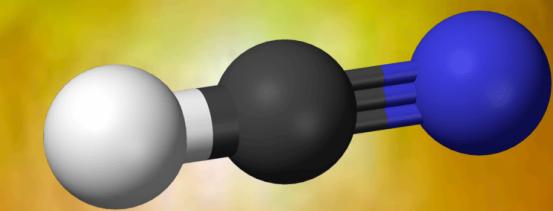


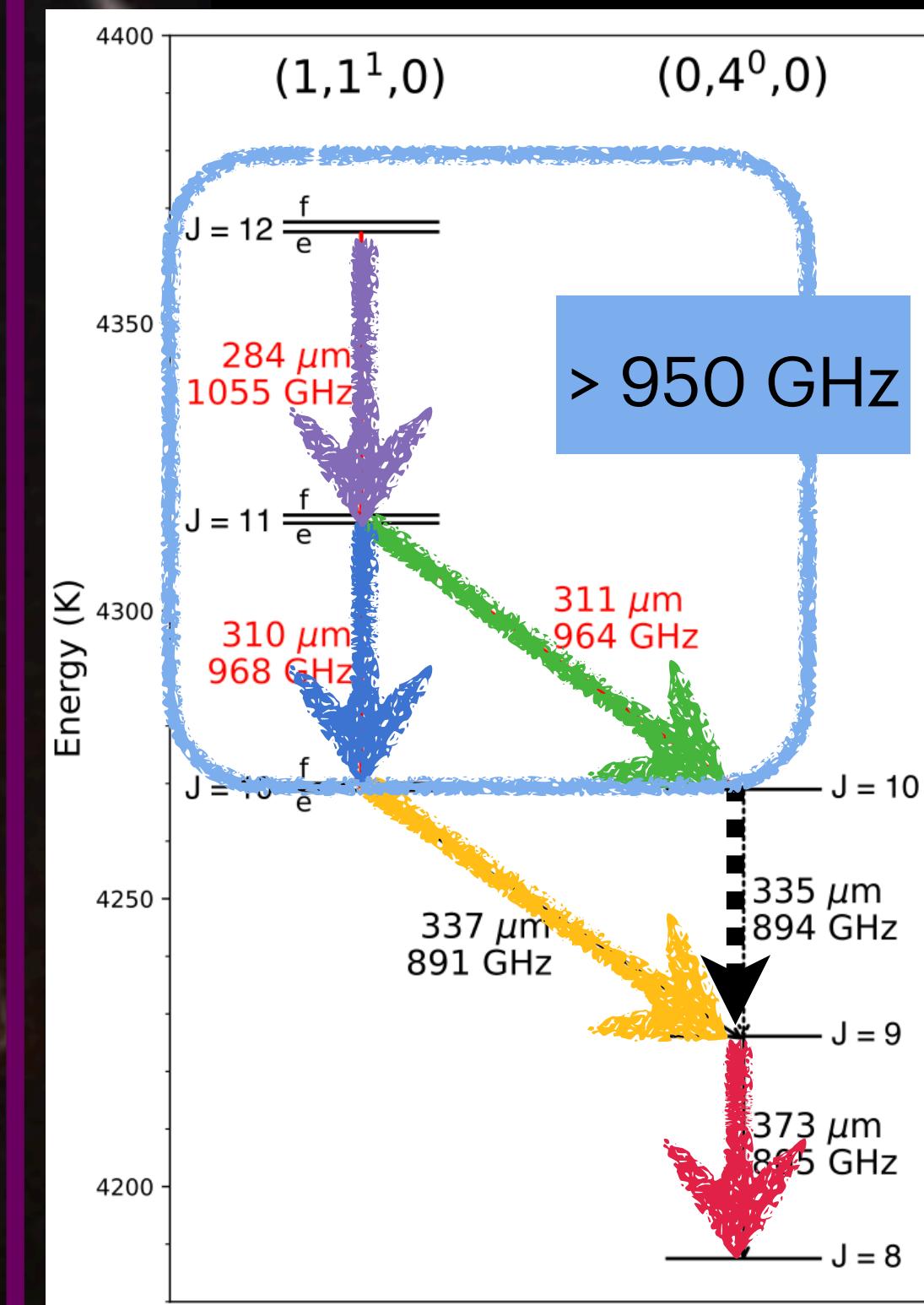
New Sub-millimeter HCN Lasers in C-rich AGB stars

Wenjin Yang (NJU, MPIfR), Ka Tat Wong, Helmut Wiesemeyer, **Karl M. Menten**,
Yan Gong, José Cernicharo, Elvire de Beck, Bernd Klein, Carlos A. Durán



