Group C – J.R. Pardo

SiO masers in AGB stars

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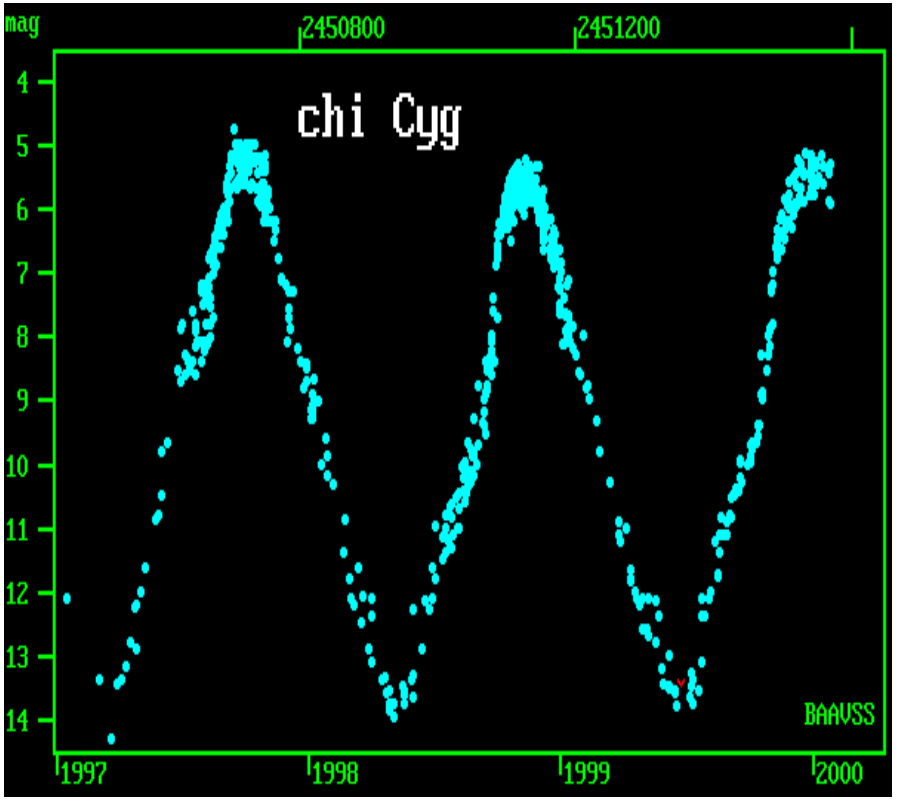
