The study of long range electric potential correlation on the GAM frequency on the T-10 tokamak

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In the recent years there has been significant interest to Geodesic Acoustic Modes (GAM). GAMs, being the high-frequency counterpart of zonal flows, can be a possible mechanism of the turbulence self-regulations. It has been shown theoretically that GAMs manifest themselves as oscillations of plasma electric potential with m = n = 0 (and can weakly be seen on density with m = 1, n = 0).

GAMs have been studied with two main diagnostics: Langmuir probes and Heavy ion beam probing (HIBP), a unique method for direct measurement of the electric potential in the hot plasma core. Diagnostics are separated by half of torus of the T-10 tokamak (R= 1.5 m, a= 0.3 m, B < 2.5 T).

This work is dedicated to simultaneous measurements of plasma potential oscillations at GAM frequencies in different locations and studying of their correlation properties. It was found that coherency between signals of two diagnostics is up to 0.8 that is unexpectedly high for such a large distance between them, half of torus in toroidal and about π in poloidal direction. Such coherency appears when Langmuir probes were located at about $\rho = 0.95$. Also, the phase shift between potentials measured with two diagnostics has been obtained.

The value of coherency decreases with increasing in radial distance between HIBP sample volume and probes position. The phase shift between electric potential oscillation measured with HIBP and measured with Langmuir probes in the GAM frequency range was negative (about - 1.5 – 2.2 rad). Its value increases with increasing in radial distance between points of observation of two diagnostics. We assume that phase shift in toroidal and poloidal directions is equal to zero because m = n = 0 for GAM. Since phase shift is negative plasma potential wave propagates outwards. The magnitude of its velocity changes from ~ 2 km/s ($\Delta r \approx 3$ cm) to 7 km/s ($\Delta r \approx 11$ cm).

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