Tracing Complex Organic Molecules in the V883 Ori protoplanetary disk

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V883 Ori is an FUor object currently undergoing an accretion burst, which increases its luminosity and consequently pushes the snowline out to larger radii, facilitating the detection of complex organic molecules (COMs) in the gas phase. We identified 25 molecules, including isotopologues, with 15 COMs and 10 other molecules. Additionally, we report the detection of CH_3CH_2CN, CH_3OD, $H_2{}^{13}CO$, and $H_2C^{17}O$ for the first time in this source.

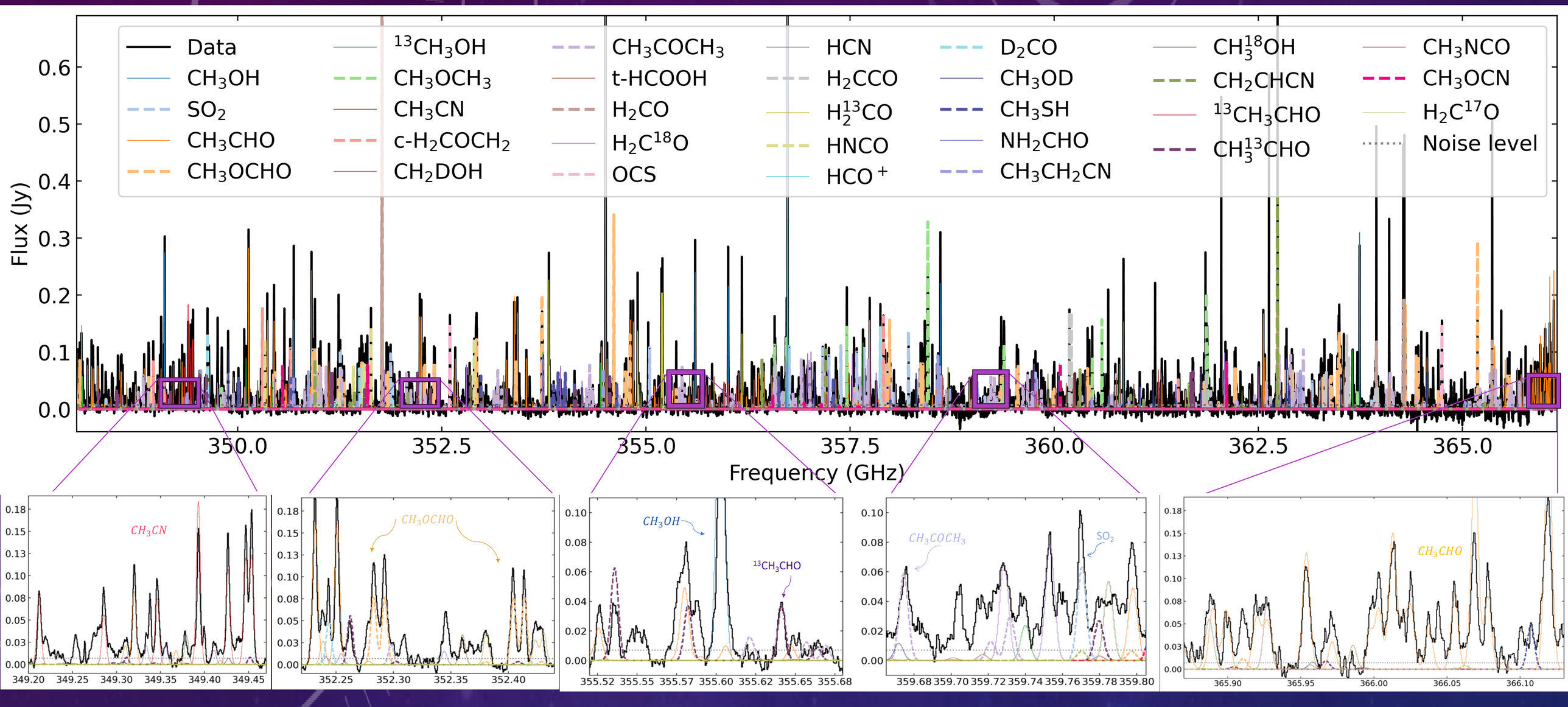

Figure 1. demonstrates the full spectra covered in our observations (ALMA Band 7; PI: Kamber Schwarz) in black, along with the best-fit model for each molecule plotted in different colors. We used Markov Chain Monte Carlo (MCMC) package implemented in Emcee (Foreman-Mackey et al. 2013) to fit the excitation temperature and the column density of each molecule, assuming Local Thermodynamic Equilibrium (LTE) conditions. Then, chi-squared (χ^2) is used to determine the best fit of the model. We fit one molecule at a time and subtract its best-fit before fitting the next molecule.

