The Dusty Nova – An Examination of Dust Production and Processing in the Ejecta of Classical Novae (CT20)

Stella Novae: Past and Future Decades
2013-02-06

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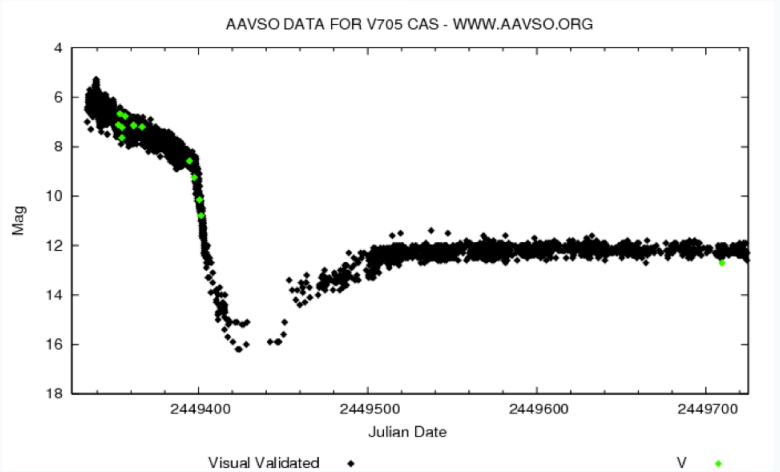
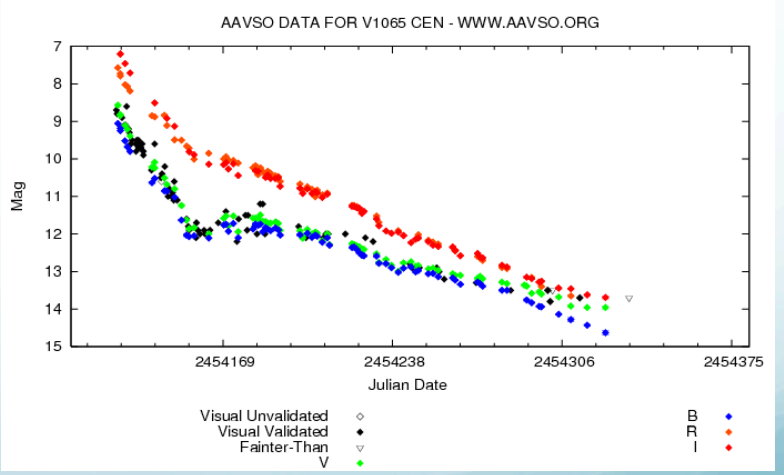
Dust in Novae

- Known at least since DQ Her (1934)
- Often characterized by (deep) extinction event in optical light curve





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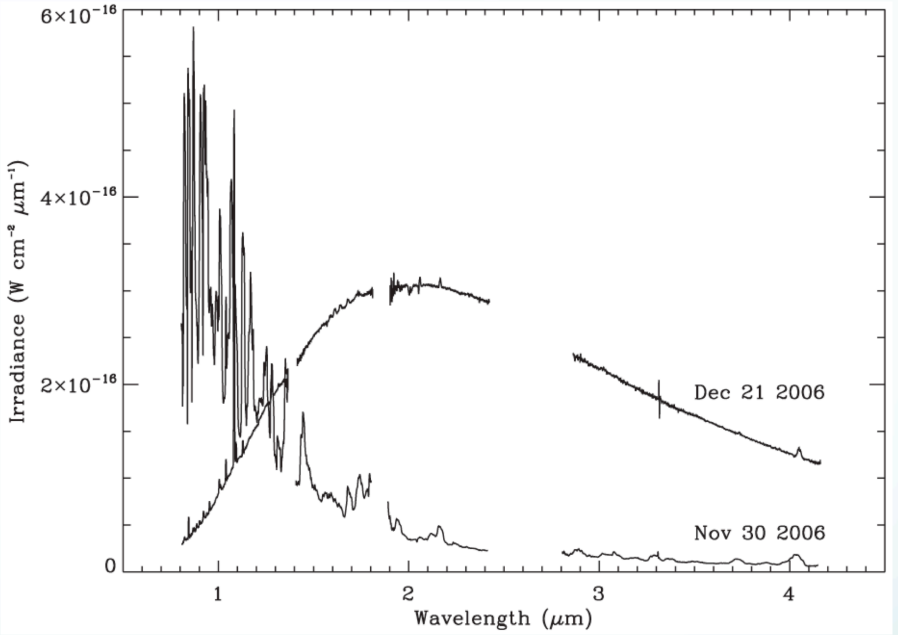
- Variety of dust species
  - Amorphous Carbon

V2362 Cyg



Lynch et al. 2008, AJ, 136, 1815

Dust in Novae

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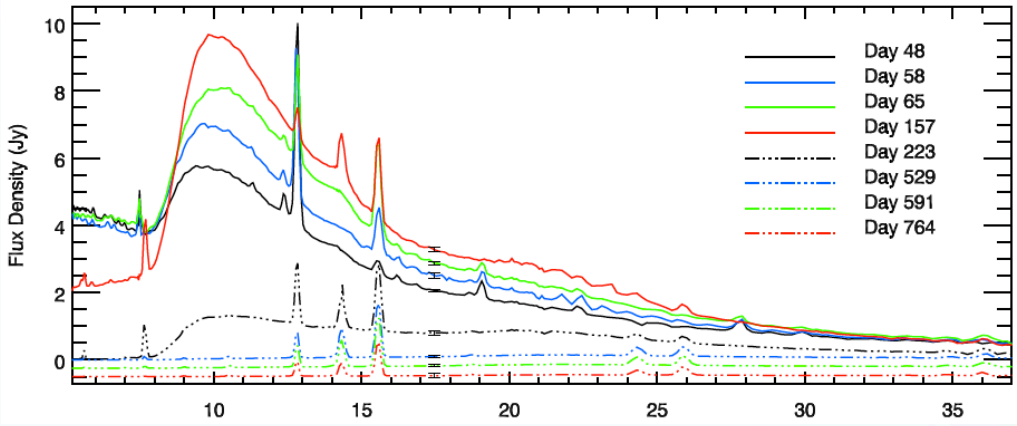
  - Silicates

V1065 Cen

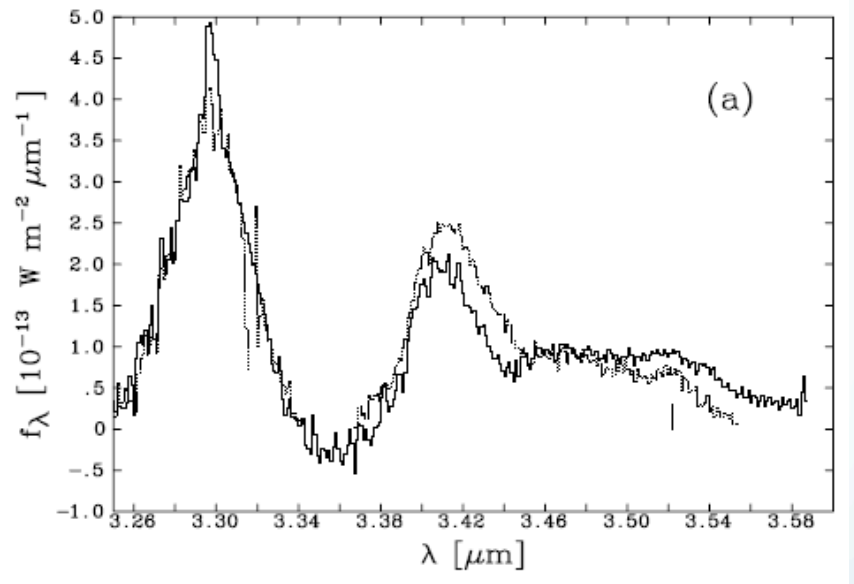


Helton et al. 2010, AJ, 140, 1347

Dust in Novae

- Known at least since DQ Her (1934)
- Often characterized by (deep) extinction event in optical light curve
- Variety of dust species
  - Amorphous Carbon
  - Silicates
  - Silicon Carbide
  - Hydrocarbons