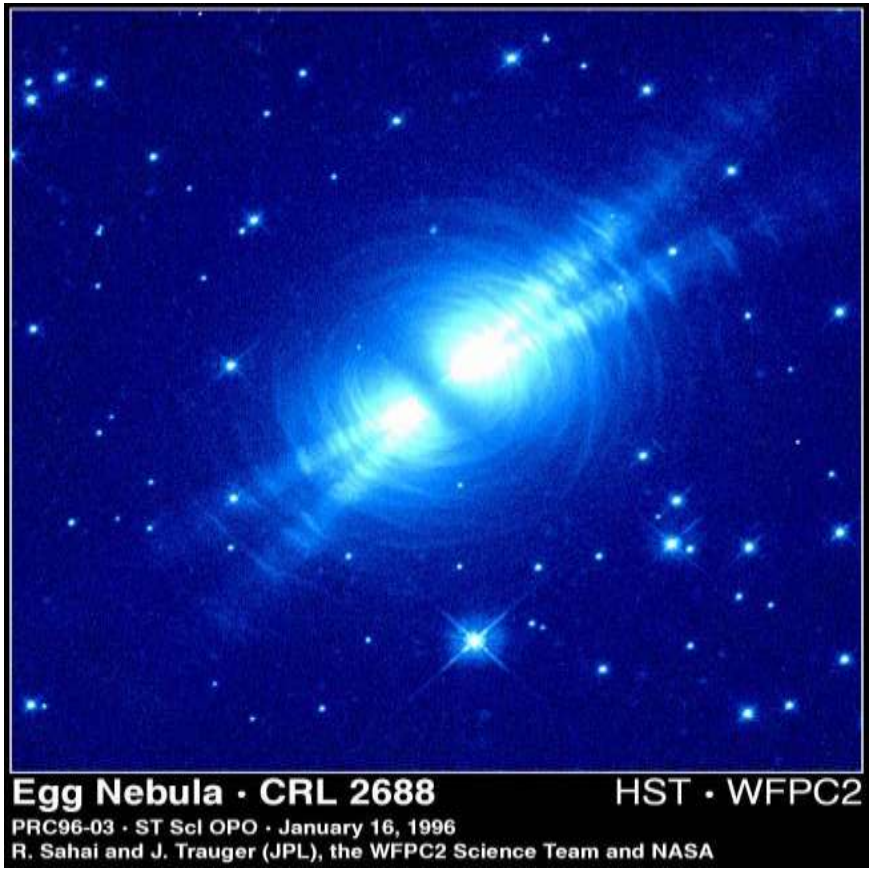
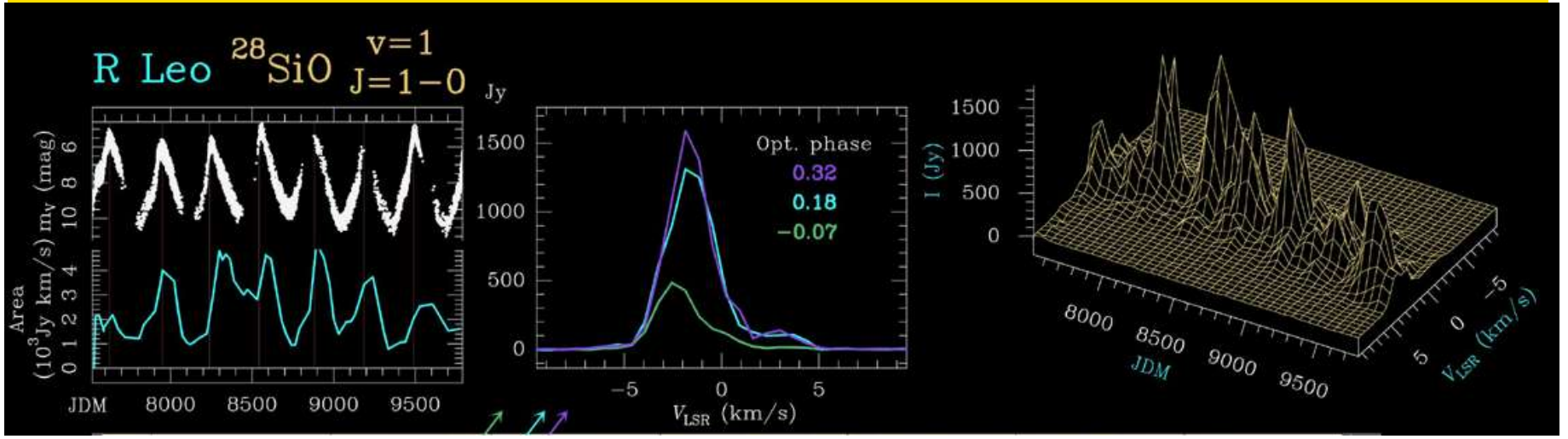
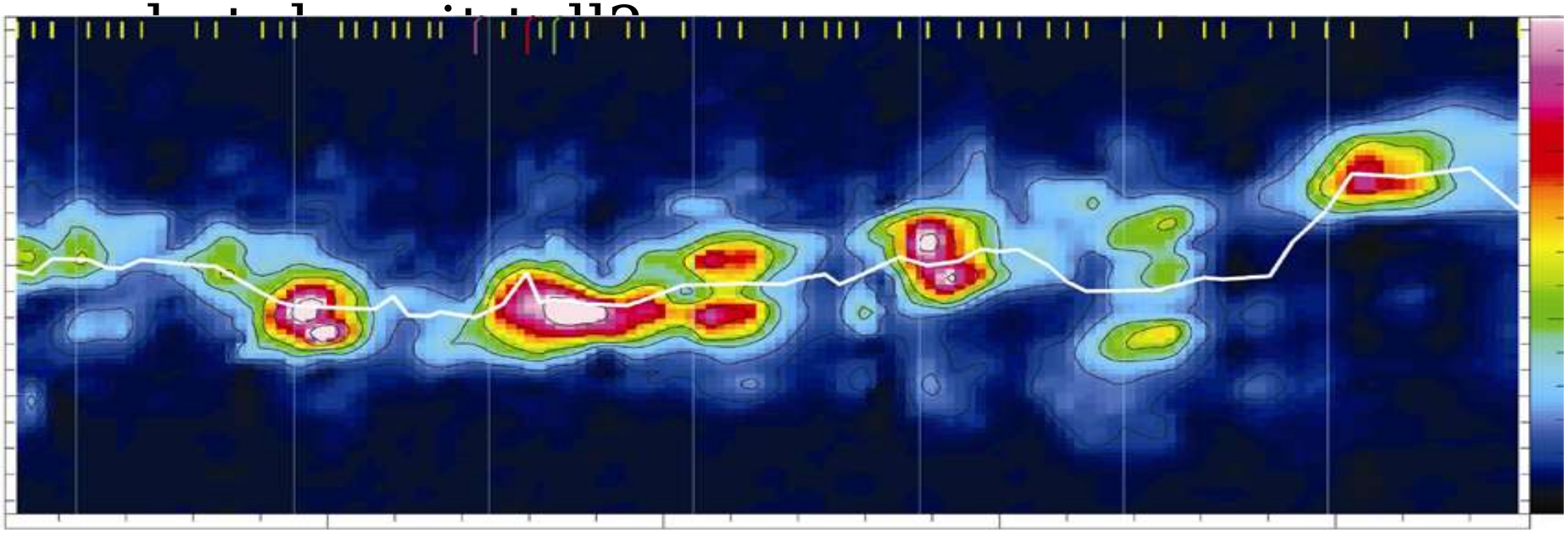
Comparing CRL 2688, CRL 618 and NGC 7027



