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Understanding the role of gas phase transition, turbulence, and magnetic field in star formation

Abstract

The neutral atomic hydrogen (HI) is the main cool gas reservoir from which star-forming molecular clouds form. According to the thermal steady-state model of HI, two distinct stable HI phases co-exist in pressure equilibrium (Wolfire et al. 2003). These are the Cold Neutral Medium (CNM, 40–300K) and the Warm Neutral Medium (WNM, 5000–8000K). The CNM is more closely linked to star formation (Schaye 2004). However, many studies of star formation using the HI emission have overlooked the existence of these two phases and treated the HI as one component (e.g., Leroy et al. 2008). These were mostly due to the lack of velocity resolution and signal-to-noise ratio (S/N). Thus, disentangling the CNM from the WNM was mostly done using HI absorption, probing only a small region within the galaxies. There are a few studies attempting to disentangle these phases using HI emission but suffered from low S/N (de Blok & Walter 2006), requiring stacking of HI spectra (e.g., Ianjamasimanana et al. 2012) and/or using a velocity resolution well above the expected thermal line-width of the CNM (e.g, de Blok & Walter 2006). Using the L-band 32K-narrow mode of MeerKAT (107 MHz, 3.3 kHz = 0.70 km/s) with its superb sensitivity, we will achieve a resolution sufficient to resolve a CNM gas with a temperature of 60 K and above, and a S/N sufficient to decompose the HI profiles to separate the CNM from the WNM. MeerKAT is the only instrument that provides the spectral resolution and the sensitivity we need.