Shocked gas and filamentary structures of OMC-2 FIR 4.

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Star formation is a complex multi-scale problem that is not completely understood. One of its characteristics is the omnipresence of intertwined filaments observed at large scales (0.1-10 pc) in molecular clouds [e.g., 1]. These filaments split up into collections of sonic fibres, that form hubs associations at the position of forming stellar clusters [e.g., 2,3,4]. The formation of clusters itself may be triggered or altered by various processes such as stellar feedback, H II regions, supernovae, and outflows. Hence, the study of cluster formation is crucial for a more comprehensive understanding of the different variables that shape star formation.

In this context, we will present our recent results on the intermediate-mass protocluster OMC-2 FIR 4. This cluster harbours several protostars including the hot corino HOPS-108 [5] that drives a southeast jet [6]. It is also located to the south of the source HOPS-370 characterised by a high velocity outflow that could be impacting the star formation within it [7,8]. To better comprehend the different processes occurring within OMC-2 FIR 4 we carried out a study with ALMA at 1.3mm with a spatial resolution of ~100 au. We analysed the emission of eight different molecular tracers (SiO, CH_3OH, $C^{18}O$, CS, CH_3CN, $H^{13}CN$, HC_3N, and CCH) probing high density extended structures and shocks. Our CS and CH_3OH maps revealed the presence of intricate filaments and outflow cavities at ~0.04 pc scale. With SiO we identified multiple bow-shock features towards the source HOPS-370 extending between ~500 and 2700 au, and a south to north monopolar jet from the embedded protostar VLA15 with a length of ~3900 au. Some filaments were also detected in SiO suggesting that there is shocked gas within these filaments, where the gas is compressed and warmed up. Furthermore, each of the observed filaments is characterised by a different velocity with the larger velocity spread observed at the centre of the cloud. Our study suggests that the OMC-2 FIR 4 protocluster is more complex than previously thought. The observed filaments might be connected to the fibres observed at ~1 pc scale by [3], however their kinematics might be altered by the stellar feedback or gravitational focusing effects. The bow-shock features detected in SiO could be the signature of the precessing jet from HOPS-370 which is impacting on the OMC-2 FIR 4 region. However, the impact from the jet is controversial [9], and we will investigate this possibility precisely with our recently approved NOEMA observations.

References

[1] André, P., Di Francesco, J., Ward-Thompson, D., et al. 2014 in Protostars and Planets VI
[2] Hacar, A., Tafalla, M., Kauffmann, J., & Kovács, A. 2013, A&A, 554, A55
[3] Hacar, A., Tafalla, M., Forbich, J., et al. 2018, A&A, 563, L3
[4] Henshaw, J. D., Jiménez-Serra, I., Longmore, S. N., et al 2017, MNRAS et al. 2017, 464, L31
[5] Chahine, L., López-Sepulcre, A., Neri, R., et al. 2022, A&A, in press
[6] Lattanzi, V., Alves, F.O., Padovani, M., et al. submitted
[7] Shimajiri, Y., Takahashi, S., Takakuwa, S., Saito, M., & Kawabe, R. 2008, ApJ, 683, 255
[8] Osorio, M., Díaz-Rodríguez, A. K., Anglada, G., et al. 2017, ApJ, 840, 36
[9] Favre, C., Ceccarelli, C., López-Sepulcre, A., et al. 2018, ApJ, 859, 136