

Shocked Gas around SNRs and YSOs

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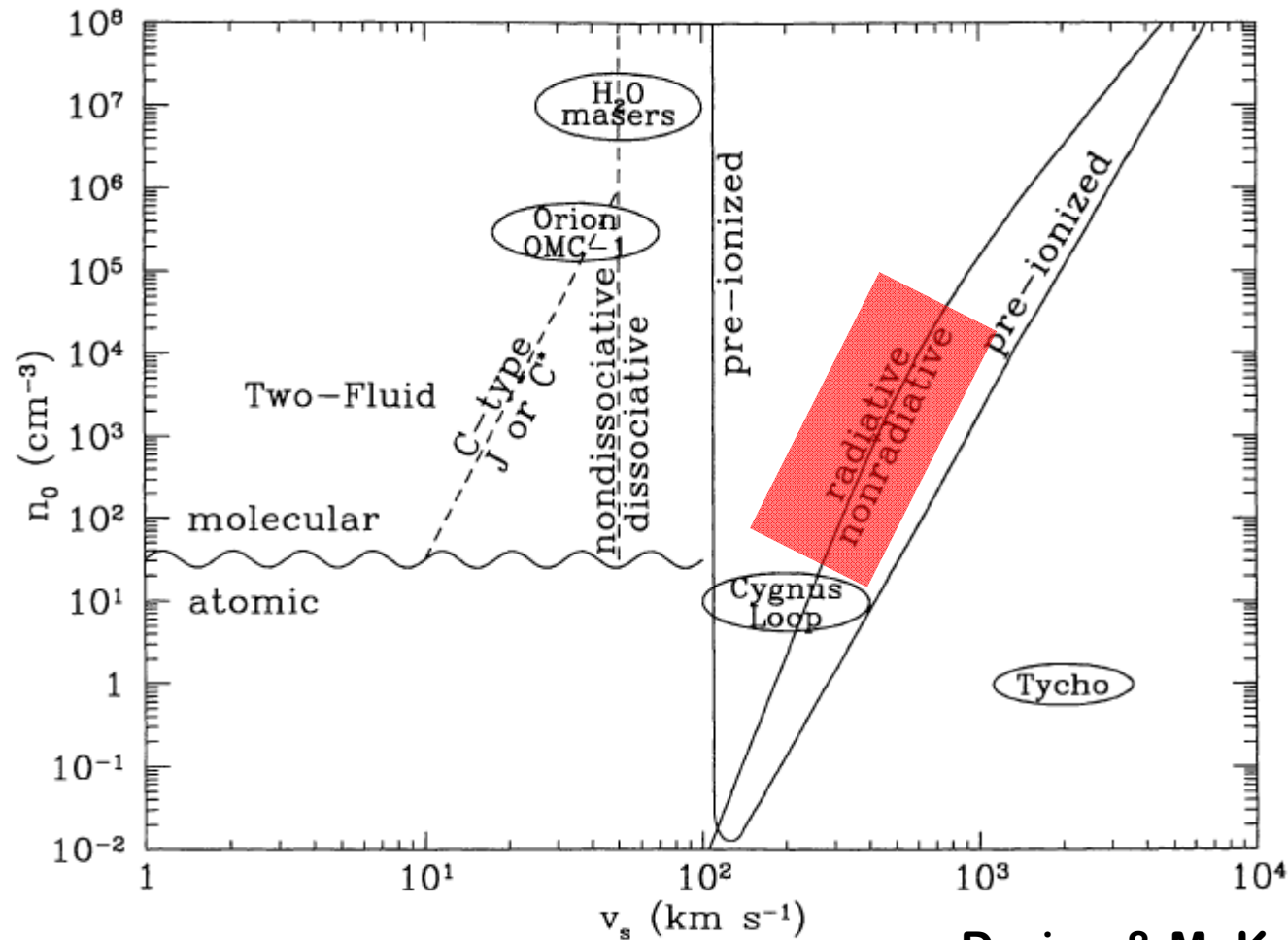
Shocks

- **Manifestation through radiations**
 - Energy flows
 - system dynamics, particle acceleration, ...
 - Medium States
 - density, temperature, element abundance, ...



Shocks

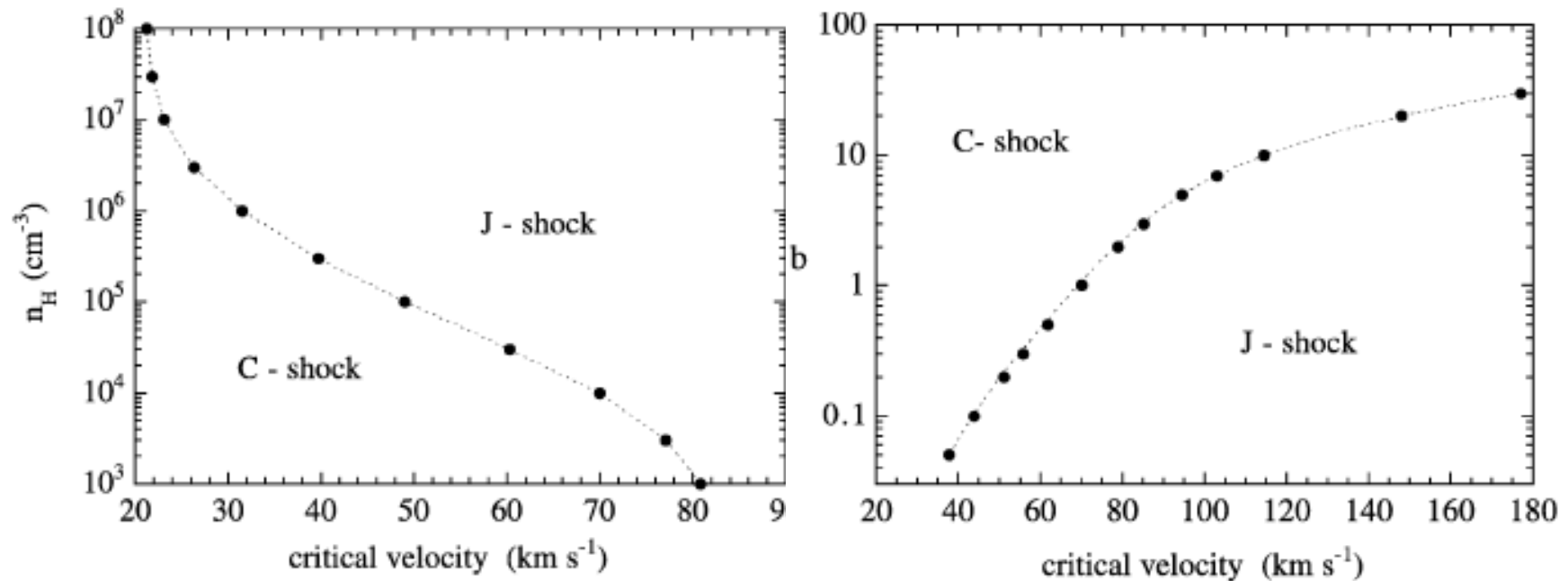
- Non-radiative & radiative



Draine & McKee (1993)

