is likely low-density filamentary material associated with the cloud. The core envelope appears to be located in correspondence of the merger of these filamentary structures.

- We see a velocity gradient along the filament in the DCO^+ (3-2) gas. Therefore, we measured the ongoing accretion material toward the protostar core in this gas, $\dot{M}_{acc} = 9.7 \times 10^{-7} M_\odot yr^{-1}$, where the accretion rate is expected to be accurate within a factor of 2.
- The mean velocity gradient is roughly 5.1 km s^{-1} pc^{-1} measured in DCO^+ (3-2) around the protostar core, which is linked to the rotation of the core. This velocity gradient at the position of the protostar is in the east–west direction, oriented approximately perpendicular to the bipolar outflow previously found.
- Line widths of DCO^+ (3-2) increase toward the position of the protostar, probably due to protostellar feedback.
- We observed a velocity shift between neutral and ionized species. A higher velocity is always present in the $C^{18}O$ (2-1) data compared to the DCO^+ (3-2) data. The mean velocity difference, $V_{lsr}(C^{18}O)$ - $V_{lsr}(DCO^+)$, is equal to 0.13 km s^{-1} across the full filament. This is consistent with a model of collision between filaments that is still ongoing. The velocity shift between the $C^{18}O$ (2-1) and DCO^+ (3-2) illustrates the relative motion of the dense gas, traced by DCO^+ (3-2), and the surrounding less dense envelope, traced by $C^{18}O$ (2-1).

Further observational investigations are needed to determine in more detail the connections within the kinematics and magnetic field in this source.

Acknowledgements. Elena Redaelli acknowledges the support from the Minerva Fast Track Program of the Max Planck Society. The authors would like to thank Jaime Pineda Fornerod for his support and discussion about the code to calculate the velocity gradient. This research has made use of data from the Herschel Gould Belt survey (HGBS) project (http://gouldbelt-herschel.cea.fr). The HGBS is a Herschel Key Programme jointly carried out by SPIRE Specialist Astronomy Group 3 (SAG 3), scientists of several institutes in the PACS Consortium (CEA Saclay, INAF-IFSI Rome, and INAF-Arcetri, KU Leuven, MPIA Heidelberg), and scientists of the Herschel Science Center (HSC)(André et al. 2010).

