Cosmic Magnetic Fields:
From Planets, to Stars and Galaxies
Proceedings IAU Symposium No. 259, 2008
K.G. Strassmeier, A.G. Kosovichev & J.E. Beckman, eds.

doi:10.1017/S1743921309030166

Observations of magnetic fields toward the star forming region S88B

Anuj P. Sarma[1], **C. L. Brogan**[2], **T. Bourke**[3], **and M. Eftimova**[1,4]

[1]Physics Department, DePaul University, Chicago IL, USA
email: asarma@depaul.edu

[2]National Radio Astronomy Observatory, Charlottesville, VA

[3]Harvard-Smithsonian Center for Astrophysics, Cambridge, MA

[4]Current Address: Dept. of Physics & Astronomy, Univ. of North Carolina, Chapel Hill, NC

Abstract. We present observations of the high mass star forming region S88B taken with the VLA with the aim of measuring magnetic fields via the Zeeman effect. By observing thermal absorption lines of OH at 1665 and 1667 MHz, we obtain magnetic fields between 90 and 210 μG. We find these magnetic fields to be dynamically significant in this region.

Keywords. H II regions – ISM: clouds – ISM: individual (S88B) – ISM: kinematics and dynamics – ISM: magnetic fields – ISM: molecules

1. Introduction

The importance of magnetic fields in the formation of stars has long been acknowledged. Despite remarkable advances in theory and instrumentation, however, observational data on magnetic fields is still scarce. Observations of the Zeeman effect in absorption lines with interferometers like the Very Large Array (VLA) provide an excellent method of *mapping* the magnetic field in regions that are along the line of sight toward strong background continuum sources (e.g., Brogan & Troland 2001; Sarma *et al.* 2000). With these considerations in view, we have observed the star forming region S88B with the VLA for the Zeeman effect in thermal absorption lines of OH at 1665 and 1667 MHz.

2. Observations & Data Reduction

The observations were carried out with the Very Large Array (VLA) of the NRAO in 2003 in the B-configuration, and combined with C-configuration data observed in 1997. Both right (RCP) and left (LCP) circular polarizations and both main lines (1665 and 1667 MHz) were observed simultaneously. The data were calibrated and imaged using standard procedures in the AIPS package (NRAO) while the magnetic fields were determined using routines in the MIRIAD software package (BIMA/CARMA).

3. Results & Discussion

Magnetic field strengths were determined by fitting a numerical frequency derivative of the Stokes I = (RCP + LCP)/2 spectrum to the Stokes V = (RCP − LCP)/2 spectrum. The technique is described in detail in Roberts *et al.* (1993). The results of the fits give the line-of-sight component of the magnetic field, $B_{\rm los}$. Figure 1 shows the resulting $B_{\rm los}$ map (from the 1665 MHz data for which the derived value of $B_{\rm los}$ is greater than the 3σ level). In the area enclosed by the ellipse in Fig. 1, the detected field is above the 3σ

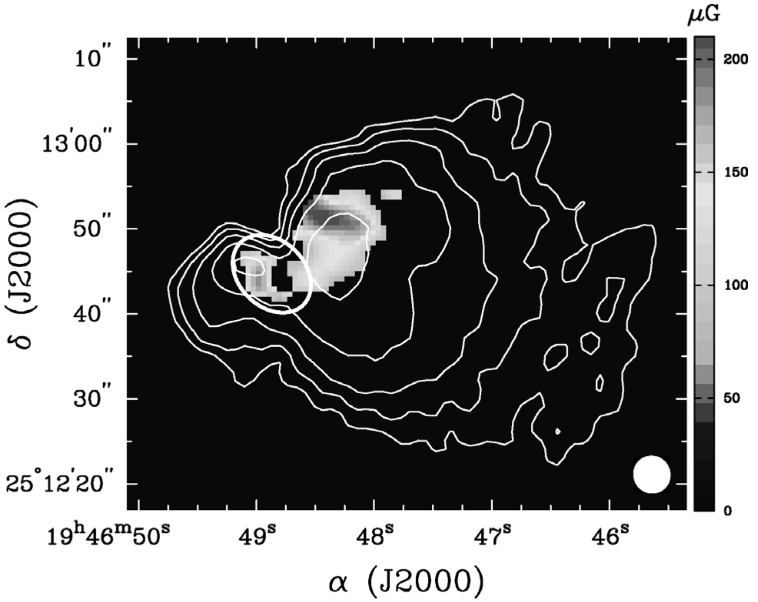

Figure 1. Gray-scale image of the detected $B_{\rm los}$ toward S88B. The filled ellipse in the bottom right represents the beam for the OH absorption line observations ($4.5'' \times 4.3''$, PA = 14°). The contours depict the 18 cm continuum, and are at 6, 12, 24, 48, 96 mJy beam^{-1}.

level only in the 1665 MHz line, whereas in the rest of the displayed $B_{\rm los}$ map, the field is above the 3σ level in both 1665 and 1667 MHz lines.

In order to estimate of the importance of the magnetic field in a star forming cloud, we use the relation

$$B_{S,\ \rm crit} = 5 \times 10^{-21}\ N_p \quad \mu\rm G,$$

where N_p is the average proton column density in the cloud. The relation has been obtained by equating the static magnetic energy of the cloud to its gravitational energy, and $B_{S,\ \rm crit}$ is then the average static magnetic field in the cloud that would completely support it against self-gravity. The field can be judged to be dynamically important to the region even if it is less than $B_{S,\ \rm crit}$, but is comparable to it. Using relevant physical parameters from our observations and the literature, we find $N_p = 1.4 \times 10^{23}$ cm^{-2}. The equation above then gives $B_{S,\ \rm crit}$ = 700 μG. Following Crutcher (1999), we use total (static) magnetic field strength equal to 2 times $B_{\rm los}$. For our average adopted value for $B_{\rm los}$ = 150 μG from Fig. 1, we find that the observed magnetic field is less than, but comparable to, the critical field. Therefore, the magnetic field should be dynamically significant, providing an important source of support against self gravity.

Acknowledgements

APS thanks the Chair of the Physics Department (Dr. Jesús Pando) and DePaul University for travel funds.

References

Brogan, C. L. & Troland, T. H. 2001, *ApJ* 560, 821
Crutcher, R. M. 1999, *ApJ* 520, 706
Roberts, D. A., Crutcher, R. M., Troland, T. H., & Goss, W. M. 1993, *ApJ* 412, 675
Sarma, A. P., Troland, T. H., Roberts, D. A., & Crutcher, R. M. 2000, *ApJ* 533, 271

https://doi.org/10.1017/S1743921309030166 Published online by Cambridge University Press