Accurate Measurements of Atomic Branching Fractions Using Fourier Transform Spectrometry and Progress on the NIST VUV– Fourier Transform Spectrometer

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Radiative transition probabilities in atoms are important quantities for a very wide range of applications of plasma physics, from astrophysics to semiconductor processing. Until very recently the uncertainty for the resulting transition probabilities was often limited by the uncertainty of the lifetime data [1]. Advances in beam–gas–laser spectroscopy (BGLS) have achieved sub–percent accuracy for lifetimes of levels in neutral alkali– and noble gas atoms [2]. Based on these new lifetime measurements, transition probabilities with relative accuracies better than 5% can now be determined once branching fractions for all transitions from an upper level have been measured.

Fourier transform (FT) spectrometry provides a reliable and very efficient method for the measurement of branching fractions with good accuracy. This is illustrated by the results of our recent measurements of branching fractions for transitions from 5p levels in neutral Kr with the NIST high–resolution IR–vis–UV Fourier transform spectrometer [3]. A high–current hollow cathode lamp was used to excite the 5p levels in Kr. To overcome the problem of self–absorption, Ar or Ne was used as a carrier gas for the hollow cathode discharge with an admixture of only a few % of Kr gas. A tungsten strip standard lamp served to determine the spectral response of spectrometer and detectors. Results for the transition probabilities of 5p–5s transitions in Kr I, and an analysis of their uncertainties will be presented.

NIST has recently acquired a UV–Fourier transform spectrometer manufactured by Chelsea Instruments Lt. (London) [4]. The FT spectrometer is currently being refurbished. A new CaF_2 beam splitter will be installed to extend the wavelength range of the instrument into the VUV down to ≈140 nm. The new spectrometer will enable us to efficiently carry out very accurate wavelength– and intensity measurements in VUV spectra. We will report on the status of the VUV Fourier transform spectrometer.

References:

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