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Atomic Oscillator Strengths for Atmospheric Models

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Abstract. We report new laboratory measurements of atomic oscillator strengths (log gfs) for stellar atmosphere models.

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In order to correctly model stellar atmospheres, fundamental atomic data must be available to describe atomic lines observed in their spectra. Accurate, laboratory-measured oscillator strengths (f-values) for Fe peak elements in neutral or low-ionisation states are particularly important for determining chemical abundances (Pickering, *et al.* 2011). However, advances in stellar spectroscopy in recent decades have outpaced those in laboratory astrophysics, with the latter frequently being overlooked at the planning stages of new projects. As a result, numerous big-budget astronomy projects have been, and continue to be hindered by a lack of suitable, accurately-measured reference data to permit the analysis of expensive astronomical spectra (Nailing Fingerprints in the Stars, Nature Editorial Nov. 2013); a problem only likely to worsen in the coming decades as spectrographs at new facilities increasingly move to infrared wavelengths.

At Imperial College London - and in collaboration with NIST, Wisconsin University and Lund University - we have been working with the astronomy community in an effort to provide new accurately-measured f-values for a range of projects. In particular, we have been working closely with the Gaia-ESO (GES) and SDSS-III/APOGEE Galactic surveys, both of which have discovered that many lines that would make ideal candidates for inclusion in stellar analyses have poorly defined f-values, or are simply absent from the databases. Using high-resolution Fourier transform spectroscopy (R $\approx$ 2,000,000) to provide atomic branching fractions, and combining these with level lifetimes measured with laser induced fluorescence, we have provided new laboratory-measured f-values for a range of Fe-peak elements, most recently including Fe I, Fe II, and V I (e.g. Ruffoni, *et al.* 2013, Ruffoni, *et al.* 2014). For strong unblended lines, uncertainties are as low as $\pm$0.02 dex. Details of challenges in these measurements can be found in the papers. We have produced accurate log gfs in the visible for the GES and in the IR H-band for the APOGEE surveys. We continue this work, and welcome requests from astronomers for specific atomic data needs. This work is supported by the STFC of the UK.

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