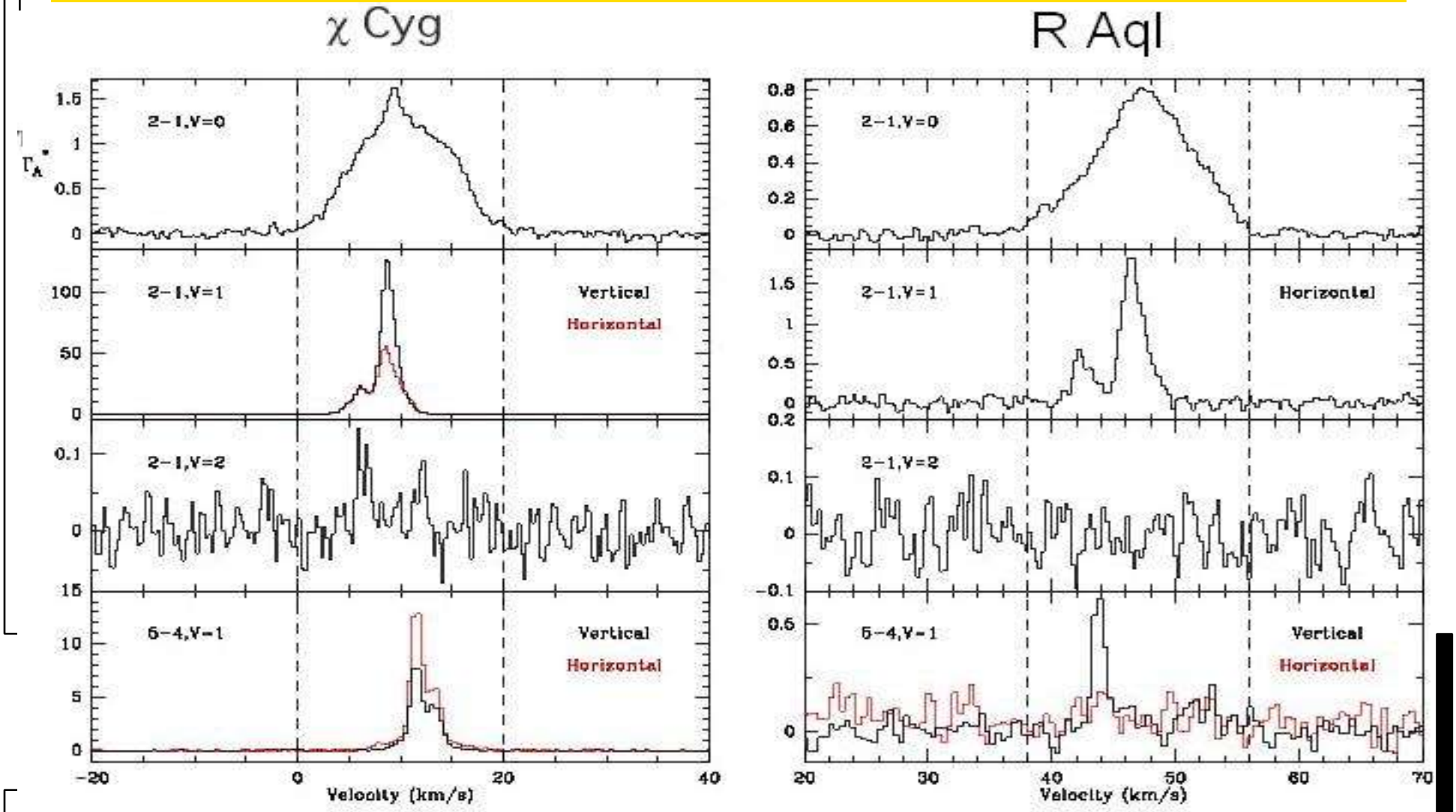


SiO masers

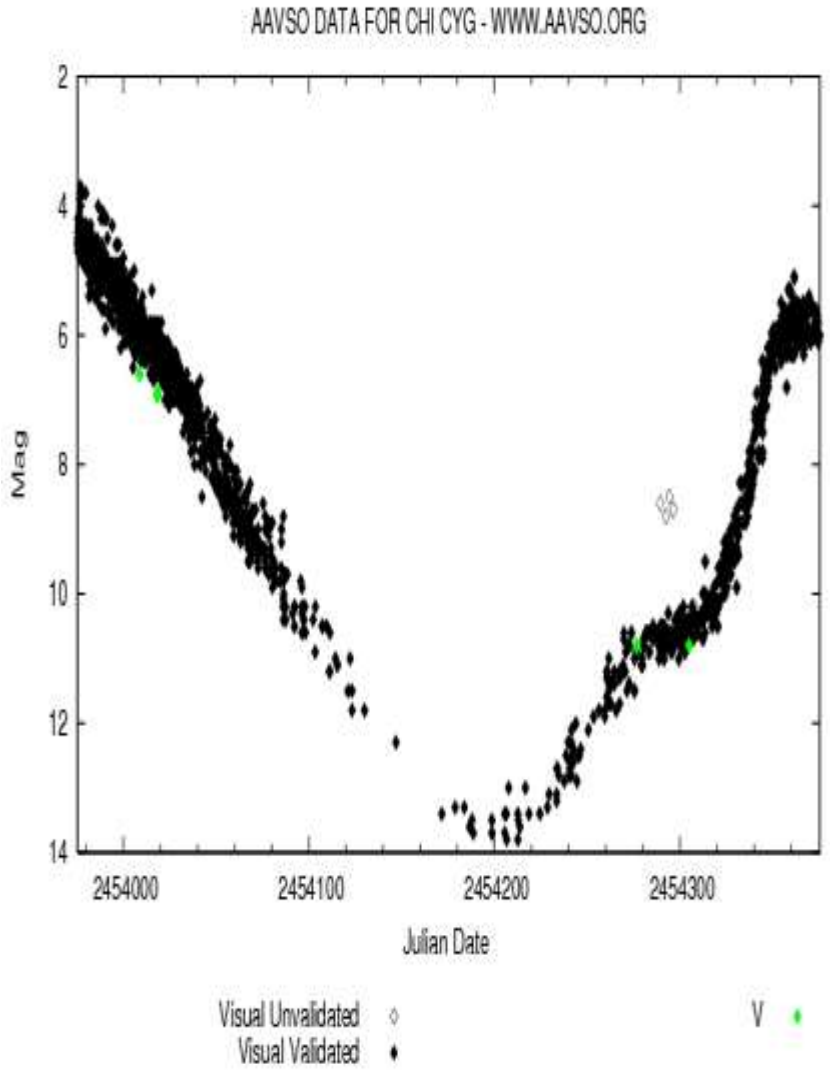

R Leo
28SiO
v=1
J=1−0
Jy
Area
(10^3 Jy km/s)
m_V (mag)
JDM
8000
8500
9000
9500
1500
1000
500
0
Opt. phase
0.32
0.18
−0.07
−5
0
5
V_LSR (km/s)
I (Jy)

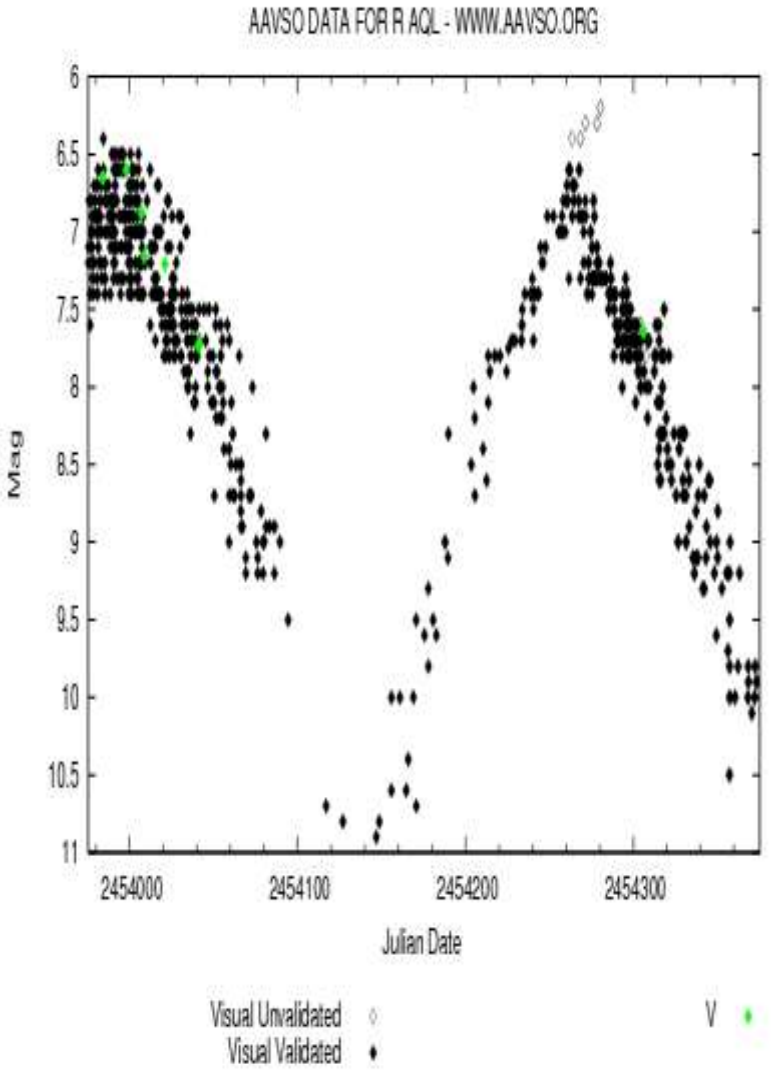


SiO masers


χ Cyg
R Aql
2-1,V=0
2-1,V=1
2-1,V=2
6-4,V=1
Vertical
Horizontal
Velocity (km/s)

