Laboratory Study of the Diagnostic Utility of the 3C/3D Line Ratio in Fe XVII

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Fe XVII x-ray emission is present in a multitude of sources observed by *XMM- Newton* and the *Chandra X-Ray Observatory*, such as, the corona of the Sun, Capella, HR1099, and Eta Pup. Two of the strongest lines observed in these spectra are the resonance and intercombination lines located at 15.01 and 15.26 Å, respectively. After being resolved in the Sun [1], calculations of the relative intensity, R, of these lines have varied by nearly a factor of two. As part of the laboratory astrophysics program at the electron beam ion traps EBIT-I & EBIT-II located at the Lawrence Livermore National Laboratory we have measured this line ratio and found it to be significantly lower than most calculations [2]. However, our ratio is still higher than many of the ratios measured in the corona of the Sun. To address this discrepancy we have measured R as a function of the relative abundance of sodium-like Fe XVI [3]. Our results show that an Fe XVI innershell satellite line coincides with the intercombination line and can significantly reduce the apparent R. We measure $R = 1.90 \pm 0.11$ when the relative abundance of Fe XVI to Fe XVII is ~ 1. This explains the anomalously low ratios observed in the solar and stellar coronae previously believed to be the result of resonant scattering. The fact that the apparent relative intensity of the resonance and intercombination line in Fe XVII is sensitive to the strength of an Fe XVI innershell satellite, and therefore, the relative abundance of Fe XVI to Fe XVII, makes the line ratio a diagnostic of temperature.

References:

[1] J. H. Parkinson, *Astron. Astrophys.* **24**, 215 (1973).

[2] G. V. Brown, P. Beiersdorfer, S. M. Kahn, D. A. Liedahl, and K. Widmann, *ApJ* **502** 1015–1026 (1998).

[3] G. V. Brown, P. Beiersdorfer, H. Chen, M. H. Chen, and K. J. Reed, *ApJL* **557** L75–L78 (2001).

Acknowledgments:

Work by the University of California, LLNL was performed under Contract No. W-7405-Eng-48 and supported by NASA SARA P.O. No. S-03958G and Smithsonian-CXO award No. EL9-1015A.