Radiative Shocks

- J & C-type shock

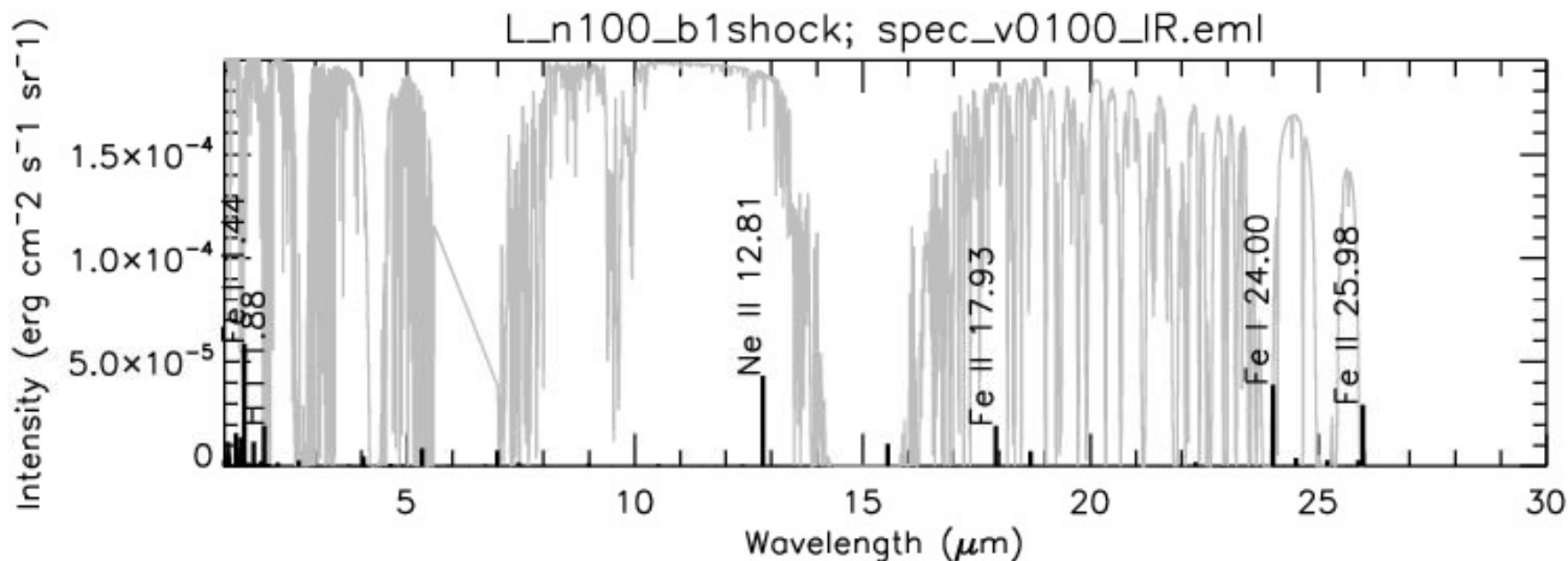
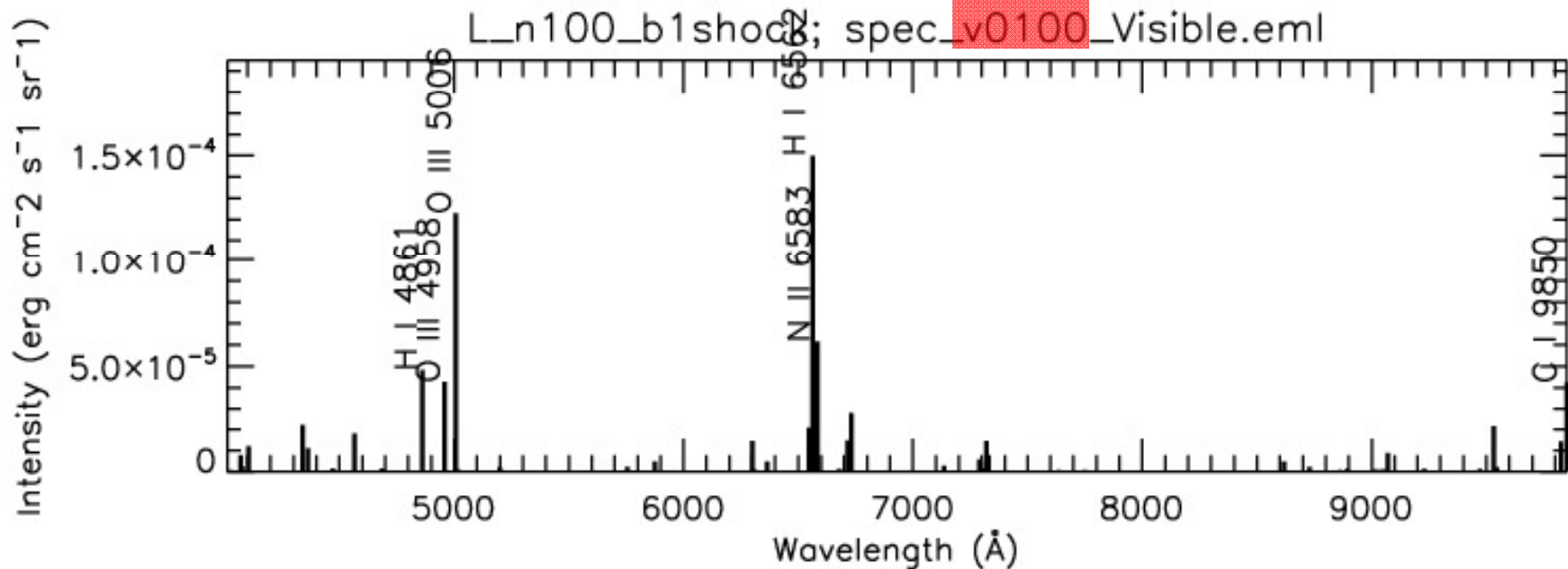


Le Bourlot et al.
(2002)

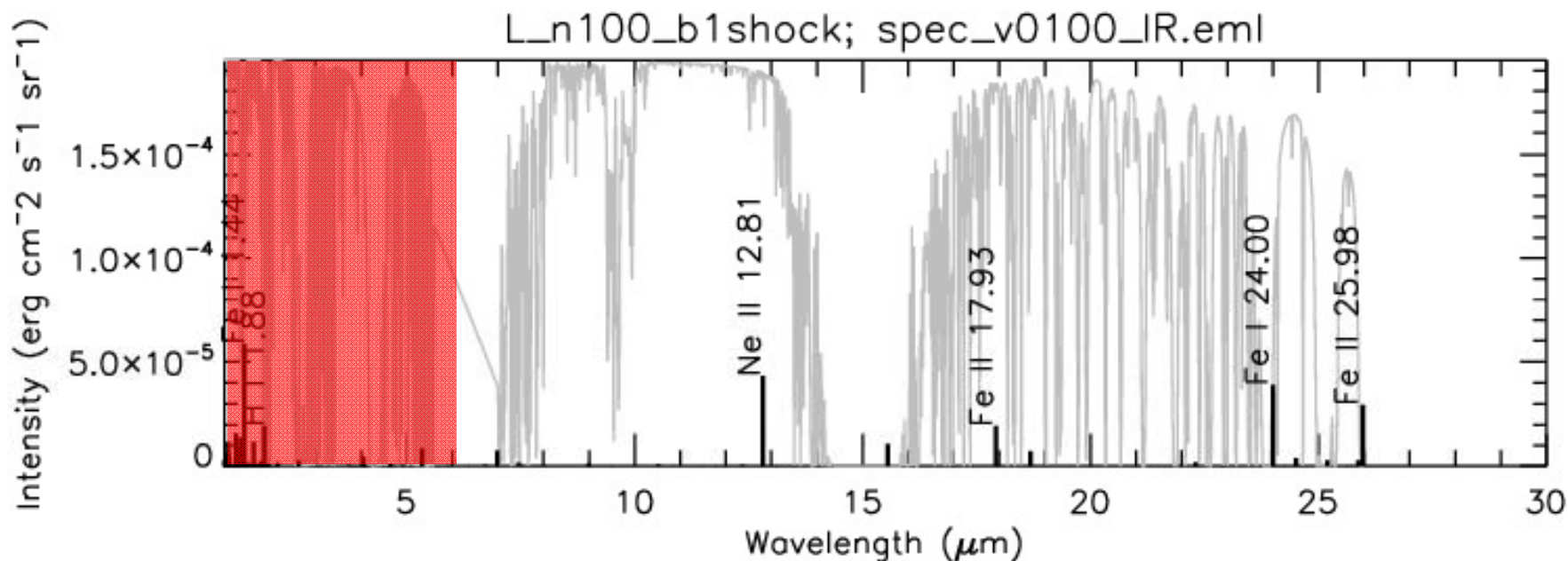
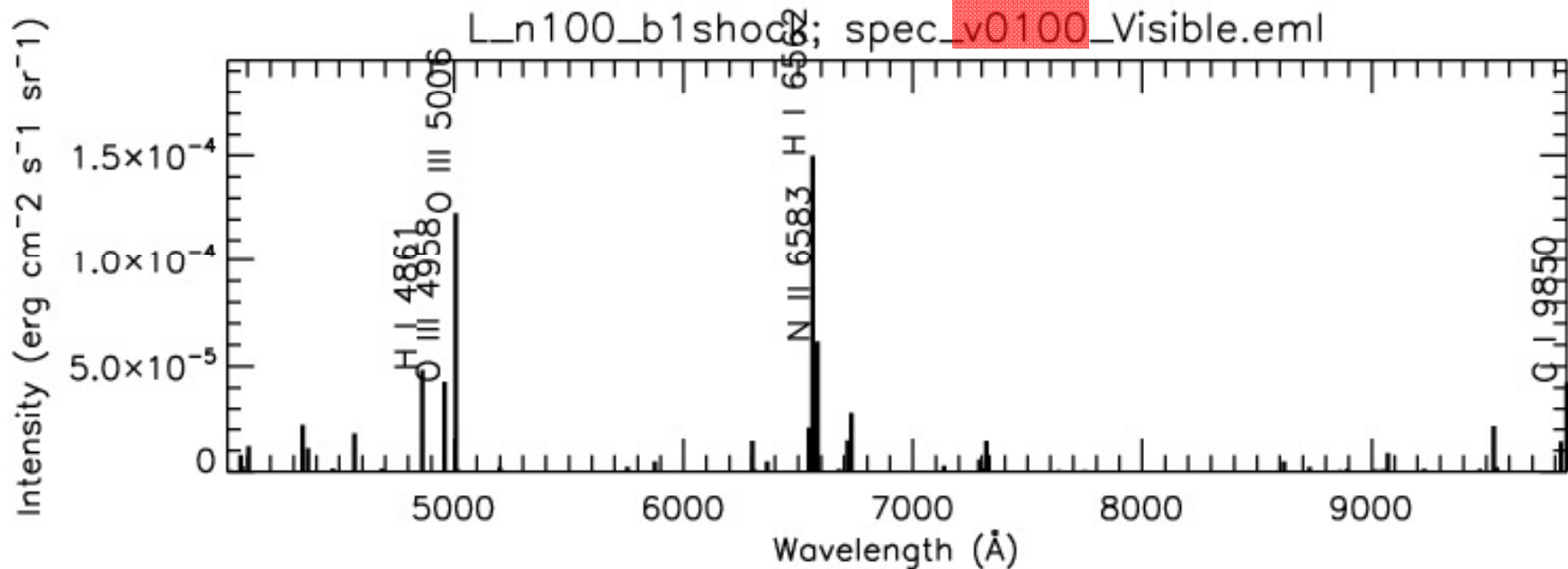
J-Shocks in GMT coverage

