INVESTIGATION OF ION PLASMA COMPONENT ON REBEX MACHINE

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To obtain information about ion component of plasma heated by a high power relativistic electron beam [1] , corpuscular diagnostic methods are used.

The distribution function of ions in direction perpendicular to the external magnetic field is determined by analyzing fast charge exchange atoms, escaping freely the magnetized plasma column. As the energy confinement time of the plasma ions is much shorter than time of flight of charge exchange atoms through a drift tube, the signal from a fast neutrals detector (placed on its end) can be simply transformed to distribution function. Thus, by such a simple time-of-flight analyzer the distribution function is determined in one shot.

The fast neutrals are analyzed in the energy range 0,1-30 keV and registered by a secondary-emission-type detector. In OREB regimes (oscillating relativistic electron beam) two temperatures can be assigned to measured spectrum. The lower temperature is typically 0,1-0,3 keV, the higher one decreases from 7 keV to 1 keV with increasing t_d (t_d - time delay between plasma and beam injection). Rough quantitative estimates show that only a tail (1%) of the ion distribution is measured by this method. Apparently, the bulk of plasma ions has temperature well under 100 eV.

Ions leaving the interaction chamber along the external magnetic field are analyzed by one-channel electrostatic energy analyzer in energy range (0,03÷4) keV. By simultaneous time-of-flight analysis the place of origin of registered ions in the plasma can be determined. The form of signals of the "axial" ions corresponds approximately to the length and position of the plasma column in OREB regimes. This fact was checked both with hydrogen and deuterium plasma. Following the energy distribution function measurement, the ion drift and thermal velocities are comparable corresponding to some 100 eV. As these values are in the range of ion sound velocities, an efficient mechanism of fast ion generation based on the fast overheating of the electron component is proposed.

REFERENCES

[1] Šunka P., Jungwirth K.,Kováč I.,Piffl V., Stöckel J.,Ullschmied J.: Int. Conf. Plasma Phys. and contr. nuclear fusion research, Berchtesgaden 1976 vol. 2. p. 535.