Mapping the magnetic field structure in the filamentary cloud IC5146 with optical dust polarization observations

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Recent Herschel and Spitzer survey discover numerous filamentary clouds in the star-forming regions. Stretching many parsecs in the sky, these filaments often encompass dense clumps that are fertile ground of massive stars or clusters. However, how filamentary clouds form is still on debate. The filamentary clouds may form from compression of large scale convergent flows (Mac Low & Klessen 2004), while other theoretical works suggest filamentary clouds may result from the gas collapsing along the field line of a strong magnetic field (Ostriker et al. 2001). To evaluate the relative importance of these two mechanisms on filament formation, we map the magnetic field structure of IC5146 though the optical polarization produced by the dust absorption of the background starlight. IC5146 is one of the first filamentary clouds observed by Herschel Gould Belt Survey, and the complex network of filaments discovered within the cloud favors the scenario that the filaments network are generated by large scale MHD turbulence and fragment into prestellar cores by gravitational instability (Arzoumanian et al. 2011). Our observations reveal that the large scale structure of magnetic field is well perpendicular to the main filament, but is likely parallel to the sub-filaments, extended out from the main filaments. In addition, our CO observations show that the material in the sub-filament is flowing into the main-filament along the magnetic field. Those results suggest that the sub-filaments may be gravitationally unbound clouds, thus can freely flow along the magnetic fields. On the other hand, the main-filament is possibility reach the gravitationally bound stage. Our results will be a good example to demonstrate how a magnetized filament evolves from gravitationally unbound to bound.