IRC+10216

Coriolis-coupled system



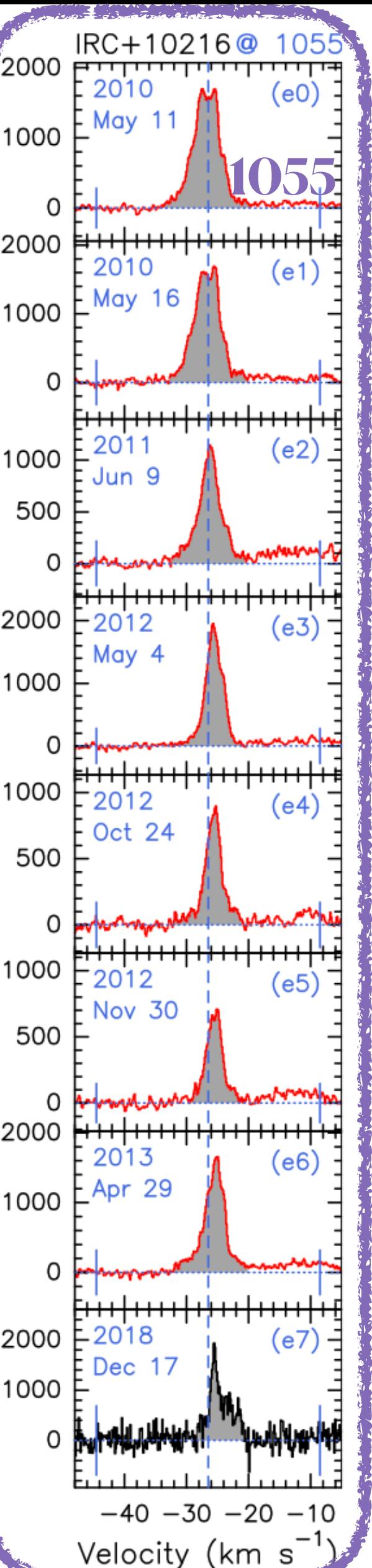
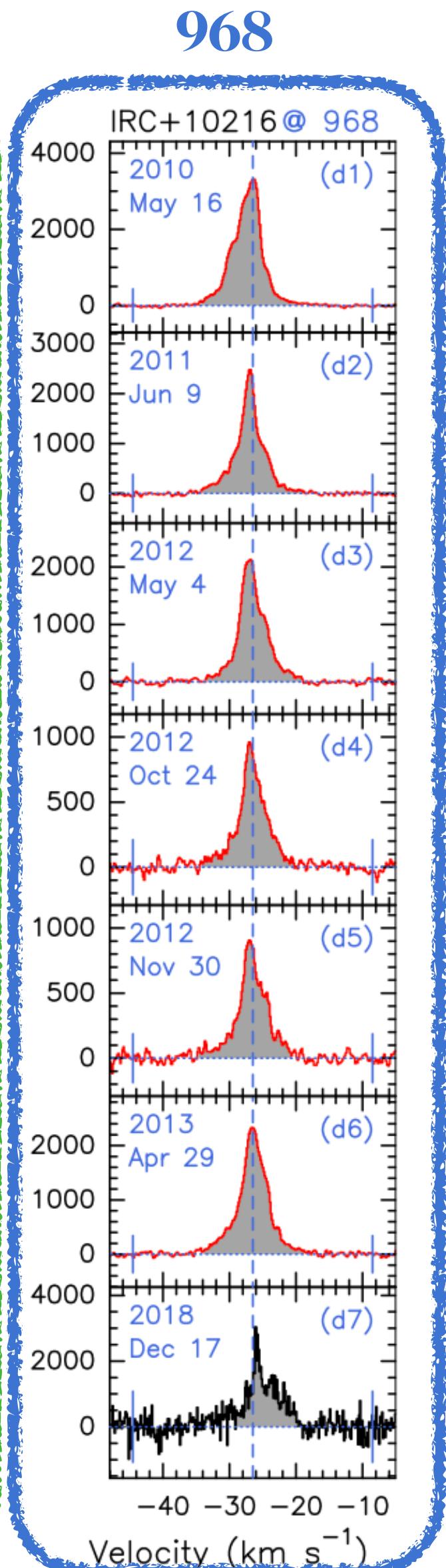