References

André, P., Men'shchikov, A., Bontemps, S., et al. 2010, A&A, 518, L102
André, P., Ward-Thompson, D., & Barsony, M. 1993, ApJ, 406, 122
André, P., Ward-Thompson, D., & Barsony, M. 2000, in Protostars and Planets IV, ed. V. Mannings, A. P. Boss, & S. S. Russell, 59
Bacmann, A., Lefloch, B., Ceccarelli, C., et al. 2002, A&A, 389, L6
Barnes, A. T., Henshaw, J. D., Caselli, P., et al. 2018, MNRAS, 475, 5268
Benedettini, M., Pezzuto, S., Schisano, E., et al. 2018, A&A, 619, A52
Bjerkeli, P., Jørgensen, J. K., & Brinch, C. 2016, A&A, 587, A145
Bontemps, S., André, P., Könyves, V., et al. 2010, A&A, 518, L85
Caselli, P., Walmsley, C. M., Tafalla, M., Dore, L., & Myers, P. C. 1999, ApJ, 523, L165
Caselli, P., Walmsley, C. M., Terzieva, R., & Herbst, E. 1998, ApJ, 499, 234
Caselli, P., Walmsley, C. M., Zucconi, A., et al. 2002, ApJ, 565, 331
Chen, H.-R. V., Zhang, Q., Wright, M. C. H., et al. 2019, ApJ, 875, 24
Crutcher, R. M. 2012, ARA&A, 50, 29
Dzib, S. A., Loinard, L., Ortiz-León, G. N., Rodríguez, L. F., & Galli, P. A. B. 2018, ApJ, 867, 151
Evans, Neal J., I., Di Francesco, J., Lee, J.-E., et al. 2015, ApJ, 814, 22
Evans, Neal J., I., Dunham, M. M., Jørgensen, J. K., et al. 2009, ApJS, 181, 321
Franco, G. A. P. & Alves, F. O. 2015, ApJ, 807, 5
Frau, P., Girart, J. M., Alves, F. O., et al. 2015, A&A, 574, L6
Galametz, M., Maury, A., Girart, J. M., et al. 2018, A&A, 616, A139
Gerner, T., Shirley, Y. L., Beuther, H., et al. 2015, A&A, 579, A80
Ginsburg, A. & Mirocha, J. 2011, PySpecKit: Python Spectroscopic Toolkit, Astrophysics Source Code Library, record ascl:1109.001
Goldsmith, P. F. 2001, ApJ, 557, 736
Goodman, A., Benson, P., Fuller, G., & Myers, P. 1993, The Astrophysical Journal, 406, 528
Hacar, A. & Tafalla, M. 2011, A&A, 533, A34
Henshaw, J. D., Caselli, P., Fontani, F., et al. 2013, MNRAS, 428, 3425
Hull, C. L. H. & Zhang, Q. 2019, Frontiers in Astronomy and Space Sciences, 6
Hull, C. L. H. & Zhang, Q. 2019, Frontiers in Astronomy and Space Sciences, 6, 3
Joos, M., Hennebelle, P., & Ciardi, A. 2012, A&A, 543, A128
Jørgensen, J. K., Visser, R., Sakai, N., et al. 2013, ApJ, 779, L22
Krumholz, M. R., Crutcher, R. M., & Hull, C. L. H. 2013, ApJ, 767, L11
Lee, J. W. Y., Hull, C. L. H., & Offner, S. S. R. 2017, ApJ, 834, 201
Li, Z. Y., Banerjee, R., Pudritz, R. E., et al. 2014, in Protostars and Planets VI, ed. H. Beuther, R. S. Klessen, C. P. Dullemond, & T. Henning, 173
Li, Z.-Y., Krasnopolsky, R., & Shang, H. 2013, ApJ, 774, 82
Mac Low, M.-M. & Klessen, R. S. 2004, Reviews of Modern Physics, 76, 125
Maury, A. J., André, P., Men'shchikov, A., Könyves, V., & Bontemps, S. 2011, A&A, 535, A77
McKee, C. F. & Ostriker, E. C. 2007, ARA&A, 45, 565
Okoda, Y., Oya, Y., Sakai, N., et al. 2018, ApJ, 864, L25
Pattle, K., Fissel, L., Tahani, M., Liu, T., & Ntormousi, E. 2022, arXiv e-prints, arXiv:2203.11179
Pineda, J. E., Segura-Cox, D., Caselli, P., et al. 2020, Nature Astronomy, 4, 1158
Redaelli, E., Alves, F. O., Santos, F. P., & Caselli, P. 2019a, A&A, 631, A154
Redaelli, E., Bizzocchi, L., Caselli, P., et al. 2019b, A&A, 629, A15
Roy, A., André, P., Palmeirim, P., et al. 2014, A&A, 562, A138
Rygl, K. L. J., Benedettini, M., Schisano, E., et al. 2013, A&A, 549, L1
Seifried, D., Banerjee, R., Pudritz, R. E., & Klessen, R. S. 2015, MNRAS, 446, 2776
Tachihara, K., Dobashi, K., Mizuno, A., Ogawa, H., & Fukui, Y. 1996, PASJ, 48, 489
van Kempen, T. A., van Dishoeck, E. F., Hogerheijde, M. R., & Güsten, R. 2009, A&A, 508, 259
Wurster, J. 2021, MNRAS, 501, 5873
Yen, H.-W., Koch, P. M., Hull, C. L. H., et al. 2021, ApJ, 907, 33
Yen, H.-W., Koch, P. M., Takakuwa, S., et al. 2017, ApJ, 834, 178
Zhang, C.-P., Yuan, J.-H., Li, G.-X., Zhou, J.-J., & Wang, J.-J. 2017, A&A, 598, A76