Occurrence of concurrent ‘orthogonal’ polarization modes in the Liénard-Wiechert field of a rotating superluminal source

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ABSTRACT: Moving sources of the electromagnetic radiation whose speeds exceed the speed of light *in vacuo* have already been generated in the laboratory. Such sources are necessarily extended: their superluminally moving distribution patterns are created by the coordinated motion of aggregates of subluminally moving particles. The field of a sufficiently localized source of this type in the far zone, however, is expected to have many features in common with that of a point-like source. Evaluating the Liénard-Wiechert field of a rotating superluminal point source numerically, we find that this radiation field has the following intrinsic characteristics: (i) it is sharply focused along a rigidly rotating spiral-shaped beam that embodies the cusp of the envelope of the emitted wave fronts, (ii) it consists of either one or three concurrent polarization modes (depending on the relative positions of the observer and the cusp) that constitute contributions to the field from differing retarded times, (iii) the position angle of each of its linearly polarized modes swings across the beam by as much as $180°$, and (iv) the position angles of two of its modes remain approximately orthogonal throughout their excursion across the beam. Given the fundamental nature of the Liénard-Wiechert field, the coincidence of these characteristics with those of the radio emission that is received from pulsars is striking. Coupled with the experimentally demonstrated fact that the radiation emitted by a (volume-distributed) rotating superluminal source has an intensity that decays like $1/R$ instead of $1/R^2$ with distance (R), and so is also intrinsically bright, these results support the superluminal model of pulsars.