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Ultralight Dark Matter and Magnetic Fields on Cosmological Scales

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We propose a mechanism for the generation of magnetic fields on cosmological scales that is operative after recombination. An essential
ingredient is an instability of the electromagnetic field driven by an oscillating pseudo-scalar dark matter field, ϕ, that is coupled to the electromagnetic field tensor via a $\phi F \wedge F$ term in the Lagrangian of axion-electrodynamics. We find that magnetic fields larger than the observational lower bounds can be generated on scales of $1\mathrm{Mpc}$.

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