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Axion Production in Pulsar Magnetosphere Gaps

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Pulsar magnetospheres admit non-stationary vacuum gaps that are characterized by non-vanishing $\mathbf{E}\cdot\mathbf{B}$. The vacuum gaps play an important role in plasma production and electromagnetic wave emission. We show that these gaps generate axions whose energy is set by the gap oscillation frequency. The density of axions produced in a gap can be several orders of magnitude greater than the ambient dark matter density. In the strong pulsar magnetic field, a fraction of these axions may convert to photons, giving rise to broadband radio signals. We show that dedicated observations of nearby pulsars with radio telescopes (FAST) and interferometers (SKA) can probe axion-photon couplings that are a few orders of magnitude lower than current astrophysical bounds.

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