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HCL1 and HCL2 - low mass star formation in violent and quiet environments

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Abstract. Recently a large number of Galactic cold clumps were located with the Planck all-sky survey. Our radio line observations have revealed the distribution and physical properties of the interstellar medium in dozens of PGCC sources. Clumps can be affected by many external effects. HCL1 (a.k.a. L1251) and HCL2 (which contains also TMC-1) are examples of low mass star forming clouds in violent and quiet environments.

Keywords. stars: formation, radio lines: ISM

1. Introduction

The Solar System may have formed in a violent environment but solar mass stars can also form without external triggering. Heiles (1968) traced cold interstellar gas with OH detections at positions of high visual extinction. Since then the name "Heiles Cloud 2" (HCL2) identifies the most massive molecular cloud in Taurus as was shown e.g. by a large scale $C^{18}O$ survey by Onishi *et al.* (1996). It is however not recognized these days, that Heiles' Cloud 1, where he also detected normal (i.e. not non-thermal) OH lines, is L1251, one of the prominent molecular clouds of the Cepheus region. Here we compare HCL1 and HCL2 as examples of low mass star formation in different environments.

2. Results and discussion

L1251 is at the boundary of the Cepheus Flare GMC (Lebrun 1986, Kiss *et al.* 2006). It faces an old SNR bubble as the overlaid soft X-ray contours show in the CO map of Grenier *et al.* (1989). The Cepheus Planck FIR, sub-mm polarization pattern (Planck collaboration *et al.* 2015) shows a large scale structure, and the elongated L1251 cloud (see recently Levshakov *et al.* 2016) looks unrelated.

HCL1 has two Planck Galactic Cold Clumps (PGCC, Planck collaboration 2011, 2015, Montillaud *et al.* 2015) and a number of low and intermediate mass YSOs mostly around it (Tóth & Walmsley 2011). HCL2 is a "bush" type cluster of PGCCs, as revealed by the minimum spanning tree (MST) method, with a group of low mass YSOs (Tóth *et al.* 2004, 2017). HCL2 is embedded in a complex of clouds, with a B field pattern that may be the result of colliding HI flows (Ballesteros-Paredes *et al.* 1999). The Taurus filaments

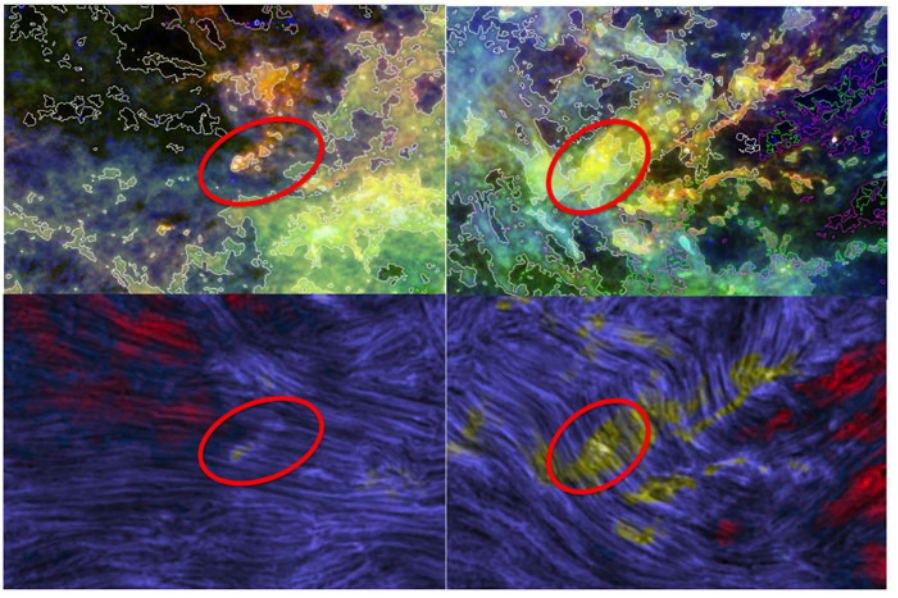

Figure 1. FIR continuum and polarization images of the environment of L1251 (left) and HCL2 (right). The positions of the clouds are marked with red ellipses. Top row: Composite of Red: Planck 857GHz; Green: IRIS 100μm; Blue: IRIS 12μm continuum images. Bottom row: B field pattern based on Planck polarization data (LIC convolved to 10 arcmin).

are perpendicular to the B field while striations (fibers outside filaments) are parallel to B field, based on CO observations and optical polarization (Goldshmith *et al.* 2008) and Planck FIR and sub-mm polarization data.

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References

Ballesteros-Paredes, J. *et al.* 1999, *ApJ*, 527, 285
Fehér, O. *et al.* 2016, *A&A*, 590, A75
Goldshmith, P. *et al.* 2008, *ApJ*, 680, 428
Grenier, I. *et al.* 1989, *ApJ*, 347, 231
Heiles, C. *et al.* 1968, *ApJ*, 151, 919
Kiss, Z. T. *et al.* 2006, *A&A*, 453, 923
Lebrun, F. *et al.* 1986, *ApJ*, 306, 16
Levshakov, S. A. *et al.* 2016, *A&A*, 586, 126
Montillaud, J. *et al.* 2015, *A&A*, 584, 92
Onishi, T. *et al.* 1996, *ApJ*, 465, 815
Planck collaboration *et al.* 2011, *A&A*, 536, A23
Planck collaboration *et al.* 2015, *A&A*, 576, A104
Tóth, L. V. *et al.* 1995, *Ap&SS*, 233, 175
Tóth, L. V. & Walmsley, C. M 1996, *A&A*, 311, 981
Tóth, L. V. *et al.* 2004, *A&A*, 420, 533
Tóth, L. V. *et al.* 2017, *IAUS*, 316, 133

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