



Contribution ID: 1 Contribution code: P1.1

Type: Poster

New solution to Airy's equation for describing electromagnetic beams near turning points

Tuesday 3 October 2023 16:00 (4 minutes)

Nicolas Lopez
University of Oxford

A wave near an isolated turning point is typically assumed to have an Airy function profile with respect to the separation distance. This description is incomplete, however, and is insufficient to describe the behavior of more realistic wavefields that are not simple plane waves [1]. Asymptotic matching to a prescribed incoming wavefield generically introduces a phasefront curvature term that changes the characteristic wave behavior from the Airy function to that of the hyperbolic umbilic function. This function, which is one of the seven classic 'elementary' functions from catastrophe theory along with the Airy function, can be understood intuitively as the solution for a linearly focused Gaussian beam propagating in a linearly varying density profile, as I shall discuss. The morphology of the caustic lines that govern the intensity maxima of the diffraction pattern as one alters the density lengthscale of the plasma, the focal length of the incident beam, and also the injection angle of the incident beam are presented in detail. This morphology includes a Goos-Hanchen shift and focal shift at oblique incidence that do not appear in a reduced ray-based description of the caustic. The enhancement of the intensity swelling factor for a focused wave compared to the typical Airy solution is highlighted, and the impact of finite lens aperture is discussed. Collisional damping and finite beam waist are included in the model and appear as complex components to the arguments of the hyperbolic umbilic function. The observations presented here on the behavior of waves near turning points should aid the development of improved reduced wave models to be used, for example, in designing modern nuclear fusion experiments.

[1] N. A. Lopez, E. Kur, and D. J. Strozzi, to appear in Phys. Rev. E, arXiv:2301.12788 (2023)

Author: LOPEZ, Nicolas (University of Oxford)

Presenter: LOPEZ, Nicolas (University of Oxford)

Session Classification: Poster session: 01