

Dust Polarization and Magnetic Field in Star formation

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Stars form in giant molecular clouds under the threads of turbulence and large-scale magnetic (B) fields. Theoretically, the significance of the B field influences how structures are formed, such as the density contrast within structures, the star formation rate, and the suppressed fragmentation. However, the B fields in star-forming clouds are not well-constrained observationally, because they are difficult to detect. One of the methods to probe the B field is dust polarization. Dust grains are known to align with their shorter axes parallel to the field lines in most circumstances. The plane-of-sky projected B field integrated along the line of sight can be traced by rotating the detected polarization of the thermal dust emission by 90 degs. In this talk I will present our studies of the magnetic (B) field through dust polarization in the star forming cores and in the envelopes of molecular clouds using the Submillimeter Array. The B morphologies are resolved with an angular resolution up to 0.3". Dense structures with a number density 10^5 to 10^7 cm⁻³ are traced. The B morphologies of sources at different evolutionary stages, from the collapsing core (W51 e2 and part of Orion BN/KL) to the ultra-compact HII region G5.89-0.39 will be presented. We will further present a new case study of the B morphologies toward the W51 North region, combining field structures at three different physical scales. In a sequence of increasingly higher resolution observations - from CSO/JCMT single dish at 2 pc to the SMA highest resolution at about 10 mpc - it becomes manifest how the field morphologies change from the envelope surface layer to the inner core and disk. Structures vary from uniform to cometary and hourglass-like. We quantify these changes, which provide an evidence that the interplay of the B field with other forces evolves with scale. In the end of the talk I will report the status of the SMA polarization legacy project "Filaments, Star Formation and Magnetic Fields".