- **Emission lines**
 - **Visible**
 - Ionic: [N II], [O III], [S II]
 - Atomic: H-Balmer, [C I]
 - Molecular: N/A
 - **Infrared**
 - Ionic: [Fe II]
 - Atomic: H-Paschen, H-Brackett
 - Molecular: H₂, CO, H₂O

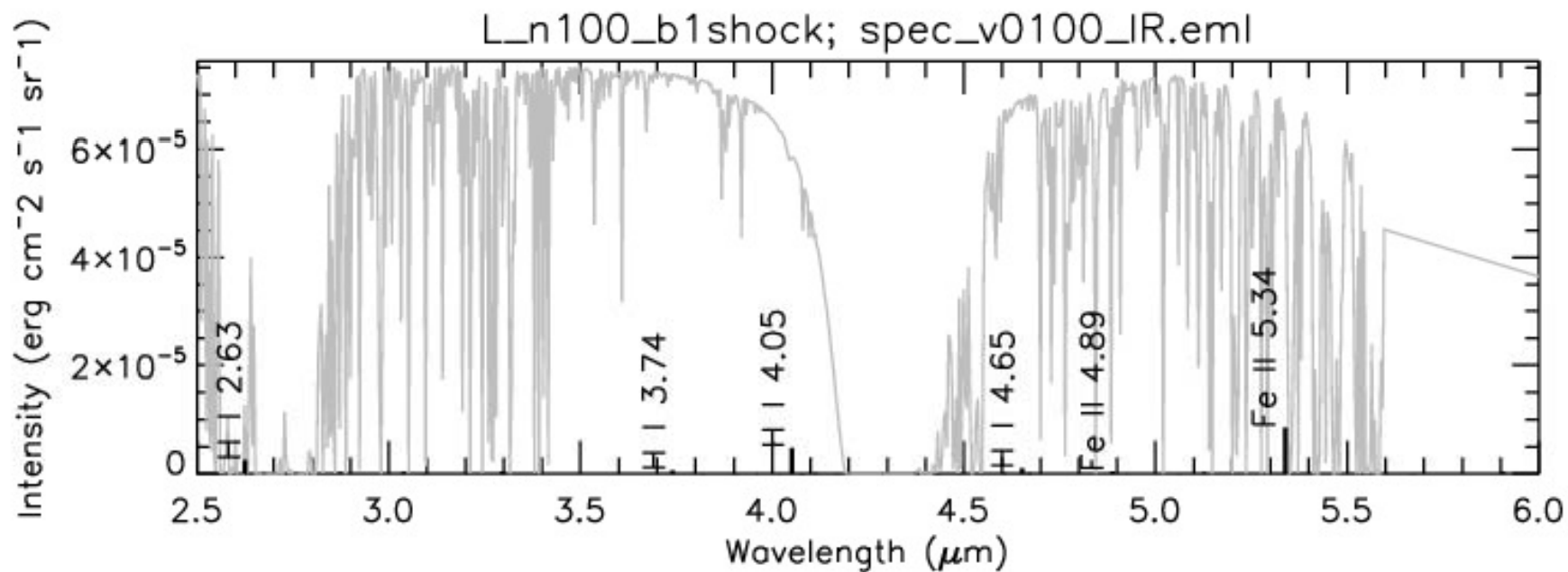
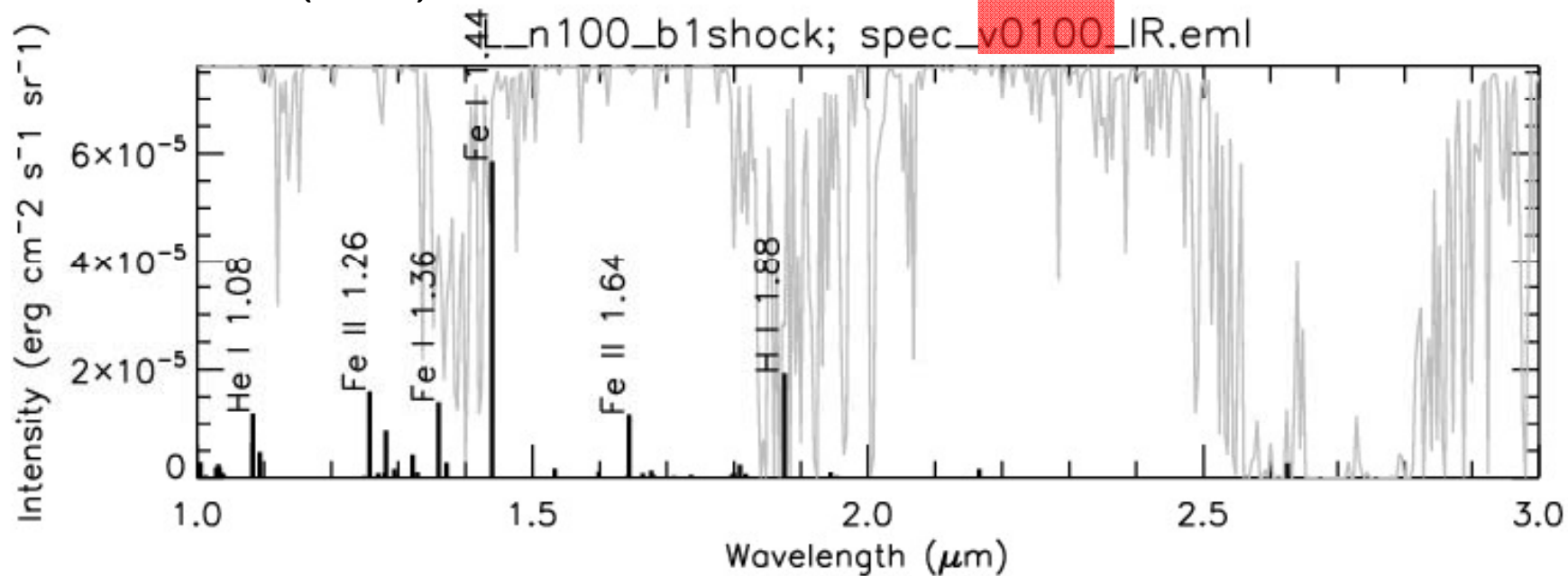
Allen et al. (2008)