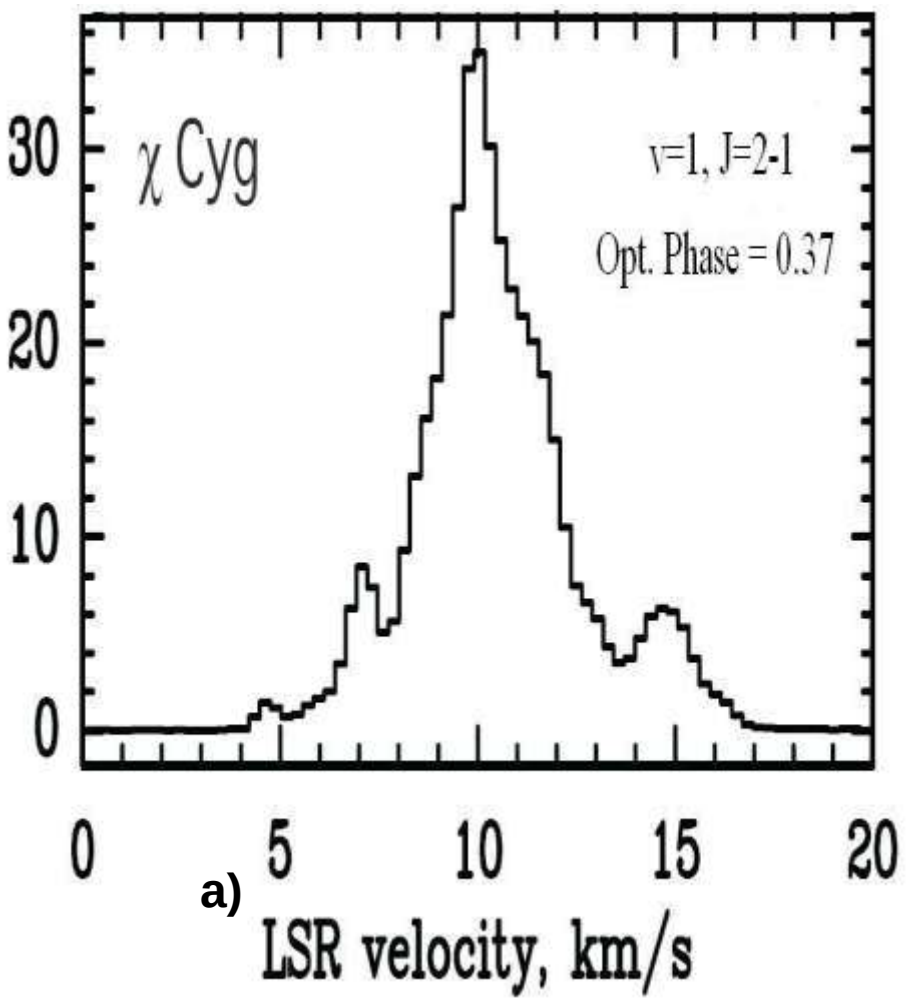
SiO masers



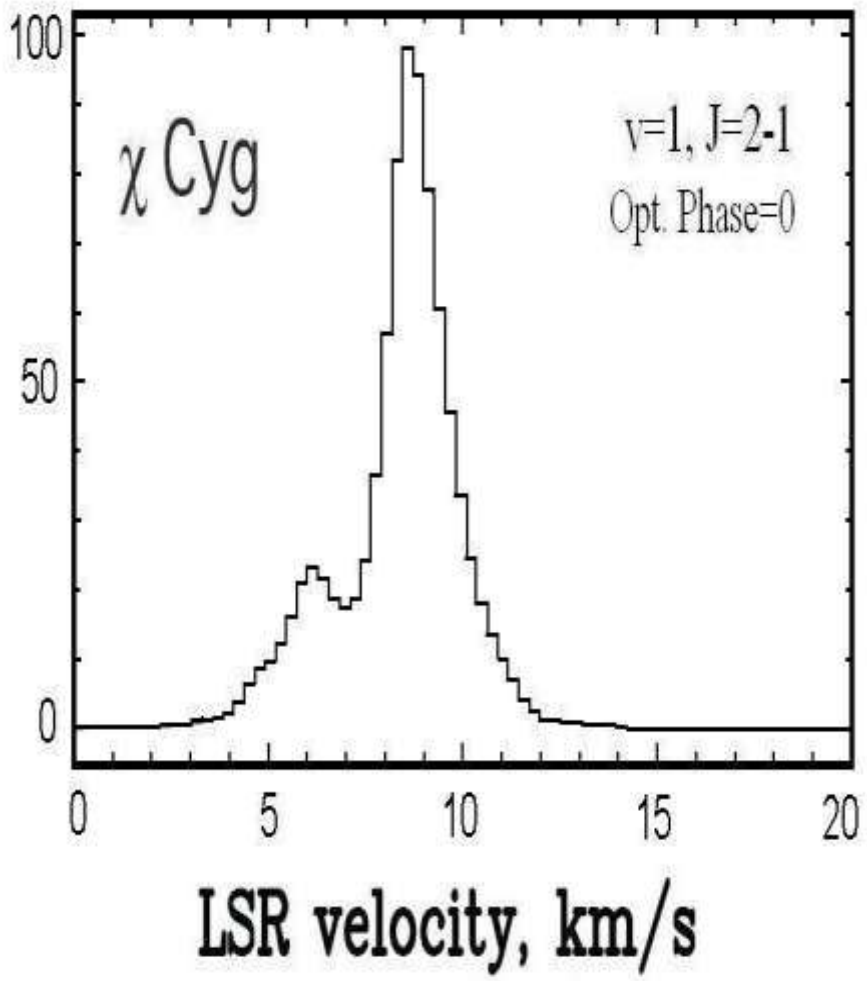


http://www.aavso.org/data/lcg/

SiO masers



a)



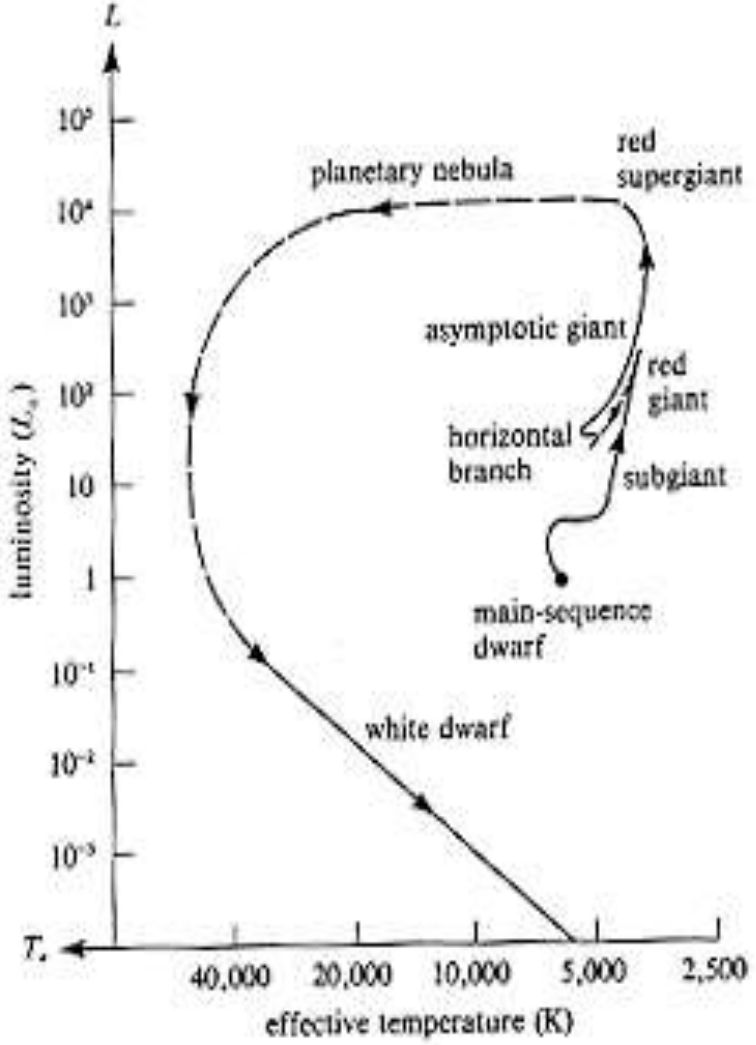
a) *F.Herpin, A. Baudry, C. Thum, D.Morris, and H.Wiesemeyer, A&A 450, 667–680 (2006)*

Protoplanetary Nebulae (PPNe)

- transition step from Post-AGB to Planetary Nebula and finally White Dwarf
  ± 1000 yrs

