Complex Scattered Radiation Fields and Multiple Magnetic Fields in the Protostellar Cluster in NGC 2264

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Near-infrared imaging polarimetry in the *J*, *H*, and *Ks* bands has been carried out for the protostellar cluster region around NGC 2264 IRS 2 in the Monoceros OB1 molecular cloud. Various infrared reflection nebula clusters (IRNCs) associated with NGC 2264 IRS 2 and the IRAS 12 S1 core, as well as local infrared reflection nebulae (IRNe), were detected. The illuminating sources of the IRNe were identified with known or new near- and mid-infrared sources. In addition, 314 point-like sources were detected in all three bands and their aperture polarimetry was studied. Using a color-color diagram, reddened field stars and diskless pre-main-sequence stars were selected to trace the magnetic field (MF) structure of the molecular cloud. The mean polarization position angle of the point-like sources is 81° ± 29° in the cluster core, and 58° ± 24° in the perimeter of the cluster core, which is interpreted as the projected direction on the sky of the MF in the observed region of the cloud. The Chandrasekhar-Fermi method gives a rough estimate of the MF strength to be about 100 μG. A comparison with recent numerical simulations of the cluster formation implies that the cloud dynamics is controlled by the relatively strong MF. The local MF direction is well associated with that of CO outflow for IRAS 12 S1 and consistent with that inferred from submillimeter polarimetry. In contrast, the local MF direction runs roughly perpendicular to the Galactic MF direction [1].

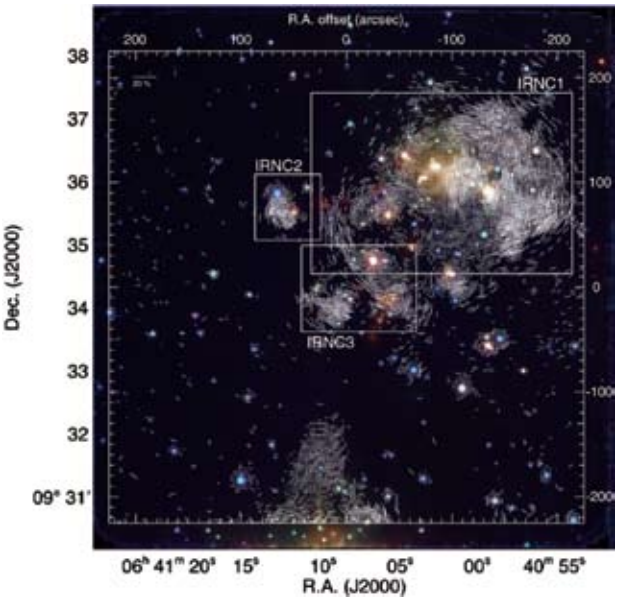

Figure 1: *H* polarization vector map superposed on the color composite image in the IRSF/SIRPOL *JHKs* (blue), Spitzer/IRAC 5.8 μm and Spitzer/MIPS 24 μm (red) bands. The length of the vectors is proportional to the degree of polarization. Shown in the upper left corner is a 20 % vector. The vectors were made by 6 × 6 pixel smoothing (twice the seeing size), and the vectors were shown every 6 pixels with intensities greater than 3σ above the mean sky level, where is the standard deviation of sky brightness. Three IRNCs are labeled.

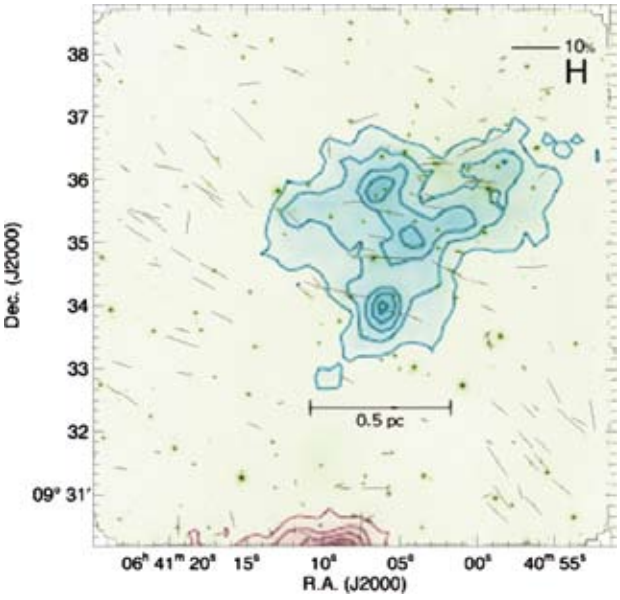

Figure 2: Stokes *I* image of the *H* band with contours of 870 μm continuum emission [2]. Con- tours are at 0.5, 1.0, 1.5, 2.0, and 2.5 Jy beam^{-1}. Red con- tours: dense cluster of the IRS 1 region. Blue contours: dense cluster of the IRS 2 region.

References

[1] Kwon, J., et al.: 2011, *ApJ*, **741**, 35.
[2] Williams, J., Garland, C.: 2002, *ApJ*, **568**, 259.