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A global normal form for two-dimensional mode conversion

DAVID JOHNSTON, EUGENE TRACY, College of William & Mary, ALLAN KAUFMAN, UC Berkeley and LBNL — Mode conversion is a phenomenon that is of interest as a method for heating in fusion reactors. A magnetosonic wave with dispersion relation D_{MS} propagates toward the interior of the plasma, where it excites an ion-hybrid wave with dispersioon relation D_{IH} and thereby transfers energy to the plasma. We wish to study this process using ray-based methods. The 2 $\times$2 dispersion matrix D, which is, in general, a function of the phase space variables (x, y, k_x, k_y), must be put into *normal form*, in which the diagonals of D are identified as the *uncoupled* dispersion relations, D_{MS} and D_{IH}, with the off-diagonals as the coupling constants. Once in this form, the dynamics of the mode conversion are analyzed using the technique of Tracy, et al. (E. R. Tracy, A. N. Kaufman, and A. J. Brizard, Phys. Plasmas 10, 2147 (2003)). The focus of our work is putting the dispersion matrix into normal form. We are considering a two-dimensional model of the polodial cross section of a tokamak reactor with a DT plasma with a density ratio of one-to-one. It is possible to put the dispersion matrix into normal form, *locally*, everywhere on the dispersion surface (E. R. Tracy and A. N. Kaufman, Phys. Rev. Lett. 91, 130402 (2003)). However, using numerical methods, we put the matrix into normal form *globally*. Once in normal form, it is possible to compute the rays and follow their trajectories using the notion of *rooms* (E. R. Tracy, A. J. Brizard, D. Johnston, A. N. Kaufman, A. S. Richardson, and N. Zobin, Communications in Nonlinear Science and Numerical Simulation 17, 5, 2161 (2011)).

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