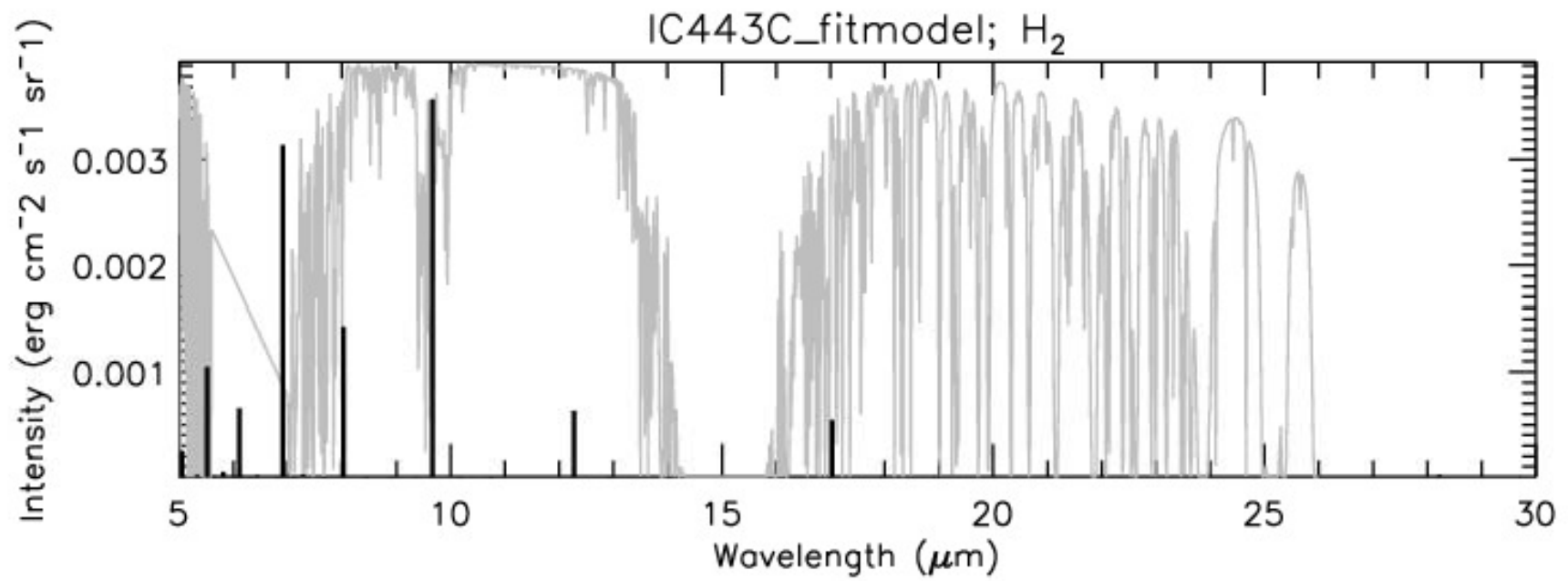
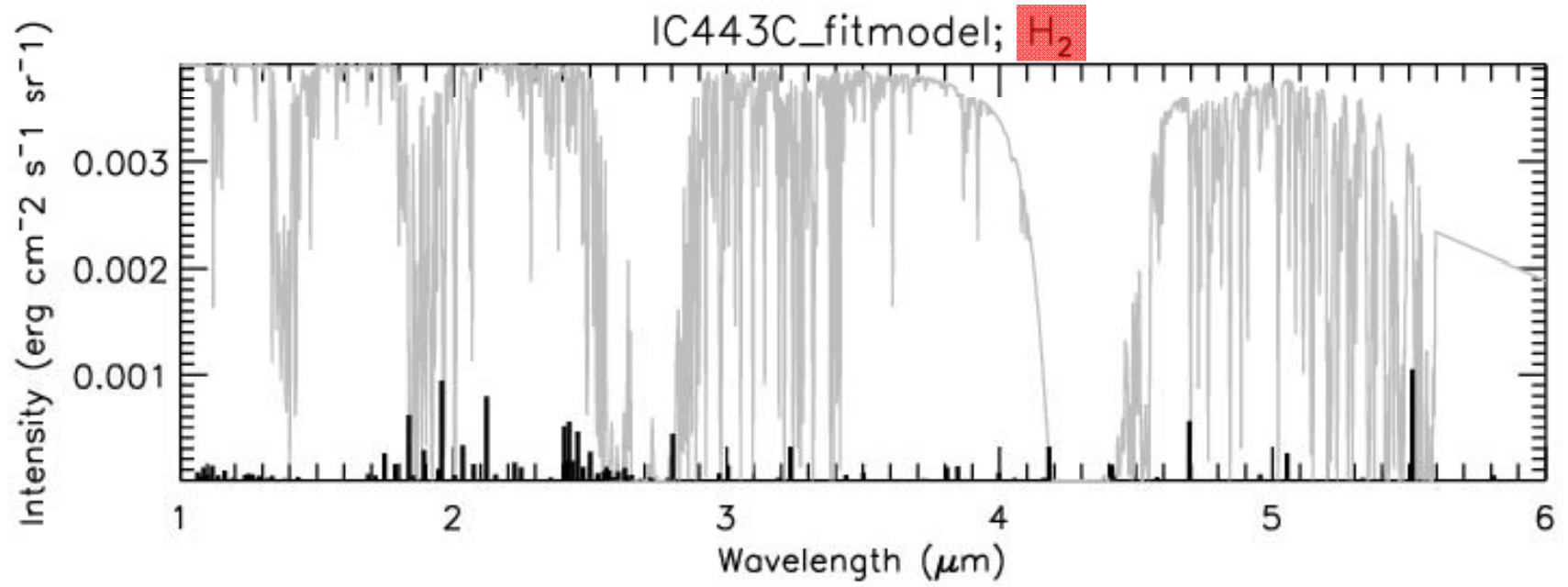


Allen et al. (2008)



Allen et al. (2008)

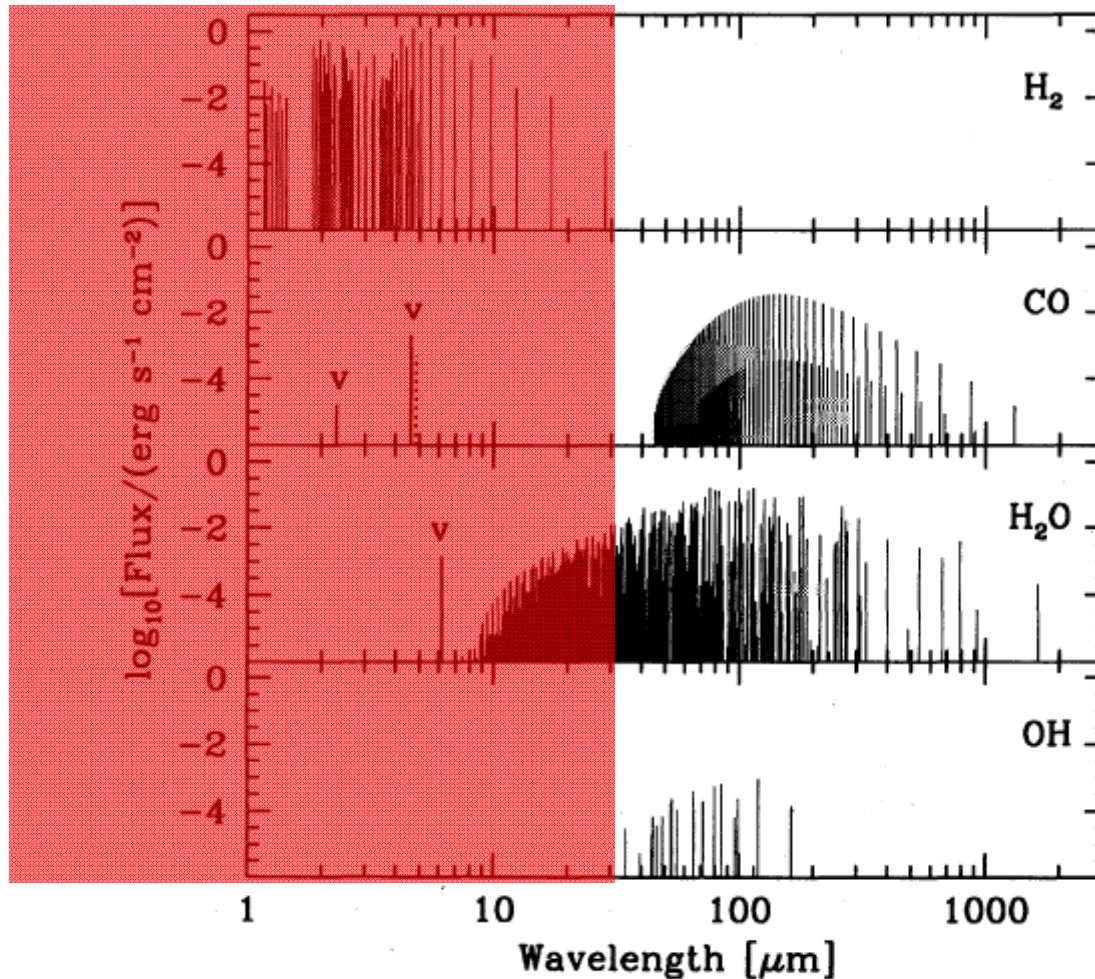




C-Shocks in GMT coverage

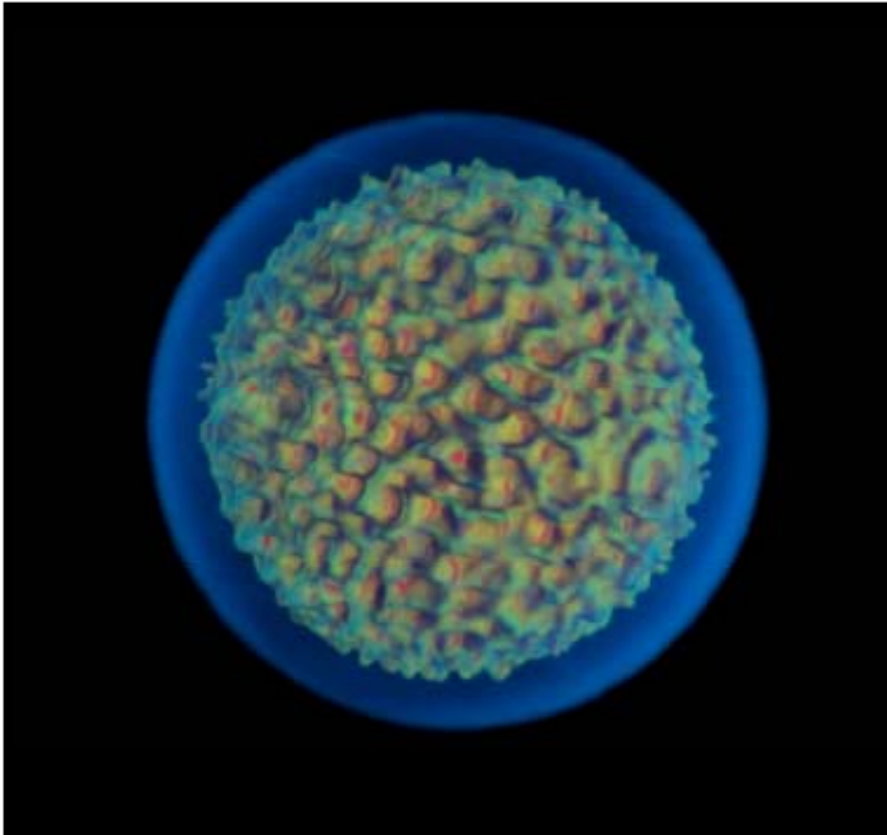
- **Emission lines**
 - **Visible**
 - Ionic: N/A
 - Atomic: N/A
 - Molecular: N/A
 - **Infrared**
 - Ionic: N/A
 - Atomic: N/A
 - Molecular: H₂, CO, H₂O?

