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Effective Approximation of Electromagnetism for Axion Haloscope Searches

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An effective approximation is applied to Maxwell's equations with an anomalous axion interaction. A new set of Maxwell's equations acquired from this approximation describes only reacted fields generated by the anomalous interaction. Unlike other approaches, this set of Maxwell's equations inherently satisfies the boundary condition for haloscope searches. The electromagnetic field solutions are evaluated for both cylindrical and toroidal cavity geometries. A small but non-zero difference between electrically and magnetically stored energies appears in both cases. The difference may come from an anomalous non-dissipating current induced by oscillating axions.

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