

EXES Science

Edward Montiel & Curtis DeWitt
October All-Hands Scientist Meeting

EXES Papers Published in 2020**

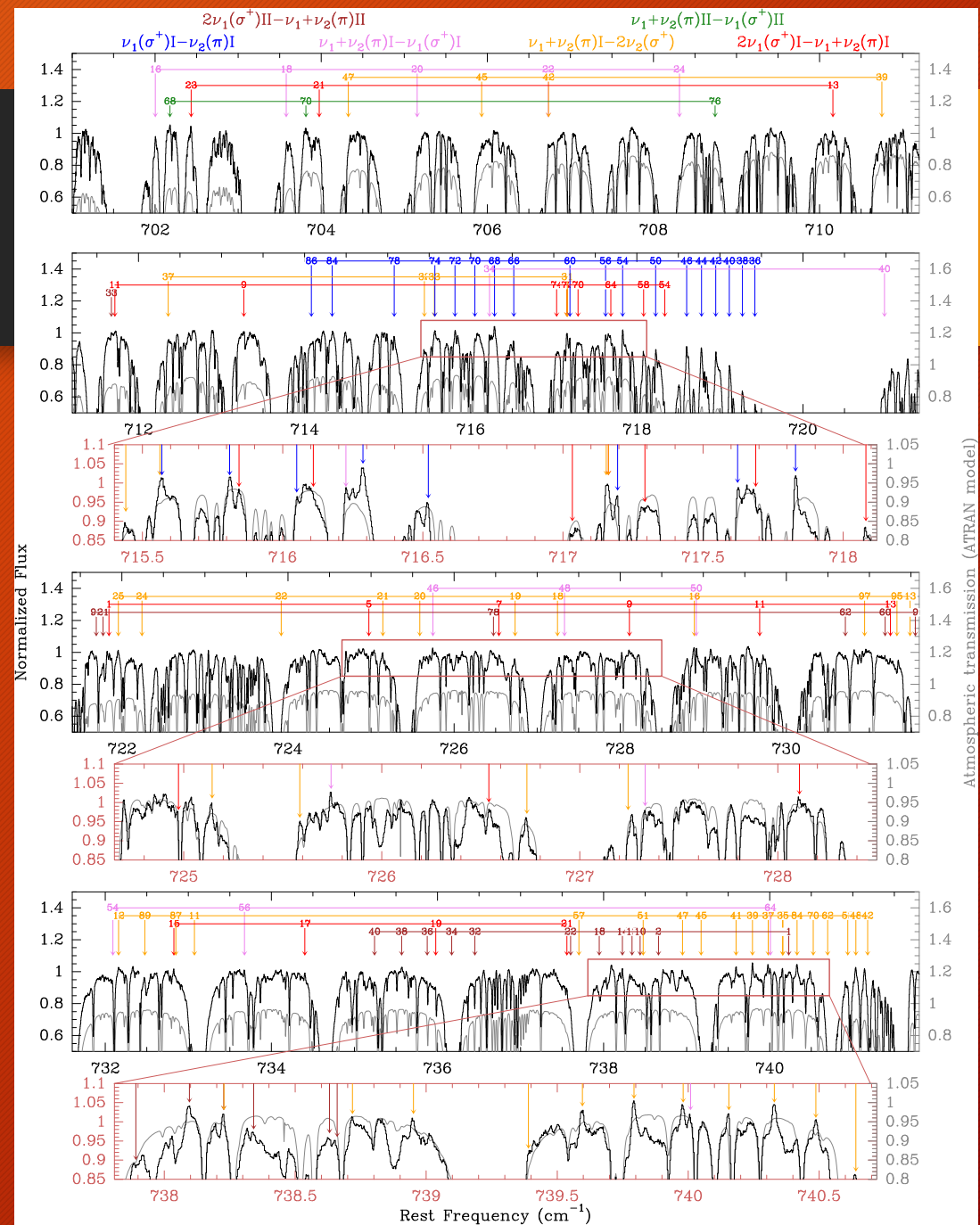
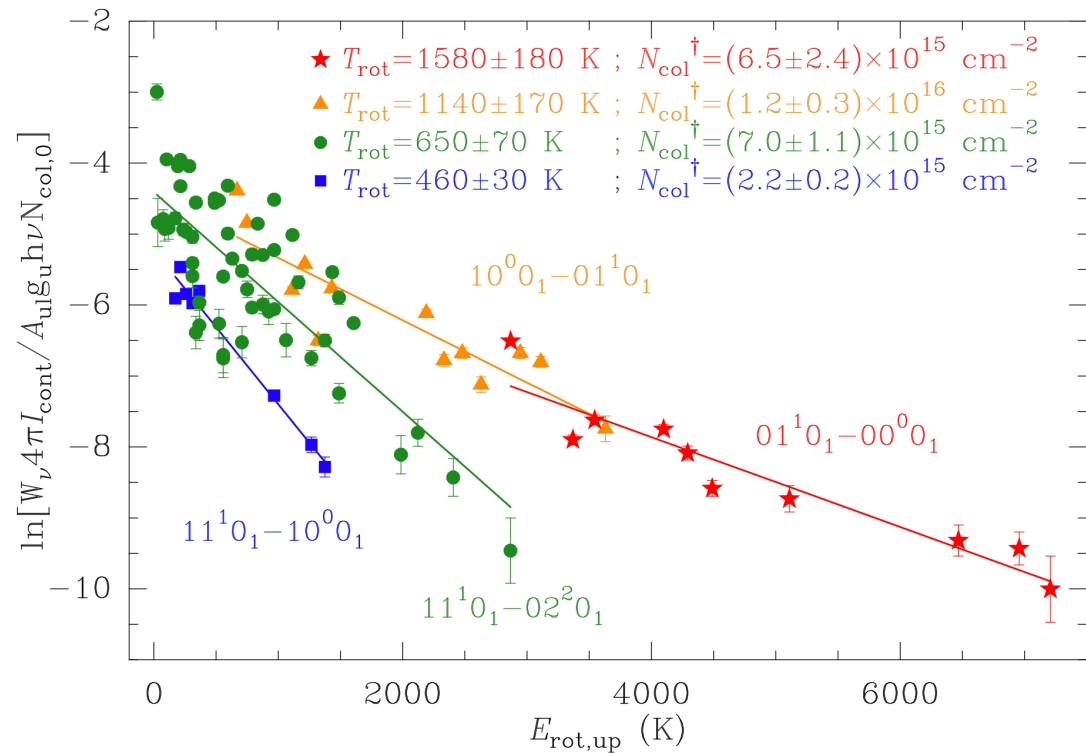
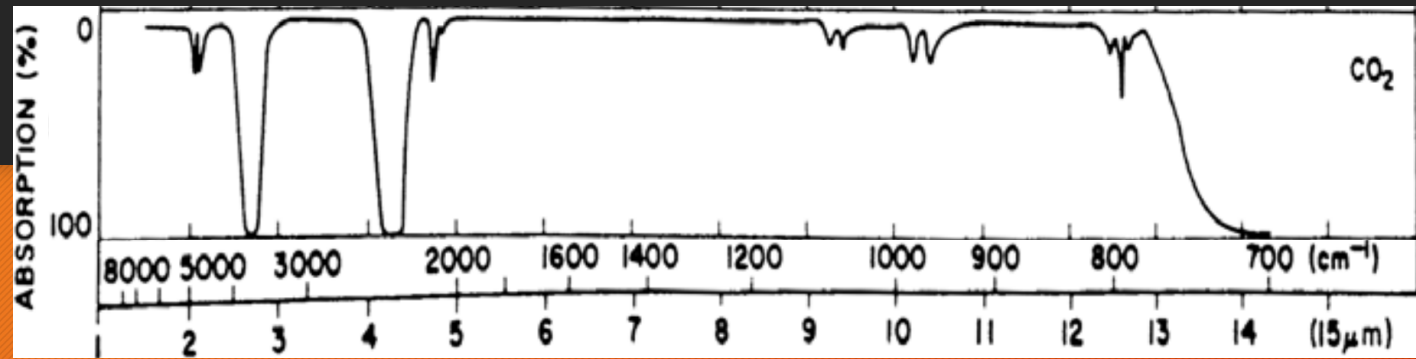
- “Search for H_3^+ isotopologues toward CRL 2136 IRS 1” (Goto et al. 2019, A&A, 632, A29)
- “Benzynes in V4334 Sgr: A Quest for the Ring with SOFIA/EXES” (Woodward et al. 2020, AJ, 159, 87)
- “SOFIA-EXES Observations of Betelgeuse during the Great Dimming of 2019/2020” (Harper et al. 2020, ApJL, 893, L23)
- “The H_2O Spectrum of the Massive Protostar AFGL 2136 IRS 1 from 2 to 13 μm at High Resolution: Probing the Circumstellar Disk” (Indriolo et al. 2020, ApJ, 894, 107)
- “High-resolution Infrared Spectroscopy of Hot Molecular Gas in AFGL 2591 and AFGL 2136: Accretion in the Inner Regions of Disks around Massive Young Stellar Objects” (Barr et al. 2020, ApJ, 900, 104)

