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Revealing magnetic fields towards massive protostars: a multi-scale approach using masers and dust

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Abstract. Magnetic fields play a significant role during star formation processes, hindering the fragmentation and the collapse of the parental cloud, and affecting the accretion mechanisms and feedback phenomena. However, several questions still need to be addressed to clarify the importance of magnetic fields at the onset of high-mass star formation, such as how strong they are and at what evolutionary stage and spatial scales their action becomes relevant. Furthermore, the magnetic field parameters are still poorly constrained especially at small scales, i.e. few astronomical units from the central object, where the accretion disc and the base of the outflow are located. Thus we need to probe magnetic fields at different scales, at different evolutionary steps and possibly with different tracers. We show that the magnetic field morphology around high-mass protostars can be successfully traced at different scales by observing maser and dust polarised emission. A confirmation that they are effective tools is indeed provided by our recent results from 6.7 GHz MERLIN observations of the massive protostar IRAS 18089-1732, where we find that the small-scale magnetic field probed by methanol masers is consistent with the large-scale magnetic field probed by dust (Dall'Olio *et al.* 2017 A&A 607, A111). Moreover we present results obtained from our ALMA Band 7 polarisation observations of G9.62+0.20, which is a massive star-forming region with a sequence of cores at different evolutionary stages (Dall'Olio *et al.* submitted to A&A). In this region we resolve several protostellar cores embedded in a bright and dusty filamentary structure. The magnetic field morphology and strength in different cores is related to the evolutionary sequence of the star formation process which is occurring across the filament.

Keywords. magnetic field – masers – stars: formation – stars: massive – dust – polarisation

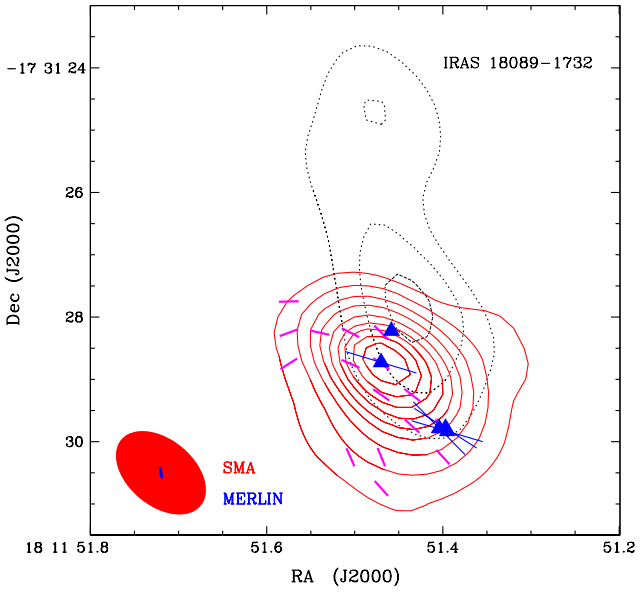

Figure 1. The red contours show the integrated Stokes I image of the continuum emission in 10σ steps. Dotted black contours show the SiO(5-4) emission, tracing the outflow, integrated from 30 to 40 km s^{-1} (5σ steps of 260 mJy $beam^{-1}$). The magenta line segments plot the orientation of the magnetic field derived from dust polarization (obtained with SMA, Beuther *et al.* 2010). The blue triangles mark the position of methanol masers and the blue lines indicate the direction of the magnetic field from methanol maser linear polarization (MERLIN observations discussed in this work).

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