



The University of
Nottingham

Observations and Modelling of PAHs

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UKIRT at 30

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PAHs

Polycyclic Aromatic Hydrocarbon molecules

Diffuse Interstellar Bands (DIBs)

Longest standing problem in astronomical spectroscopy

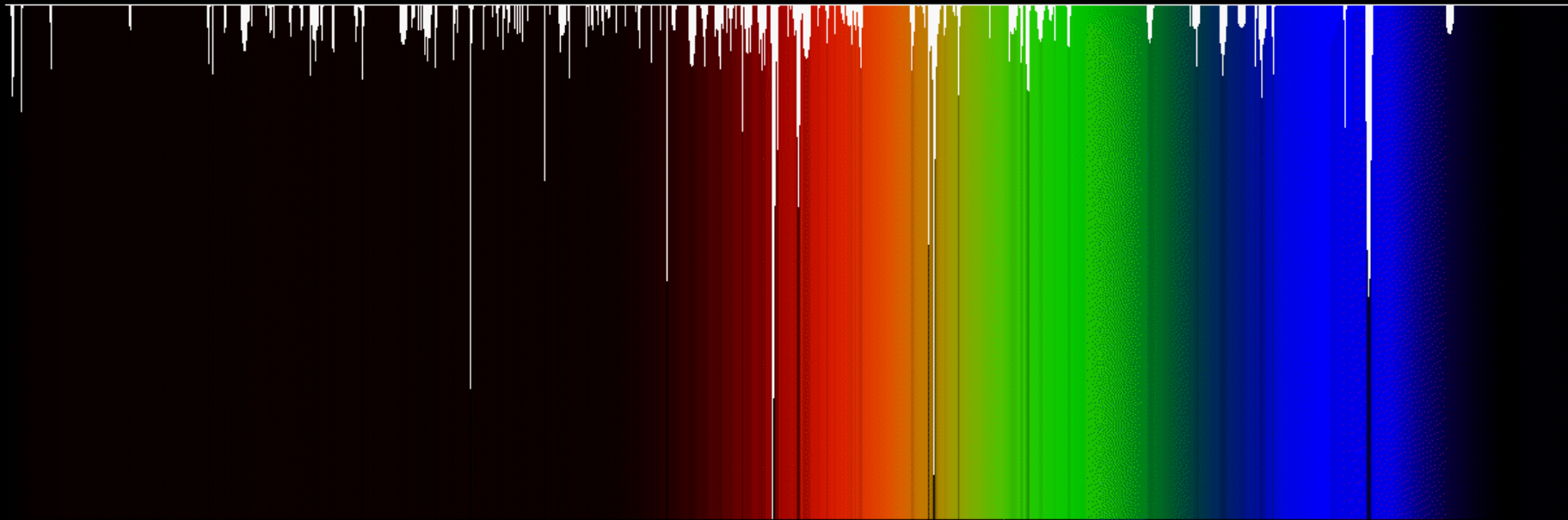
UIR Bands

'Unidentified' Infrared Bands – Aromatic IR Bands