C-Shocks in GMT coverage

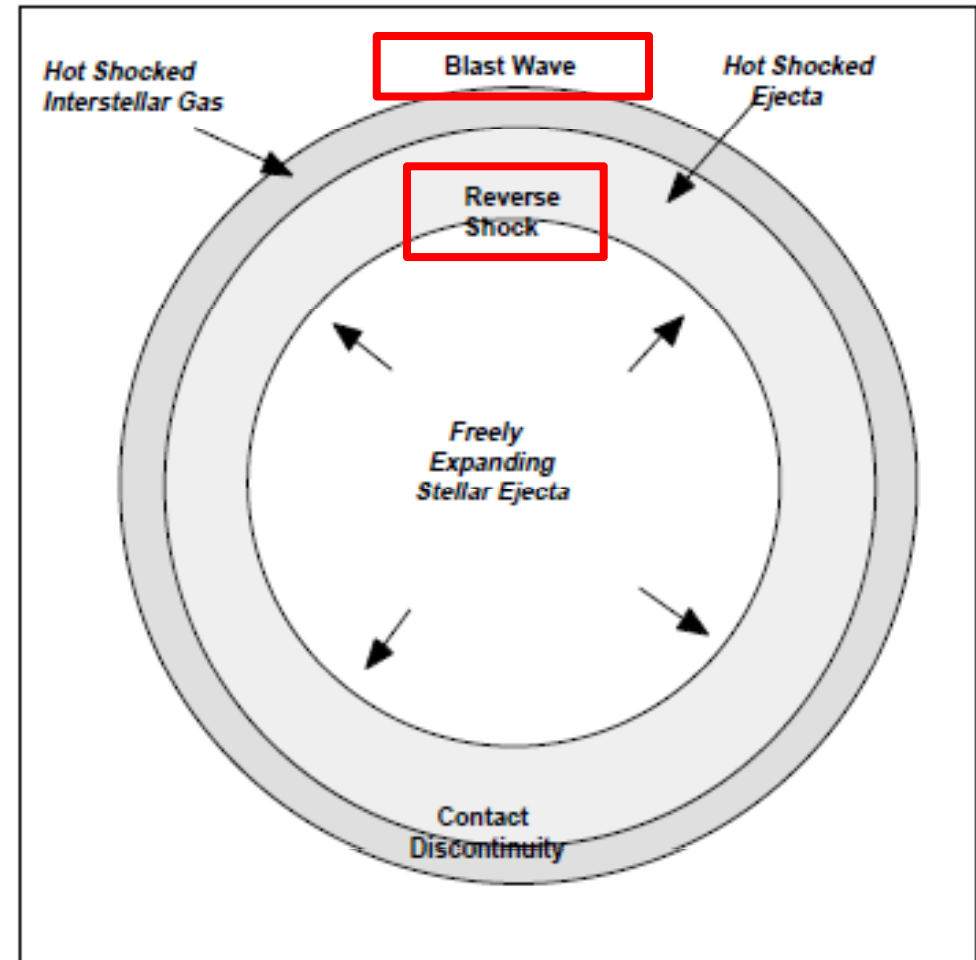


$V=40 \text{ km/s}$, $n=10^5 \text{ cm}^{-3}$
Kaufman & Neufeld (1996)

SNRs

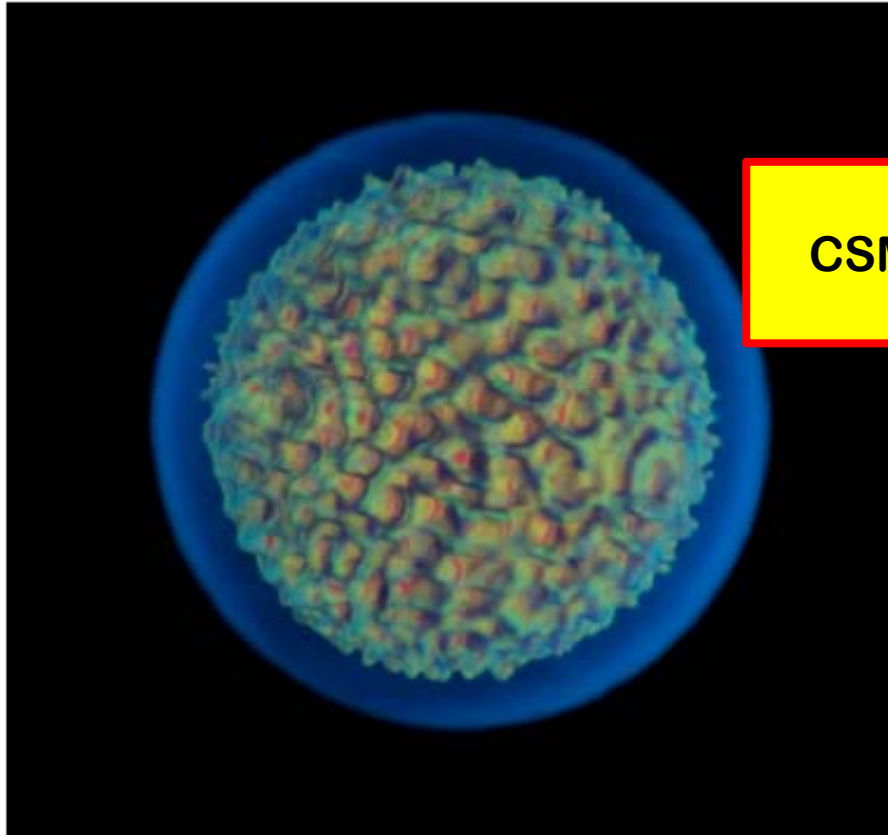


Miceli (2009)



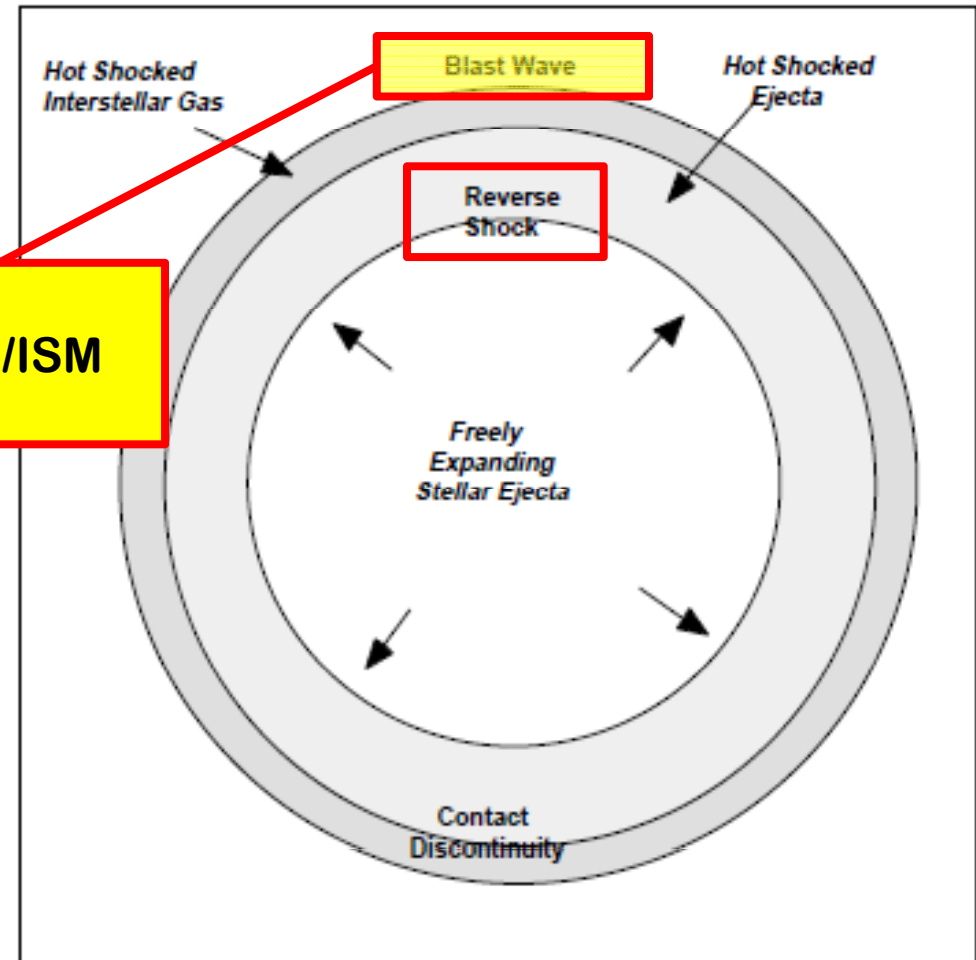
Dopita & Sutherland (2004)

