



THE RELATIONSHIP BETWEEN COLD GAS AND DUST IN BRIGHT PLANCK COMPACT SOURCES

Nóra VARGA¹, András Péter JOÓ¹, L. Viktor TÓTH^{1,2}

¹ Eötvös Loránd University, Budapest, Hungary ² University of Debrecen, Hungary

Abstract

We present a comparative study of the cold interstellar medium (ISM) structure and the magnetic field and relate those to the earliest stages of star formation.

We used Planck polarisation and Herschel FIR data, together with submm images obtained with the SCUBA2 submm camera at the James Clerk Maxwell Telescope. The ISM structure is uncovered from the FIR data, the Planck polarisation maps show the orientation of the magnetic field, and the SCUBA point sources indicate the distribution of embedded prestellar objects. We could spatially resolve structures and compare the orientations also to our former observations of cold dense gas in the HCL2 star-forming cloud.

Heiles Cloud 2

To examine the structure of HCL2 we use infrared data from the Herschel SPIRE at 500 μm . HCL2 has a ring-like structure and it identifies as the most massive molecular cloud complex in the Taurus region. We focused on the TMC1 part of HCL2 and examined the distribution of X-ray point sources and known YSOs. The x-ray sources are from the XMM-OM Serendipitous Source Survey Catalog X-ray data. ((1)) To further confirmation and to find additional X-ray sources we add XMM-Newton Extended Survey of Taurus Molecular Cloud ((2)). For the position of YSOs we used Gaia DR3 YSO sample and we cross-correlated that with a YSO sample by Gábor Marton (in prep.).

YSOs are found mostly in the dense part of the cloud and they appear evenly distributed.

Around TMC-1 X-ray point sources appear in close proximity to the dense regions of filaments and along the more dense region we can see a higher number of the sources.

Data processing

We cross-matched the X-ray sources with YSOs in TMC-1. Also examined which of the X-ray sources could be YSO candidates based on their hardness ratio in order to compare them with known YSOs from Gaia. In TMC-1 we found 63 X-ray point sources, three of them matching with known YSOs. The spectral energy distributions of these sources show that they have different stages of star formation. For the classification we used their spectral energy distribution (SED). We also used submm datas from the Planck Galactic Cold Cores catalogue to see if there are sources in this region and found three in the HCL2.

Magnetic field

For the investigation of the magnetic field we examined the polarized dust emission. We used Planck all-sky intensity and polarisation maps at 353GHz and cut out the regions in HCL2 and calculated the magnetic field orientation. In Fig.1 we can see the magnetic field orientation in HCL2 calculated from Planck polarisation data. The vectors indicate the direction of the magnetic field and the vectors' length shows the intensity of the magnetic field's transverse component to the line of sight. The magnetic field vectors are aligned, and the configuration of the field appears quite orderly in Fig.1.

The magnetic field lines are parallel to the molecular filaments, suggesting that the magnetic field plays a significant role in the formation and maintenance of these filaments.