**December 2019

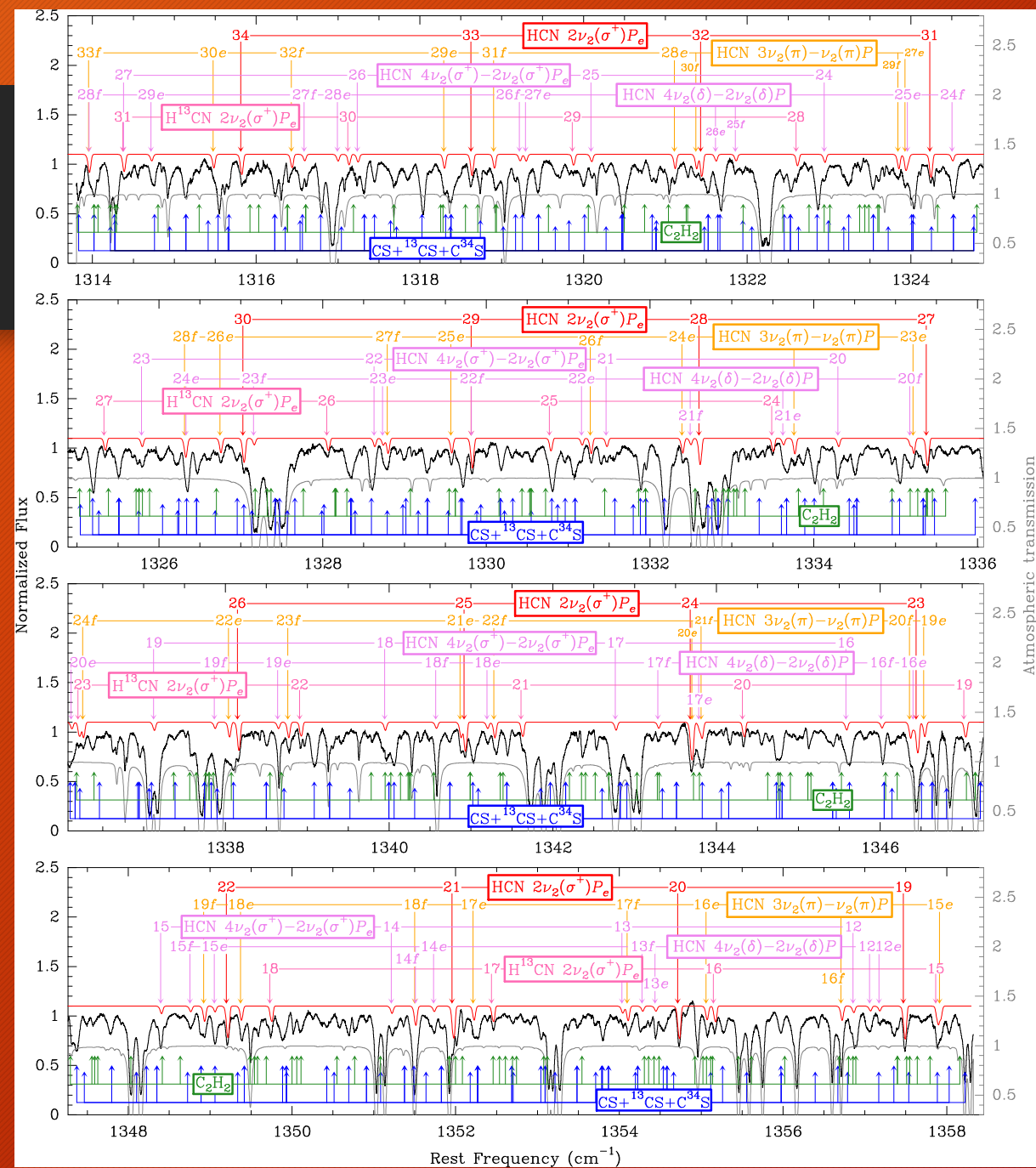
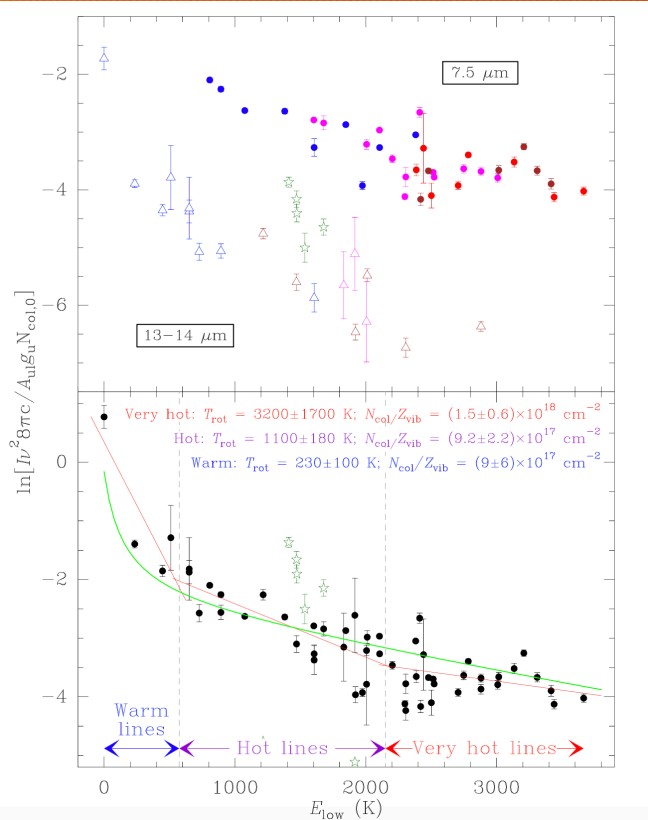
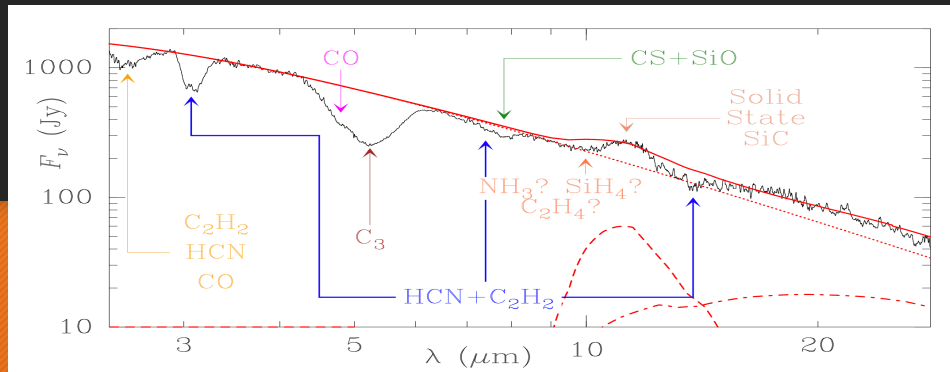
EXES Papers In Prep & Review to be Highlighted

