TRIPLICITY OF PULSAR PROFILES AND ORTHOGONAL POLARIZATION MODES

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A mechanism for generation of two concentric pulsar beams corresponding to the core and conal pulsar emission is proposed. The inner beam originates close to the star, where the radius of curvature of the dipolar magnetic field lines is suitable for coherent curvature emission at pulsar radio frequencies. Further from the star where the outer beam originates, the radius of curvature of dipolar lines is probably too large, but the actual curvature can be dominated by the toroidal component of field lines twisted back due to the pulsar rotation. One can show that for even moderate twisting the actual radius of curvature leads again to pulsar radio frequencies. Thus, the pulsar emission is a superposition of two beams originating at widely radially separated locations. When the observer's line-of--sight cuts both beams, a three-component profile should be observed. Because of the retardational time delay, the inner (core) component should appear late with respect to the profile midpoint, that is , closer to the traling component. Such an asymmetry is indeed observed in complex profile pulsars. In pulsar magnetosphere, the radius of curvature of dipolar field lines depends on the radius of the emission region in the opposite way than that of the toroidal lines. This explains why core and conal components dominate the mean profile at low and high frequencies, respectively.

The proposed version of a dual-beam pulsar model explains different polarization modes in a natural way. The curvature emission of the inner (core) beam is polarized linearly in the planes of dipolar field lines while in the outer (conal) beam the polarization planes are determined by the toroidal component. The polarization vectors of the two pulsar beams should be mutually quasi-perpendicular in most cases, although nonorthogonal, phase dependent transitions are also expected. Thus, whithin this model the different polarization modes can be identified with the core and conal pulsar emission. The modes are superposed at any instant, which produces significant depolarization. The actual position angle is determined by the stronger beam. The evidence for the correspondence between the core and conal pulsar emission and different polarization modes are discussed.

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