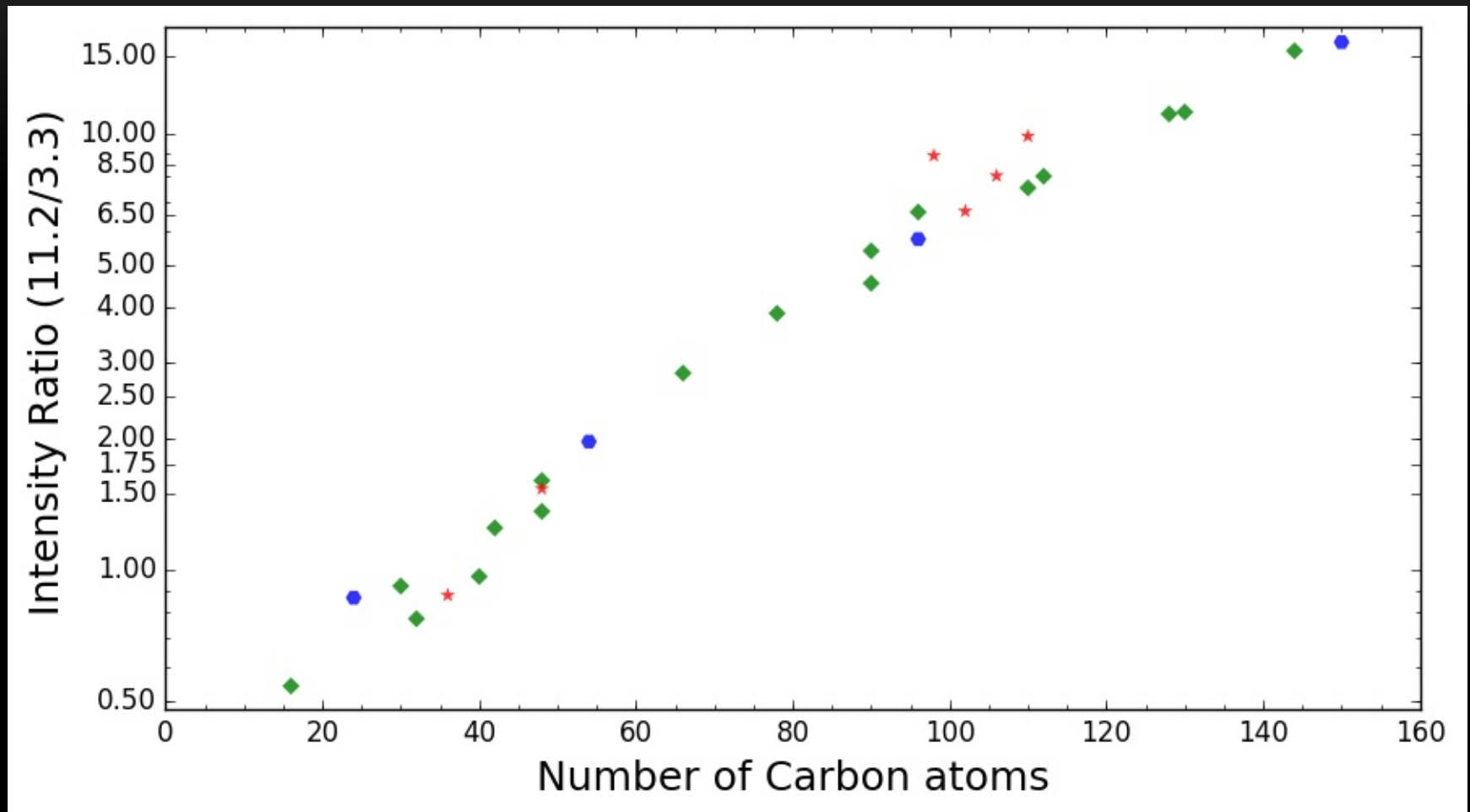
*“Avg. photon energy emitted → Dust extinction
→ absorbed by PAH → PAH spectra → 11.2/3.3 μm ”*

PAH emission-size model

*“Avg. photon energy emitted → Dust extinction
→ absorbed by PAH → PAH spectra → 11.2/3.3 μm”*

