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Herschel Galactic Cold Cloud Core Analysis

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Abstract. We have compiled a sample of 106 lesser-known cores from the Herschel Galactic Cold Cloud Cores Key Program (Juvela, M. *et al. 2007*). Based on the assumption, that these represent the crowd of the cold cores in the galaxy well, we have started a deep individual investigation, beginning with a ground-based follow-up and molecular line measurement at IRAM 30m telescope. We present the methods and calculated values of the most important parameters on a selected source: the G130.38+11.25 molecular cloud, which is part of the L1340.

Keywords. ISM: clouds — dust, extinction — ISM: molecules

During the observation at IRAM 30m telescope in 2011 April 7, a 3'x3' map was taken of the source using OTF/fsw mode. Three different line-transitions were observed simultaneously: $^{13}CO(1\text{-}0)$, $^{13}CO(2\text{-}1)$ and $C^{18}O(1\text{-}0)$, using the VESPA autocorrelation spectrometer with a velocity resolution of 0.0266 kms^{-1} (100 GHz) and 0.0531 kms^{-1} (220 GHz). The integration time was 3.918s. Pointing accuracy is $\sim$ 2". The radius of the densest part of the cloud is determined with two independent methods: first (M1), fitting a 2D Gaussian surface to the 250μm SPIRE map; second (M2), applying Larson's law to the CO velocity dispersion (σ_{1D}). Table 1 summarizes the results of the calculations. Both methods identify two cores, with a good agreement in the radius (R). The ^{13}CO column density and H_2 density is calculated from the molecular line spectra, again, using two different method. The first is a classical calculation assuming local thermal equilibrium (LTE). In the second method, we use a non-LTE excitation and radiative transfer code, called RADEX (Van der Tak *et al. 2007*). We find a big difference in the results of the two methods. For the dust temperature, we apply the Herschel SPIRE maps (SED fitting). Finally, we determine the virial-mass, using the equation: $M = 3.9R\sigma_{1D}^2 G^{-1}$ (see Roman-Duval *et al. 1995*), and we estimate the core-mass, assuming a simple spherical geometry with $\rho \sim R^{-1.5}$ using $n(H_2)$ calculated previously. The most important parameters of a molecular cloud are determined using different estimations and methods, leading us to a better model of such small cold cores.

References

Juvela, M. *et al.* 2012, *A&A*, 541A, 12J
Roman-Duval, J. *et al.* 2010, *ApJ*, 723, 492-507
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Table 1. Parameter table for G130.38+11.25 molecular cloud cores

Properties	CORE 1	CORE 2	Properties	CORE 1	CORE 2
Central Coordinate RA	2:32:28.4	2:32:26.3	M1 $n(H_2)[10^3\ cm^{-3}]$	10.2 ± 0.9	15.6 ± 2.0
Central Coordinate DEC	+72:38:38.6	+72:40:18.9	M2 $n(H_2)[10^3\ cm^{-3}]$	9.7 ± 2.2	6.1 ± 0.9
M1 R [pc]	0.052	0.036	T_{dust} [K]	11.95	12.33
M2 R [pc]	0.053	0.047	Virial Mass [$M_\odot$]	1.5 ± 0.2	0.94 ± 0.11
M1 $N(^{13}CO)$ [10^{15} cm^{-2}]	5.6 ± 0.2	7.5 ± 0.2	M1 Core-mass [$M_\odot$]	2.6 ± 1.4	1.43 ± 0.94
M2 $N(^{13}CO)$ [10^{15} cm^{-2}]	7.8 ± 0.3	11.1 ± 1.6	M2 Core-mass [$M_\odot$]	2.5 ± 1.3	0.58 ± 0.38