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Invited lecture

THE CONNECTION BETWEEN SPECTROSCOPY OF LABORATORY AND ASTROPHYSICAL PLASMAS

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In this paper the results of polarization Stark spectroscopy and Doppler measurements in several types of electric gas discharges and plasma sources are described. Methods were developed for measuring the static electric field in hydrogen and helium discharges using Stark polarization spectroscopy. Special technique has been developed for electric filed strength measurement based on line shift and intensity ratio of forbidden and allowed HeI lines in the range of 5-100 kV/cm. Also, as an example, spectrum in the vicinity of these lines recorded in a fast-fluctuating field is presented. In addition, results are presented of plasma electron density measurement in the range of 10^{14}-10^{17} cm^{-3} applying the same method, but in the presence of Holtzmark field. Doppler spectroscopy has been used to obtain results for H atom velocities in the range from 100 km/s (Grimm type discharge) to 400 km/s (1 keV) in the electrostatic confinement discharge. A Monte-Carlo code for transport of high energy hydrogen atoms and for generating Doppler profiles is developed. In the separate experiment (MPC) plasma jets are generated where plasma is accelerated to velocities up to 100 km/s. Careful interpretation of spectra is needed in the conditions where several effects are present simultaneously: electric and magnetic field, both with Doppler effect. Several examples are shown where these mentioned methods may be directly applied on plasma dynamics in astrophysics.