- central star
  - few 10^4 K
  - enshrouded by dust

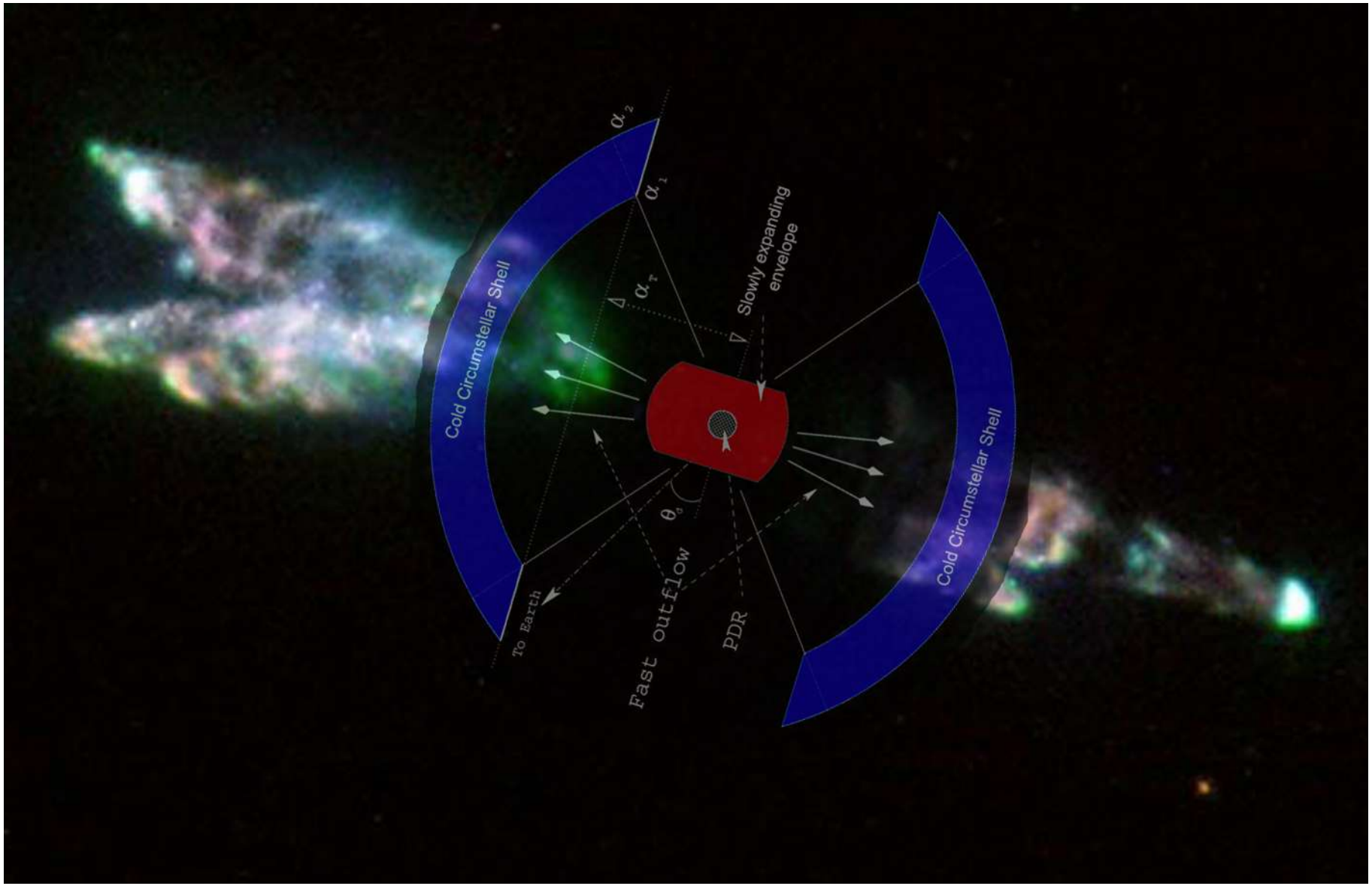
- complex structure with ejections and jets



HC_3N in CRL 618

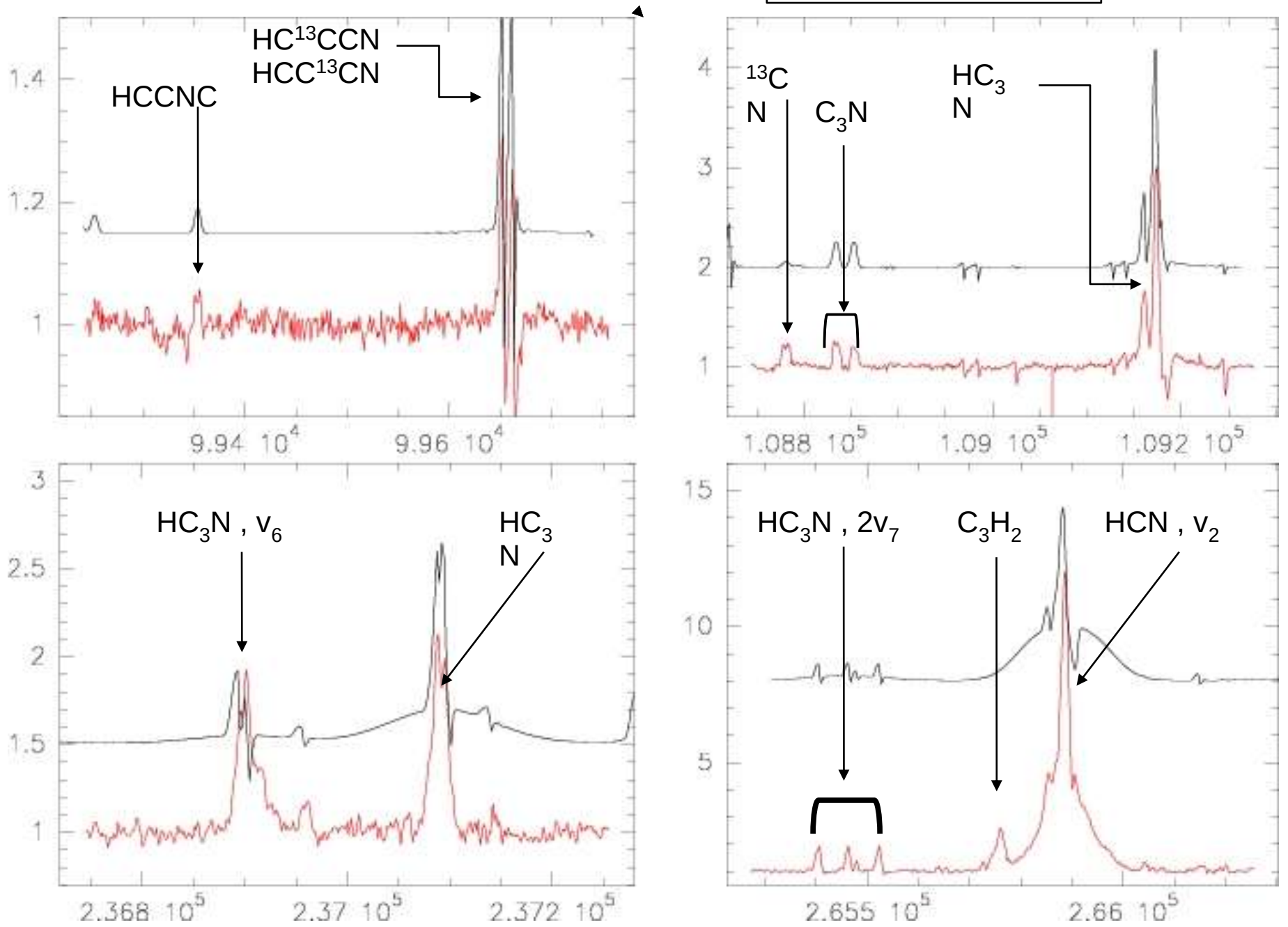
- C-rich
- HC_3N
  - linear molecule: equally spaced rotational transitions
    2B=9GHz
  - 2 lines in 1mm-window
    2 lines in 3 mm-window
  - good tracer for SEE because of many low-lying vibrational states, which can be populated in LTE regime

