☒ ORAL presentation ☐ POSTER

Breaking down the chemical complexity of high-mass star-forming cores: A combined observational and chemical modeling analysis

Mélisse Bonfand[1], **Rob Garrod**[1], **Grace Dinges**[1]
[1] *University of Virginia, Departments of Chemistry & Astronomy, Charlottesville, USA*

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ABSTRACT:

While complex organic molecules (COMs) are observed in various kinds of astronomical objects, understanding their precise origin and evolution has become one of the biggest challenges in Astrochemistry. The protostellar stage of the high-mass star-formation process is recognized as the richest phase in emission from gaseous COMs, in particular in the dense and hot envelope surrounding newly-formed protostars, referred to as hot core. While hot cores show an extremely rich chemical content, other star-forming cores are poor or devoid of any molecular lines. This calls into questions both the origin of molecular complexity due to the radiative heating of emerging protostars, and the commonly accepted star-formation sequence where all massive cores go through the hot core phase.

To get a full picture of the high-mass star formation process and the underlying chemistry, it is essential to combine high-angular resolution data that resolve the internal structure of star-forming cores at high sensitivity, with state-of-the-art dynamo-chemical simulations. I will present the results of a new model that simulates the collapse of a uniform cloud onto a central massive protostar via an accretion disk, using a 2D hydrodynamical approach, coupled with the 3-phase (gas/surface/ice mantle) chemical kinetic code MAGICKAL [1]. The full model provides an accurate 2D axisymmetric picture of the spatial and temporal dependence of the chemistry in a hot core. The calculated chemical abundances are further processed using the radiative transfer code RadMC3D to produce synthetic emission maps and molecular spectra [2]. A direct comparison with the observations allows us to assess the impact of the evolutionary stage and source structure (disk formation and inclination) on the emission and spatial distribution of COMs.

References:

[1] Garrod, R., Jin, M., Matis, K., A. et al. 2022, ApJS, 249, 26
[2] Bonfand, M., Garrod, R., Li, Z-Y., et al. 2024, in prep.