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Two-fluid relativistic waves and free electron lasers in pulsar plasmas A. RUALDO SOTO-CHAVEZ, Space Science Center, University of New Hampshire, Durham NH 03824, SWADESH M. MAHAJAN, RICHARD D. HAZELTINE, Institute for Fusion Studies, The University of Texas at Austin, TX 78712 — A relativistic two-fluid approach for a streaming magnetized pair plasma is developed. Such a scenario corresponds to secondary plasmas created at the polar caps of pulsar magnetospheres. Recent studies show that the temperature of such plasmas is very close to the rest mass energy of the particles. It is therefore critical to determine the exact properties of waves at such temperatures. For parallel propagation, four transverse modes are found. Two are electromagnetic plasma modes, which at high temperature become light waves. The remaining two are Alfvénic modes, split into a fast and slow mode. The slow mode is cyclotron two-stream unstable at large wavelengths and is always sub-luminous. We find that temperature effects cannot suppress the instability in the limit of large (finite) magnetic field. We discuss the implications of the unstable mode for radio emission theories. For example, for typical values, the instability is quite fast, and the waves can grow to sizable levels, such that, the magnetic modulation could act as a wiggler. The pulsar primary beam could interact with this wiggler and simulate a free electron laser like effect, yielding coherent radiation.

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