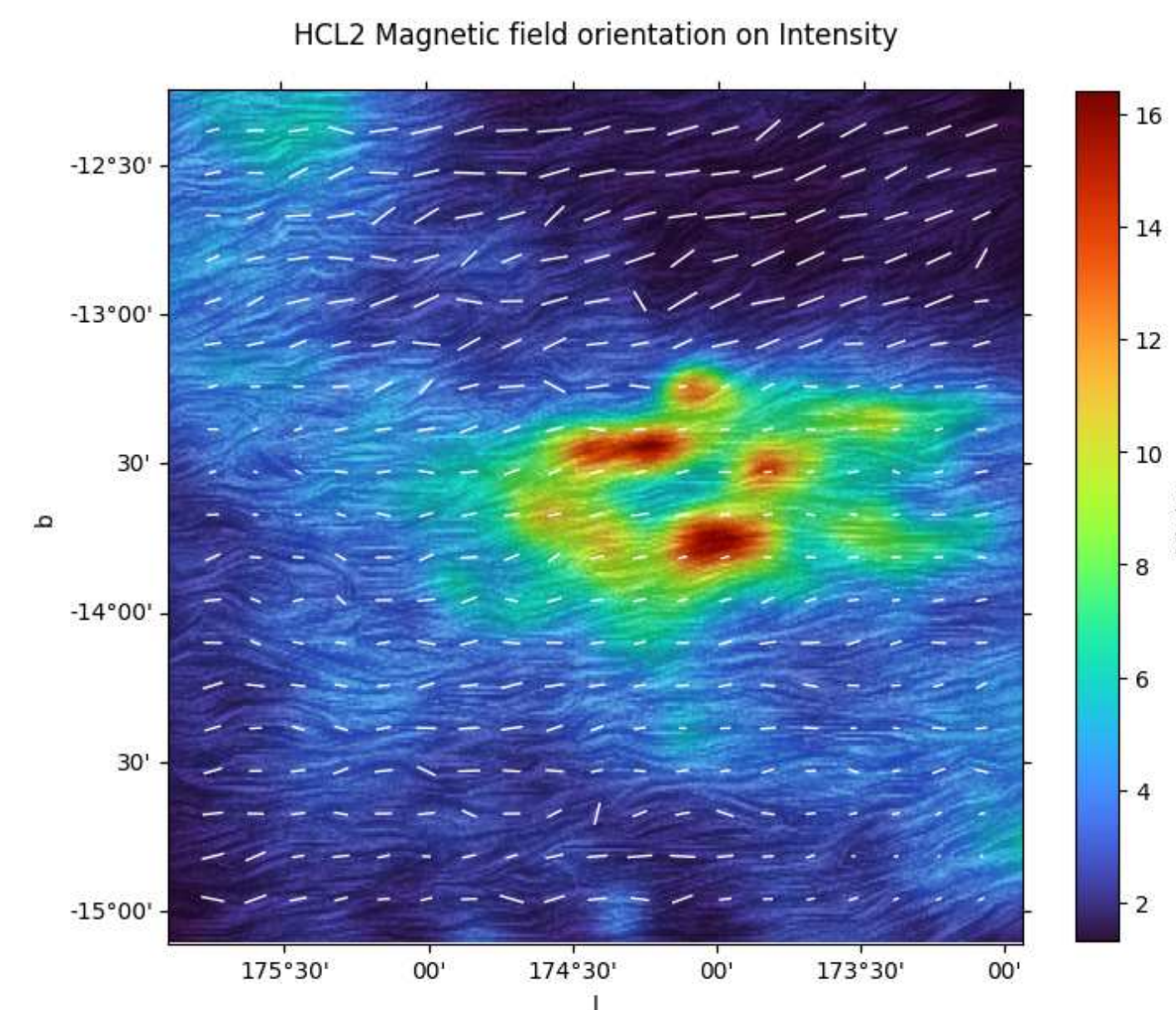


Fig. 1: Magnetic field orientation in HCL2.

Magnetic field with point sources

We analyzed the positions of YSOs compared to the structure of the interstellar medium in TMC1-1. Fig.2 shows the comparison between the structure of the magnetic field, and its relation to the sources.