SNRs



Miceli (2009)

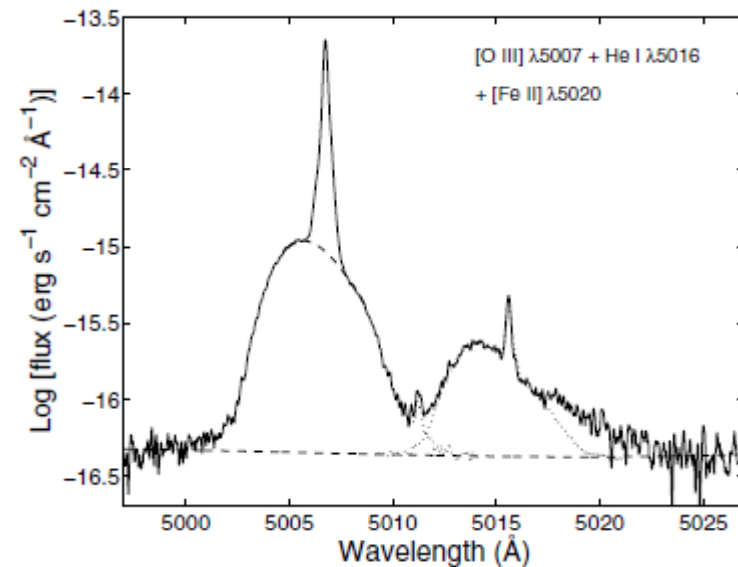
CSM/ISM



Dopita & Sutherland (2004)

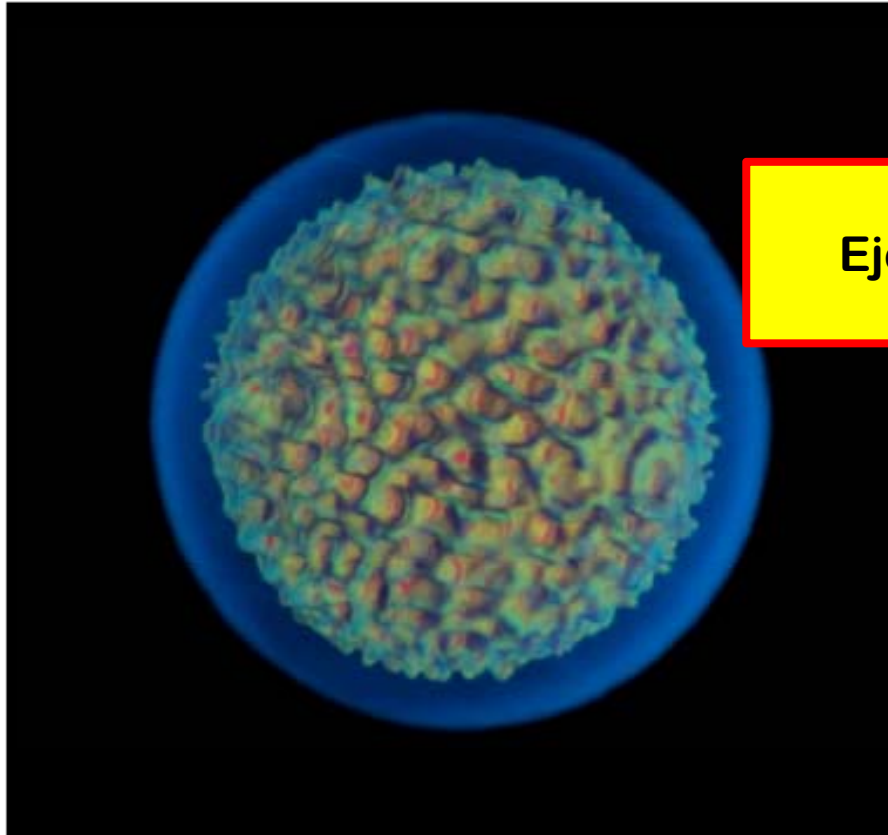
SNRs – CSM; SN 1987A

- VLT/UVES
 - $R \sim 50,000$
- Line width
 - Nebular analysis
 - Narrow: unshocked, 10^3 cm^{-3}
 - Intermediate: the photoionization zone behind the radiative shock, 10^7 cm^{-3}
- Density & structure of CSM

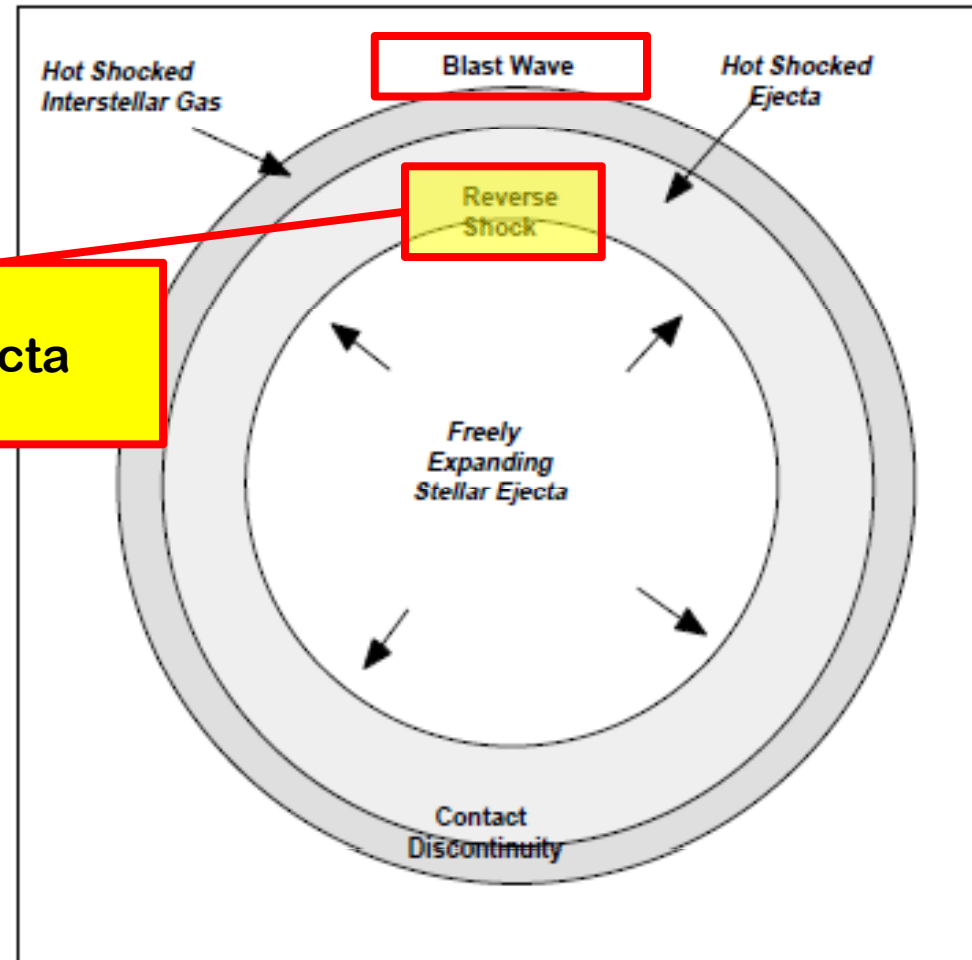


Gröningsson et al. (2008)