ρ Oph region

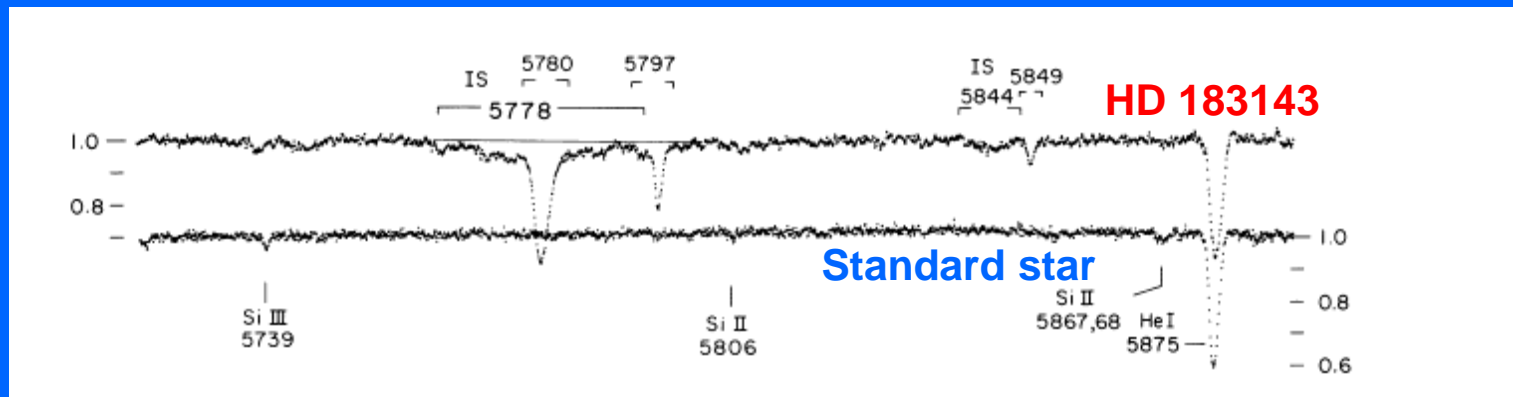


The Diffuse Interstellar Bands



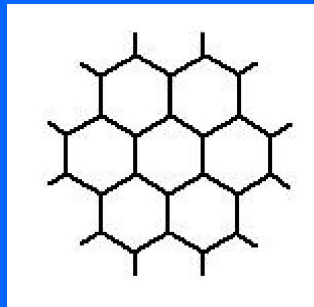
Courtesy: P. Jenniskens, F.-X. Desert

George H. Herbig Review (1975)

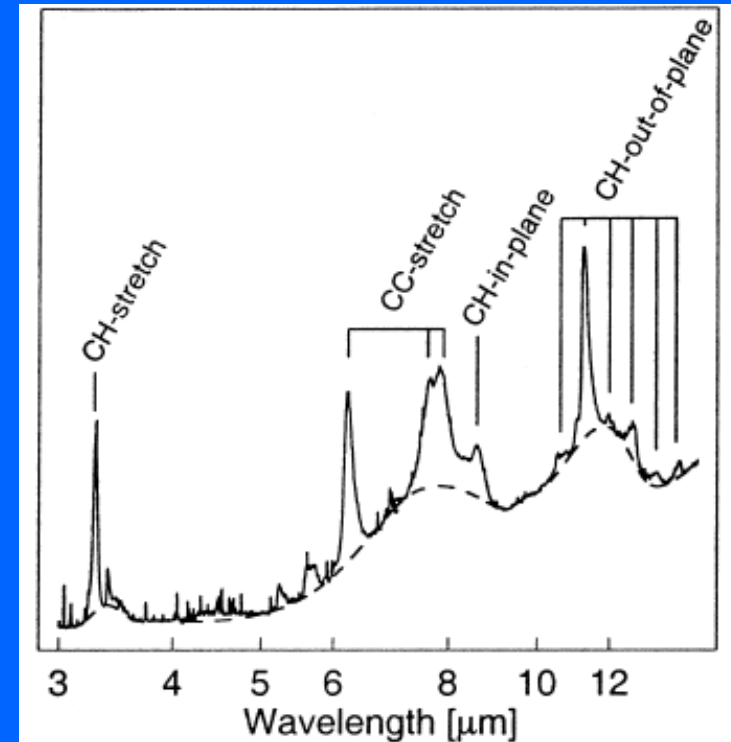


UIR bands

- Set of emission features
- Usually attributed to polycyclic aromatic hydrocarbons (PAHs)



- Coronene $C_{24}H_{12}$



Typical spectrum

Red Rectangle (RR)

