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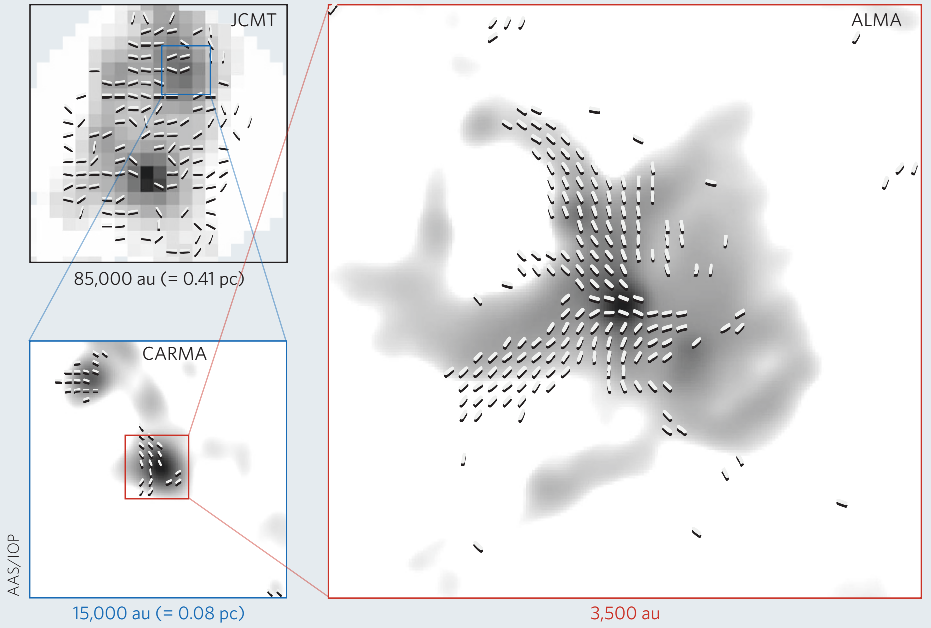
STAR FORMATION

The importance of being magnetic (or not)

Magnetic fields — questions about which are often blamed for derailing many a conference talk — are instrumental in the formation and evolution of stars, planets, black holes and galaxies. Constraining the properties of magnetic field lines on different scales can provide clues about a range of physical processes that might otherwise be inaccessible. Charles Hull and collaborators (*Astrophys. J. Lett.* **842,** L9; 2017) used the Atacama Large Millimeter/submillimeter Array (ALMA), the Combined Array for Research in Millimeter-wave Astronomy (CARMA) and the James Clerk Maxwell Telescope (JCMT) to probe the magnetic field structure of a protostellar source from scales of tens of thousands of au down to the accretion disk around the protostar on scales of ~150 au (pictured; the thermal emission from the cool dust is shown in greyscale and the white line segments show the orientation of the magnetic field).



Traditionally, magnetic fields are believed to regulate the collapse of protostellar cores and the formation of stars. In fact, strong magnetic fields are expected to dominate over the dynamic effects of turbulence in the molecular cloud, with an hourglass-like configuration of the magnetic field lines being the tell-tale sign of this scenario. However, observations of some of the brightest- and highest-mass protostellar cores have revealed such magnetic field configurations in only some cases, demanding a more nuanced approach to the role of magnetic fields in the formation of stars.

Hull *et al.* observed a low-mass protostellar core with ALMA and found no hourglass configuration. Instead, the magnetic field lines appear to be oriented randomly on both core- and accretion disk-scales. In an effort to explain their findings, the authors undertook simulations that included the effects of both magnetic fields and turbulence and compared them to their ALMA results. Their observations matched simulations with a weak magnetic field, essentially showing that turbulence dominates over the magnetic field in terms of dynamics. Intriguingly, the widely expected hourglass configuration only appeared in the set of simulations with the strongest magnetic field, indicating that this is an exception rather than the rule.

The example of this protostellar core illustrates the diversity of environments within which stars form and grow. The propagation speed of turbulence may be the deciding factor as to the degree that the magnetic field aids the accretion of matter onto a protostar. Protostellar outflows and the accretion disk itself may further influence the interplay between turbulence and magnetic effects. These results move us a step farther from a monolithic paradigm of protostar formation.

MARIOS KAROUZOS