

Millimetre molecular lines in Planck cold clumps

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Abstract. Galactic cold clumps have been identified from the Planck data (Planck Collaboration, 2011a, 2011b, 2015) as 10 342 cold (7 - 19 K) sources that stand out against a warmer environment, with the Early Cold Cores as a subsample of 915 most reliable detections. There is CO emission associated with the Planck Cold Clumps (PCCs), which has been observed with ground-based radio telescopes at higher resolution (Wu *et al.* 2012, Liu *et al.* 2014). A subset of PCCs have also been observed with Herschel at higher resolution (Juvela *et al.* 2012).

A southern sub-sample of the PCCs has been observed with the Mopra 22-m telescope to study the molecular gas. The Mopra telescope has 3-mm, 7-mm and 12-mm bands, with broadband correlator configuration 8-GHz wide with 0.27-MHz channels, or multiple zoom bands 137-MHz wide with 33-KHz channels, within the 8 GHz.

During the 2013 southern winter season we observed 10 clumps. This included observations in the 3-mm band of ¹²CO, ¹³CO and C¹⁸O and lines around 89 GHz (e.g. HCN, HCO⁺ and HNC), in the 7-mm band (e.g. CS) and in the 12-mm band (e.g. NH₃). These observations were heterogenous, with sources selected by LST in gaps between observations of other projects, and band chosen by weather (i.e. in conditions unsuitable for higher frequencies, lower frequency bands were observed). During the 2014 season we observed 34 positions in 22 clumps, with zoom mode observations of lines around 89 GHz. This was a more well-defined sample of sources.

The mapping of the CO lines shows good spatial correlation of the CO with the dust column density. The CO isotopologues show high optical depth in ¹²CO and ¹³CO. The lines of HCN, HCO⁺ and HNC are weak, but detected in many of the 2014 sample. We are modelling the line results to determine column densities, excitation temperatures and abundances, using tools such as RADEX (van der Tak *et al.* 2007).

Keywords. ISM: molecules, ISM: kinematics and dynamics, radio lines: ISM

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