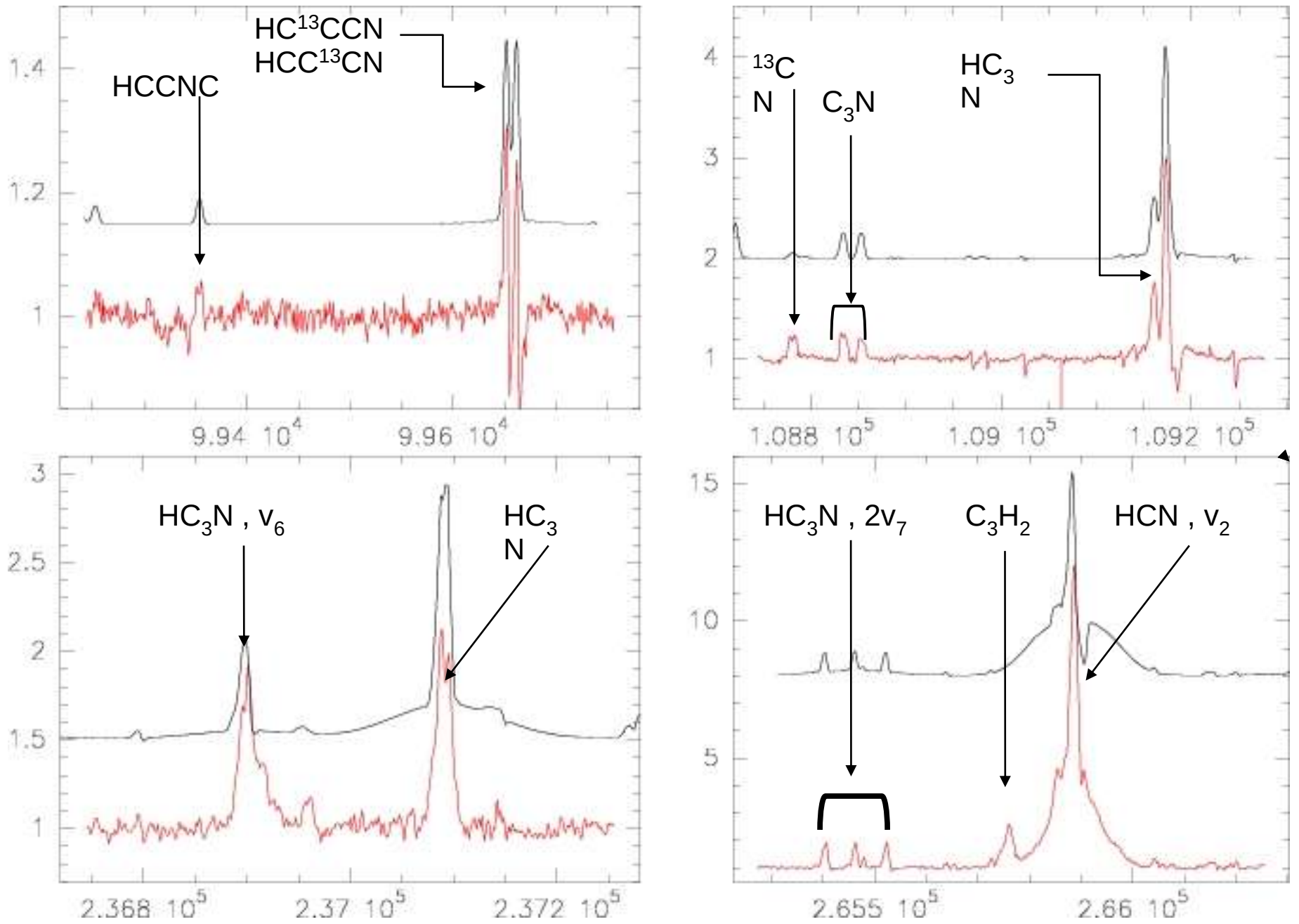
CRL 618: Optical image + structure of molecular outflows



