Beam Tracing Description of the Linear and Weakly Nonlinear Propagation of Wavepackets

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The beam tracing method [1-3] is an asymptotic technique for solving *linear* wave equations, with reference, in particular, to the propagation of electrostatic [1] as well as to electromagnetic *wavebeams* in both isotropic and anisotropic (spatially non-dispersive) media [1, 2], and, more recently, it has been successfully applied also to the description of short wavelength eigenmodes in tokamak plasmas (microinstabilities) [3]. Furthermore, it has been possible to apply the beam tracing method for studying the propagation of linear wavepackets [4].

The description of wavebeams is fundamental for both heating and diagnostics of tokamak plasmas, and, on the other hand, the understanding of the propagation of wavepackets can be exploited in order to study microinstabilities since the Fourier transform in time of the wavefield gives spectral informations on the underlying eigenmodes (as pointed out by Heller for the case of the Schrödinger equation [5]).

In this work a number of analytical beam tracing solutions of model equations are presented in order to prove the applicability of such a technique to the description of wavepackets propagating in dispersive inhomogeneous and non-stationary media. The case a weakly nonlinear wave equation is also considered and the appropriate beam tracing treatment is put forward.

References

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