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P2.051 Hydrogen isotope ratios measurements by Penning gauge spectroscopy of molecular Fulcher-α band

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ITER and DEMO will use a optimum 50%:50% deuterium-tritium gas mixture as fuel. The fusion reaction rates depend on the hydrogen isotope ratios, therefore, these ratios are important to monitor both in the confined fusion plasma itself and in the pump ducts. Penning gauge spectroscopy of Balmer-α lines of hydrogen isotopes is widely used in present-day experiments to determine the hydrogen isotope ratios and the partial pressures in the pump duct. Such a diagnostic system is also foreseen in ITER.
The Balmer-α line isotopic shifts are very small <0.18 nm and the lines partially overlap because of the presence of energetic atoms produced by molecular dissociation. The molecular ro-vibrational emission band of each hydrogen isotopomer consists of many narrow molecular lines, covering a wide wavelength span and have unique signature. The drawback is the low line intensities in comparison with atomic hydrogen lines from the most prominent Balmer series.
To investigate the capability of the hydrogen molecular spectroscopy to improve the hydrogen isotopic ratio determination, an Alcatel-type Penning gauge equipped with the optical window and the collecting optics was coupled by the optical fibre to the Echelle spectrometer having 370-680 nm spectral range and the spectral resolving power above 20000. The intensities of both atomic Balmer-α lines and molecular Fulcher-α bands were measured for gas mixture pressures in the range of 1E-6-1E-3 mbar. Different mixtures of H2 and D2 gases for given base vacuum pressure were produced by varying of both hydrogen and deuterium gas flows. The total intensities of the Fulcher-α molecular bands were determined by using the measured rotational and vibrational population temperatures. The comparison of isotopic ratios measured both by Balmer-α and by Fulcher-α bands spectroscopy will be presented. The capability of the molecular spectroscopy to determine the hydrogen isotopic ratio with high precision will be discussed.

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