- “The First Mid-Infrared Detection of HNC in the Interstellar Medium: Probing the Extreme Environment Towards the Orion Hot Core -- [Nickerson et al. \(2021, ApJ, 907, 51\)](#)”
- “Detection of Infrared Fluorescence of Carbon Dioxide in R Leonis with SOFIA/EXES” -- [Fonfría et al. \(2020, A&A, 643L, 15\)](#)”
- “The Envelope of the Low Mass-Loss Rate C-Rich AGB Star Y CVn” - -- Fonfría et al. (A & A, in review)

Fonfría et al. (2020, A&A, 643L, 15)



Fonfría et al. (A &A, in review)



Late Stages of Stellar Evolution with EXES (Pending projects)

Carbon chains 08_0231

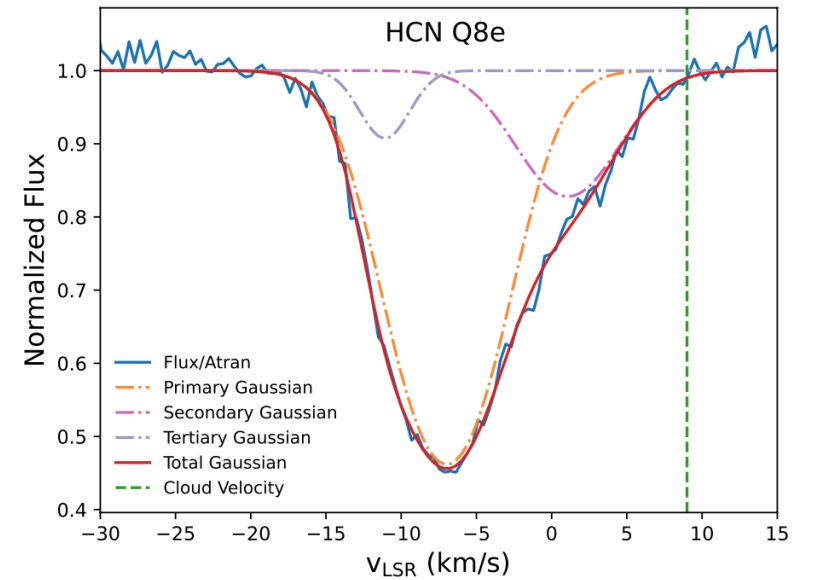
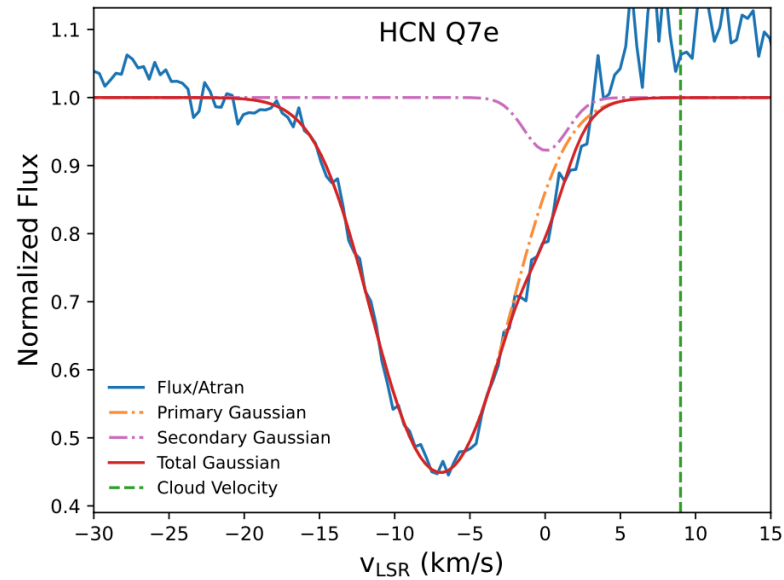
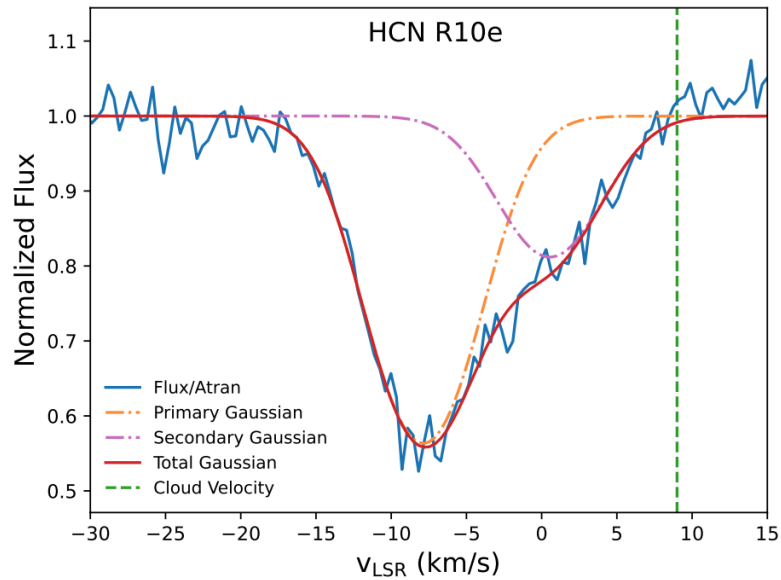
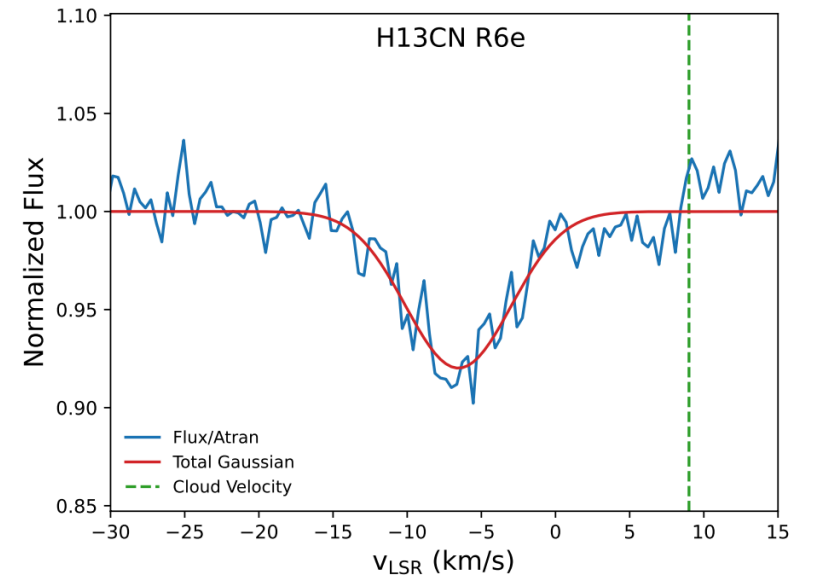
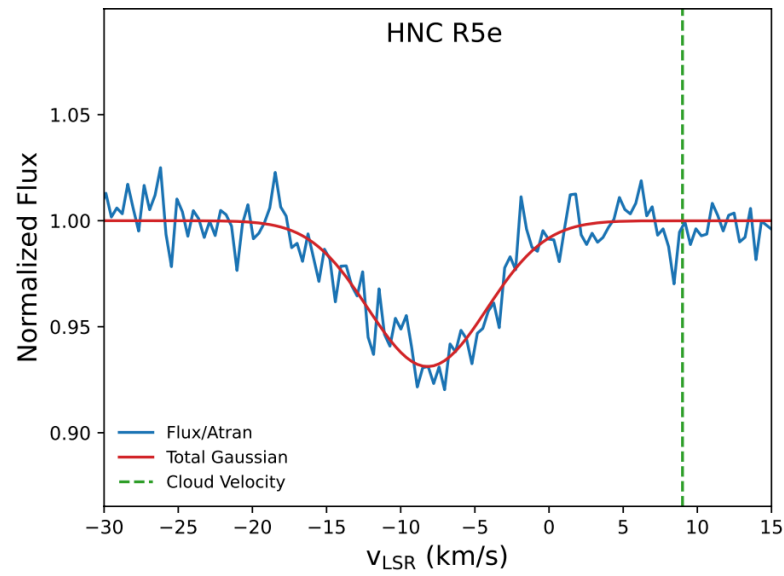
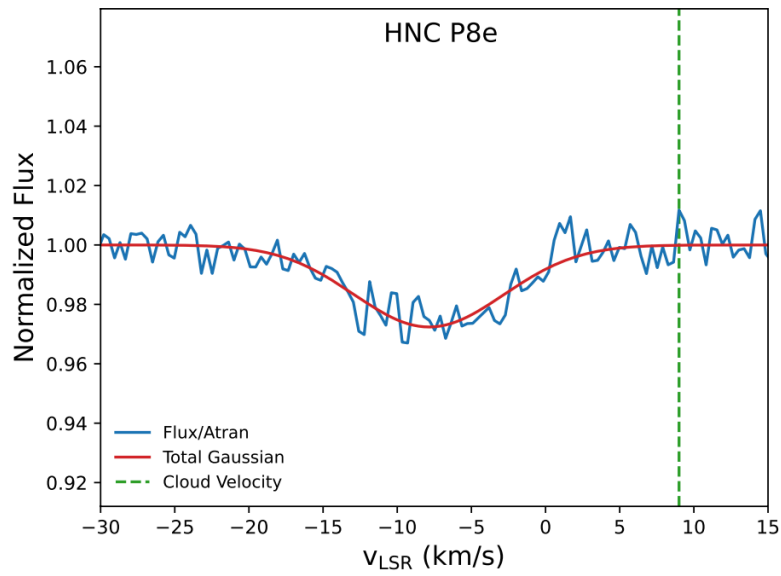
- C₂, C₃ (see below), C₅, C₆₀, and C₇₀ have all been detected
- C₄ has yet to be detected
 - Search for signal in Y CVn and IRC+10216

