High Resolution Radio Polarimetric Study of the Pulsar Wind Nebula MSH 15−5*2*

Ryan, W.-Y. Leung[1*], C.-Y. NG[1]

[1]Department of Physics, The University of Hong Kong

Pulsar winds are charged particles acclerated by the extremely strong magentic field of rotation-powered pulsars. These particles are shocked upon interacting with the ambient environment and they emit broadband synchroton radiation. Such a structure is known as a pulsar wind nebula (PWN).

We present a high-resolution radio imaging study of the PWN MSH 15−5*2* with new Australia Telescope Compact Array observations at 6 cm and 3 cm. The system is powered by a young and energetic radio pulsar PSR B1509−58 with a high spin down luminosity of $\dot{E} \approx 2 \times 10^{37}$ erg s^{-1} [2].

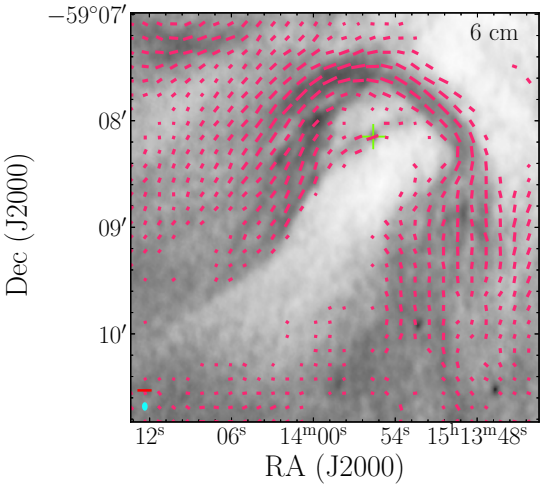

Figure 1: Intrinsic B-field vectors for MSH 15−5*2* overlaying on the 6 cm radio intensity map in grey-scale. The vector length is porportional to the polarized intensity. The beam size and polarization scale is indicated at the lower-left corner. The pulsar B1509−58 is indicated by a green cross.

Previous X-ray studies found a complex morphology for the PWN: the overall shape resembles a hand, extending over 10 pc with small-scale features like jets, arc, filaments and enhanced emission knots in the associated HII region RCW 89 [1]. The new radio images show different morphology than the X-ray counterpart. No radio emission is detected at the X-ray jet position, instead we found enhanced emission in a sheath surrounding the jet. Additional small-scale features including a polarized linear filament next to the pulsar have also been discovered. Our polarization measurements show that the intrinsic orientation of magnetic field aligns with the sheath wrapping around the edge of the jet. Spectral analysis results indicate a flat spectrum across the nebula, with some spatial variations. Implications of these findings will be discussed.

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References

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*E-mail: yanyan07@connect.hku.hk