Star

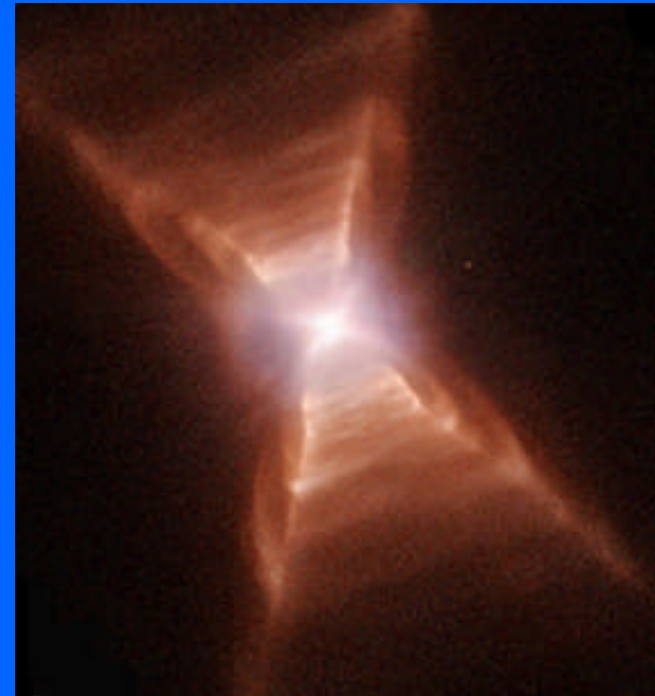
- Central star A0, Fe poor
- Binary – period 318 ± 3 days
- Partner: white dwarf?
- Bipolar outflow from binary system

Nebula

- Nebula (C-rich)
- Circumbinary disk (O-rich)

Spectral Features

- Unidentified infrared emission (UIR) – PAHs
- Silicate emission (disk)
- Unidentified optical emission bands



HST image 2004, NASA, ESA & H. Van Winckel and M. Cohen

Red Rectangle (RR)

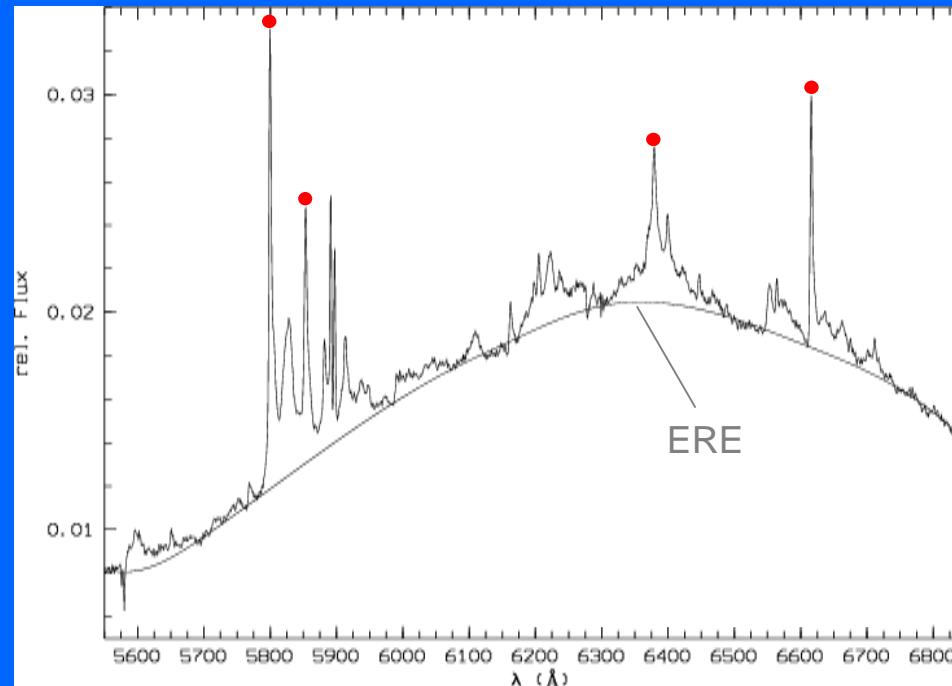
- Unidentified infrared emission (UIR) – PAHs
- **Unidentified optical emission bands – wavelengths close to some DIBs**