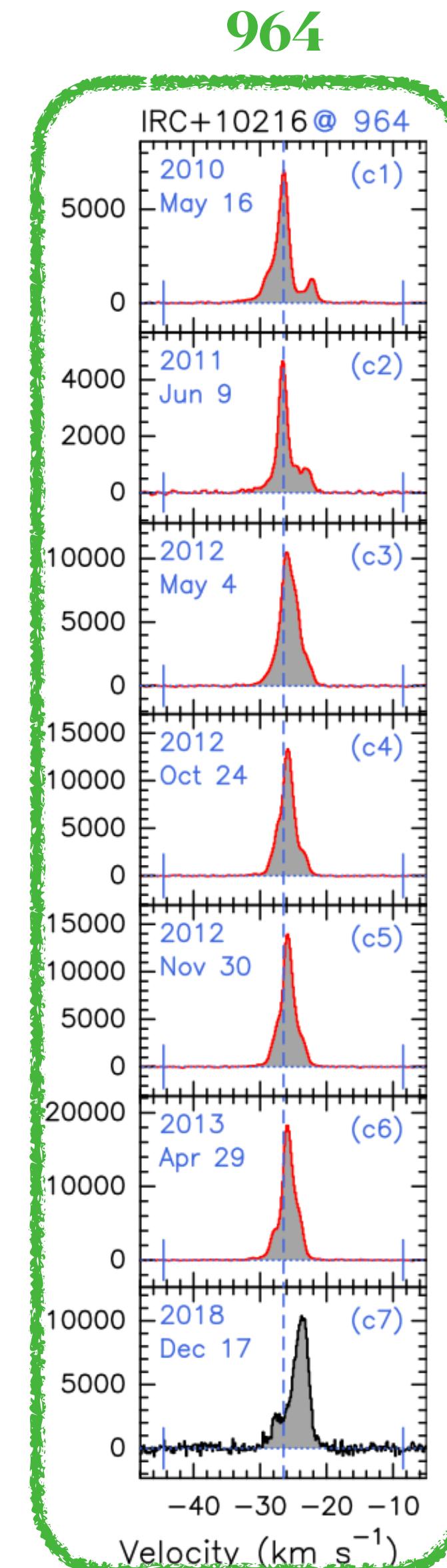
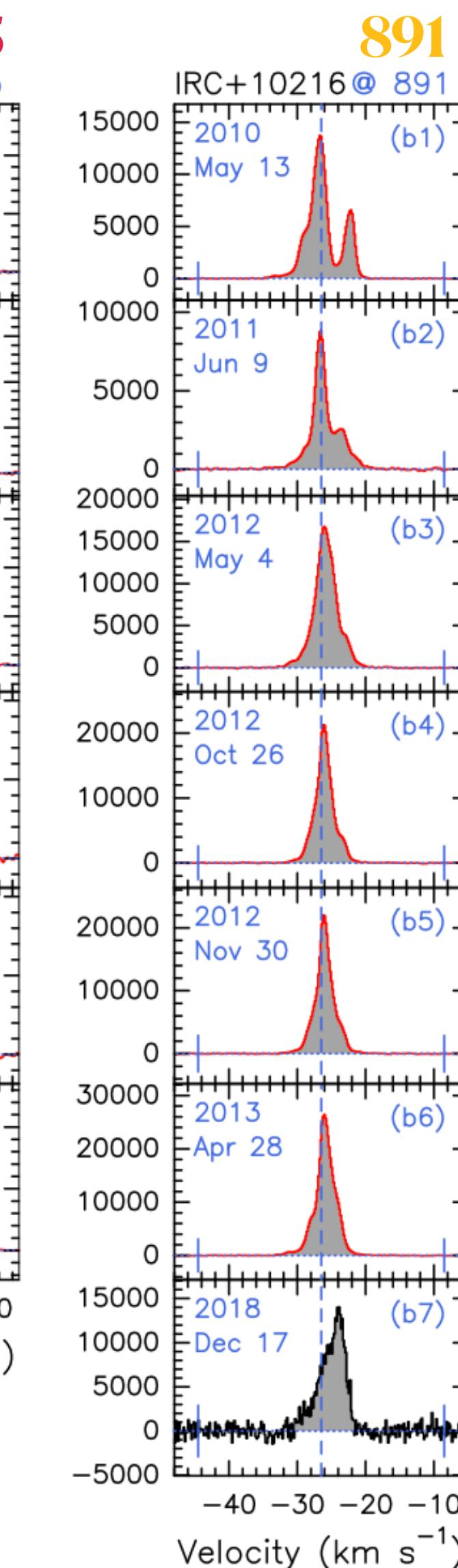