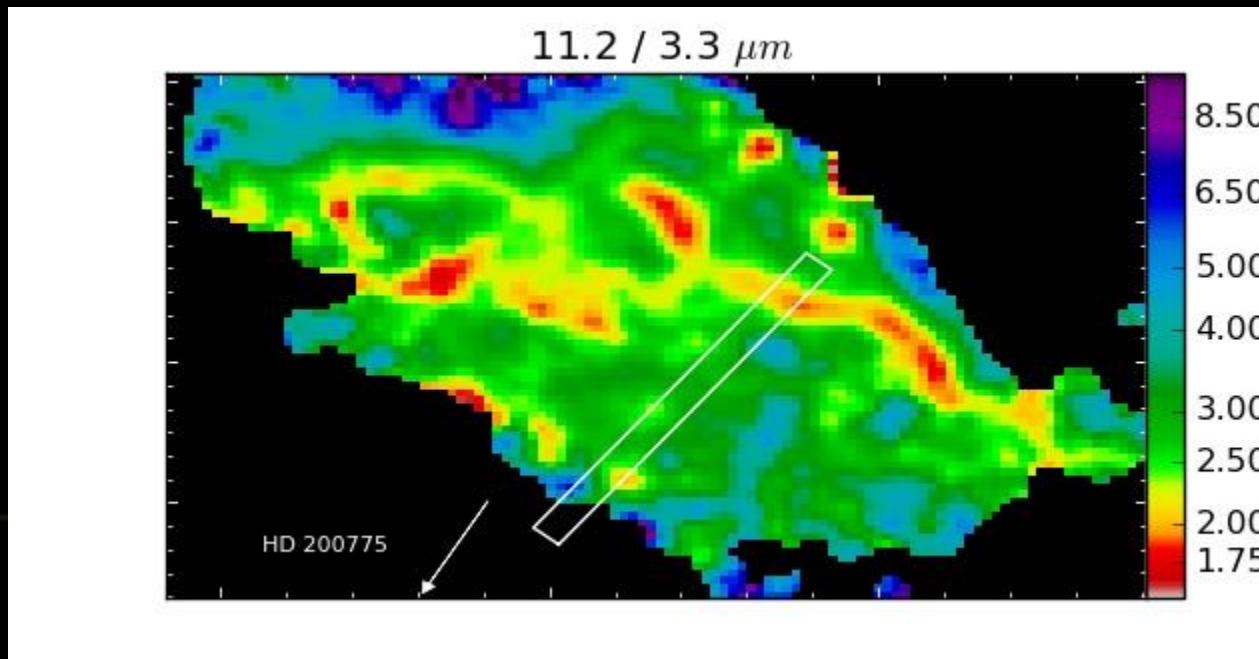
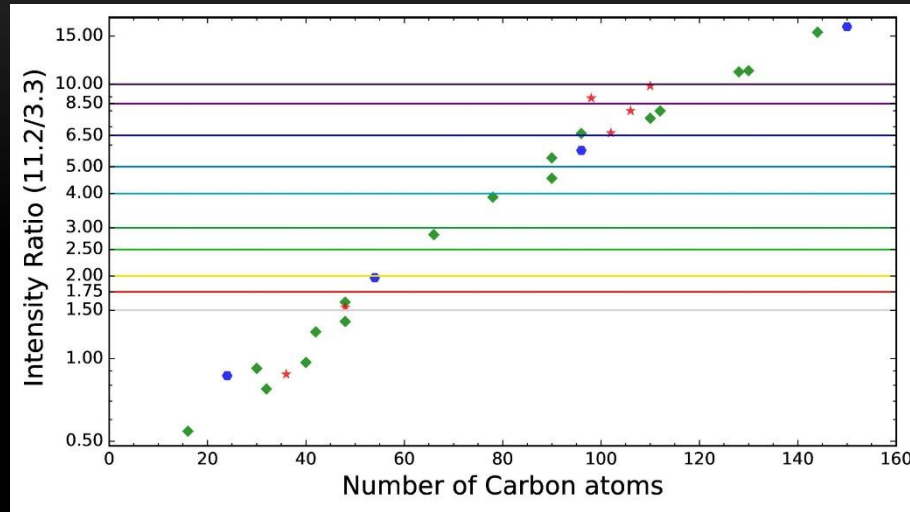