SNRs



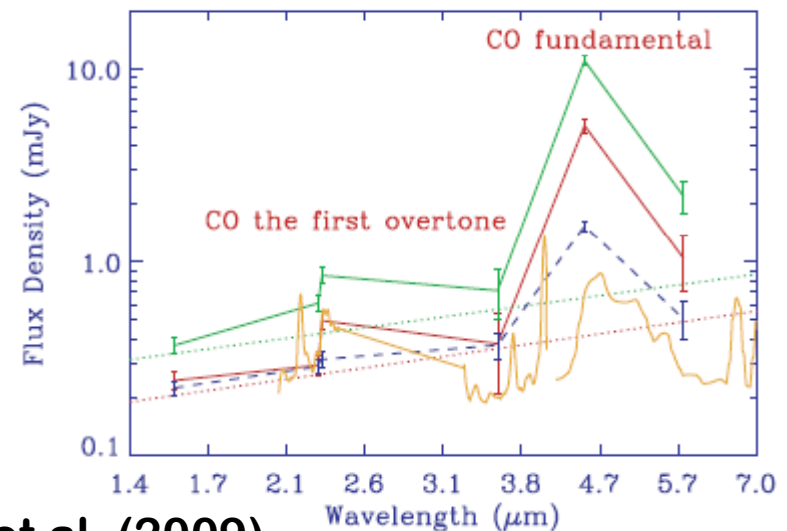
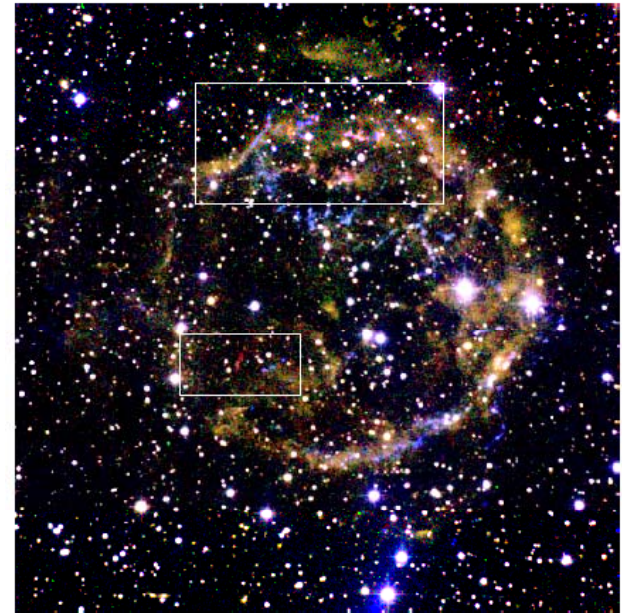
Miceli (2009)



Dopita & Sutherland (2004)

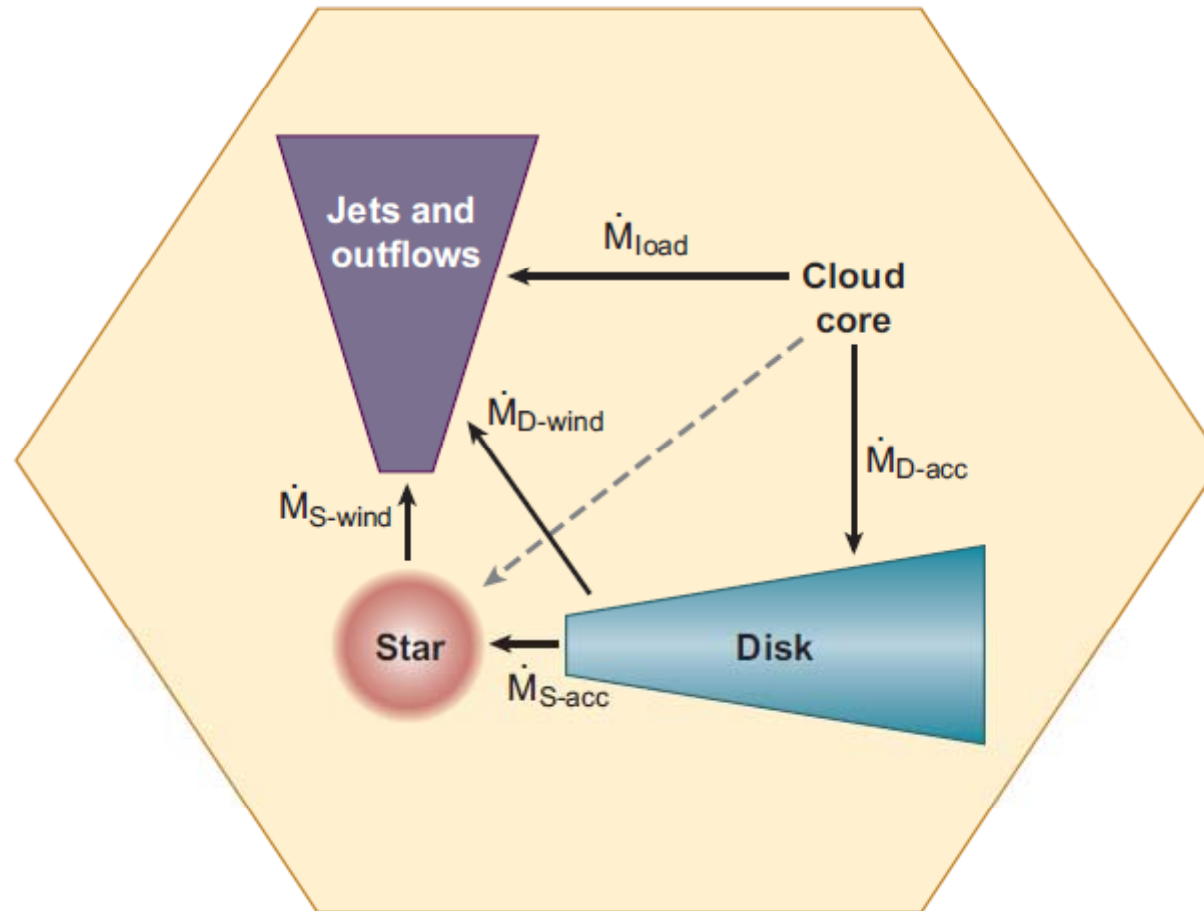
SNRs – Ejecta; Cas A

- Palomar/WIRC
- CO $v=1-0$ & $v=2-0$
- CO in reverse shock
 - Small molecule mixing in ejecta
 - Astrochemical process & molecule formation last long (~300 yr)



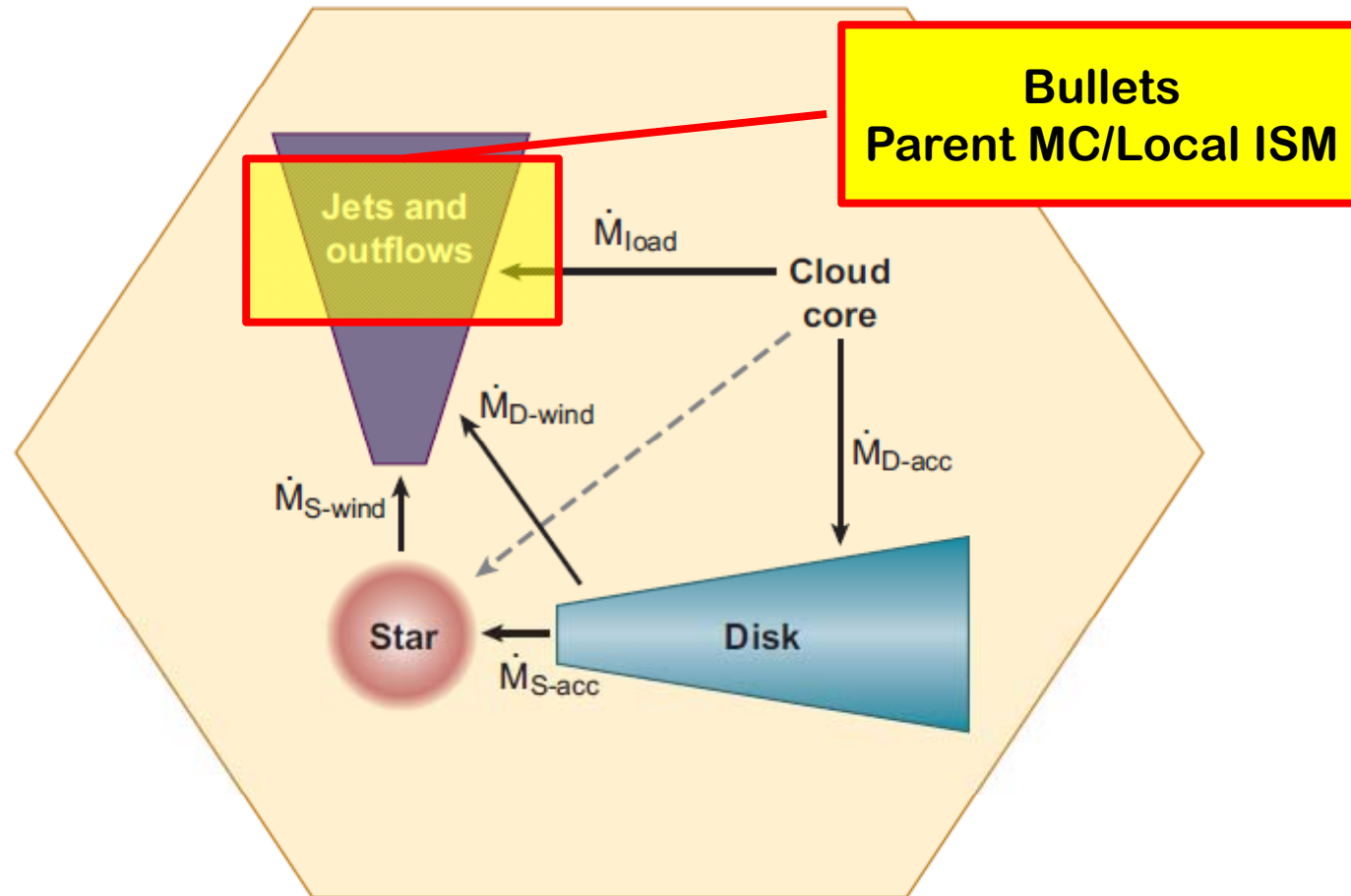
Rho et al. (2009)