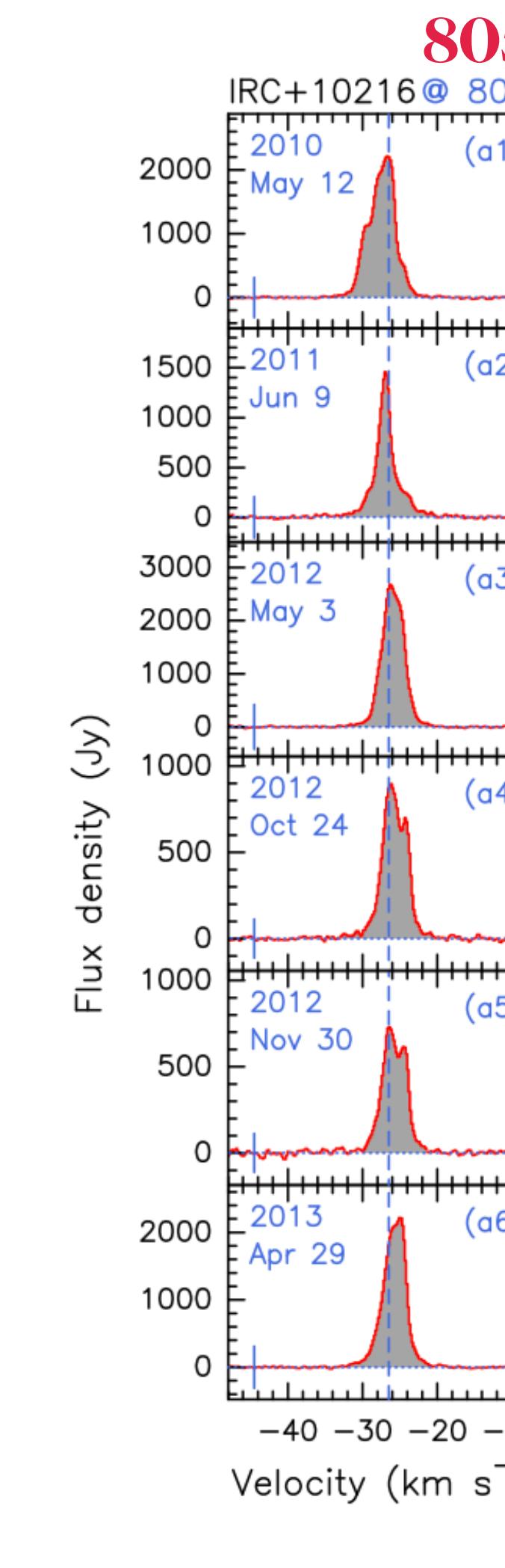
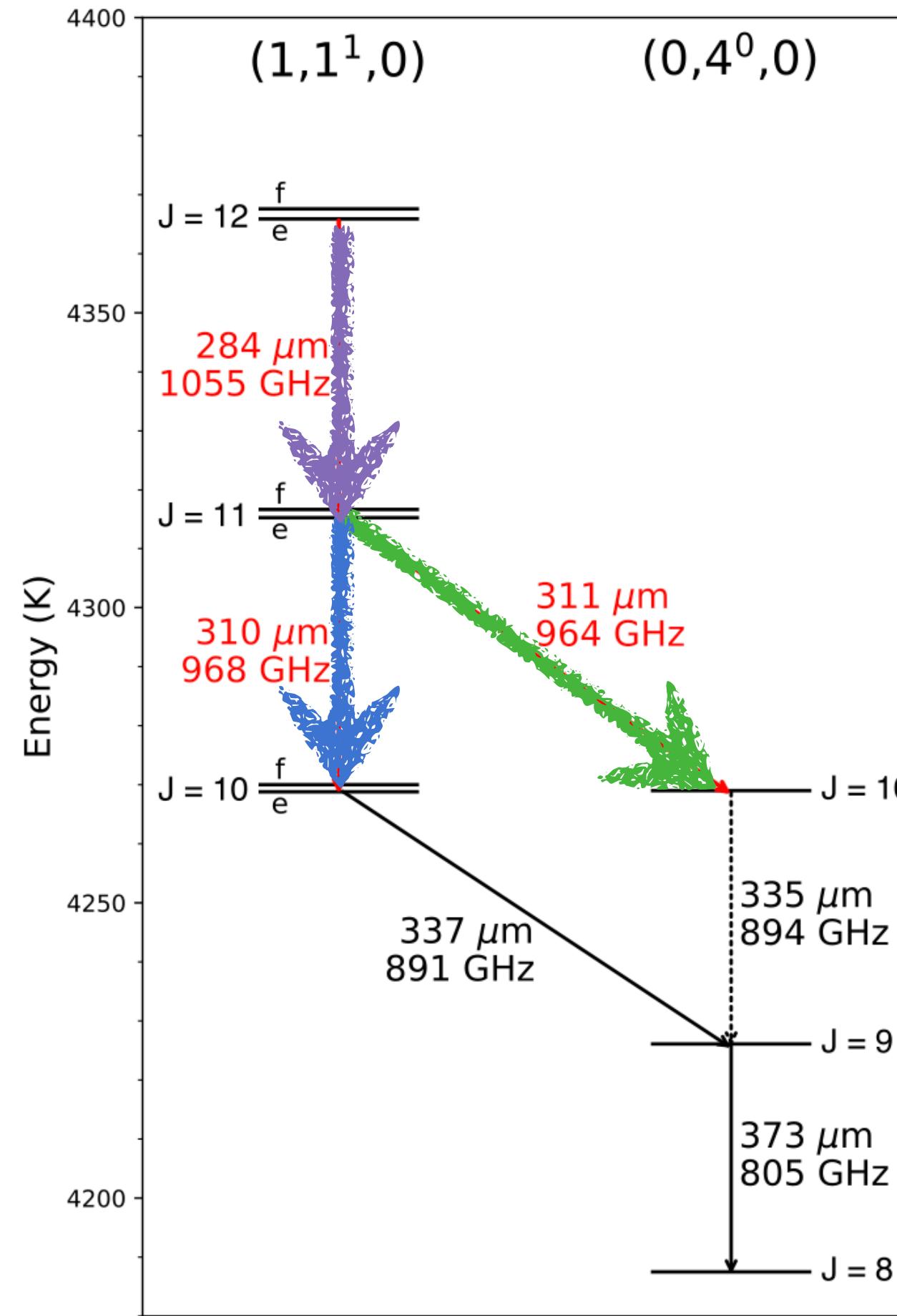
Bright HCN laser lines found in Lab

