§12. New Computer Program HIDMEG for Eigenvalue and Boundary Value Problems

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To study nonlinear dynamics, stability, heating process or diagnostic process of plasmas, we have developed a powerful and accurate computer algorithm named HIDM[1]. A new computer program HIDMEG is reconstructed based on the algorithm of HIDM. HIDMEG is summarized in a module (module name is hidmeg) of Fortran90. The module hidmeg contains a subroutines hidm_eg_complex and hidm_eg_real. The former (the latter) can solve complex (real) variable nonlinear eigenvalue and boundary value problems, described by system of equations

$$L_n(\phi, \phi_x, \lambda, x) = 0\,, \quad (n = 1,..,N) \qquad (1)$$

$$(x_0 \leq x \leq x_1)$$

under the boundary conditions

$$Q_k(\phi(x_0, \phi(x_1), \lambda) = 0\,, \quad (k = 1,..,K) \qquad (2)$$

where $\phi(x)$ is unknown function of lengths N and λ is unknown eigenvalues of lengths $(K - N)$.

A numerical example of HIDMEG for a boundary problem is shown in Fig.1. In this example, perpendicular injection of 40 GHz microwave (ordinary mode) is assumed to LHD plasma. Density and filed intensity profiles are assumed appropriately. Due to magnetic shear of LHD, mode conversion from ordinary mode to extraordinary mode is present. (Set of equations and LHD plasma model are due to Dr. Ejiri,A., and Prof. Minami, K.).

References

[1] Watanabe,T., and Gnudi, G., in *Numerical Analysis of Ordinary Differential Equations and its Applications*, (ed. by T.Mitsui and Y. Shinohara, Word Sci., (1995) Singapore), p91-111.

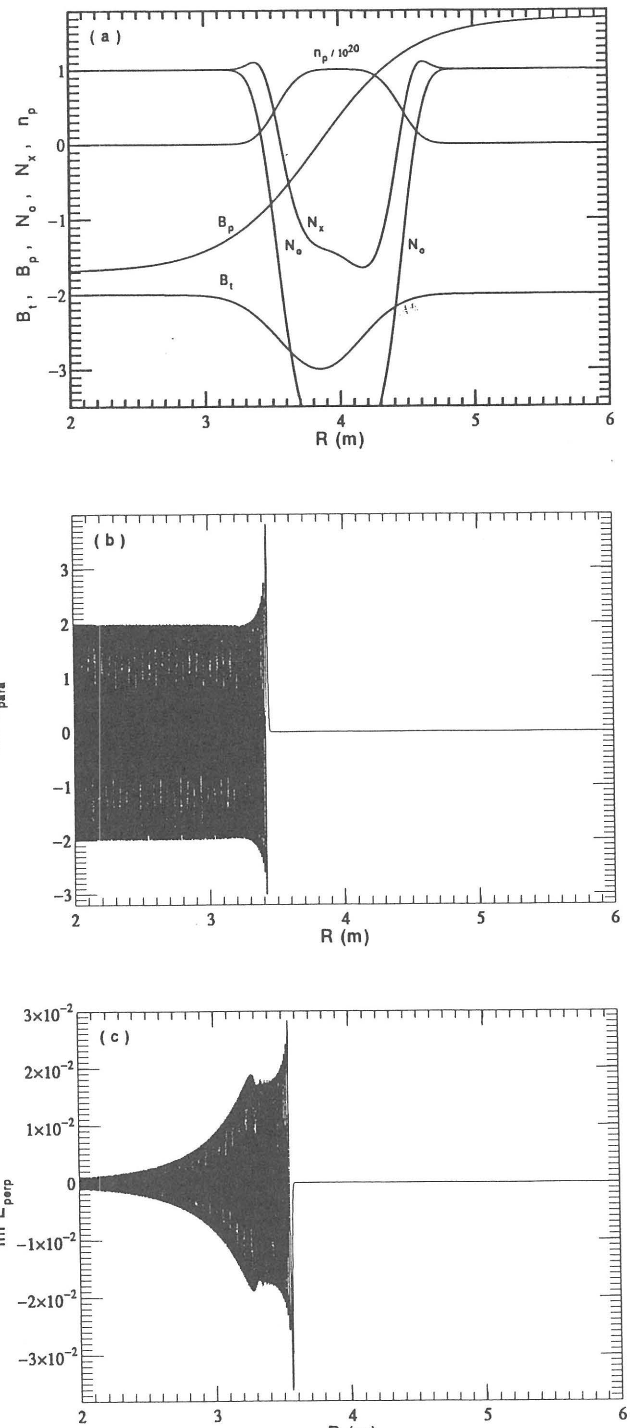

Fig.1 (a) LHD model and corresponding refractive index for ordinary (N_o) and extraordinary mode (N_x) along radial position on ($z = 0$, $\phi = 0$) plane. B_t, B_p are toroidal and poloidal magnetic field strength and n_p is plasma density in MKS unit. Microwave frequency is assumed to be $40GHz$. Real part of $E_{\|}$ (b) and imaginary part of $E_{\perp}$ are also shown.