Contribution ID: **70** Type: **not specified**

First Laboratory Measurement of Magnetic-field-induced Transition Effect in Fe X at Different Magnetic Fields

Wednesday, 17 May 2023 16:30 (20 minutes)

The magnetic field is extremely important for understanding the properties of the solar corona. However, there are still difficulties in the direct measurement of the coronal magnetic field. The magnetic-field-induced transition (MIT) in Fe X, appearing in coronal spectra, was discovered to have prospective applications in coronal magnetic
field measurements. In this work, we obtained the extreme ultraviolet spectra of Fe X in the wavelength range of 174–267 Å in the Shanghai High-temperature Superconducting Electron Beam Ion Trap, and examined the effect of MIT in Fe X by measuring the line ratios between 257.262 Å and the reference line of 226.31 Å (257/226) at different magnetic field strengths for the first time. The electron density that may affect the 257/226 value was also obtained experimentally and verified by comparing the density-sensitive line ratio (175.266 Å/174.534 Å) measurements with the theoretical predictions, and there was good agreement between them. The energy separation between the two levels of 3s2 3p4 3d 4D5/2 and 4D7/2, one of the most critical parameters for determining the MIT rate, was obtained by analyzing the simulated line ratios of 257/226 with the experimental values at the given electron densities and magnetic fields. Possible reasons that may have led to the difference between the obtained energy splitting and the recommended value in previous works are discussed. Magnetic field response curves for the 257/226 value were calculated and compared to the experimental results, which is necessary for future MIT diagnostics.

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Session Classification: Astrophysical Plasmas

Track Classification: Astrophysical Plasmas