Contribution ID: **208** Type: **Contributed Oral**

Electromagnetic helicity in twisted cavity resonators

Thursday 4 December 2025 17:40 (15 minutes)

Through left- or right-handed twisting, we investigate the impact of mirror-asymmetry (chirality) of the conducting boundary conditions of an equilaterial triangular cross section electromagnetic resonator. We observe the generation of eigenmodes with nonzero electromagnetic helicity as a result of the coupling of near degenerate $\mathrm{TE}_{11(p+1)}$ and TM_{11p} modes. This can be interpreted as an emergence of magnetoelectric coupling, which in turn produces a measurable shift in resonant mode frequency as a function of twist angle. We show that this coupling mechanism is equivalent to introducing a nonzero chirality material parameter κ_{eff} or axion field θ_{eff} to the medium. Our findings demonstrate the potential for real-time, macroscopic manipulation of electromagnetic helicity.

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Session Classification: Quantum Science and Technology

Track Classification: Topical Groups: Quantum Science and Technology