V705 Cas

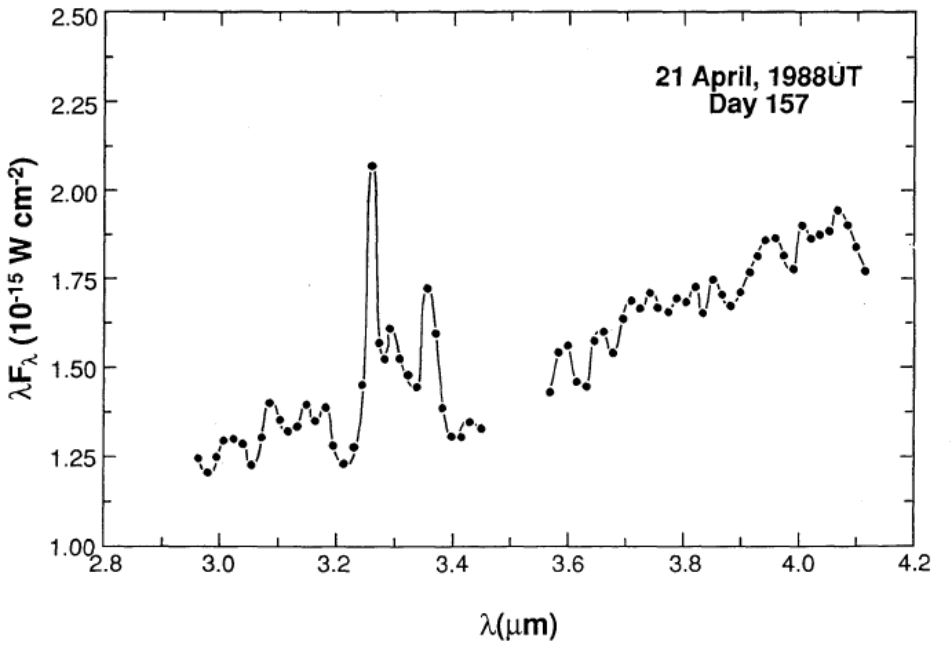


Evans et al. 2005, MNRAS 360, 1483

Hydrocarbons in Novae

- QV Vulpeculae

QV Vul

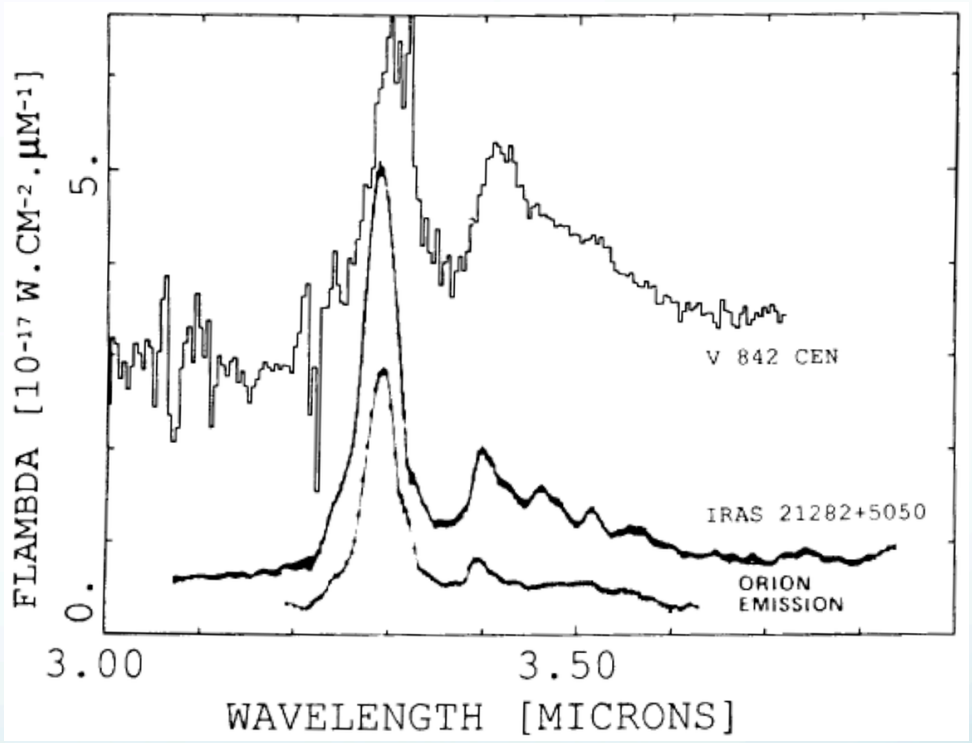


Gehrz et al. 1992, ApJ 400, 671

Hydrocarbons in Novae

- V842 Centauri
- 3.28/3.4 ratio smaller than that observed in other astronomical sources
- This ratio is indicative of the aromatic to aliphatic ratio

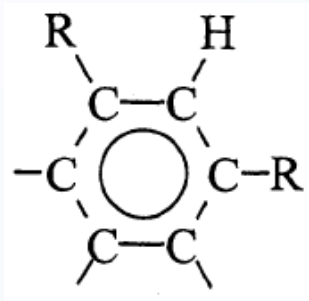
V842 Cen



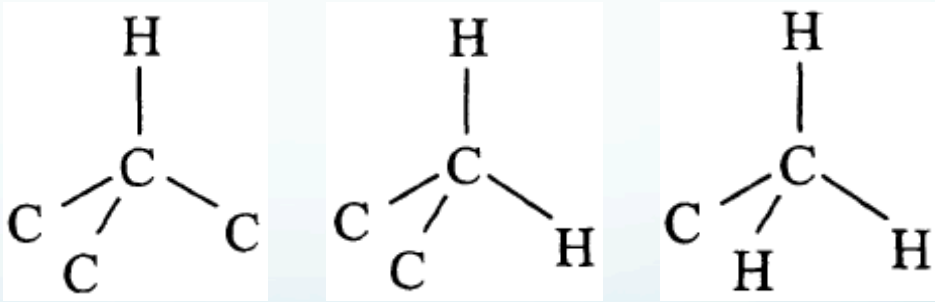
Hyland & McGregor 1986, IAU Symp. 135, 101

Aromatics & Aliphatics

- Aromatics → Carbon ring molecules
  - C–H stretching mode oscillations give rise to 3.3 μm feature



