Extreme time modulation of materials properties and Hawking radiation

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Experiments demonstrating extremely rapid modulation of the permittivity have been performed by exploiting the enhanced non-linear effects possible in the presence of plasmonic resonances. These experiments measure an extreme rise time by exploiting the analogy between Young's slits which produce diffraction in momentum space, and closely spaced time windows which produce diffraction in frequency space. [1]

I go on to discuss some theoretical consequences of space-time modulated structures. Diffraction gratings moving at trans-luminal velocities contain points where wave and grating velocity are equal. We show these points can be understood as a series of optical event horizons where wave energy can be trapped and amplified, leading to radiation from the quantum vacuum state. We calculate the spectrum of this emitted radiation, finding a quasi-thermal spectrum with features that depend on the grating profile, and an effective temperature that scales exponentially with the length of the grating, emitting a measurable flux even for very small grating contrast. Stimulated emission also takes place under the influence of incident photons, but in contrast to emission from excited atoms, transluminal systems radiate correlated photon pairs. [2]

References

[1] Romain Tirole et al (2023)
arXiv:2206.04362 "Double-slit time diffraction at optical frequencies"
[2] Simon A. R. Horsley and J. B. Pendry
ArXiv.2302.04066 "Time varying gratings model Hawking radiation"