

HIGH RESOLUTION MOLECULAR SPECTROSCOPY IN ORION WITH THE JWST

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As part of the PDRs4All observing program (pdrs4all.org), we have observed the Orion star-forming region using the JWST in imaging and spectroscopic modes. With a resolution of $\frac{\nu}{\Delta\nu} \sim 3000$, the spectra of the Orion Bar and the protoplanetary disks we have obtained provide access to hundreds of lines and bands from numerous atomic ions, neutral atoms, small and large molecules. The molecular species include the ro-vibrational transitions of H₂, HD, CO, CH⁺, OH, and the emission from vibrationally excited polycyclic aromatic hydrocarbons.

In a protoplanetary disk, we detected a series of strong lines that did not correspond to any known species in spectroscopic databases. Combining efforts from astronomers and spectroscopists (both lab and theory), we were able to identify the molecular species responsible for the observed lines, i.e., the Methyl Cation CH₃⁺. CH₃⁺ had been postulated to play a pivotal role in interstellar chemistry since the '80s but remained elusive. We found that CH₃⁺ results from the hot UV-driven chemistry.

Overall, these first results demonstrate the spectroscopic potential of the JWST but also the necessity to rely on state-of-the-art spectroscopic data to interpret observations.

Bibliography

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