

Enhanced Polarization Purity of Stimulated Raman Conversion in Two-Fold Symmetric Anti-Resonant Fibers

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Gas-filled hollow-core fibers are powerful platforms for nonlinear frequency conversion across broad spectral ranges due to their unique optical properties. However, two persistent limitations have prevented unlocking their full potential: the reduced polarization extinction ratio of nonlinearly generated light, and the inability of conventional hollow-core geometries to maintain stable polarization eigenmodes during propagation. In this talk we will present a solution that addresses both challenges simultaneously using gas-filled polarization-maintaining anti-resonant hollow-core fibers with engineered birefringence. By exploiting polarization-selective stimulated Raman scattering, we generate frequency-downshifted Stokes pulses with high polarization purity in the near-infrared, even when the input beam has a poor polarization extinction ratio. The enhanced modal birefringence of the novel fiber design suppresses polarization cross-coupling during both the nonlinear conversion process and subsequent propagation, remaining robust even under tight bending conditions. These results establish that a single gas-filled fiber architecture can simultaneously deliver efficient nonlinear wavelength conversion and reliable polarization-stable light transport, meeting the stringent demands of fields such as precision metrology, quantum communications and optical sensing.