Sarre (1991), Fossey (1991)



HST image 2004, NASA, ESA & H. Van Winckel and M. Cohen

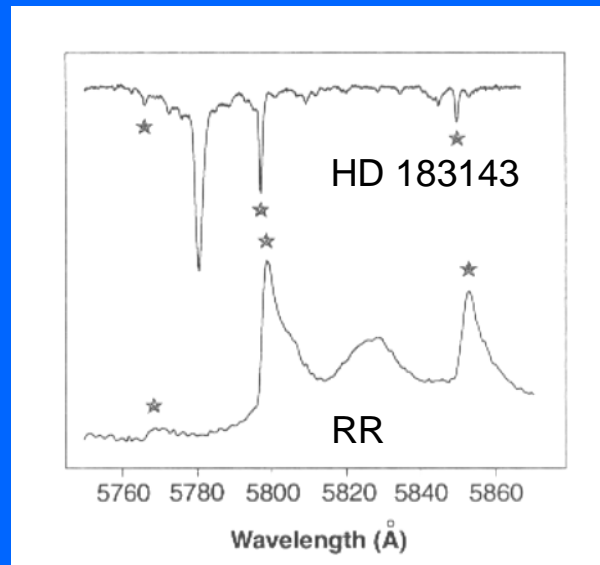
Optical Spectrum of the RR nebula



- Emission bands lie \sim few \AA to longer wavelength of *some* DIBs
Peak maxima shift to lower wavelengths with increasing offset

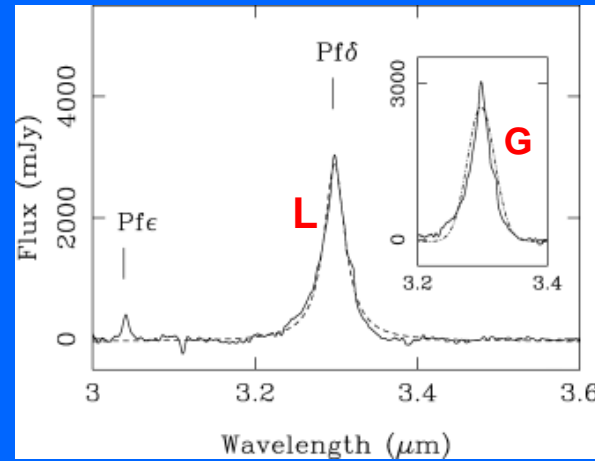
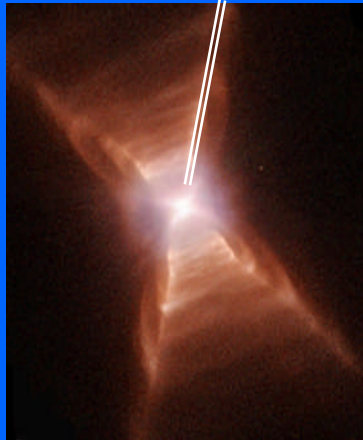
RR First studied in 1975: Cohen et al. ApJ 196, 179-189

Red Rectangle Optical Emission



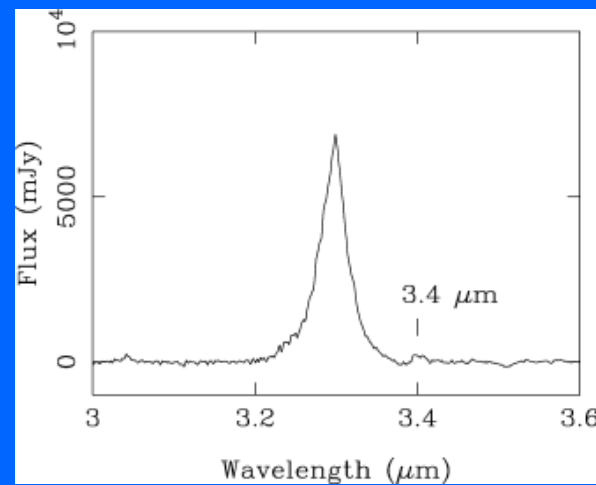
Sarre et al. Science 269, 674 (1995)

