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Probing axion-like particles via laser-plasma wakefields and coherent photon regeneration

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We propose a novel Light-Shining-Through-a-Wall (LSW) scheme that utilizes the ultra-strong electromagnetic fields of laser-driven plasma wakefields for highly efficient, in situ axion generation. Moreover, by injecting a coherent seed field into the regeneration region, the axion-induced photon signal is coherently amplified via constructive interference, offering a pathway to probe axion-photon couplings at the $g_{a\gamma\gamma} \sim 10^{-12}\mathrm{GeV}^{-1}$ level without requiring resonant cavities.

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