§9. Receiving Antenna Design of Scattering from ECH Beam

Kharchev, N., Petrov, A., Skvortsova, N., Sarksian, K. (General Physics Institute),
Notake, T. (Nagoya Univ.),
Kubo, S., Shimozuma, T., Idei, H., Yoshimura, Y., Kobayashi, S., Ito, S., Mizuno, Y., Takita, Y., Sato, M., Ohkubo, K.

The study and description of the spectral and probability characteristics of random plasma processes has long been attracted the attention of investigators engaged in the field of plasma physics. Recently, interest to this problem even has been increasing, when it became clear that many global plasma processes (diffusion of particles, heat conductivity, equilibrium in the magnetic field, etc.), to a great extent, depend on random fluctuation of a number of plasma variable. Therefore, information on spectral and probability behavior of fluctuations is of prime importance for solving fundamental and applied problems associated with the creation of high temperature plasma in thermonuclear toroidal devices. To date, the probability and spectral characteristics of fluctuations in the region of toroidal devices in which a low-temperature plasma exists (the edge of the plasma column) has been studied in sufficient detail. As a rule, the density fluctuations in a low-temperature plasma are described by the model of strong structural turbulence[1)]. The term 'strong structural turbulence' means that, against the background of strong turbulence induced by some plasma instability, there exists an ensemble of stochastic interacting plasma structures. Such spatial and temporal structures comprise a substantial portion of turbulent pulsations, and random events in this turbulence appear to be significant for variation of the macroscopic parameters of the plasma. In the literature, the turbulence in which random events appear to be significant is also referred to as rigid turbulence[2)]. The temperature and density in the central region of the the plasma column are two orders of magnitude higher than those at the edge. Study of fluctuation processes in this region is much more interesting, but more complicated problem because of the lack of adequate diagnostic techniques.

The purpose of the present work is the design of receiving antenna system for gyrotron scattering. During the last two experimental campaigns of LHD, the gyrotron scattering experiment have been carried out using one of the heating antennas as a receiving antenna. These experiments have confirmed the possibility of using the gyrotron radiation as a source of scattering, but using only one channel in one shot. It is important to receive the scattering signals from several spatial points andwavenumbers and to analyse correlations between each signal in one shot of LHD. The chosen number of channels is 10. Transmission of scattered radiation inside the LHD vacuum chamber utilizes the quasi optical system with phase correcting mirrors. Two flat (M2, M4) and two focusing (M1, M3) located on one support structure. Scattered radiation is transmitted through a window whose aperture diameter is 80mm. Reception of signals will be done by horn antenna set outside the vacuum. Mirror M1 consists of 10 sub-mirrors with the size 150×100 mm^2, 2 in raw and 5 in column. Mirror M3 consists of 10 sub-mirrors with the size 240×200 mm^2, 2 in raw and 5 in column. By adjustment of the angle position of sub-mirrors 3, various combination of signals with the spatial resolution and signals from one point of space with different wavenumber,k, can be received. In the present design, 4 channels are used for the reception of signals from one spatial point with k = 3.7, 5.0, 6.0, 7.5 cm^{-1}; 7 channels for spatial measurements. Changing an angle of a mirror 4 in an operating time it is possible to change the position of scattering volume. References

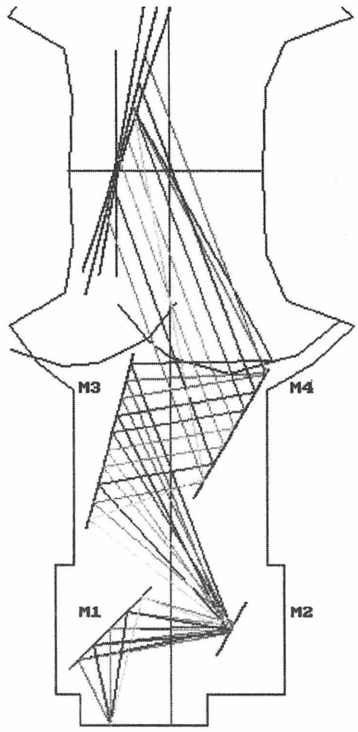

Figure 1: Preliminary design of 10 channel scattering receiving system.

1) N.K. Kharchev, K.A. Sarksyan, N. N. Skvortsova, B.P. van Milligen. Plasma Phys. Reports (English transl.), 1999, 25(4), 312.
2) G. G. Malinetskii, A. B. Potapov, Modern Problems of Nonlinear Dynamics, URSS, Moscow, 2000.