The circumstellar environment of the massive proto-O star G11.02-0.61 MM1

- John Ilee

The formation process of massive stars is not well understood, in particular it is unclear whether or not it proceeds as a scaled-up version of low mass star formation. Furthering our understanding requires high angular resolution observations of the circum(proto)stellar environments of young massive stars. In this talk, I will discuss our recent work to characterise G11.92-0.61 MM1 - a young massive star located at a distance of 3.37 kpc. Our sub-arcsecond observations with the SMA and VLA showed strong evidence for the presence of a Keplerian circumstellar disc of several solar masses on scales of thousands of au, surrounding an enclosed mass of ∼30 solar masses, and an unresolved centimetre source consistent with a hyper-compact Hii region and/or ionised jet (Ilee et al. 2016). In addition, hydrodynamic modelling has allowed us to assess the stability of the star-disc system, suggesting the disc around MM1 is susceptible to gravitational fragmentation (Forgan, Ilee et al.). Targeting the G11.92 system with ALMA in Cycle 4 has allowed us to image the circumstellar environment at a much higher spatial resolution (∼250au) in both dust continuum emission at 1.3mm and lines of several complex molecules. Our new observations i) confirm the presence of a bona-fide Keplerian disc surrounding a central mass of 20 Msol, ii) reveal evidence for previous fragmentation in the disc around MM1, allow us to iii) obtain a spatially-resolved temperature and density structure for the disc using ladders of CH3CN emission and, finally, enable us to iv) examine the morphology of the outflow cavity and compare with recent radiation-hydrodynamic simulations of massive star formation (Ilee et al. in prep). In combination, our results suggest G11.92-0.61 MM1 is one of the cleanest massive protostellar systems to study, and a unique astrophysical laboratory in order to answer the fundamental question - do massive stars form in the same way as their lower mass counterparts?

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