Jets/Outflows of YSOs



Zinnecker & Yorke (2007)

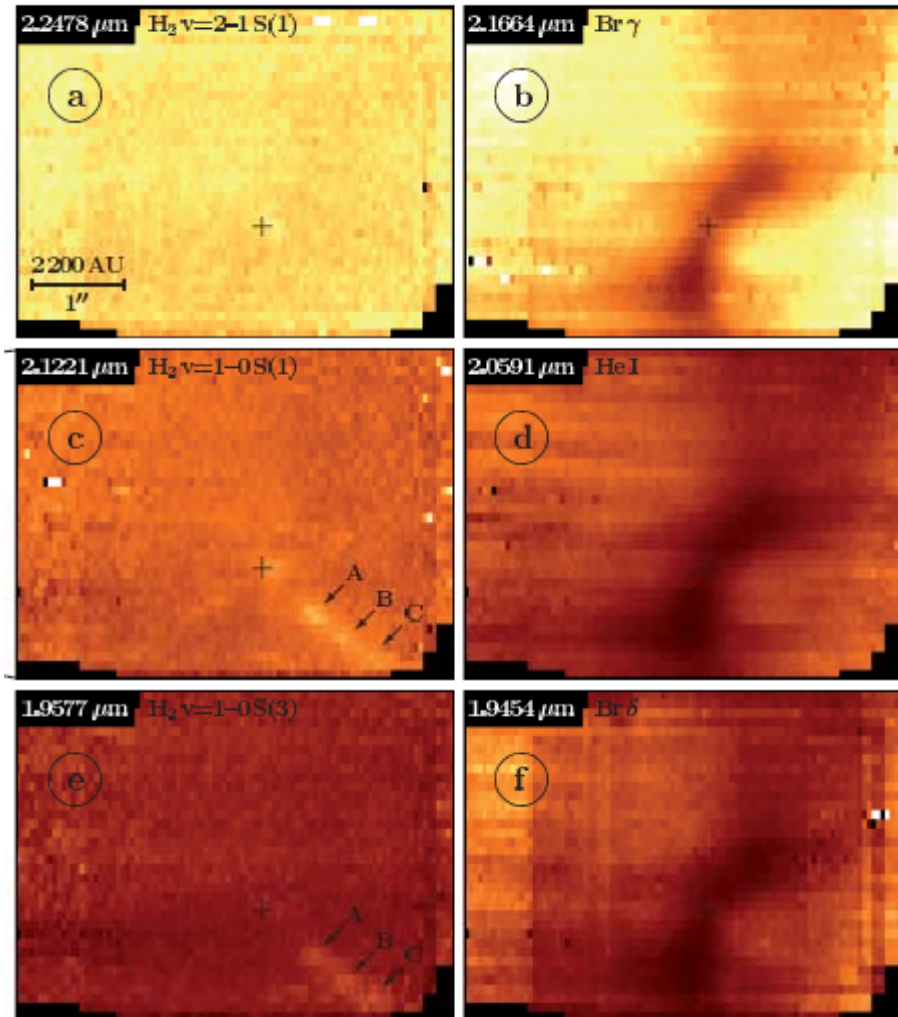
Jets/Outflows of YSOs



Zinnecker & Yorke (2007)

YSOs; M 17 disk

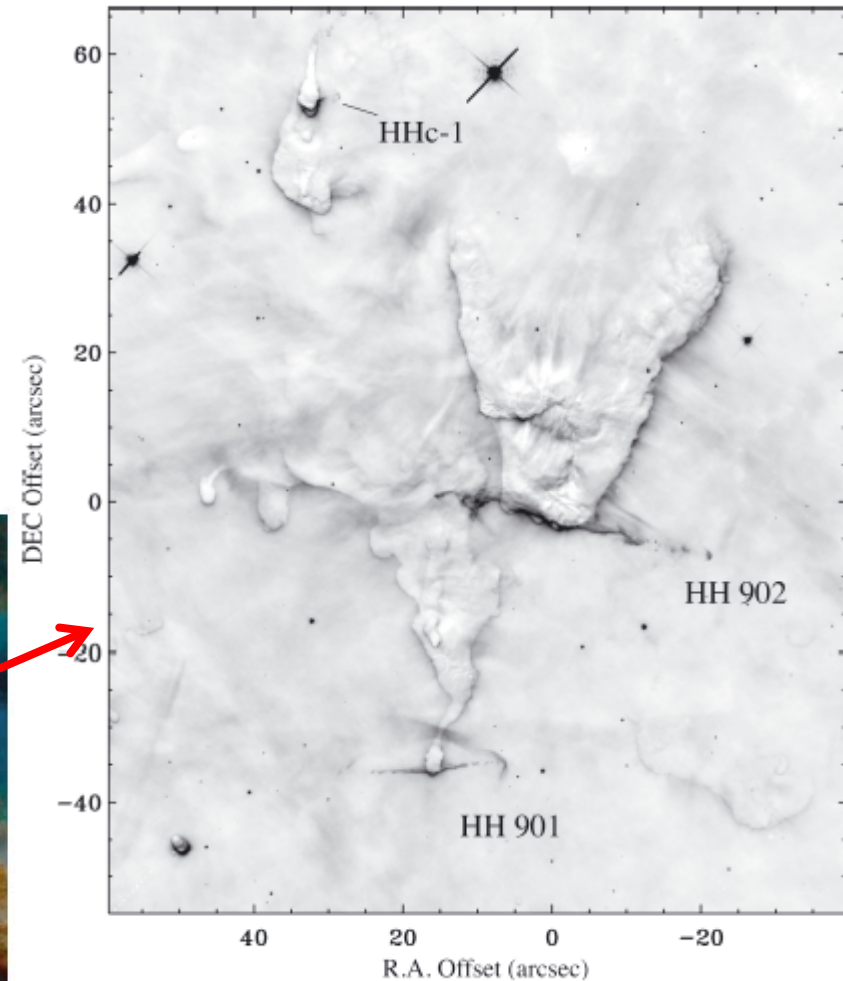
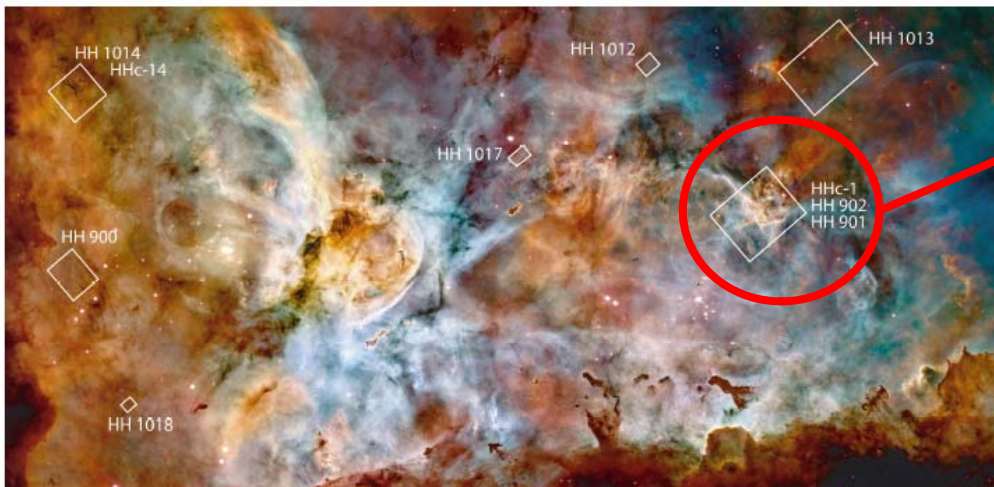
- SINFONI, AO
 - FoV: $4.8'' \times 3.6'' \sim 10560 \text{ AU} \times 7920 \text{ AU}$
- H_2 jet
 - $L(\text{H}_2) \rightarrow dM_{\text{acc}}/dt > 10^{-5} M_{\text{sun}}/\text{yr}$
- Disk silhouette against M 17 H II regions
 - $\text{Br}\gamma$, $\text{Br}\delta$, He I



Nurnberger et al. (2007)

HH objects in Carina Nebula

- HST-ACS/WFC, H α
 - R \sim 0.1''
- New HH objects
 - 21 + 17 candidates
 - D $<$ 0.01 pc; Active SF



Smith et al. (2010)

What can we do with GMT?

- **Higher sensitivity (V & IR)**
 - Attack **obscured** regions
- **Higher imaging resolution (IR)**
 - Attack **complex** regions
- **Higher spectral resolution (IR)**
 - Attack **small kinematic variations**

What can we do with GMT?

- **Higher sensitivity (V & IR)**
 - Attack **obscured** regions
 - e.g. Massive SF, Larger sample
- **Higher imaging resolution (IR)**
 - Attack **complex** regions
 - e.g. Source Identification (CS/Jet/AccDisk)
- **Higher spectral resolution (IR)**
 - Attack **small kinematic variations**
 - e.g. Slow shocks