Spectroscopy: 3.3 μm feature: CGS4



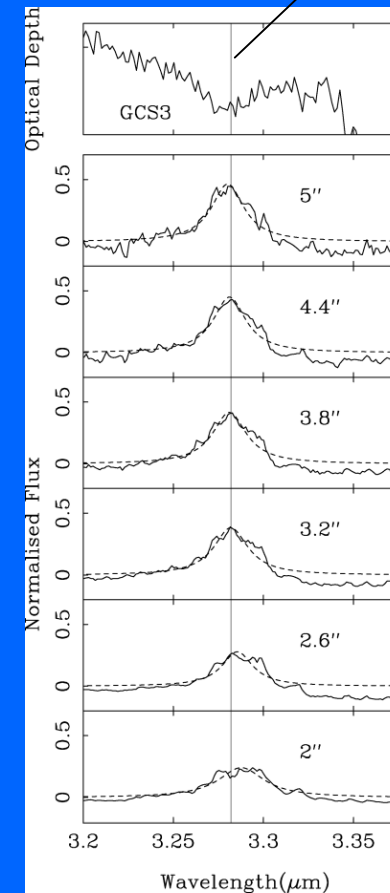
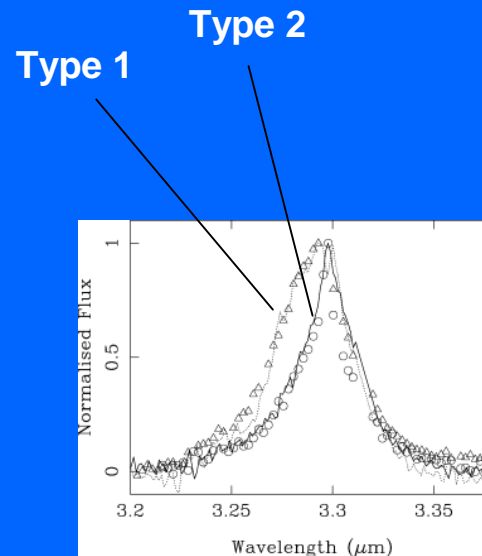
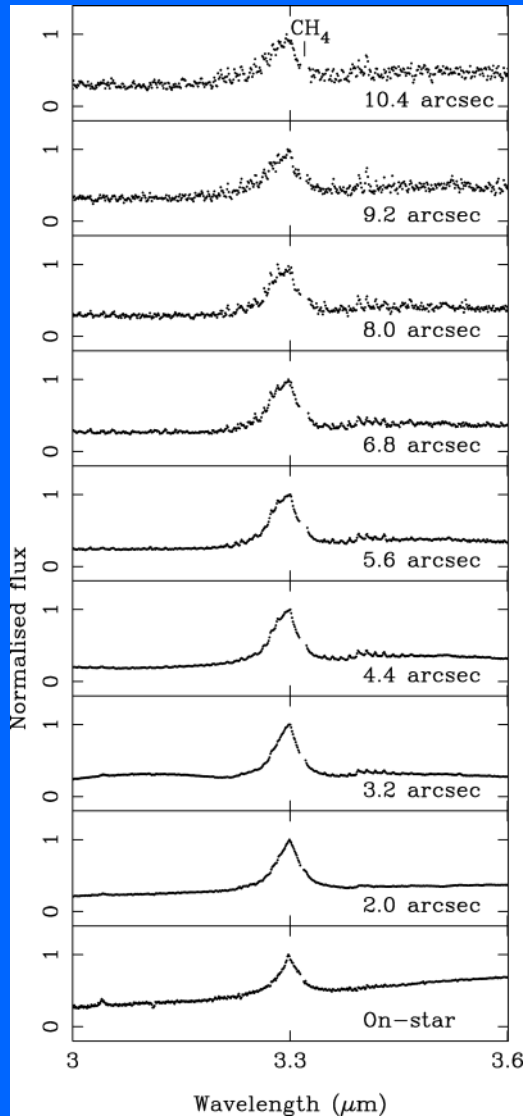
On-star

