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**Optical spin-orbit coupling and Darwin terms in epsilon-near-zero materials** ANDREW COOK, JENS NOECKEL, University of Oregon — In optical cavities formed from spatially inhomogeneous epsilon-near-zero (ENZ) meta-materials, optical spin-orbit coupling can be made nearly isospectral to relativistic electron spin-orbit coupling in atoms; the only difference is that the 3x3 classical spin-orbit operator shifts transverse fields by a different integer amount than the quantum operator. When the electric field is rescaled to account for unequal dispersive energy density in the electric and magnetic field quadratures, Maxwell's equations give a Darwin term with the same form as in quantum mechanical systems. These classical/QM similarities, combined with a pronounced importance of the Kerr nonlinearity, make ENZ materials ideal for coaxing electron-like behavior from light.

Andrew Cook  
University of Oregon

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