Aims

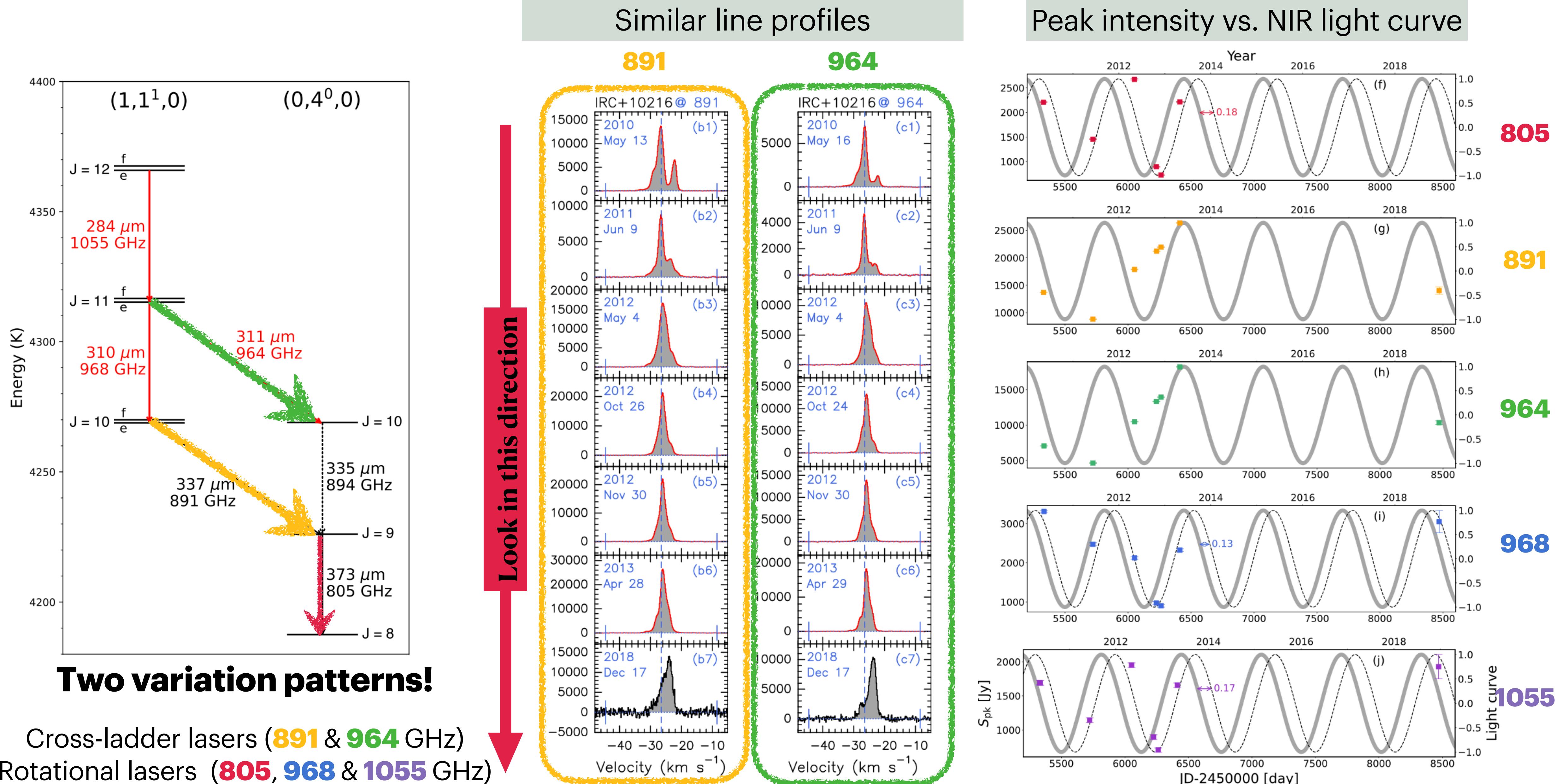
- 1. Study lasers in this system**
(excitation, variability, pumping mechanism)
- 2. Common & bright maser species in C-rich AGBs?**