Good Lorentzian fit



2'' offset

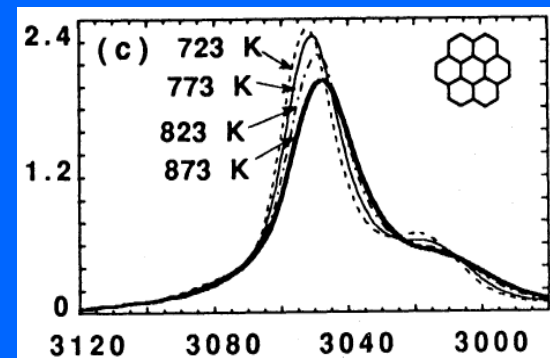
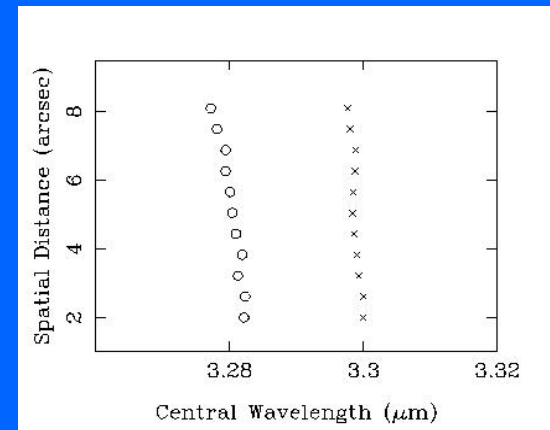
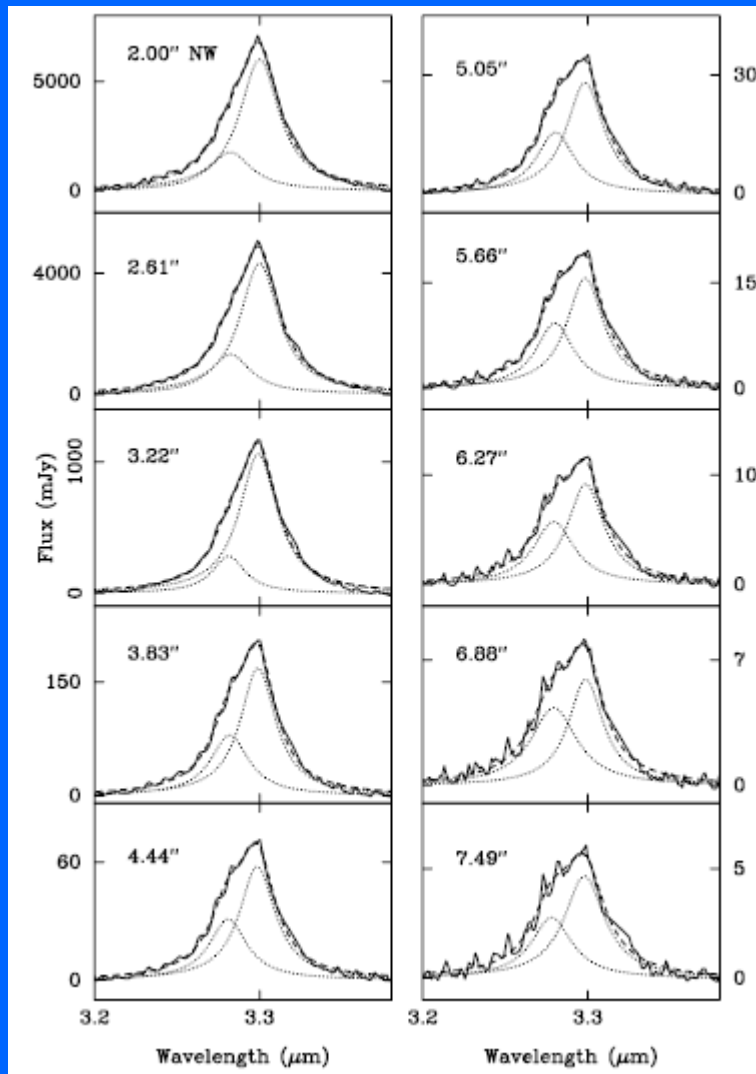
Evolution as f(offset): 3.30 and 3.28 μm



