We present maps of the plane-of-sky magnetic field within two regions of the Taurus molecular cloud: one in the dense core L1495, the other in a diffuse region for comparison. The field is measured from the near-infrared polarization of background starlight seen through the cloud. The percentage polarization increases with column density, suggesting that the dust grains are aligned with the magnetic field in the denser regions, rather than grain alignment occurring only near the surface of the cloud. From the dispersion in angles of the field vectors, we have estimated the plane-of-sky magnetic field strength in different regions and find that the field may be strong enough to support the cloud against gravitational collapse. Finally, the magnetic field in L1495 is parallel to the observed filament. This may be explained if L1495 is the surface of a bubble, possibly arising from a supernova remnant. A recently discovered gamma-ray pulsar is located nearby.

Polarization of Dust Grains in Dense Regions

\[ P = A_V^{-0.82\pm0.04} \]

\[ P = A_V^{-0.84\pm0.05} \]

\[ A_V \text{ (mag)} \]

\[ 0.5 \]

\[ 0 \]

\[ 0 \]

\[ 10 \]

\[ 5 \]

\[ 10 \]

Observations

Dust grains in molecular clouds tend to align with their long (rotational) axis perpendicular to the local magnetic field. The exact mechanism causing alignment is uncertain, radiative torques are the most likely candidate (Dolginov & Mitrophanov 1976; Draine & Weinberg 1996, 1997; Lazarian & Hoang 2007). These dust grains will preferentially attenuate light polarized parallel to the long axis. Thus, background starlight seen through molecular clouds is polarized, and this polarization can be measured to probe the magnetic field in the cloud. Mimir is a near-infrared polarimeter and imager on the 72\text{cm} telescope at Lowell Observatory. We used Mimir to observe the H-band (1.62 \text{\mu m}) polarization of background starlight seen through two regions of the Taurus Molecular Cloud. Our results can be seen in Figure 1 as the two regions with green vectors. The other vectors in Figure 1 come from previous surveys of Taurus (Luhman et al. 2006).

Magnetic Field Strength

\[ \frac{\delta B}{B_0} = \frac{\sigma(u)}{V_A} V_A = \frac{B_0}{\sqrt{4\pi \rho}} \]

\[ \mu = \frac{(M/H)}{(M/H)_{\text{crit}}} = 7.6 \times 10^{-21} N(H_2)/B \]

\[ \text{Bubble} \]

\[ \text{Figure 4: The L1495 region in } ^{13}\text{CO}, ^{12}\text{CO}, \text{and H}. \text{The } ^{12}\text{CO} \text{ and } ^{13}\text{CO} \text{ are integrated from } \sim 7.6 \text{ to } 8.9 \text{ km s}^{-1}, \text{while the Hi is integrated from } \sim 5.5 \text{ to } 6 \text{ km s}^{-1}. \]

\[ \text{Figure 5 shows the region to the northwest of L1495.} \text{\(B\) stars with parallax distances of } 1.4 \text{ to } 3.3 \text{ pc} \text{ are shown as squares. There are no } O \text{ stars in the field at that range of distance. Because there are so few } B \text{ stars, and because they are scattered throughout the field, it seems unlikely that the bubble is created by one or more } B \text{ stars.} \]

\[ \text{Alternatively, a supernova may have created the bubble. A recently discovered gamma-ray pulsar, Fermi-LAT PSR J0357+32 is located approximately } 6 \text{ away (Abdo et al. 2009). Its position is marked with a cross.} \]

Published

This work has been published as Chapman et al. (2011), ApJ, 741, 21.