Deep optical observations of the fast moving nearby radio pulsar B1133+16 with the VLT[1]

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Recent optical observations with the 8-meter-class groundbased telescopes and with the HST of the two old radio pulsars, PSR B0950+08 (17 Myr) (Zharikov et al. 2002; Zharikov et al. 2004) and PSR B1929+10 (3 Myr) (Mignani et al. 2002), have shown that old pulsars can produce nonthermal photons in the optical range with almost the same efficiency as young and energetic Crab-like pulsars. Optical data for other old pulsars can provide new insights into the origin of such a high efficiency. Parameters of the high velocity nearby radio pulsar PSR B1133+16 (5 Myr) are almost the same as for the above two pulsars. We report on a deep BR and H_α imaging of the pulsar field obtained in 2003–2004 with the VLT in attempt to detect its optical counterpart and to search for a bowshock nebula (which is possibly produced due to supersonic motion of the pulsar through the interstellar medium). Our images reveal no counterpart at the expected radio position down to a 3σ upper limit of $\sim$ 28.3 mag in the B band. We cannot resolve also any bowshock structure in our H_α and R images. However, archival B band images of the same field obtained earlier within the ESO/VLT program 66.D-0069A by Gallant et al. (2001) have allowed us to go deeper in the B band. After combining the archival and original images the resulting detection limit is B$\sim$ 28.7 mag. In the combined B band image some hints of the counterpart candidates consistent with the pulsar radio position can be resolved within the 28.3–28.7 mag range. We discuss our results in connection with a phenomenological picture of the pulsar efficiency evolution in different spectral domains suggested by Zharikov et al. (2004) and by current pulsar bowshock theories.

References

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