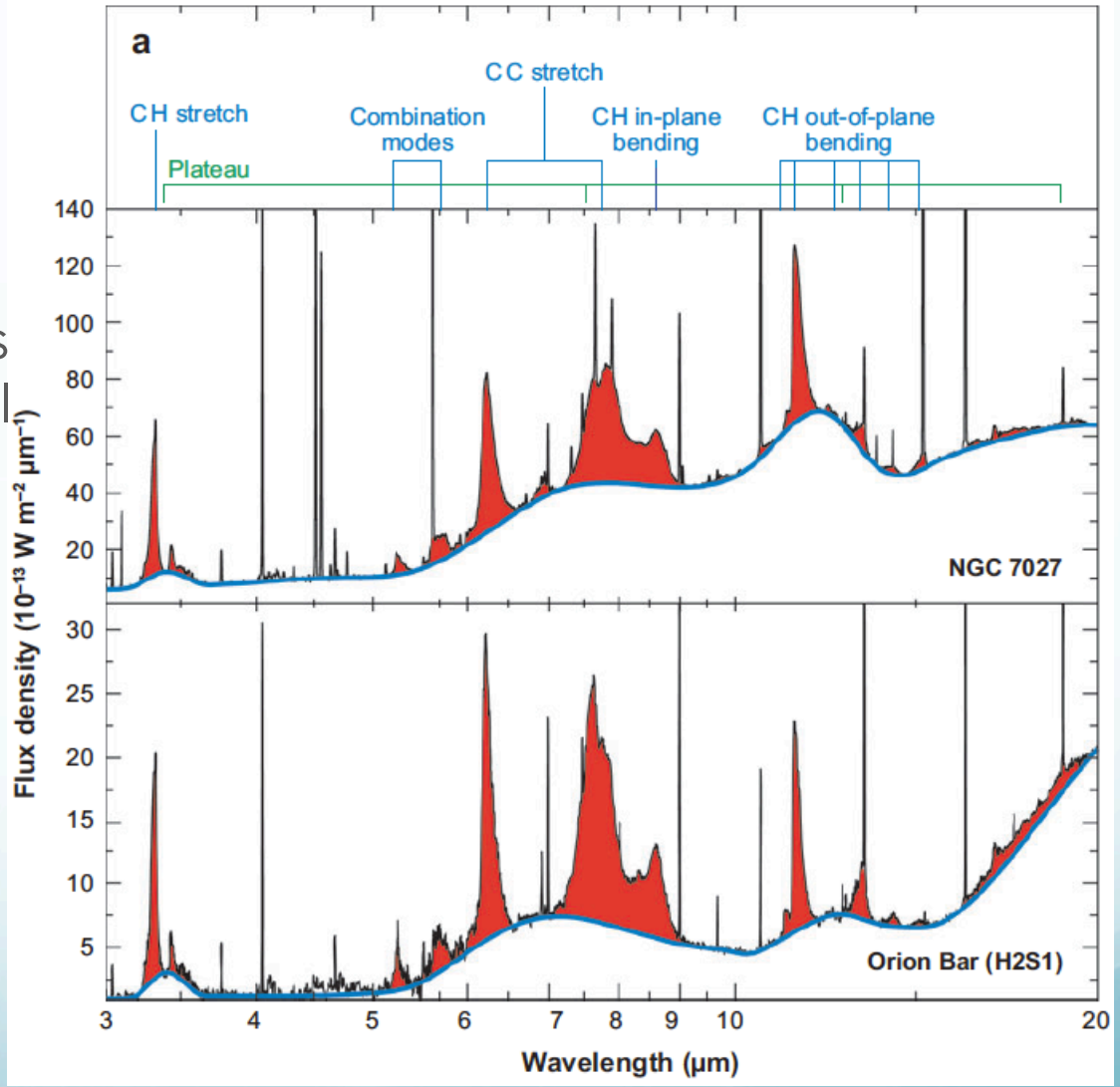
- Aliphatics → Carbon chains
  - C–H stretching mode oscillations give rise to 3.35 – 3.55 μm features



Papoular et al. 1996, A&A 315, 222

Polycyclic Aromatic Hydrocarbons (PAHs)

- Prominent Features at 6.2, 7.7, 8.6, & 11.3 μm
- Found in a tremendous variety of astronomical sources
- Arise from single FUV photon excitation of PAHs



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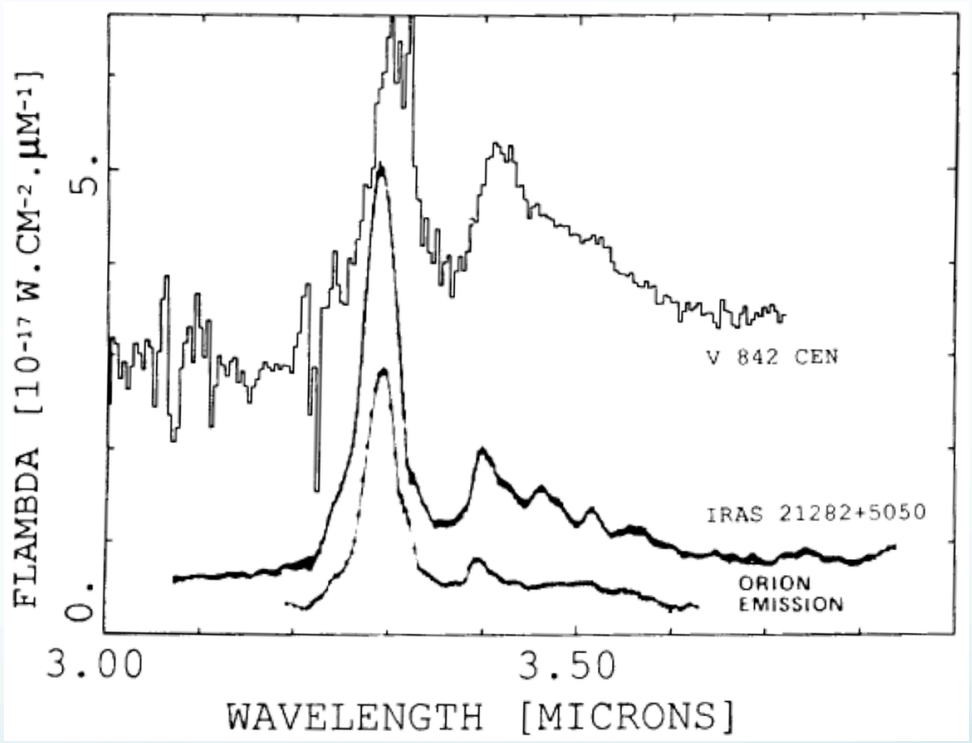
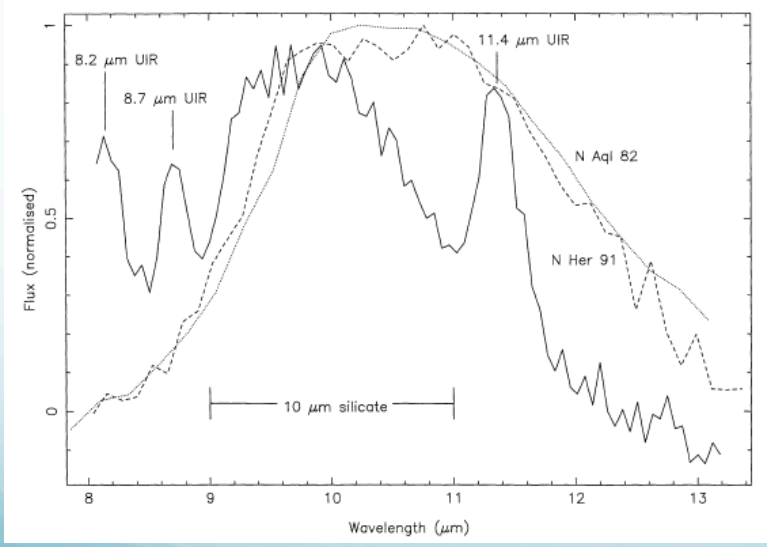


