Contribution ID: **56** Type: **Oral contribution**

Thermodynamics of H2 in the context of the First Stars

Tuesday 10 September 2019 17:10 (20 minutes)

It is well known that the adiabatic index of H2 varies as its rovibrational modes are excited as a function of temperature. For the formation of the first stars at redshifts 20 and above, this variation can be significant because the primordial molecular clouds where the first stars form and the material present in accretion shocks near the first protostars can reach high temperatures where these modes can be excited. We build a statistical population of the first stars by performing a set of 80 3D gravito-hydrodynamic simulations of collapsing clouds with random seeds of sonic turbulence at high resolution (7.6 AU). We use the adaptive mesh refinement code FLASH with the primordial chemistry network KROME and follow all simulations till the time when 5 per cent of the initial cloud mass has been accreted by sink particles. The simulations are divided into two subsets - one where the adiabatic index of H2 is fixed to 7/5 (used in almost every 3D simulation of first stars), and another where it is calculated based on the temperature, ortho to para ratio and mass fraction of H2. The simulations result in the formation of 379 sink particles, implying that high fragmentation occurs in primordial clouds close to the primary sink. However, they also predict that there is a one-third chance that the massive primary might evolve in isolation, at least during its earliest stages. We find no significant differences in the mass distribution, clustering and multiplicity fraction of sinks in the two subsets. Thus, while it seems valid to treat H2 as a diatomic gas in these systems, the assumption may not stand if radiation feedback is included in simulations and followed to late times.

Author: SHARDA, Piyush (Australian National University)

Co-authors: Prof. KRUMHOLZ, Mark (Australian National University); Dr FEDERRATH, Christoph (Australian National University)

Presenter: SHARDA, Piyush (Australian National University)

Session Classification: THEORETICAL APPROACH TO CEMP STARS, FIRST STARS, AND FIRST GALAXIES