§70. Graphite-made UHF Fabry-Perot Resonator for Investigation of the Divertor Plasma Flow

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The UHF resonators have some advantage in comparison to interferometers in measuring plasma flow parameters. The resonator allows to measure a plasma density beginning from 2-4 orders in magnitude lower than the critical density for given frequency. It can be successfully used for thin plasma layer (of the order of wavelength) as well as for study of fluctuations in a plasma flow [1]. In modern fusion devices with graphite protected first wall there is a reason to change the metallic mirrors of resonator for ones made of graphite. To study the properties of such resonators the transmitted resonator was fabricated of graphite mirrors, with diameter D=70mm, curvature radius r=100mm and connection holes of d=1.5 mm. The distance between mirrors, L, were variable in the range 10-100 mm. The frequency of unloaded resonator (f=36.47GHz) was not changed significantly when L was changed.

With L increasing there were observed some increase of the quality factor, Q, and decrease of resonance amplitude, A, Fig.1. Important fact is that the measured Q for graphite resonator was only 5-10 times lower in comparison to identical copper resonator, in spite of much higher difference predicted on the base of the electrical conductivity ratio: $(\sigma_{Cu}/\sigma_C)^{1/2} = 50$. It is evident from this fact that the contribution of difraction losses in the case of a graphite resonator is less than in the case of metallic one, where such losses determine the Q value.

For L=60mm and with Q measured, the minimal density is $(n_eL)_{min}=10^{10}/cm^2$, and the maximum value of (n_eL) is determined by the frequency sweeping range. Taking into account the realignment range of a Gan type solid diode (i.e., Δf=0.5-1.0 GHz) the $(n_eL)_{max}$ can be found as $\sim 7\cdot 10^{12}/cm^2$. Therefore, in reality the range of n_eL to be measured, with small influence on the resonator characteristics, will be limited by meanings: $1\cdot 10^{10}$-$5\cdot 10^{12}/cm^2$.

To check effects of heating on resonator properties, the measurements were carried out when temperature of one mirror varied up to 300C, using Ohmic current heating. We observed the increase of the resonance amplitude, (up to 30%) and the shift of resonant frequency. These results can be explained, correspondingly, by increasing the graphite conductivity due to temperature growth and by some changing of L due to thermal expansion.

So, the heating of mirrors will lead to errors related to measurement of the frequency shift, however, this error will be small and controlled for slow temperature change.

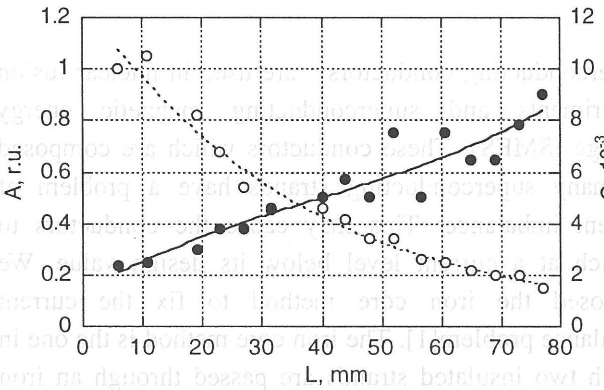

Fig. 1.

Reference

[1] A.I.Skibenko, et al. Proc.23rd EPS Conf. on Contr. Fusion Plasma Phys., Part III, p.1124.