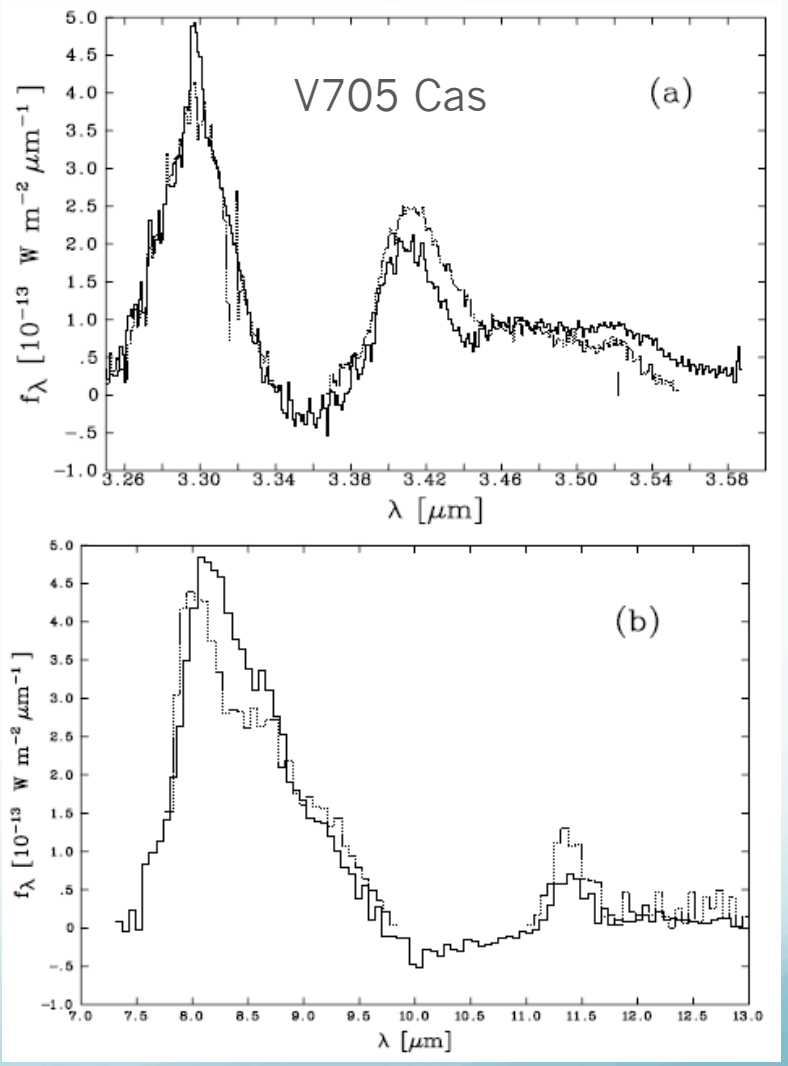
Hyland & McGregor 1986, IAU Symp. 135, 101

Hydrocarbons in Novae

- V705 Cassiopieae
- 3.28/3.4 ratio comparable to V842 Cen
  - An order of magnitude greater than stars with a high UV flux
  - More similar to post-AGB stars



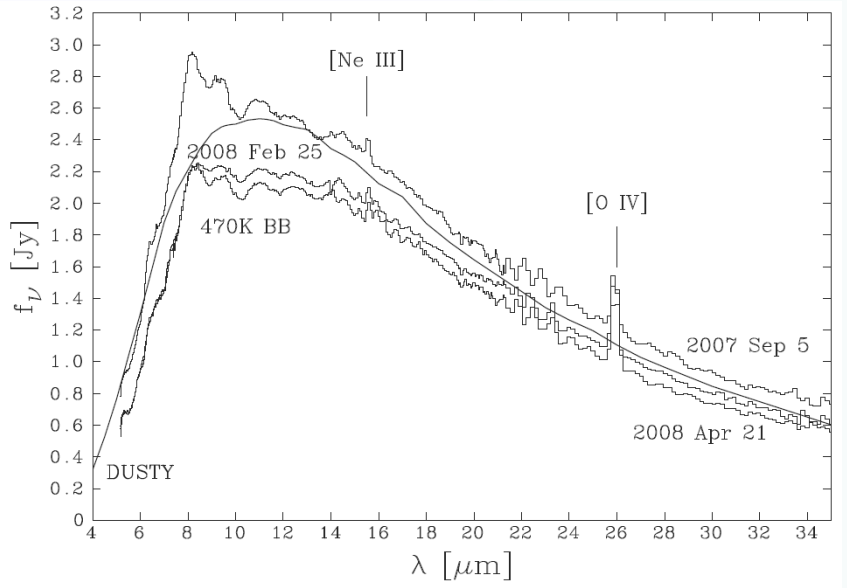
Evans et al. 1997, MNRAS 292, 192

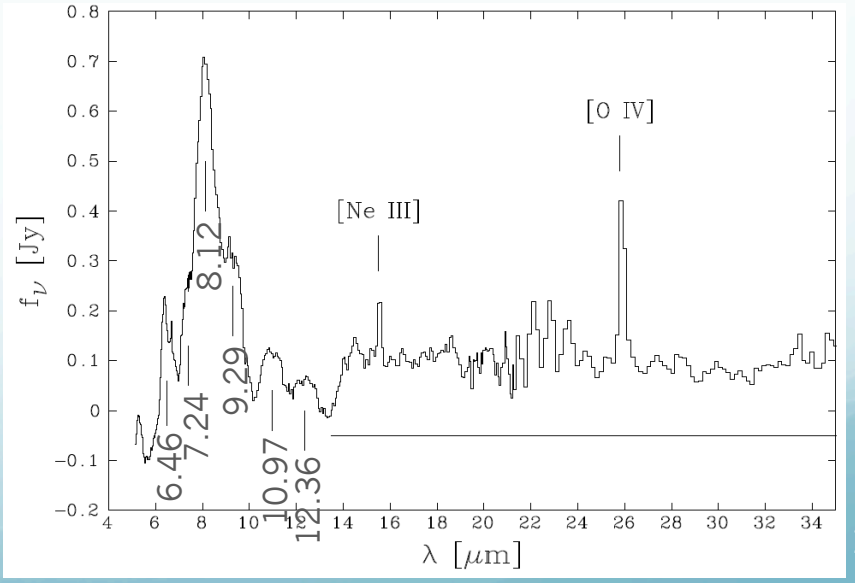


Evans et al. 2005, MNRAS 360, 1483

Hydrocarbons in the Spitzer Era

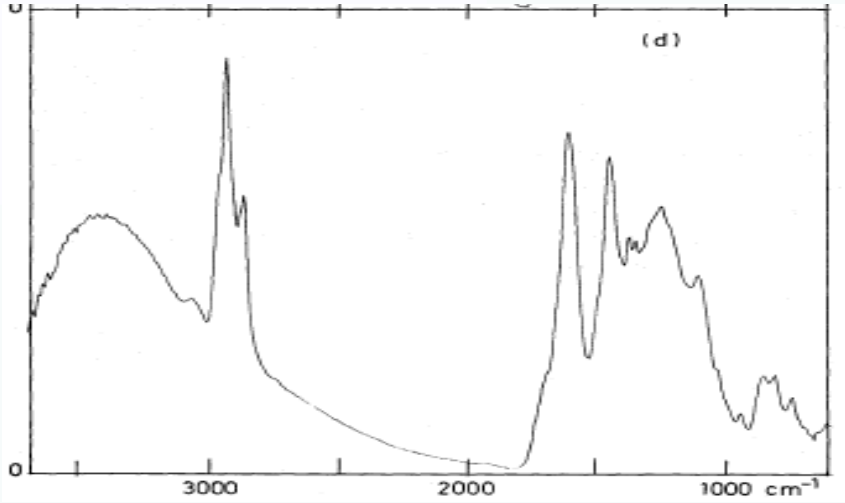
- DZ Crucis
- Evans et al. 2010 MNRAS 406, L85
  - Fitted with 470K DUSTY model
  - Residual features inconsistent with PAHs
  - Cannot be explained by excitation effects alone