- A sample of 8 C-rich AGBs
- **IRC+10216**
7 epochs observations

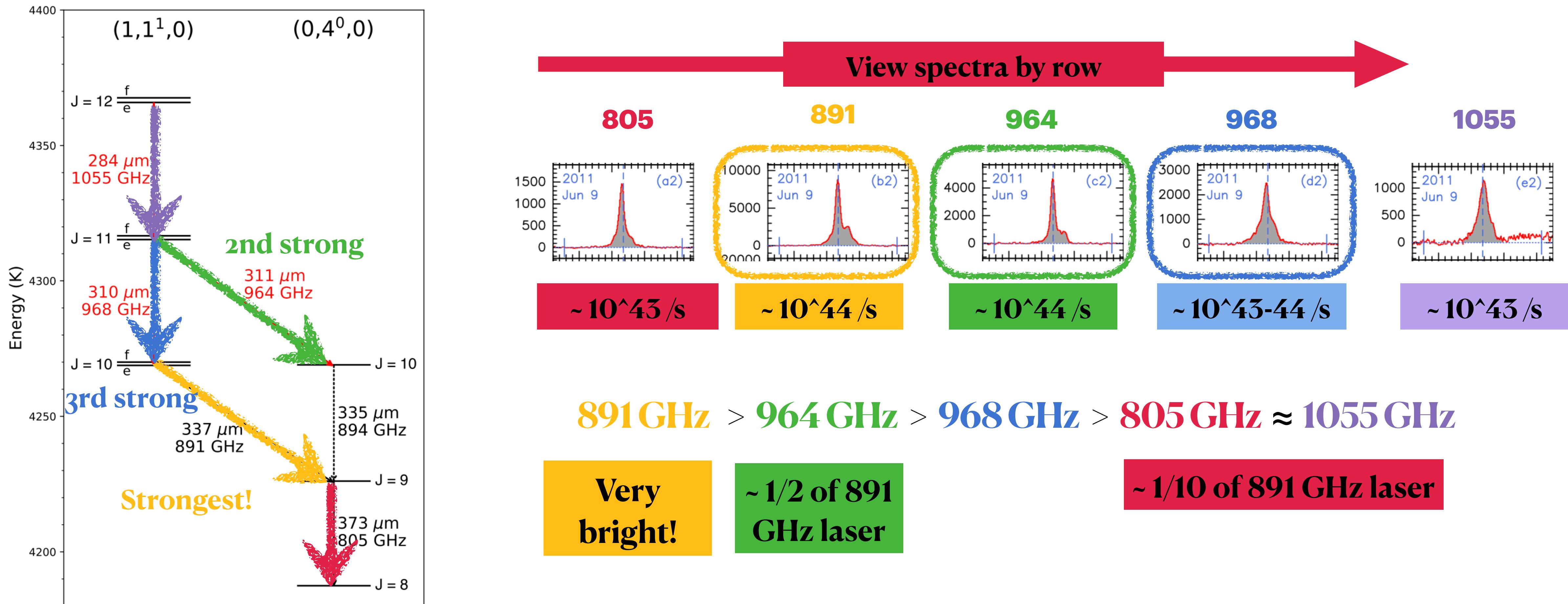
Discovery of HCN laser transitions at 964, 968 & 1055 GHz in space!



Laser variability (IRC+10216)

