Studies of the GDT plasma MHD activity using charge exchange atoms monitor

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The multichannel diagnostics of charge exchange atoms spatial distribution was created on Gas Dynamic Trap. Time resolution of diagnostics is 30 mks and it allows us to visualize MHD activity of GDT plasmas. Diodes AXUV16ELG (16 sensitive elements) and experimental diodes [1] (9 sensitive elements) was used as a sensor. Thin «dead» layer allows registering optical radiation in wide spectral range. Also electrons and atoms (and ions) with energy of several keV and more can be registered by the diodes. First pinhole camera is designed for registering atoms flux at an angle of 45° into the magnetic field axis and mounted near the center of GDT. Charge exchange occurs at artificial gas target created by NBIs. So distribution function of fast ions is strongly anisotropic and pitch angle of all fast ions is near 45° and ratio of signal from particles to signal from radiation exceeds 1000. Second pinhole camera mounted near the mirror point of fast ions registers atoms flux at an angle of 90° approximately. Artificial target was not use in this case and charge exchange occurs on residual gas.

Spatial profile of fast ions changes and decrease of fast ions energy content signal is observed as a result of Alfven ion cyclotron (AIC) instability. The AIC instability on GDT was studied experimentally [2] and theoretically [3]. Monitors of charge exchange atoms flux show in-phase signal decreases. It is a result of angular spreading of fast ions as a result of instability. So it is another experimental proof of theory of AIC instability on GDT.

Plasma MHD activity and disruption is visualized by neutral atoms monitors. For instance plasma periphery rotation as a result of voltage supply into the limiters and plasma absorbers [4] is accompanied by atoms flux modulation with a frequency of plasma rotation. Model for experimental data analysis was created and good agreement of model and experiment was shown.

References

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