

On the mystery of the interpulse shift in the Crab pulsar

V. M. Kontorovich^{1,3*}, S. V. Trofymenko^{2,3†}

¹Institute of Radio Astronomy of NAS of Ukraine, Kharkov, Ukraine

²Akhiezer Institute for Theoretical Physics of NSC KIPT, Kharkov, Ukraine

³Karazin Kharkov National University, Kharkov, Ukraine

A new mechanism of radiation emission in the polar gap of a pulsar is proposed. It is based on the curvature radiation which is emitted by positrons moving towards the surface of the neutron star along magnetic field lines and reflects from the surface (Fig2). It is shown that the proposed mechanism may be applicable for explanation of the mystery of the interpulse shift in the Crab pulsar at high frequencies discovered by Moffett and Hankins [1] twenty years ago (for recent confirmation see [2]).

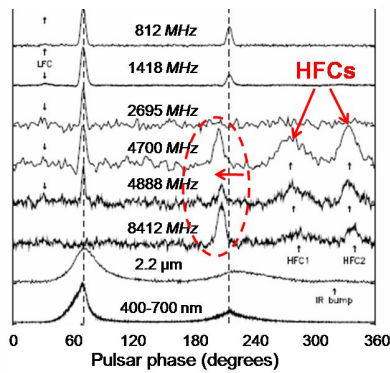


Figure 1: Light curves obtained at multi-frequency observations in [1]. The shifted (to about 7°) interpulse and high-frequency components (HFCs) are marked. With gratitude to the authors

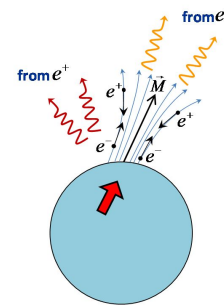


Figure 2: Schematic picture of motion and radiation by electrons and positrons in the polar gap of the pulsar in the case of a tilted magnetic axis [3]. The directions of radiation by electrons and reflected radiation by positrons are shifted at the angle of mirror reflection

We also took into account the positron curvature radiation coherence and calculated the spectrum which coincides with the observed one. The high-frequency components, appearing at the same frequencies as the interpulse shift, can be naturally explained by nonlinear reflection (stimulated scattering) of radiation by returning positrons [4].

References

- [1] D. Moffett & T. Hankins, *ApJ* 468, 779 (1994); arXiv:astro-ph/9604163.
- [2] T. Hankins, G. Jones & J. Eilek, *ApJ* 802, 130 (2015); arXiv:1502.00677v1.
- [3] V.M. Kontorovich & S.V. Trofymenko, arXiv:1606.02966v3.
- [4] V.M. Kontorovich, *Low Temp. Phys.* 42, 672 (2016); arXiv:1701.02304v2.

*E-mail: vkont@rian.kharkov.ua

†E-mail: trofymenko@kipt.kharkov.ua