Spacetime Lensing via Metamaterial Shells

Concept
Inspired by gravitational lensing, this theoretical note explores how a metamaterial shell might induce effective spacetime distortion detectable via phase shifts in matter waves or altered light propagation paths.

Key Analogies

- Transformation optics and general relativity share formal similarities.
- Gradient-index materials can mimic curved space metrics.

Example Metric Analogy

ds2=−α(r)2dt2+β(r)2dr2+r2dΩ2ds^2 = -\alpha(r)^2 dt^2 + \beta(r)^2 dr^2 + r^2 d\Omega^2ds2=−α(r)2dt2+β(r)2dr2+r2dΩ2

Can be emulated by a radial index profile:

n(r)=β(r)/α(r)n(r) = \sqrt{\beta(r)/\alpha(r)}n(r)=β(r)/α(r)

Applications

- Designing spherical cloaks with spacetime-mimicking behavior.
- Testing matter-wave interference phase shifts across shell boundary.