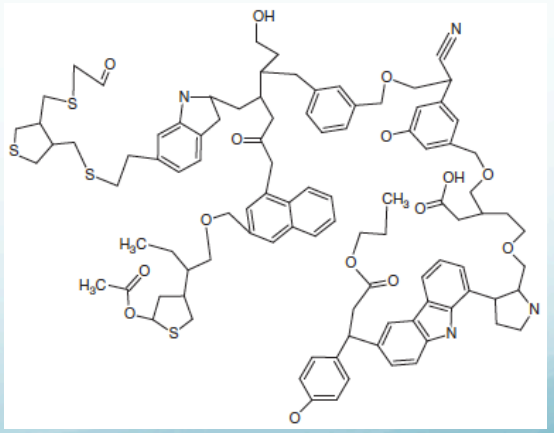


The Nature of the Carrier

- Evans & Rawlings 1994, MNRAS 269, 427
  - The nova environment is not conducive to the survival of free flying PAHs
- Kwok & Zhang 2011, Nature, 479, 80; Kwok 2004, Nature 430, 985
  - Features consistent with what would be expected from complex, "disordered" hydrocarbons
  - Similar to coal, hydrogenated amorphous carbon (HACs), or quenched carbon composites (QCCs)

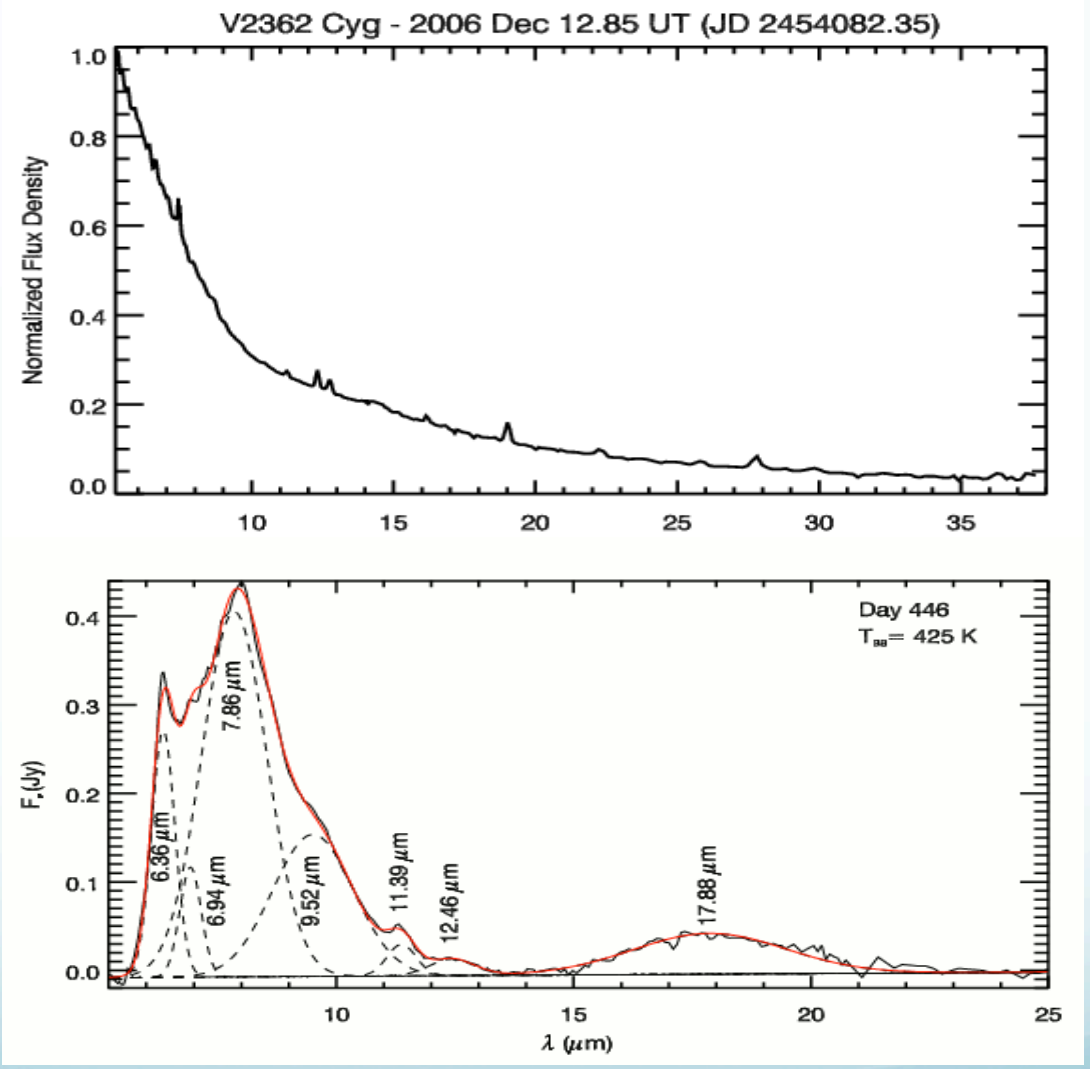


Papoular et al. 1989, A&A 217, 204



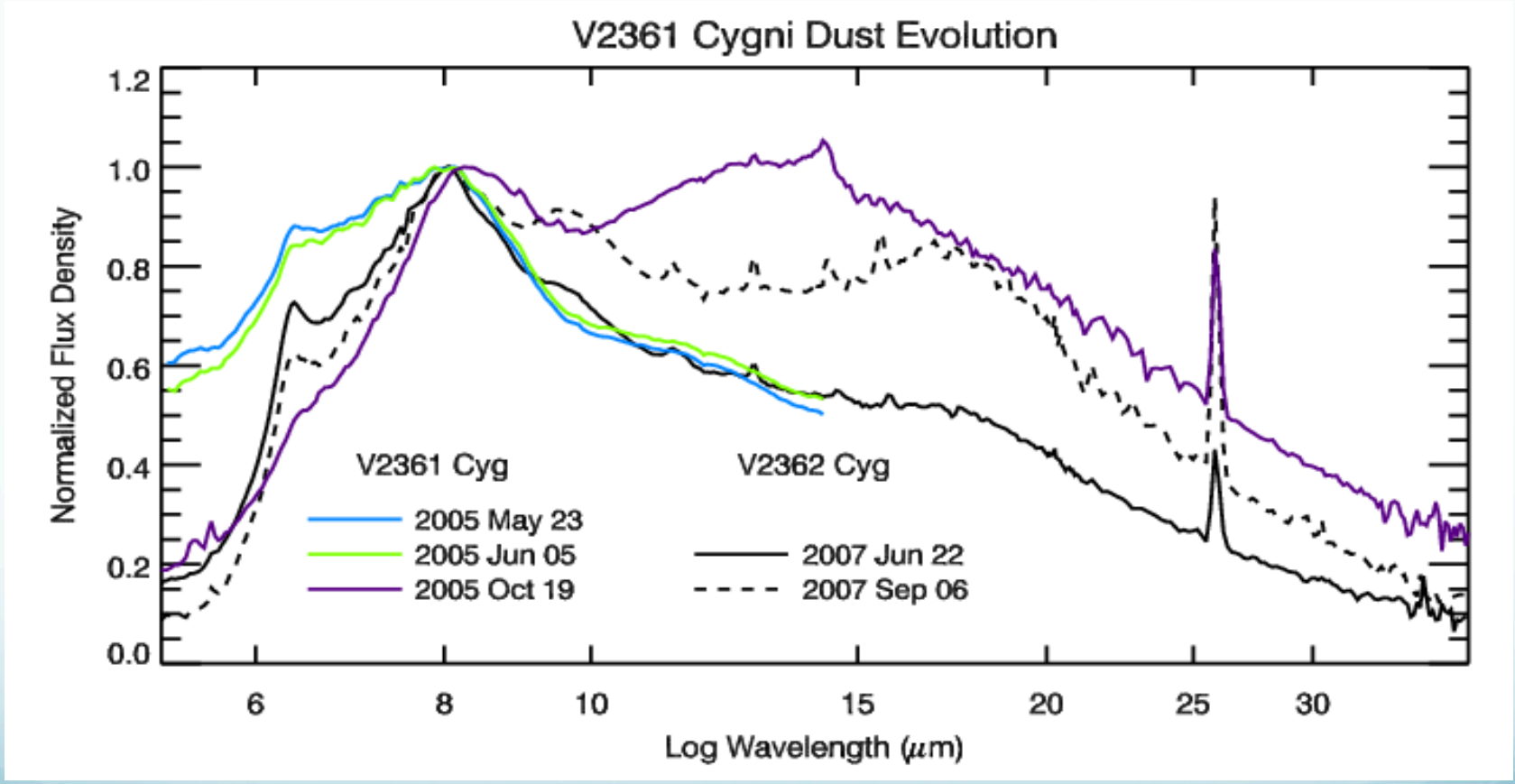
Kwok & Zhang 2011, Nature, 479, 80

Hydrocarbons in the Spitzer Era – V2362 Cyg

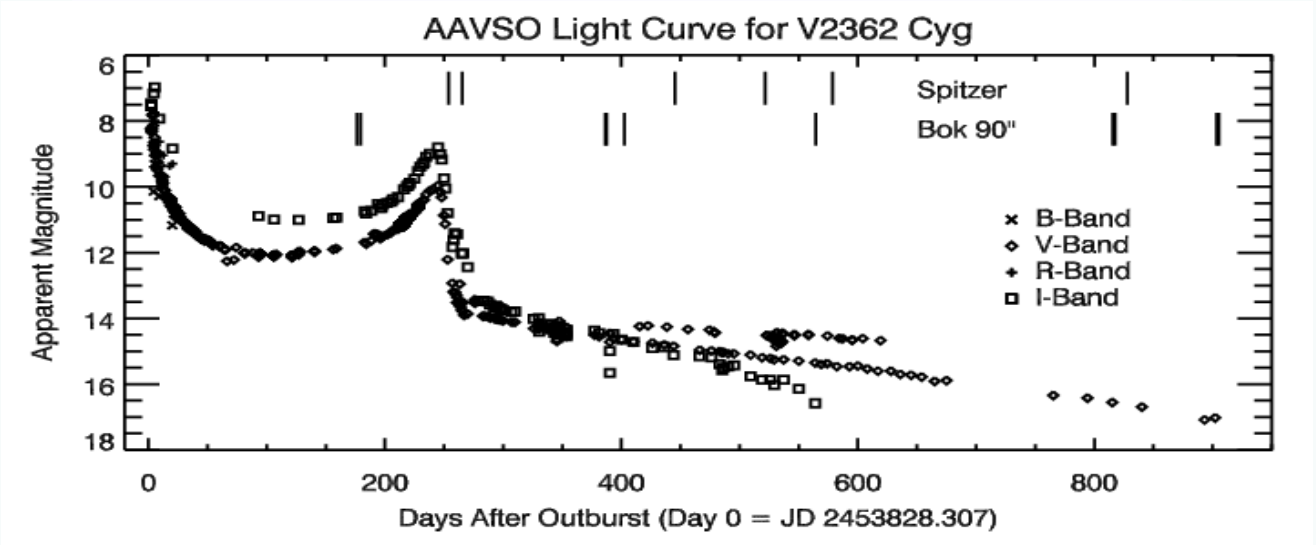


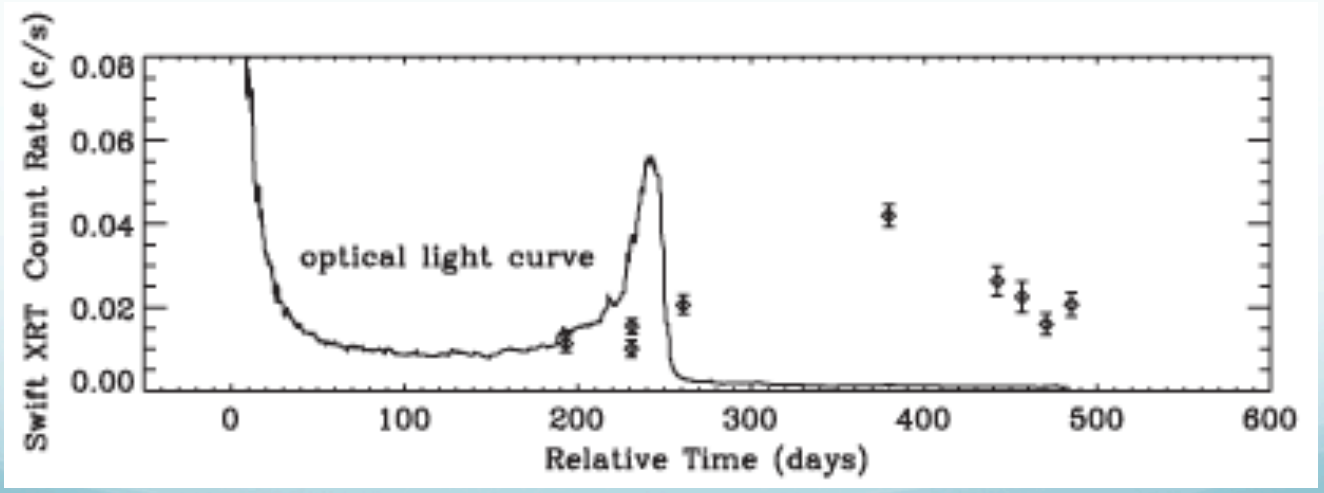
Helton et al. 2011, EASP 46, 407

Hydrocarbons in the Spitzer Era – V2361 Cyg



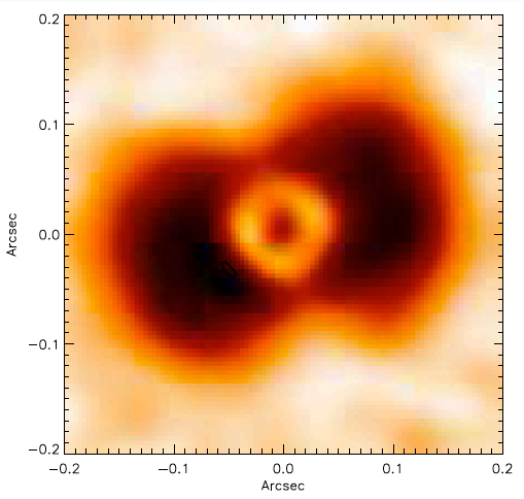
Hydrocarbons in the Spitzer Era – V2362 Cyg



