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Unique Properties and Prospects: Quantum Theory of the Orbital Angular Momentum of Ince-Gauss Beams[1] WILLIAM PLICK, MARIO KRENN, ROBERT FICKLER, SVEN RAMELOW, ANTON ZEILINGER, Institute for Quantum Optics and Quantum Information — The Ince-Gauss modes represent a new addition to the standard solutions to the paraxial wave equation. Parametrized by the ellipticity of the beam, they span the solution space between the Hermite-Gauss and the Laguerre-Gauss modes. These beams may be decomposed in either basis, and single photons in the Ince-Gauss modes exist naturally as superpositions of either Laguerre-Gauss or Hermite-Gauss modes. We present the fully quantum theory of the orbital angular momentum of these beams. Interesting features that arise are: stable beams with fractional orbital angular momentum, non-monotonic behavior of the OAM with respect to ellipticity, and the possibility of orthogonal modes possessing the same OAM. We believe that these modes may open up a fully new parameter space for quantum informatics and communication, and thus are worthy of thorough study.

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