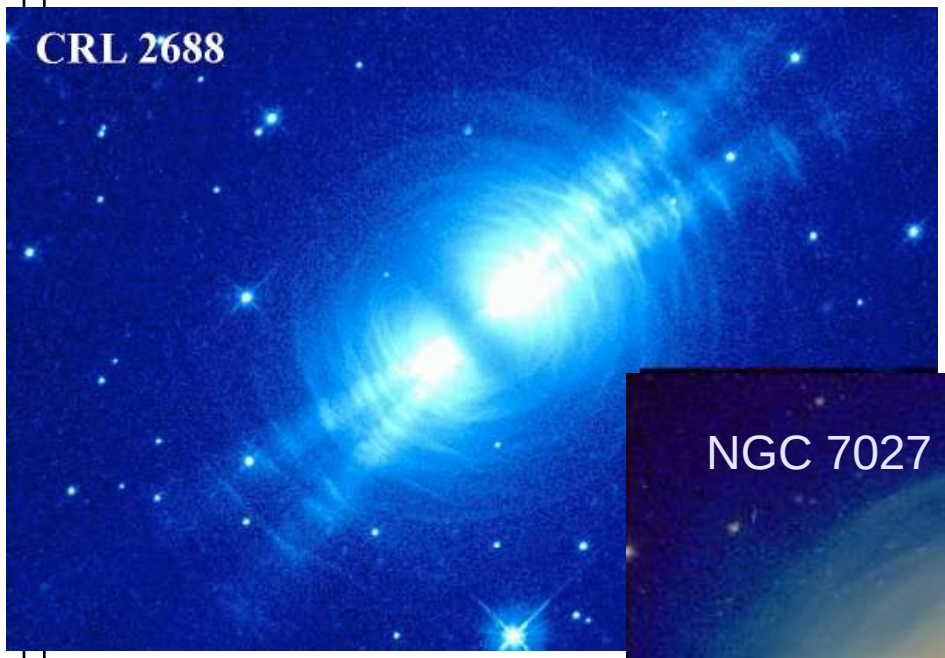
PPNe - Model

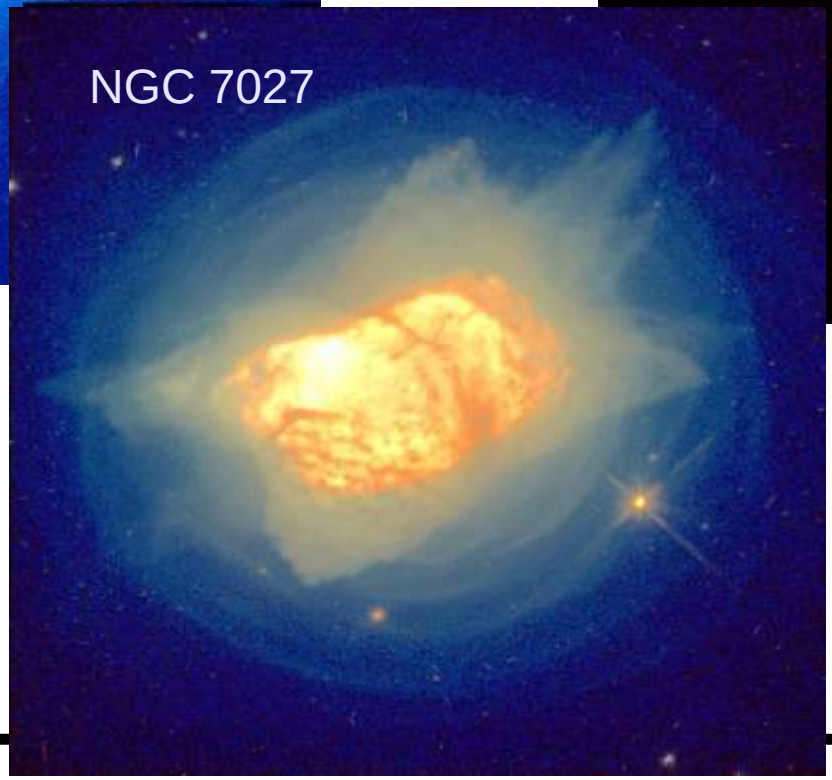
- CRL 618
  - Input
    - Temperature structure in slowly expanding envelope (SEE)
    - Number density of HC_3N
  - Output
    - Spectrum
    - Column density of HC_3N


model
data
HC13CCN
HCC13CN
HCCNC
13C
N
C3N
HC3
N
HC3N , v6
HC3
N
HC3N , 2v7
C3H2
HCN , v2
9.94 10^4
9.96 10^4
1.088 10^5
1.09 10^5
1.092 10^5
2.368 10^5
2.37 10^5
2.372 10^5
2.655 10^5
2.66 10^5

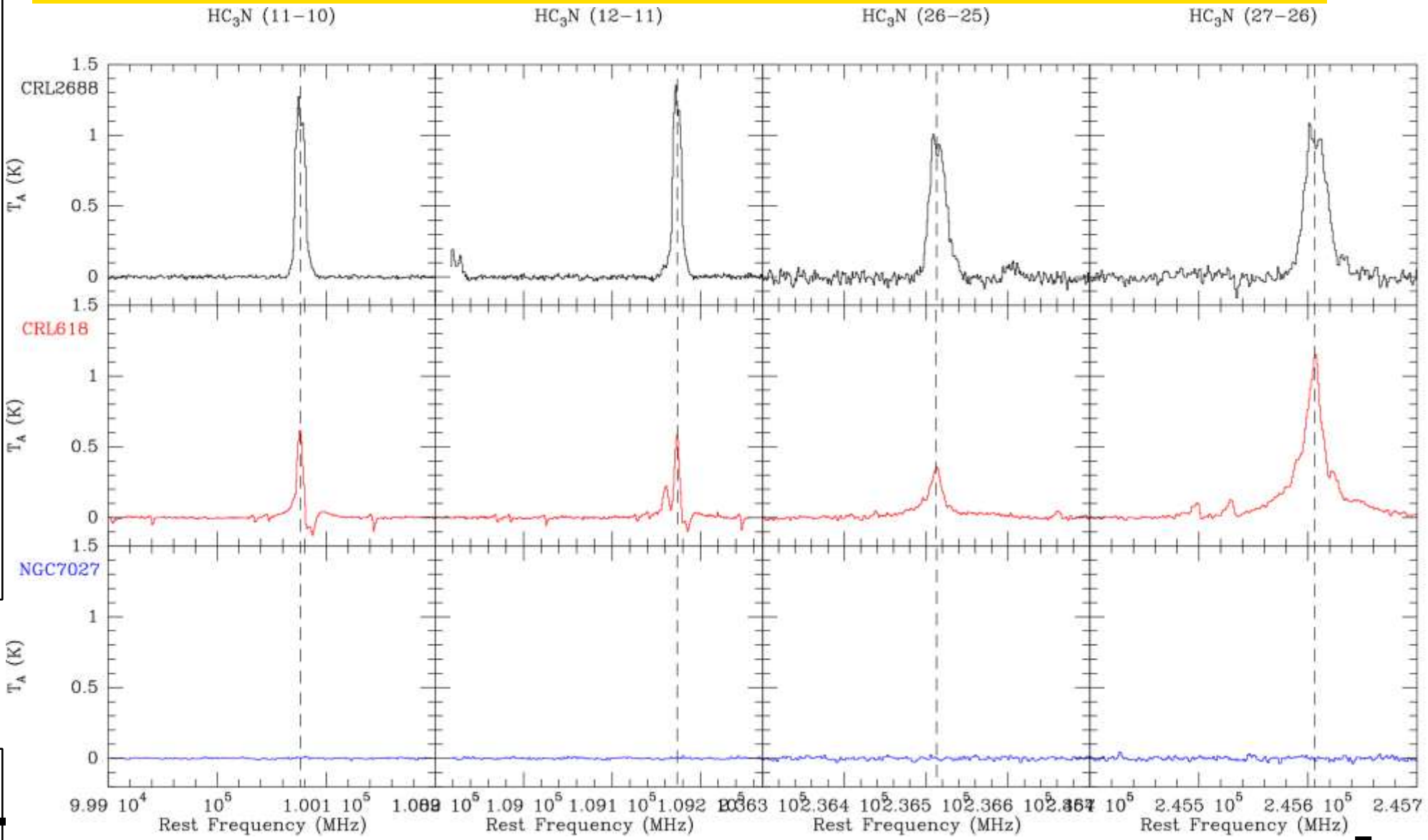

model
data
HC13CCN
HCC13CN
HCCNC
13C
N
C3N
HC3
N
HC3N , v6
HC3
N
HC3N , 2v7
C3H2
HCN , v2
9.94 10^4
9.96 10^4
1.088 10^5
1.09 10^5
1.092 10^5
2.368 10^5
2.37 10^5
2.372 10^5
2.655 10^5
2.66 10^5

