# Critical Evaluation and Compilation of Atomic Transition Probability Data Relevant to Space Astronomy

W. L. Wiese and D. E. Kelleher
*National Institute of Standatds and Technology*

With partial support from NASA, we are in the process of critically re-evaluating transition probabilities of H - Ca ($Z$=1-20), elements published about 30 years ago in Vols. I and II of "Atomic Transition Probabilities" by W. L. Wiese et al. Much work has been done since then, mostly theoretical, with the most extensive results being provided by members of the Opacity Project (OP). In 1996, "Atomic Transition Probabilities of Carbon, Nitrogen, and Oxygen" was published by W. L. Wiese, J. R. Fuhr, and T. M. Deters. Work on updating the other elements is continuing. Our new compilations rely heavily on OP results because they are so extensive and are reasonably accurate in many cases. Accurate experiments and other accurate computations are of course also essential to evaluation.

H-Ne ($Z$=1-10), plus Fe I: During FY 97, we have continued critically evaluating and compiling transition probability data for the light elements H, He, Li, Be, and B. In addition, we have worked on Fe I. We expect to complete these elements during FY 98. As part of out data evaluation process, we have included neutral species and all stages of ionization. Our table for neutral helium is essentially complete. The tables for Li I and II will be finished as soon as relevant energy-level data become available, which should be in FY 98. A new relativistic code for transition probabilities of hydrogenic spectra, with treatment of QED effects, has been written. During FY 98, our group plans to complete f-value tables for hydrogenic spectra of H-Ni ($Z$= 1-28), for transitions up to principal quantum number n=20. Much of the data for beryllium and boron have been taken from the Opacity Project (OP), and we have included other data sources whenever we deemed to be of comparable or greater accuracy than OP values. We expect to complete our tables on Fe I during FY 98. This table will include vastly improved transition probabilities, incorporating new energy levels and term designations, thereby superseding our previous publication from 1988. We will continue our work on fluorine and neon.

Na-Ca ($Z$=11-20): Revision and extension of Vol. II also relies heavily on OP results. Thus far we have focused on Na, Mg, Al, and Si ($Z$=11-14). Currently available OP calculations do not, however, include the effects of the Spin-Orbit interaction, and only multiplet values are reported. For most transitions and most spectra, OP results compare favorably with experiments and other accurate calculations which include Spin-Orbit effects, except for halogen-like and noble-gas-like spectra. Spin-Orbit effects account for the bulk of the noble-gas-like discrepancies, but the origin of the large discrepancies between OP and CIV-3 in Fluorine-like spectra is not yet known. Agreement is good only for the largest line-strengths, S, and rapidly deteriorates for $S < 1$. K. Berrington and his colleagues at the Belfast OP group have recently developed the capability to incorporate Spin-Orbit effects perturbatively. Early results for F-like Na III indicate that the major part of this discrepancy is not due to this effect.