Pernicious Systematics in Atomic Spectroscopy

J. D. Gillaspy[a,b]

[a]National Institute of Standards and Technology, Gaithersburg, MD 20899, USA
[b]National Science Foundation, Arlington, VA 22230, USA

At the heart of accurate experimental atomic data is the inclusion of all significant sources of systematic error. Recently, the search for new sources of systematic errors has been spurred by substantial discrepancies in studies of one-electron [1], two-electron [2], and three-electron [3] systems. In the course of recent work in the Atomic Spectroscopy Group at NIST [4-7] (summarized in this report briefly), two pernicious systematic effects have been considered which appear to be widely neglected in many precise measurements found in the literature. These effects are: (a) quantum interference between widely spaced spectral lines [4], and (b) charge exchange mediated satellite blends [10]. These are not new, but discussions of them in the literature are rare and they are frequently dismissed informally because of widespread misunderstanding about how to accurately estimate their magnitudes or because of the incorrect assumption that if they are significant they will manifest themselves in the residuals of fits to symmetric line profiles. Results are shown to bolster the propositions that these two effects should be in the consciousness of all producers of robust atomic data, and that they will become increasingly important to the atomic, molecular, and optical physics community as the frontier of accuracy is pushed forward in all spectral ranges.

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