Planetary Nebulae in our Galaxy and Beyond
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OH maser emission toward the young planetary nebula K3-35

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Abstract. We present VLA (Very Large Array) observations of the 1720, 1667, 1665 and 1612 MHz OH maser emission from the central region of K 3–35. Circular polarization was found in the 1720, 1665, and 1612 MHz transitions. An estimate of the magnitude of the magnetic field, derived from the 1665 lines, toward this young planetary nebula is $\sim$ 0.14 mG at a radius of $\sim$ 250 AU.

Keywords. Planetary Nebulae, Magnetic Fields, Individual: K 3–35

K 3–35 is an emission nebula that has been studied at optical, radio and infrared wavelengths. At radio and optical wavelengths it is characterized by an S-shaped emission morphology with a clear point-symmetric structure. It is one of the two planetary nebulae (PNe) where water maser emission has been detected, suggesting that this kind of objects departed from the AGB phase some decades ago (Miranda *et al.* 2001; De Gregorio-Monsalvo *et al.* 2004).

The OH maser lines, typical for oxygen-rich AGB envelopes, can be polarized in the presence of a magnetic field. The detection of magnetized disks toward PNe and proto-PNe is crucial for understanding the generation of jets and bipolar structures. The presence of magnetic fields has been inferred in several proto-PNe but only in a few PNe. Previous OH maser observations, made toward the young PN K 3-35 by Miranda *et al.* (2001), show circularly polarized OH maser emission in the 1665 MHz line around the central region, with strong levels of circular polarization, suggesting the presence of a magnetic field.

We present new VLA (Very Large Array) observations of the 1720, 1667, 1665 and 1612 MHz OH maser emission from the central region of K 3-35. Circular polarization was found in the 1720, 1665, and 1612 MHz transitions. It is the only PN that we know exhibits OH 1720 MHz and the spots are located near the radio continuum peak position. The OH 1665 MHz spots are distributed in an elongated structure, along the minor axis of the radio continuum bipolar outflow, and they exhibit high circular polarization suggesting the presence of a toroidal magnetic field in K 3-35.

In conclusion, if at least one Zeeman pair is present in K 3-35 (see Figure 1), we can estimate the magnetic field for the 1665 MHz observations to be $B_{LOS} \simeq 0.14$ mG at a radius of $\sim$ 250 AU (Gómez *et al.* 2005).

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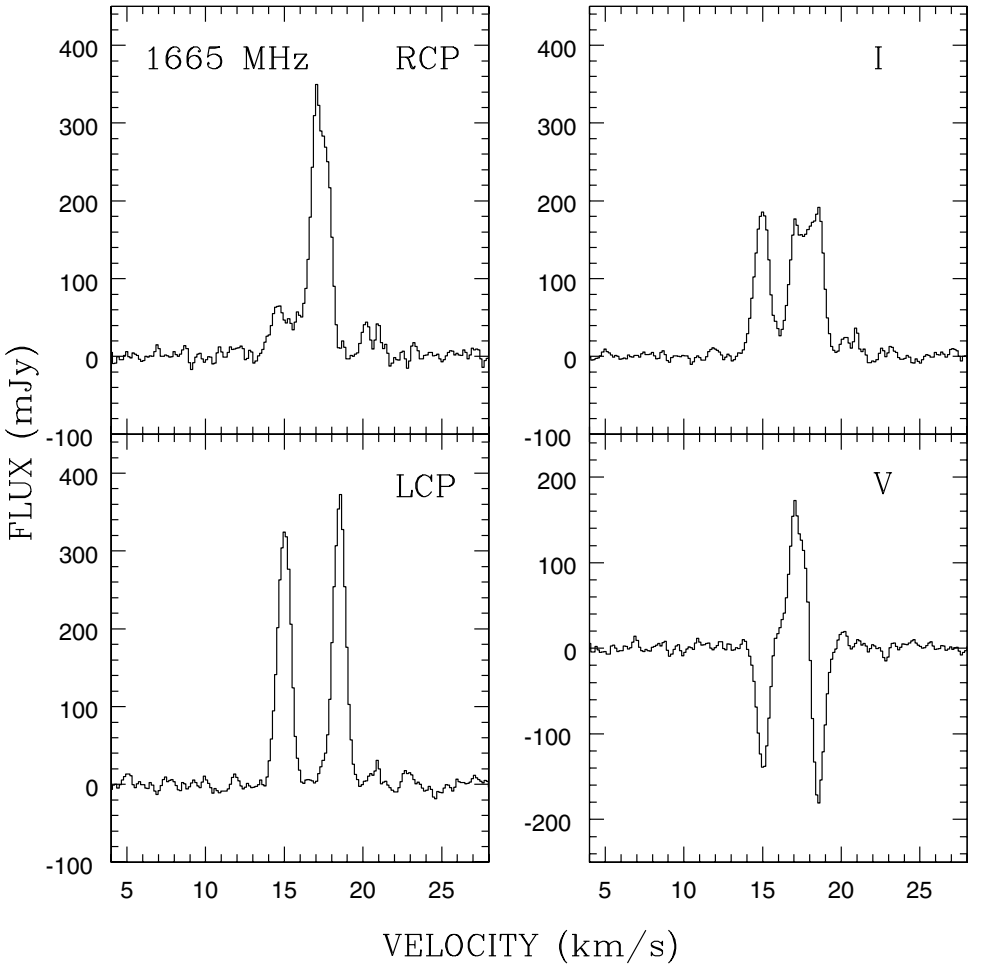

Figure 1. The OH 1665 MHz spectra of the Stokes parameters I and V and the plots of the right (RCP) and left (LCP) circular polarizations.

References

I. De Gregorio-Monsalvo, Y. Gómez, G. Anglada, R. Cesaroni, L. F. Miranda, J. F. Gómez, & J. M. Torrelles. 2004, *ApJ,* 601, 921

Y. Gómez, D. Tafoya, G. Anglada, R. Franco-Hernández, J. M. Torrelles, & L. F. Miranda. 2005, *MmSAI,* 76, 472

L. F. Miranda, Y. Gómez, G. Anglada, & J. M. Torrelles. 2001, *Nature,* 414, 284

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