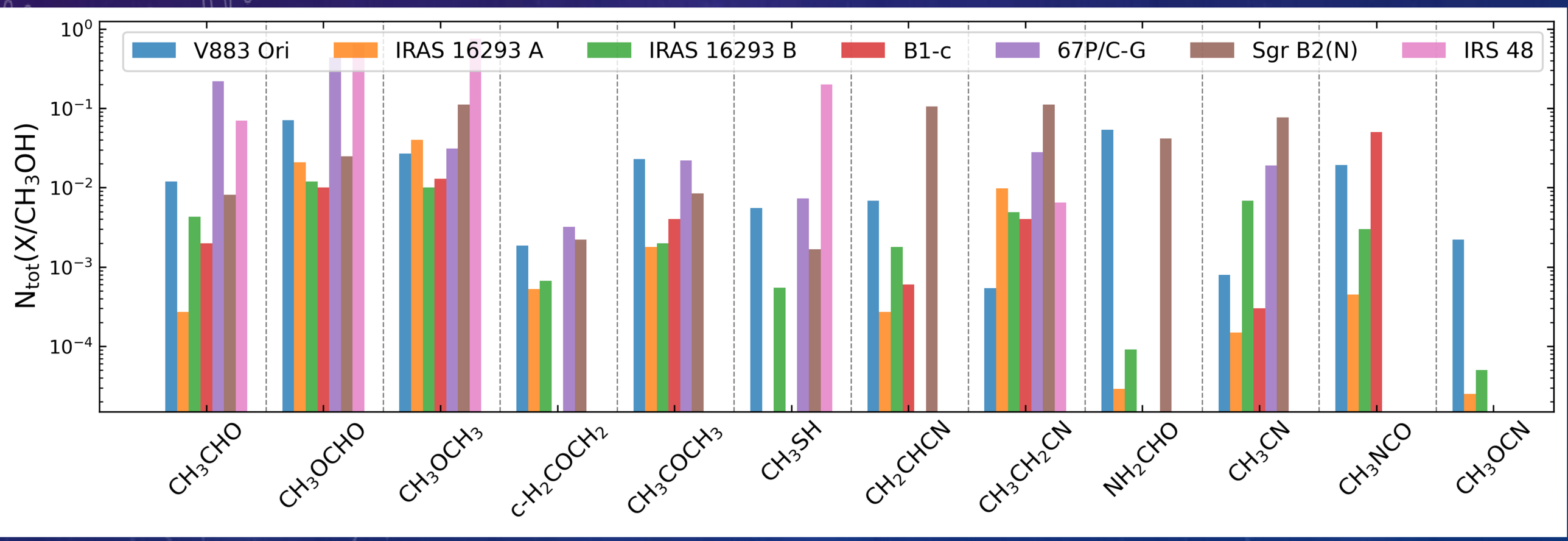

Figure 2. compares our results relative to methanol (in blue) with the low-mass protostar IRAS 16293-2422 A and B, and B1-c (Manigand et al. (2020), Calcutt et al. (2018), Manigand et al. (2019), Nazari et al. (2024), van Gelder et al. (2020), and Nazari et al. (2021)), the solar system comet 67P/Churyumov- Gerasimenko (Hänni et al. (2023) and Drozdovskaya et al. (2018)), the protoplanetary disk of Oph-IRS 48 (Brunken et al. (2022)), and the high-mass star-forming region Sagittarius B2 (North) (Belloche et al. (2013). Overall, the abundance ratios in V883 Ori are higher compared to low-mass protostars and show a similar ratio compared to the comet 67P/C-G and Sgr B2(N) for most of the molecules, which suggests that the chemical complexity increases during the evolution from the protostellar envelope to protoplanetary disks, and that the chemical composition of disks can be inherited by comets without drastic chemical processing.