*RevMexAA (Serie de Conferencias)*, **40**, 201–201 (2011)

# MEASURING THE MAGNETIC FIELD IN SN 1006

E. M. Reynoso,[1,2] J. P. Hughes,[3] and D. A. Moffett [4]

**We show that the magnetic field in SN 1006 is radial at the bright lobes but tangential at the SE of the radio shell, where the fractional polarization is highest. This result suggests that the strongest particle injection/acceleration occurs in parallel shocks and that the bright lobes represent polar caps.**

We present an analysis of the polarized emission towards SN 1006 from combined ATCA and VLA observations at 1.4 and 1.7 GHz. For each frequency, we constructed images in total intensity and in the Stokes parameters Q and U. All images were combined to map the distribution of the fractional polarization, rotation measure and position angle. We used the average rotation measure value, $\sim$12 rad m$^{-2}$, to correct the polarization vectors for Faraday rotation.

The resulting image (Figure 1) shows that the magnetic field is mostly radial in the bright lobes but clearly tangential at the SE, where the radio continuum emission is lower. At the same time, the fractional polarization is on average $\sim$20% at the lobes but rises up to almost 70% at the SE. Standard theory predicts that the linear polarized fraction of an optically thin synchrotron radiation source is limited by the following relation: $p = \left(\alpha + 1\right)/\left(\alpha + \frac{5}{3}\right)$, where $\alpha$ is the spectral index of the source. Using that $\alpha = 0.6$ for SN 1006, the expected theoretical value is $p = 70.5\%$.

The close agreement between the maximum theoretical fractional polarization and the values measured at the SE indicate that there is very little depolarization in this region; rather, the magnetic fields are highly ordered. On the other hand, the low fractional polarization at the lobes suggests an important randomization of the magnetic fields. The fact that a turbulent magnetic field coexists with the brightest synchrotron emission, in contrast with the very weak emission at the SE, strongly supports the diffusive shock acceleration (DSA) theory (see Drury 1983, and references therein).

[1]Instituto de Astronomía y Física del Espacio, CONICET-UBA, C.C. 67 Suc. 28, 1428 Buenos Aires, Argentina (ereynoso@iafe.uba.ar).

[2]Departamento de Física, Facultad de Ciencias Exactas y Naturales, Universidad de Buenos Aires, Argentina.

[3]Rutgers University, Piscataway, NJ, USA.

[4]Furman University, Greenville, SC, USA.

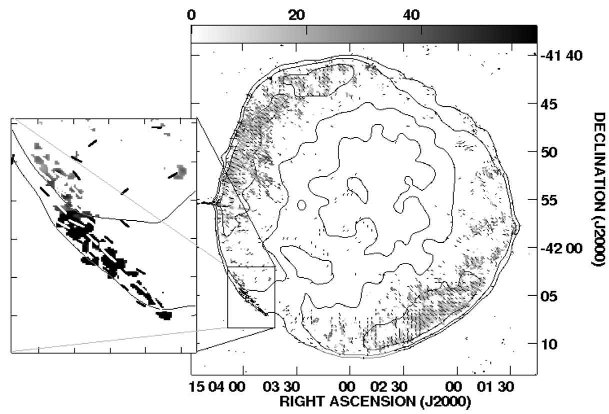


Fig. 1. Fractional polarization (greyscale) of SN 1006 with magnetic field vectors overlaid. The percentage fractional polarization is indicated at the top. The inset on the left shows an enlargement of the SE region, where the high polarization as well as the tangential direction of the magnetic field are evident. Radio continuum contours are included.

If the magnetic field in the direction to SN 1006 is parallel to the Galactic Plane, as can be inferred by the polarization vectors at the SE, then the highest efficiency in the acceleration process is achieved in parallel shocks. This means that the bright radio and X-ray lobes are polar caps rather than an equatorial belt, as also shown by Rothenflug et al. (2004). Predictions based on the gap between the shock front and the contact discontinuity also coincide in that the SE has undergone inefficient particle acceleration (Cassam-Chenaï et al. 2008).

An extended version of this study will be published elsewhere.

E. M. R. is memeber of the CIC (CONICET, Argentina) and is funded by grants from CONICET, UBA and ANPCyT.

## REFERENCES

Drury, L. O. 1983, Rep. Prog. Phys., 46, 973

Cassam-Chenaï, G., Hughes, J. P., Reynoso, E. M., Badenes, C., & Moffett, D. 2008, ApJ, 680, 1180

Rothenflug, R., Ballet, J., Dubner, G., Giacani, E., Decourchelle, A., & Ferrando, P. 2004, A&A, 425, 121