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Invited Lecture

SPECTRAL LINES ISSUES OF HYDROGEN AND IMPURITY EMITTERS IN FUSION PLASMAS

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Plasmas generated in magnetic fusion devices have relatively low electron densities, typically in the range $10^{13} - 10^{14}$ cm^{-3}, exceeding even 10^{15} cm^{-3} in the divertor region under detachment conditions. Their electron temperature covers a wide range extending from few keV in the confined core to about 1 eV in the peripheral regions. The presence of intrinsic as well as injected impurities in addition to the main hydrogen isotope species offers many situations allowing the study of various cases of emission line spectra. Emission lines may be subject to various broadening processes like the Stark effect due to the interaction of the emitter with the plasma charged particles, the Doppler effect as well as the Zeeman effect due to the presence of the magnetic field. The dominant broadening mechanisms depend on the emitter species, the considered line, the magnetic field strength (hence the location of the emission zone), as well as the plasma parameters. We propose here to present a review on the various spectroscopic techniques based on line emission spectra that are used to diagnose magnetic fusion plasmas, their limitations and a reflection on the possible improvements. The similarities with close situations of astrophysical interests will be discussed.