Protoplanetary Nebulae (PPNe)
comparing CRL 2688, CRL 618 and NGC 7027



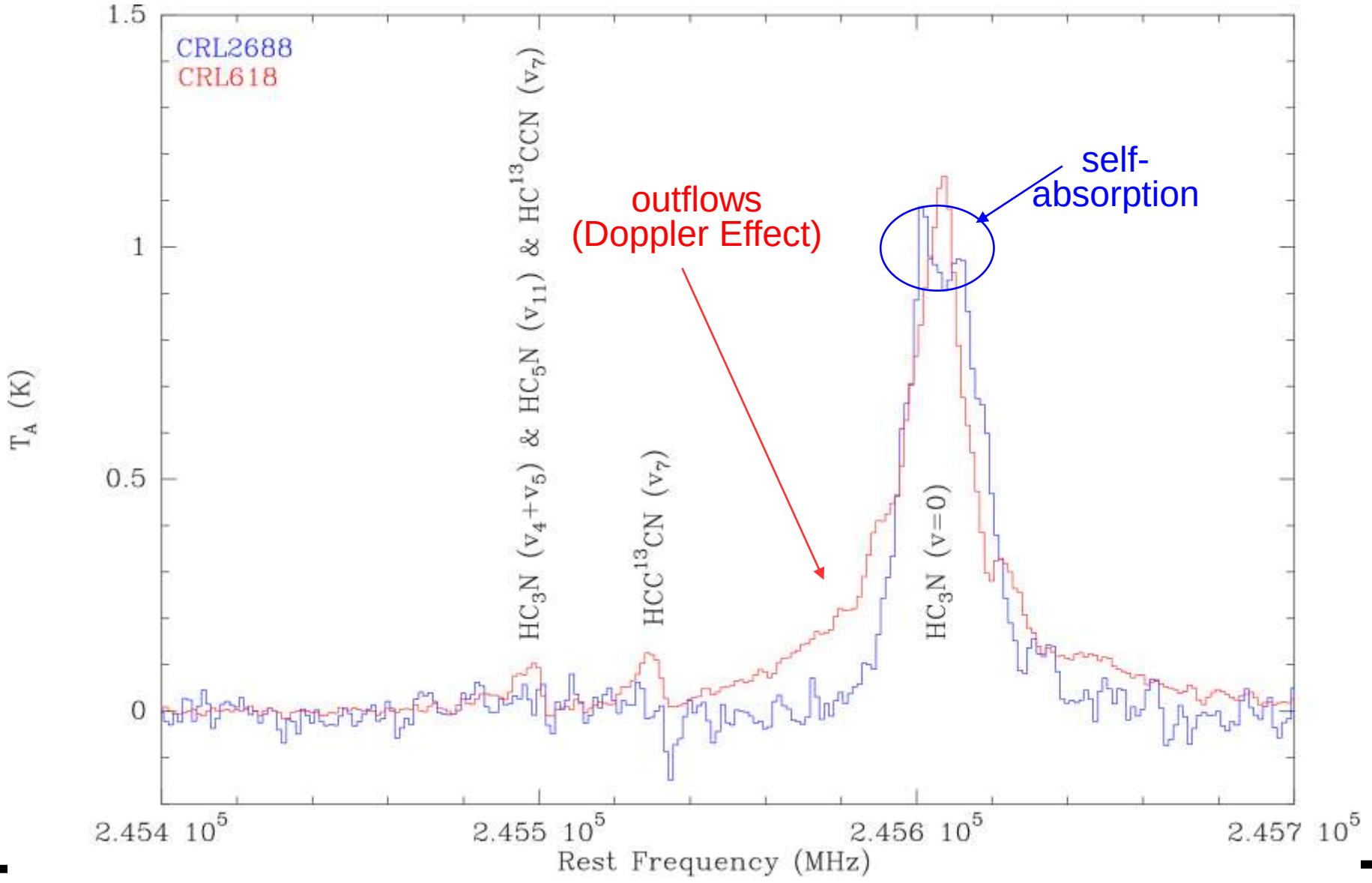


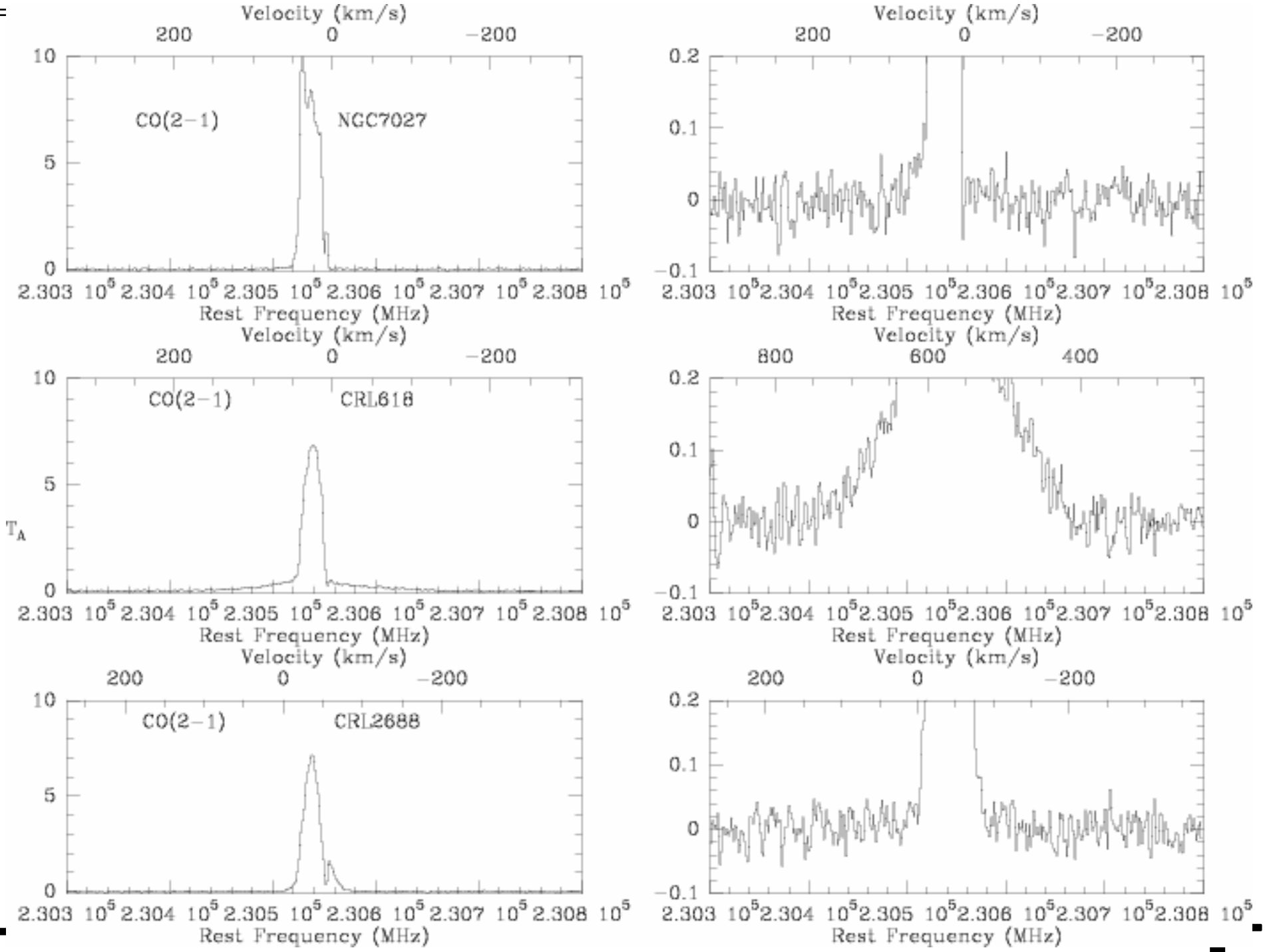
Comparing CRL 2688, CRL 618 and NGC 7027



Evolution & increasing Temperature

Comparing CRL 2688 & CRL 618




Velocity (km/s)
200
0
−200
CO(2−1)
NGC7027
CRL618
CRL2688
T_A
Rest Frequency (MHz)
2.303 10^5 2.304 10^5 2.305 10^5 2.306 10^5 2.307 10^5 2.308 10^5
800
600
400


THANK YOU ALL

AGB stars

- outflow
  - dense, molecular
  - low velocities (< 30kms^{-1})
  - Mdot up to 10^{-5} M_{sol}/yr

- many molecular lines to probe structure and dynamics

Sources under study

- R Aql
- χ Cyg

→ C-rich Miras