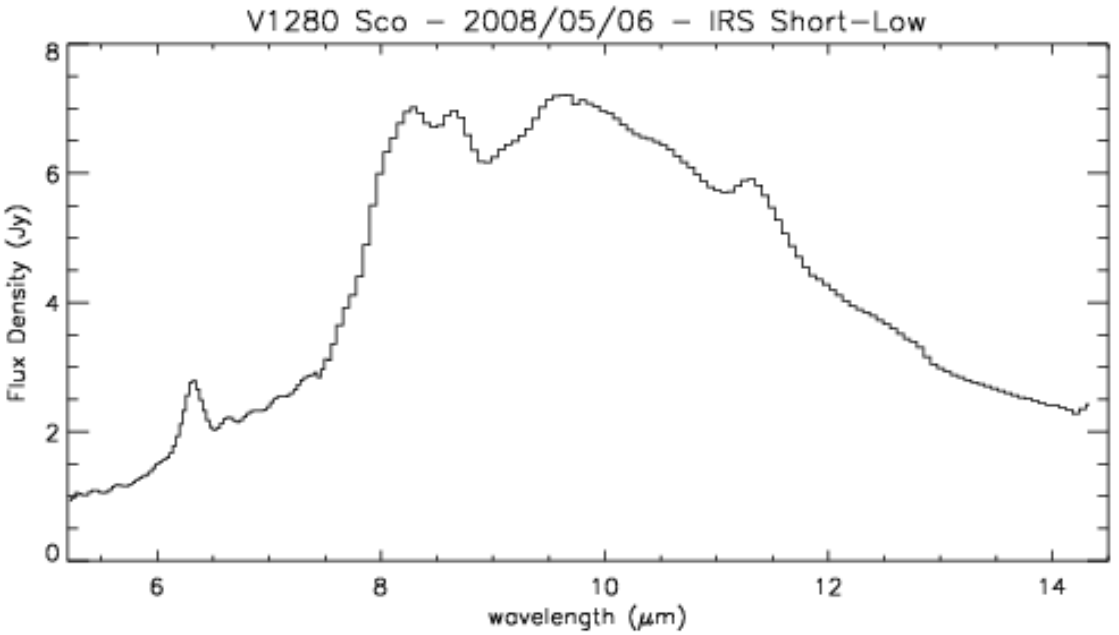


Lynch et al. 2008, AJ, 136, 1815

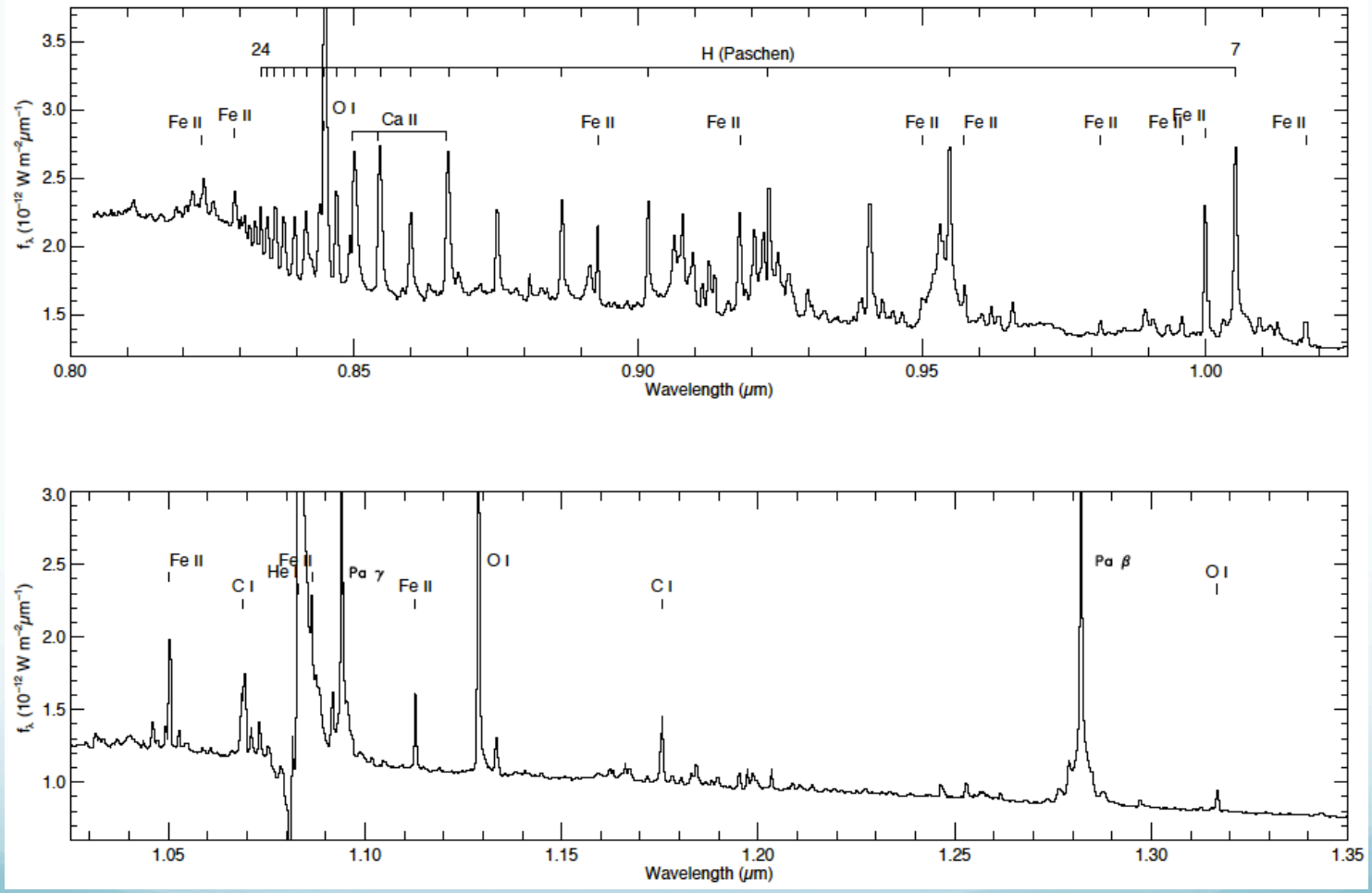
V1280 Scorpii



Chesneau et al. 2012, A&A 545, 63



V1280 Sco



IRTF SpeX – 17 Aug 2012 – Day XXX

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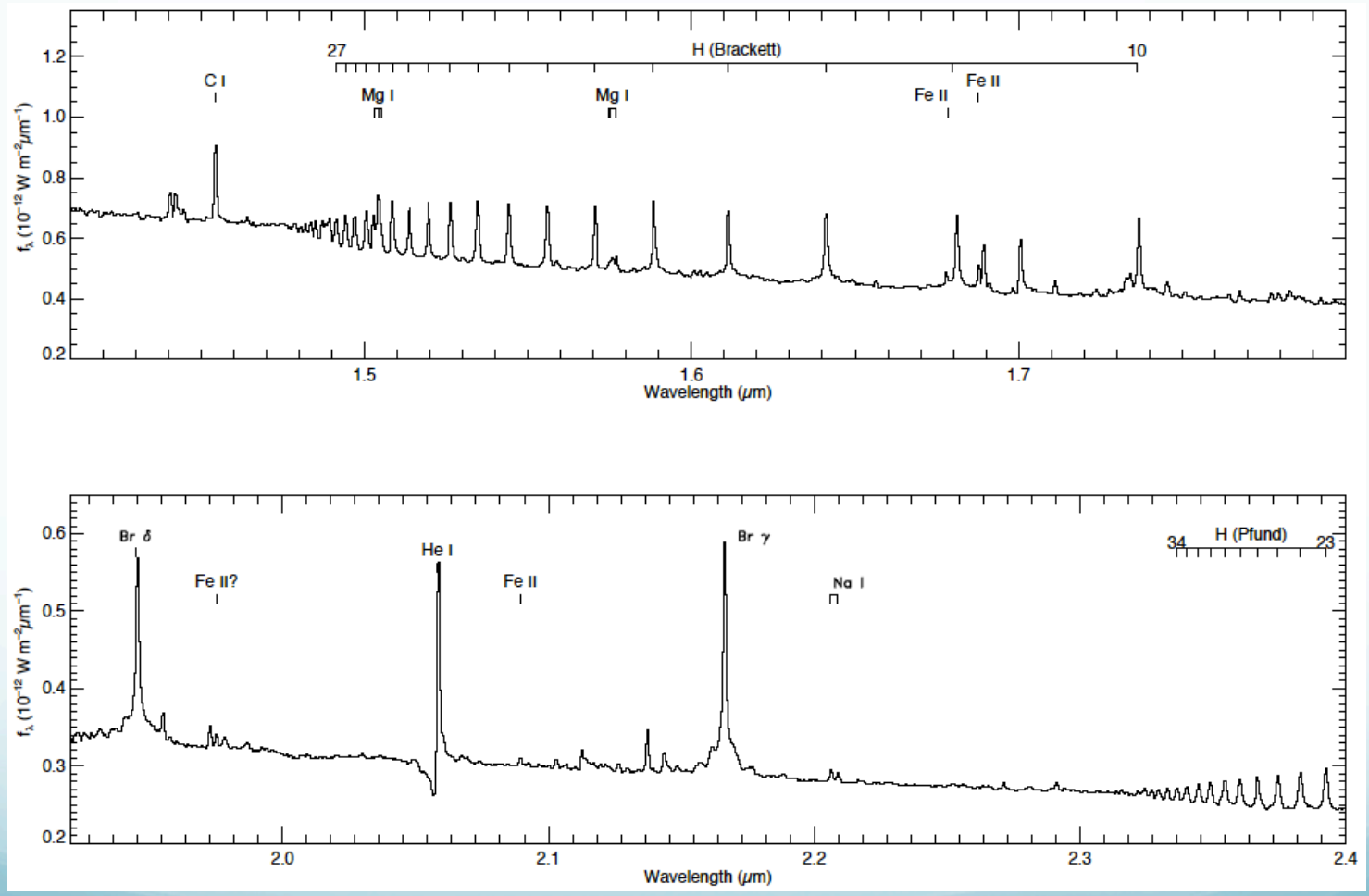
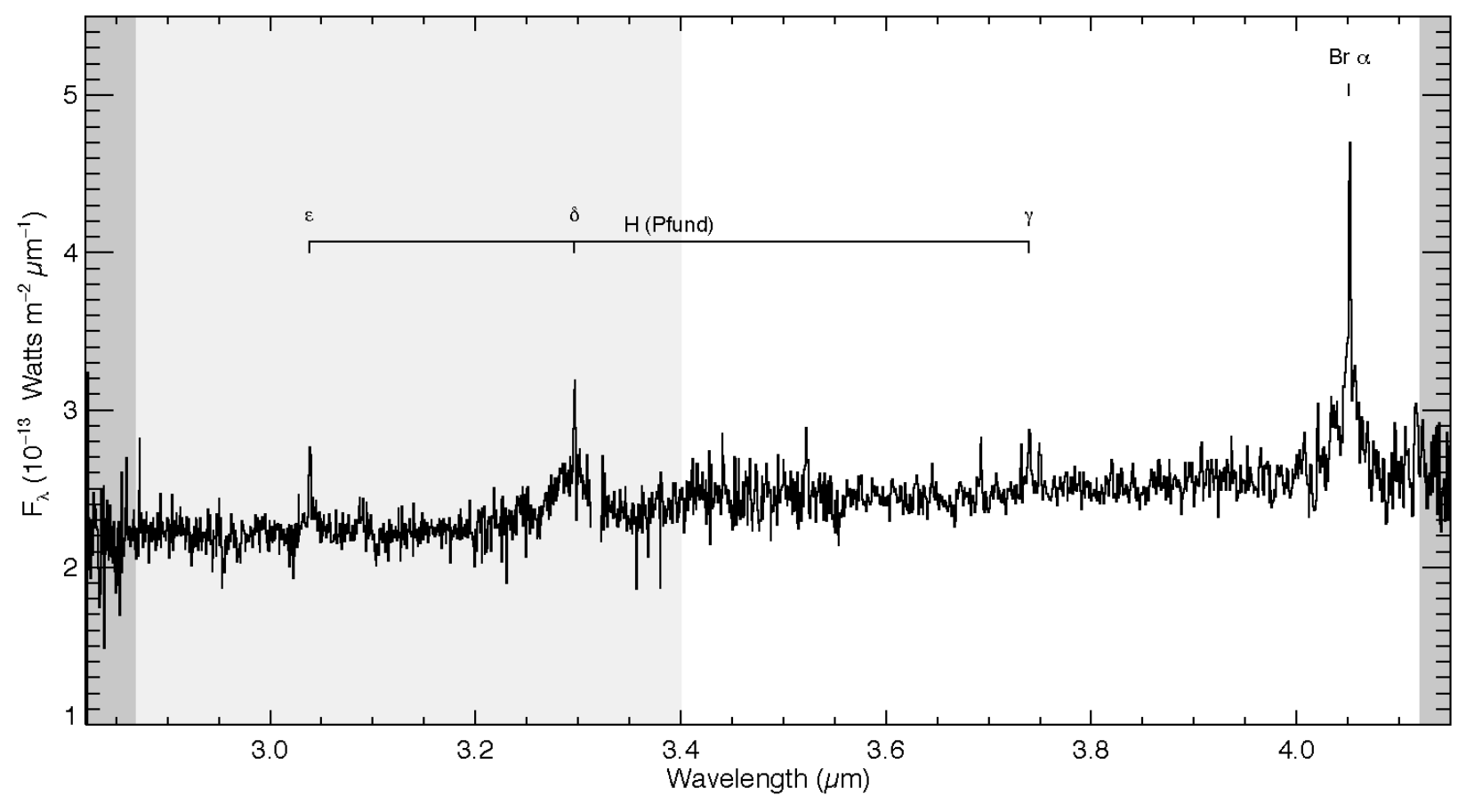


IRTF SpeX – 17 Aug 2012 – Day XXX

V1280 Sco – LXD



IRTF SpeX – 17 Aug 2012 – Day XXX

What now?

- How does the environment differ between hydrocarbon producing novae and those producing more “typical” dust species?
- What is the carrier of the hydrocarbon species?
- Are we seeing changes in excitation or evidence of hydrocarbon destruction and processing?
- What observations are needed to resolve the issue?