Charge Exchange Recombination Detection of Low- and Medium-Z Impurities in the Extreme UV Using a Digital Lock-in Technique

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More sensitive detection of charge exchange recombination lines from low-Z elements, and first-time detection from medium-Z nickel, has been achieved in DIII-D plasmas with a digital lock-in technique. That portion of the extreme UV spectrum varying synchronously in time with the square-wave modulation of a high energy, neutral heating beam is extracted by forming a scalar product of a correlation function with the data record of each pixel in the linear array detector. The usual dense array of collisionally excited, metallic lines from the tokamak plasma are strongly suppressed, leaving only a sparse spectrum of lines dominated by charge exchange recombination transitions from fully stripped, low-Z elements. In plasmas with high metal content, charge exchange recombination lines from the Li-like ion of nickel have been positively identified. This work was supported by the US DOE under DE-FC02-04ER54698 and DE-FG02-07ER54917.