PAH emission-size model

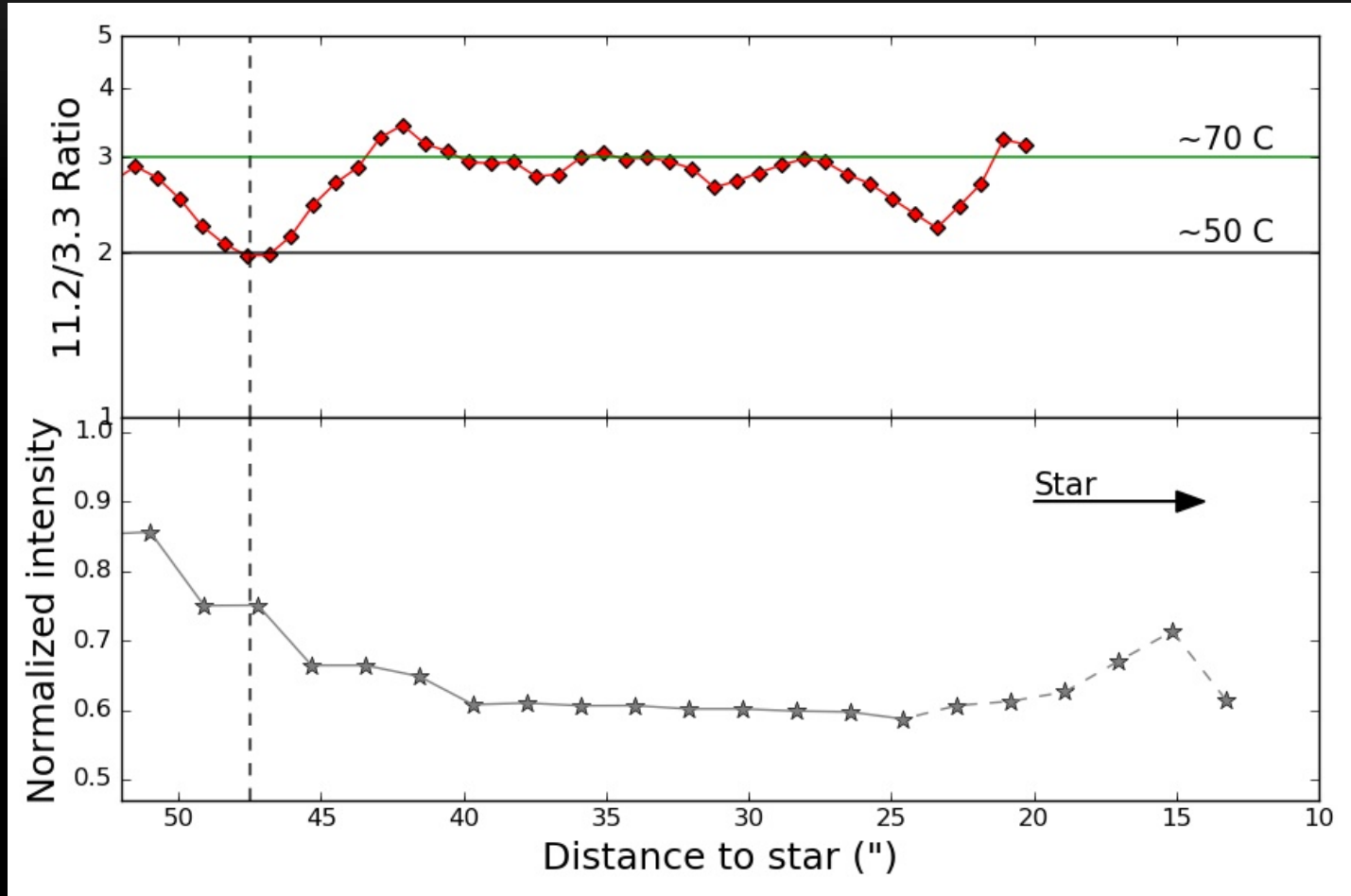


Croiset et al., 2016

PAH emission-size model



PAH emission-size model



Summary

- The PDR surface is well traced by the 11.2/3.3 ratio and H₂
- A factor of ~2 in size variation
- unstable VSG evaporate → compact PAH at PDR surface
→ smallest PAH broken down → Avg. size increases in the cavity

