Complex-eikonal methods applied to geodesic acoustic modes

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The tokamak represents a very complex system in which several actors such as drift waves, streamers, turbulence, zonal flow, geodesic acoustic modes (GAMs)... interact each other defining the transport properties of the plasma. GAMs represent the oscillation counterpart of the zonal flow and have received much attention for their potential role in the energy confinement in plasma fusion domain. In particular they interact with turbulence in an inhomogeneous environment in which plasma shape and profile gradients strongly affects their amplitude and their position [1, 2]. Because of the complexity of the system, it is crucial to develop and to apply methods that allow to have simple and accurate descriptions of specific properties of plasma behavior. In this way, it is possible to distinguish in an intuitive and useful manner relevant aspects of global physical systems. To this purpose, ray method or geometrical optics provides a very powerful tool that has been applied in many important problems related to wave propagation and energy transport. By using the paraxial WKB (pWKB) method [3, 4] and a complex-eikonal approach [5], we describe several GAM properties such as amplitude, shape evolution and energy flux of GAM in homogeneous and inhomogeneous equilibria. These findings allow us to predict the GAM evolution, in simulations (see Fig. 1) performed with the particle-in-cell code ORB5 [6, 7].

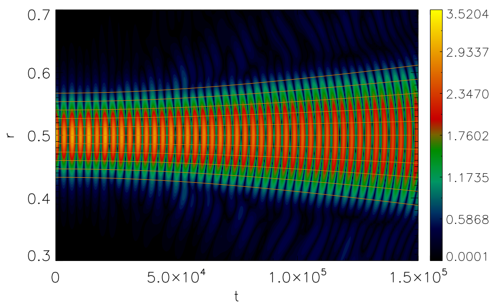

Figure 1: *Electric field evolution of GAM in (time, radial) plane. Overlapped it is shown the ray paths predicted by using the geometrical optics methods.*

References

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