EXES Science

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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)

**December 2019
EXES Papers In Prep & Review to be Highlighted


• “The Envelope of the Low Mass-Loss Rate C-Rich AGB Star Y CVn” -- Fonfría et al. (A & A, in review)
Fonfría et al. (A&A, in review)
Late Stages of Stellar Evolution with EXES

Carbon chains 08_0231

- C$_2$, C$_3$ (see below), C$_5$, C$_{60}$, and C$_{70}$ have all been detected
- C$_4$ has yet to be detected
  - Search for signal in Y CVn and IRC+10216

H$_2$O Outflow in Miras 06_0093/75_0027/07_0014

- Borrows “hot core” settings to survey H$_2$O 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) 07_0086

- Alkanes in CRL618
  - 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

(Pending projects)
### Star formation

#### High mass (hot cores)

- Barr et al. preparing to analyze 1000+ H$_2$O 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

#### Low mass (T Tauri & FU Ori)

- Cycle 5 program to study GV Tau system
  - TEXES observations find red shifted absorption features & H$_2$O absorption seen with EXES matches
  - Suggests that the surface accretion mode is being traced
- H$_2$O in FU Ori Stars
  - Cycle 7 & 8 proposal to confirm Spitzer/IRS findings of H$_2$O 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

### Pending projects

- 05_0041/06_0117/07_0063/08_0136/75_0024/76_0004
- 05_0097
- 07_0023/08_0028

(Pending projects)
Solar System Objects: Titan

(Pending project)

Molecular Nitrogen and Methane

Dissociation
\[ \text{C}_2\text{H}_2 \quad \text{C}_2\text{H}_4 \quad \text{C}_2\text{H}_6 \quad \text{HCN} \]

Ionisation
\[ \text{C}_2\text{H}_5^+ \quad \text{HCNH}^+ \quad \text{CH}_5^+ \quad \text{C}_4\text{N}_5^+ \]

Benzene \( (\text{C}_6\text{H}_6) \)

Other Complex Organics \( (100\sim350 \text{ Da}) \)

Negative Organic Ions \( (20\sim8000 \text{ Da}) \)

Tholins

Titan
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)