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Improved and Expanded Near-IR Oscillator Strengths for Fe-group Elements

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Abstract. Modern experimental techniques, including LIF lifetime and FTS branching fraction measurements, have increased the reliability of atomic transition probabilities in the UV and visible. However, this combination is problematic in the increasingly important IR region, resulting in a significant gap between the capabilities to record new astronomical spectra and the data needed to sufficiently analyze them. To aid in closing this gap, we are incorporating alternative techniques to measure sets of Fe-group oscillator strengths in the near-IR.

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While new and upcoming spectrometers, including IGRINS for the H and K bands, are opening the rich IR spectral region for exploration, the basic atomic data necessary to analyze IR spectra are often inaccurate or altogether missing. As a result, spectral analyses are forced to lean heavily upon theoretical work (e.g. Kurucz & Bell 1995), which lack uncertainty estimates and can be off by large factors from the correct values. This is especially true for the important Fe-group elements; the current NIST ASD (Kramida, *et al.* 2015) totals only 108 experimental oscillator strengths with $\lambda \geqslant 1$ μm for the elements Sc-Zn, and seven of those elements have no reported values.

Traditional laboratory methods are problematic, when measuring oscillator strengths in the IR, and this work utilizes alternative techniques to circumvent these problems. For the branching fractions, a secondary calibration determined using Ar branching ratios reduces systematic uncertainties in the radiometric calibration of the NIST FTS over large λ ranges. Many levels with strong IR branches do not have suitable transitions for measuring laboratory lifetimes, so this work makes use of reverse stellar analyses on the Sun and Arcturus to determine level lifetimes. These analyses are done in a robust fashion, connected to laboratory measurements in the visible/UV to check for systematic effects in the lifetime determination.

Preliminary comparisons to previous measurements show good agreement, confirming our calibration method. Work is now underway on previously unmeasured levels, starting with IR lines of interest in Ti I.

References

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