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Stark Spectroscopy: Measuring Electric Fields in Plasmas

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The electric field is one of the most important parameters in discharge plasmas. Many applications that use discharges depend on behavior at the boundary, and the electric field is closely connected with other discharge parameters, such as charge densities, fluxes of electrons and ions, and energy distribution functions. It is therefore necessary to understand the spatial distribution of electric field in the discharge, but this is difficult to measure. With this background, there has been considerable effort in recent years to develop a suite of spectroscopic methods capable of providing quantitative measurements of electric fields in glow discharges. The main techniques are laser-based active methods that seek to measure Stark effects in atoms or molecules in the discharge. Techniques have been developed for glow discharges based on the spectroscopy of atomic hydrogen and each of the noble gas atoms, using shifts and /or splitting of energy levels due to Stark effects. This paper will contain a brief overview of work in this area, and then explain in detail the development of a method based on spectroscopy of xenon atoms. The theory and experiments used to calibrate the method will be explained and the application of the technique to measure electric fields during plasma ignition will be presented.