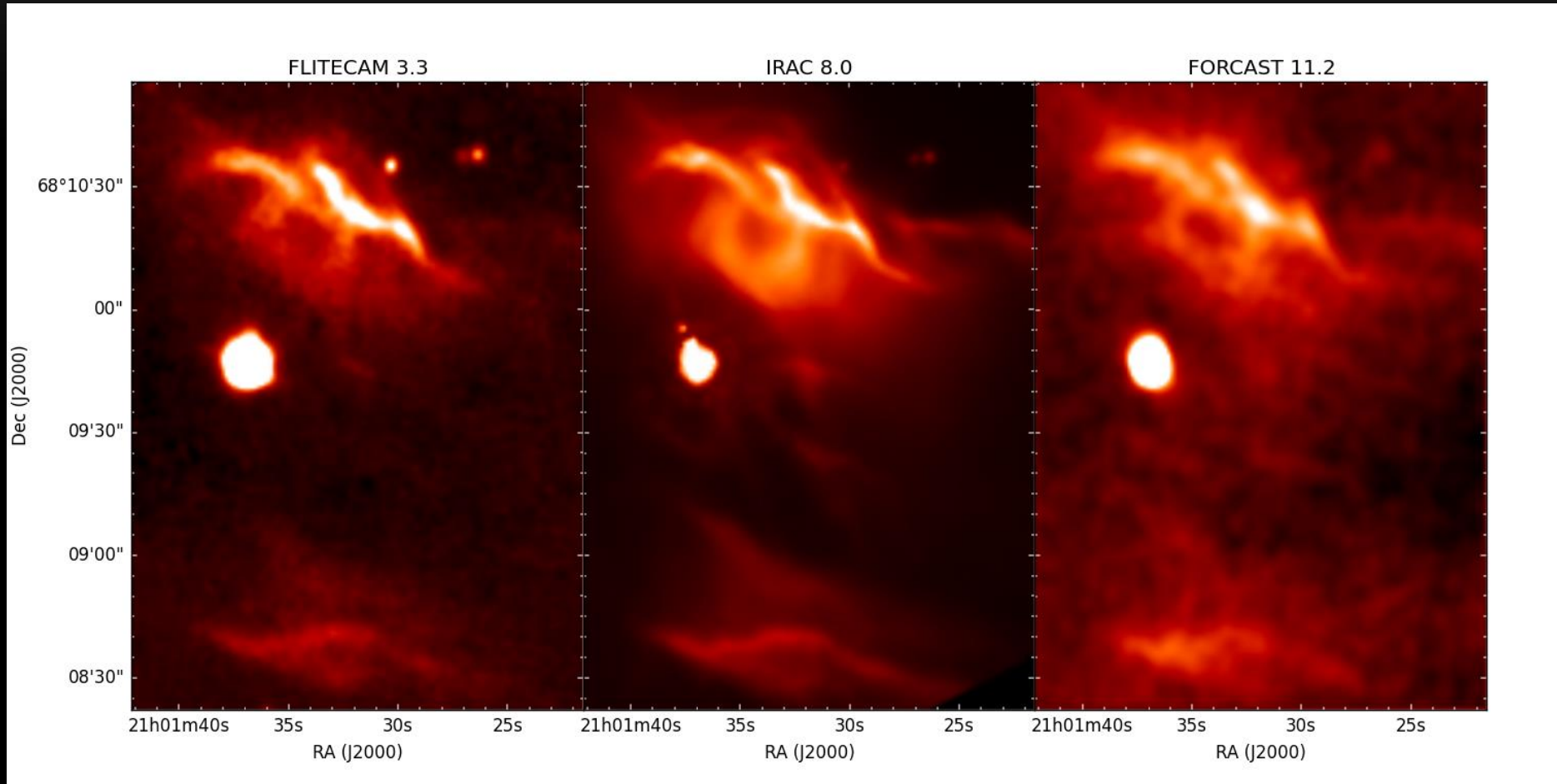
Croiset et al., 2016 , A&A, 590, A26

Future work

- Observe more objects with SOFIA
- Laboratory work to examine the 11.2/3.3 μm
- Model the effect PAH size in PDR models
- JWST

Croiset et al., 2016 , A&A, 590, A26

Images



SOFIA

Spitzer IRAC

SOFIA