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K-shell spectroscopy uncertainty due to spectral models[1]

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— In high energy density plasma physics, K-shell spectra from H-, He-, and Li-like ions are often used to diagnose plasma conditions. Line ratios and line broadening of the measured spectra are sensitive to the electron temperature and density of the source plasma, respectively. Thus, plasma electron temperature, T_e, and electron density, n_e, can be uniquely and precisely determined by reproducing the measured spectra with a spectral model. However, the different spectral models do not perfectly agree with each other and the diagnostic results depend on the selection of spectral models. Here, we investigate the level of disagreement in inferred T_e and n_e due to differences in spectral models. Models in the study are ABAKO, ATOMIC, FLYCHK, OPAL, OPAS, PrismSPECT, and SCRAM. As an example, we selected Mg K-shell spectroscopy used for Fe opacity experiments [Bailey et al, Nature 517, 56 (2015)] where Fe plasma conditions are inferred from K-shell spectra of a Mg dopant. The T_e and n_e diagnostics using different models agree within 5% and 30%. We discuss the main source of discrepancies.

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