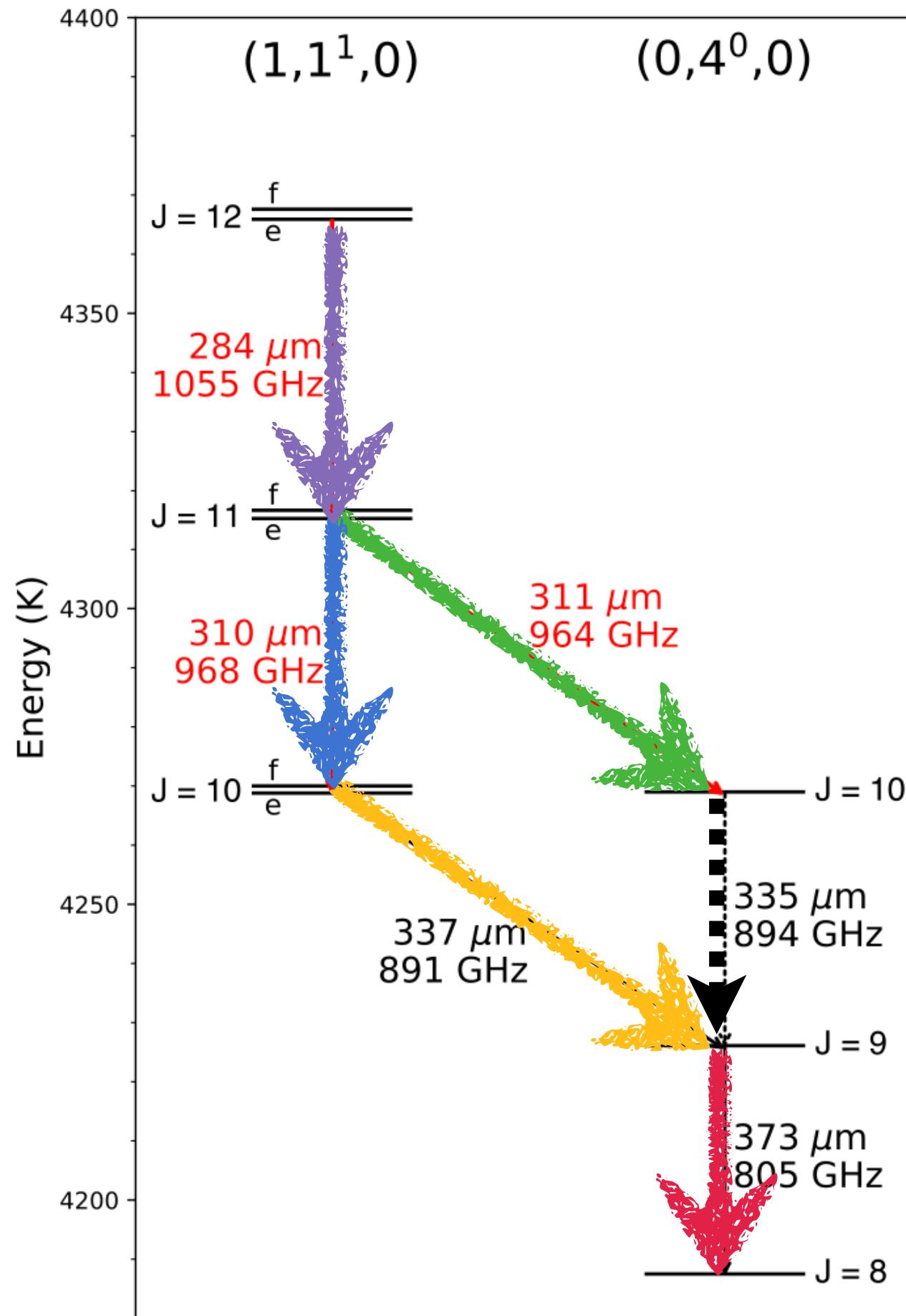


Laser ranking (IRC⁺10216)



Laser excitation & pumping

Observation findings in 8 C-rich AGB stars



- 1. 891 GHz laser always strongest
- 2. 964 GHz laser is similar to 891 GHz laser, 2nd strong

infer

- 3. 968 GHz laser stronger than 1055 GHz laser
- 4. 805 GHz laser co-exists with 891 GHz laser
- 5. 894 GHz line was not detected in any observed targets

Match the scenario found in early laboratory studies
(Maki & Blaine 1964;
Lide & Maki 1967)

Radiative pumping

+

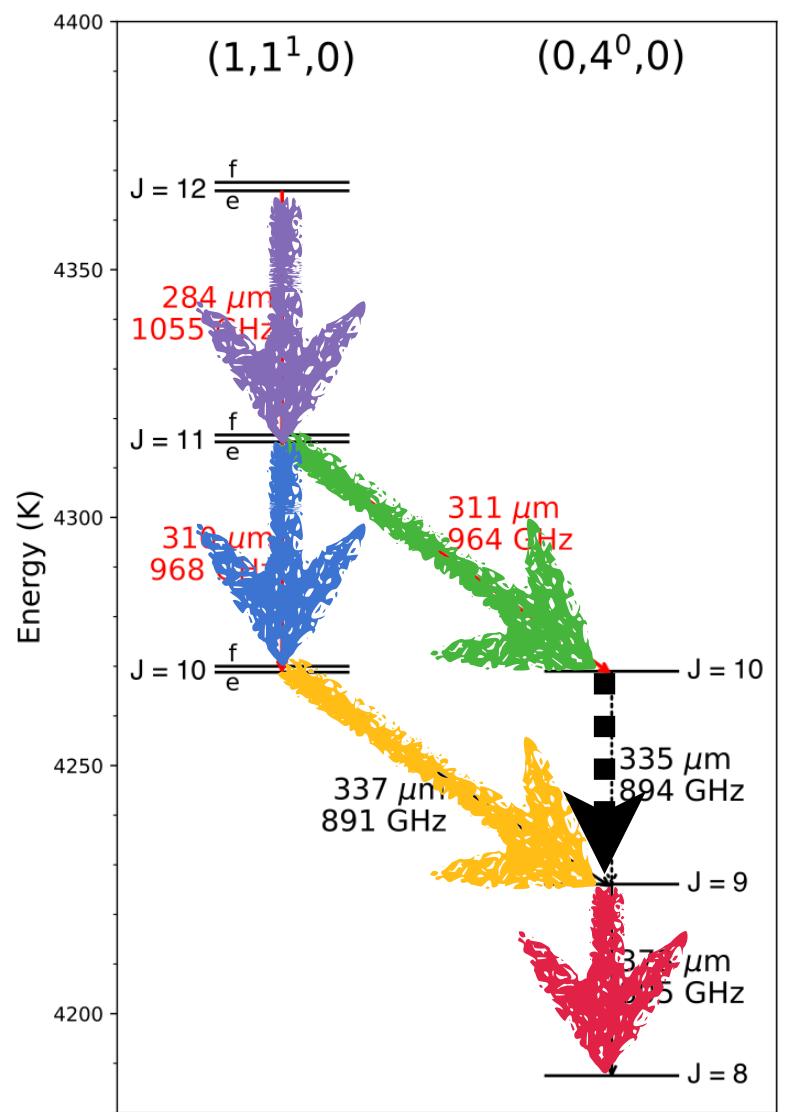
Chemical pumping

Rotational lasers
(805, 968, 1055)

