gain levels, amplification requires that the constituent metal have a larger absolute real permittivity relative to the constituent dielectric. Furthermore, the waveguide radius must be sufficiently small such that the negative index mode propagates, while being sufficiently large such that the radial component electric field does not overwhelm the longitudinal component. While arriving at our results for waveguides with PEC cladding in the local-EMT approximation, we have shown that our theoretical results apply equally well when accounting for real claddings and spatial non-locality.

Initial experiments could include proof-of-concept amplification of modes exhibiting hyperbolic dispersion in waveguides consisting of noble metals and III-V semiconductors. More advanced work includes increasing resolution of hyperlenses and fidelity of optical cloaks using optical gain based on these proof-of-concept experiments. Additionally, this work demonstrates that active waveguides may support guided modes at telecommunication frequencies to arbitrarily small transverse dimensions, limited only by fabrication technologies.

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