Spectroscopic Diagnostics of Highly Charged, Heavy Metal Impurities

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Abstract. Tungsten (W) is an important candidate material for a future fusion reactor. Its application as a first wall material is investigated in today's fusion experiments and its diagnosis is developed simultaneously. The latter offers many challenges, which need to be overcome in order to provide a reliable interpretation of the complex W spectra. For the plasma core these challenges are given by the large number of relevant ionization stages, of levels within each ion and of the emitted spectral lines. Experimentally, these spectral lines cannot be separated in all cases, such that hundreds of them form spectral features that are often called quasicontinua. The spectra typically result from integration along a line of sight crossing regions with a wide variety of electron temperatures and densities making an interpretation rely on the knowledge of the ionization and recombination equilibrium of W. The emissions of W between about 500-20000eV measured in today's fusion devices are presented and corresponding model calculations are compared to them. These investigations focus on W-ions with charge stages from about 20+ to 65+. Along with well known spectral signatures of W also puzzeling issues in the W spectra are presented in order to document current interests of the tokamak based research on W spectroscopy.