Direct formation of HCN molecules
in vibrationally excited states

Modulated by additional collisional + radiative pumping

New Sub-millimeter HCN Lasers in C-rich AGB stars

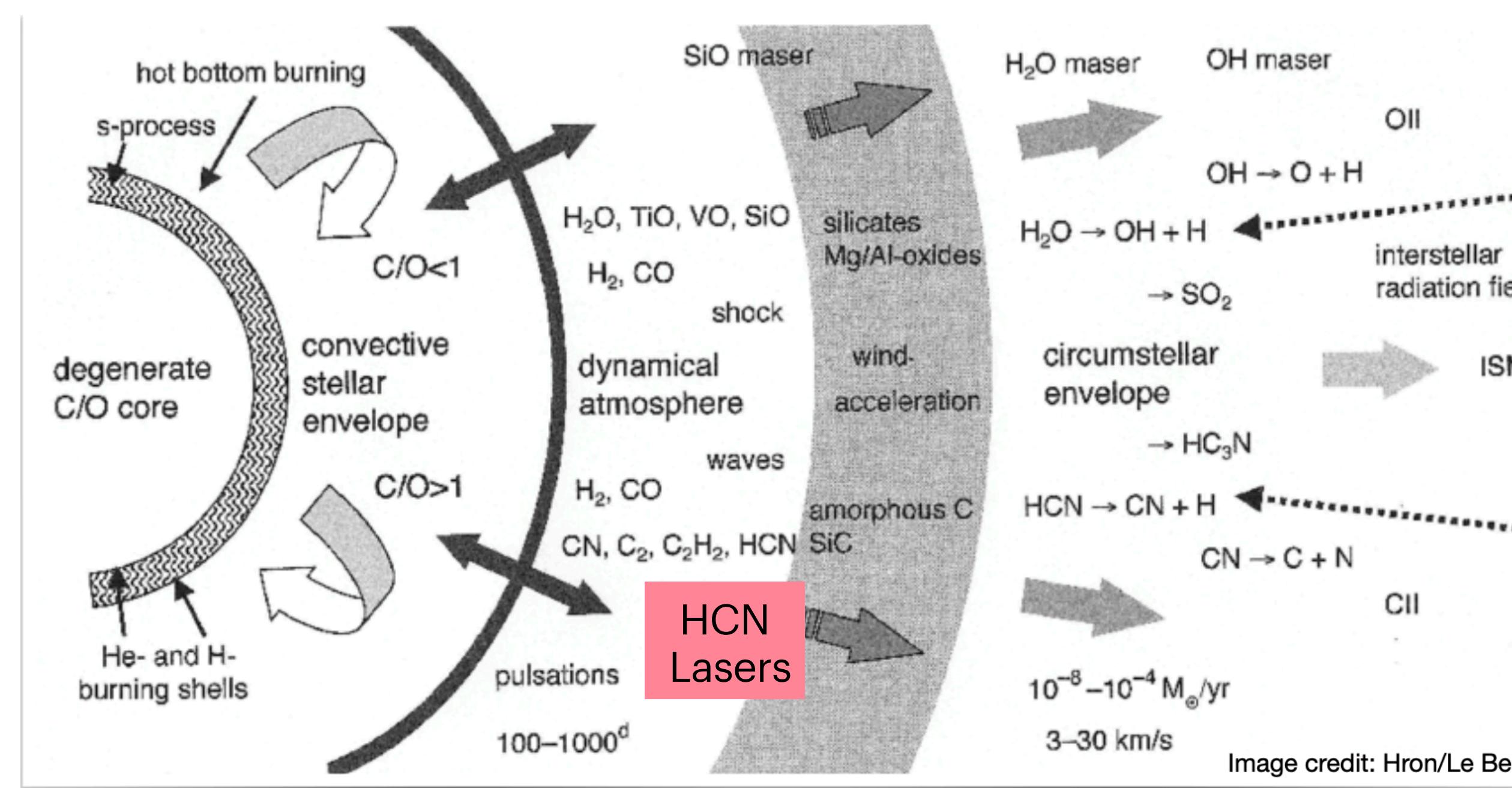


- Discovery of three HCN Laser lines in space: **964, 968 & 1055 GHz**
- Systematically study the HCN Lasers in the Coriolis-coupled system: variability, excitation & possible pumping mechanisms

Dedicated to the memory of
Prof. Karl Menten



[Yang et al. 2025, A&A, 696, A60]



Many thanks!