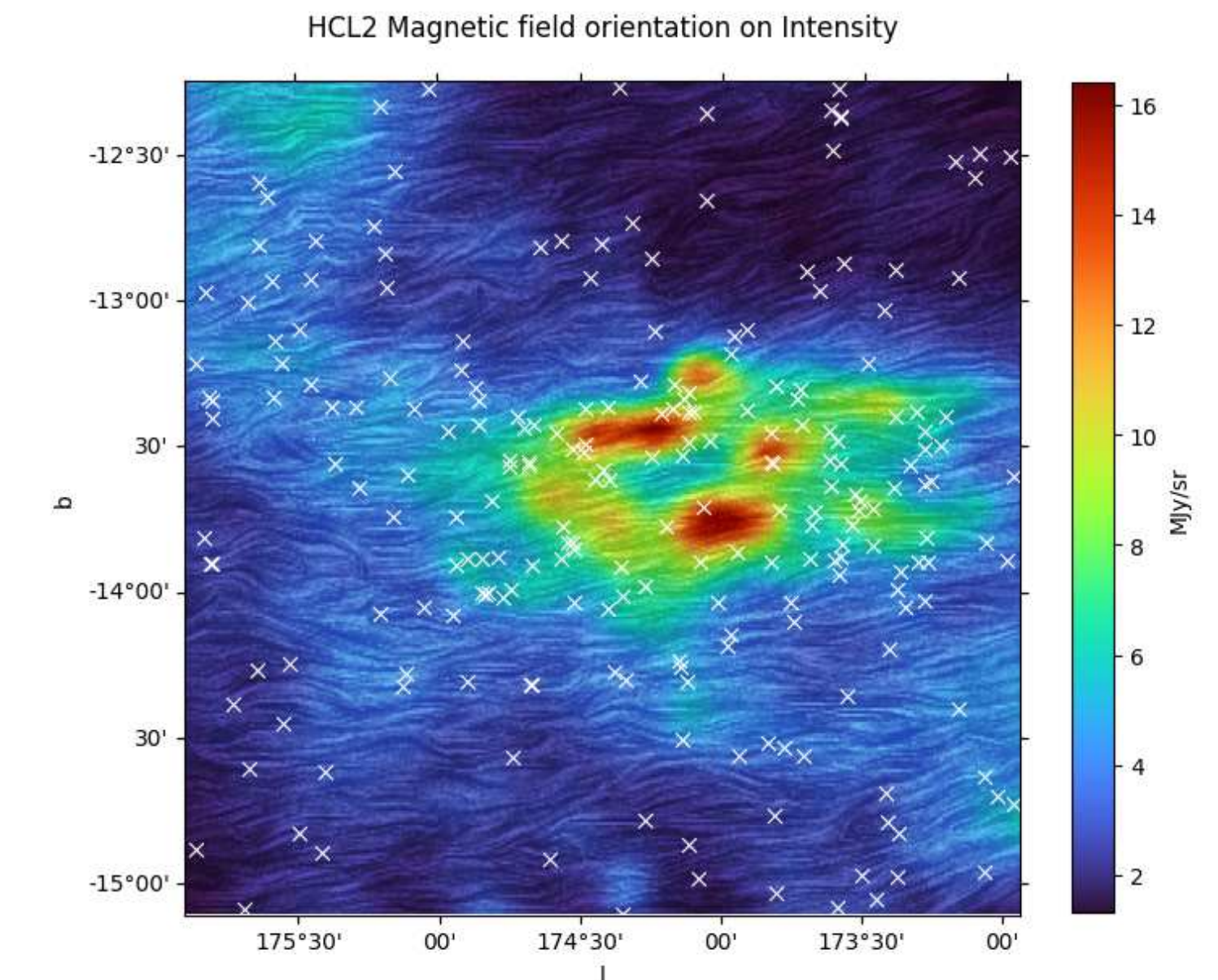


Fig. 2: Magnetic field orientation in TMC-1 with YSOs.

We can see that YSOs are distributed along the same direction as the polarization vectors, implying that the magnetic field lines are directing the formation of these objects.

In the future, we want to make correlation analysis to see the relationship between the magnetic field properties and other properties of the clouds.

Acknowledgment

The authors thank Dana Alina, Isabelle Ristorcelli, Mika Juvela, Katia Ferrière and Déborah Paradis for their invaluable help with Planck polarisation data. We acknowledge the use of the drizzweb interface provided by the Centre d'Analyse de Données Etendues (CADE), a service of IRAP-UPS/CNRS (<http://cade.irap.omp.eu>, Paradis et al., 2012, A&A, 543, 103).

References and contact

1. M. J. Page et al., **426**, 903–926, arXiv: 1207.5182 (astro-ph.CO) (2012).
2. M. Güdel et al., *Astronomy & Astrophysics* **468**, 353–377 (2006).

Contact:

varganora43@gmail.com
or András Péter Joó at IAU GA