H₂O Outflow in Miras 06_0093/75_0027/07_0014

- Borrows “hot core” settings to survey H₂O from about 5.5 to 7.2 micron
- Targets lower excitation transitions to study acceleration of gas from 2 to 20 R*

Proto-planetary Nebulae (PPNe)

- Alkanes in CRL618 07_0086
 - Look for features from propane and ethane
 - Would be first detection outside of Solar System
- Time evolution of AGB -> PPNe -> early PN 08_0216
 - Extend AGB settings to PPNe settings
 - Idea on chemical evolution as UV radiation increases from central source
 - Data would improve models by Woods et al (2003) & Cernicharo (2004) that modeled C-rich AGB stars to C-rich PPNe



Star formation

High mass (hot cores) 05_0041/06_0117/
07_0063/08_0136/
75_0024/76_0004

- Barr et al. preparing to analyze 1000+ H₂O lines in AFGL 2136 & 2591
- Additional hot cores observed with EXES by Xander Tielens and DDT
 - W3 IRS5
 - NGC 7538 IRS1 & IRS9
- Able to study hot cores as individual objects and to compare & contrast

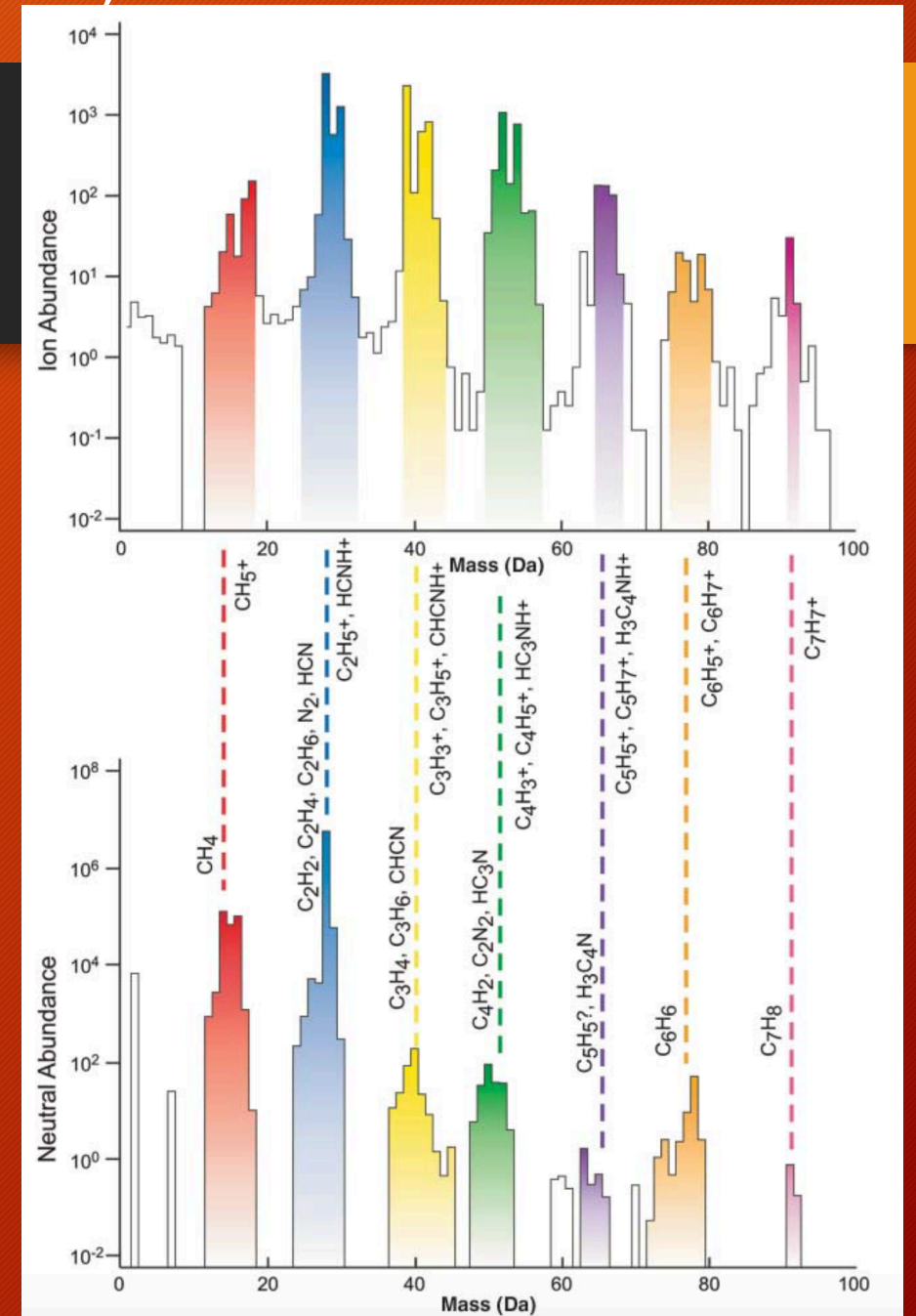
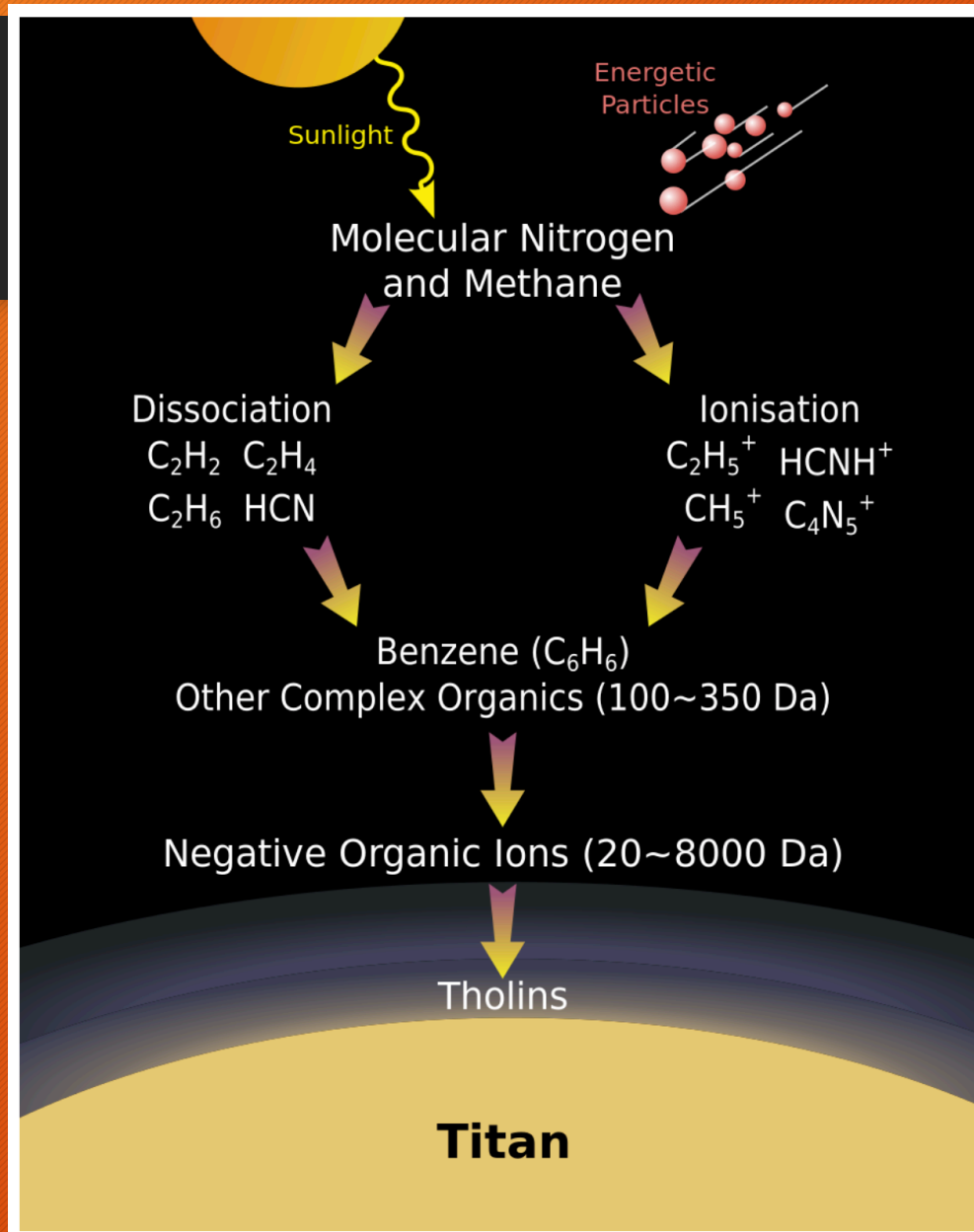
(Pending projects)

Low mass (T Tauri & FU Ori)

- Cycle 5 program to study GV Tau system 05_0097
 - TEXES observations find red shifted absorption features & H₂O absorption seen with EXES matches
 - Suggests that the surface accretion mode is being traced
- H₂O in FU Ori Stars 07_0023/08_0028
 - Cycle 7 & 8 proposal to confirm *Spitzer*/IRS findings of H₂O absorption from the disks of several FU Ori stars
- Improvements to IQ by DSI will allow for higher S/N observations of fainter sources
 - EXES will be better supported to study disks around lower mass sources

Solar System Objects: Titan (Pending project)

08_0203



Summary & Reminders

- Science results with EXES continue to be in the works, as well as refereed & published
- High spectral resolution provided by EXES serves broad community and diverse science cases
 - Molecules without permanent dipole moment can only be studied in the mid-IR
- Spectral resolution achievable with EXES will not be matched by JWST/MIRI
- **EXES Cycle 7: 2.5/11 flights (1 publication)**