Towards
Galactic
centre

Off-star
minus
On-star

UIR bands – two-component treatment

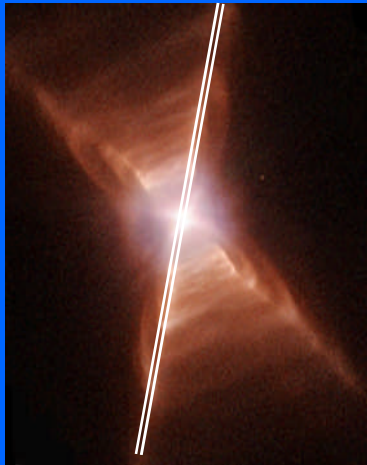


Joblin et al. (1995) – effect of temperature (lab)

Using lab data for Ovalene gives ΔT of 90 K for 3.28 μm over 2-8'' in the Red Rectangle

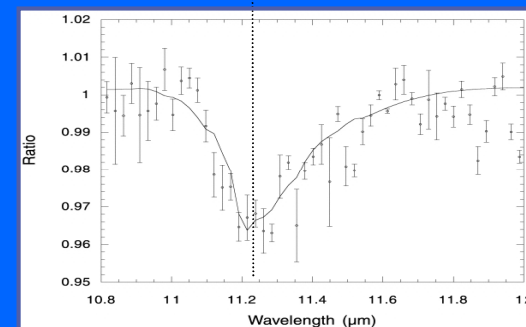
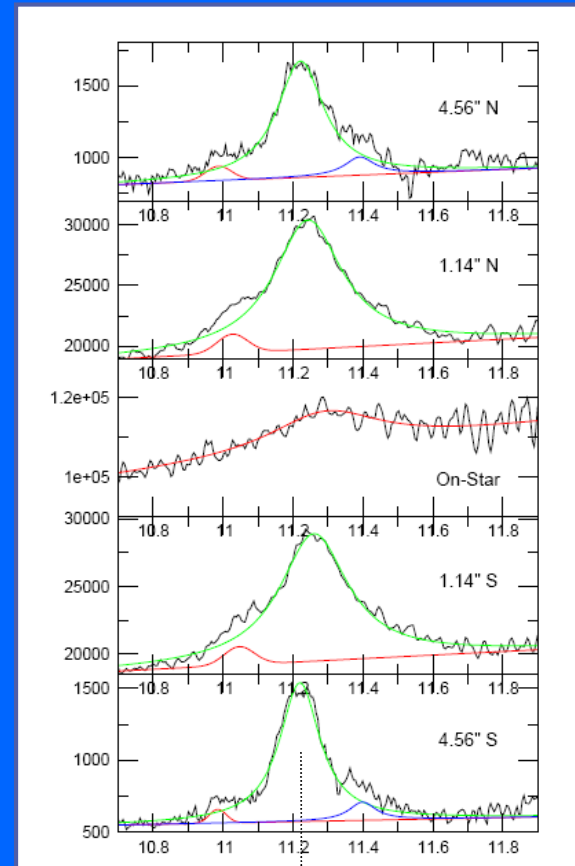
UIR bands – mid-IR

MICHELLE



11.0 μm

11.2 μm



Data of Bregman et al. (2000) towards Mon R2 IRS 3. The solid line is the inverted profile of 11.3 μm emission from BD +30° 639