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SOLAR LOG GF VALUES IN THE INFRARED J AND H BANDS

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ABSTRACT

Solar IR spectra have been utilised by us to derive *log gf* values for atomic lines due to 17 chemical elements, in the J and H bands, i.e. in the wavelength ranges 1.00 - 1.34 μm and 1.49 - 1.80 μm respectively. The observed central line depths wrer based on the FTS atlases published at Liege and KPNO. We also reprot new *log gf* values for 51 lines for which neither theoretical nor experimental values are available till date.

Key Words : Sun: atmosphere - Sun: abundances - atomic data - *gf*

I. INTRODUCTION

Among other things, the strength of a Fraunhofer line depends upon the number of absorbers producing the line and its oscillator strength. Therefore, in order to determine the abundances of elements, a precise knowledge of weighted oscillator strengths (*gf*) is necessary. The entire deifice of our knowledge of chemical abundances of celestial bodies depends upon our knowledge of the *gf* values. Thus the importance of accurate derivation of *gf* is self evident.

Theoretical *gf* values n the infrared region have been published for a large number of atomic lines by Biemont & Grevesse (1973) and KP (Kurucz & Peytremann, 1975). Improvements upon the calculations of KP were made by Kurucz (1994) to provide data for 58 million lines. The OP and OPAL projects too have contributed to a huge quantity of data. But, still *gf* values are lacking for a large number of lines. Under such circumstances solar *gf* values come in handy to astrophysicists.

II. PROCEDURE

This work closely follows Stalin et al. (1996). We made a rigorous selection among the interesting lines listed by RSB (Ramsauer et al., 1995) based on Liege - 81, KPNO - 91 and KPNO - 93 FTS atlases. RSB also give *log gf* values from different sources which mostly use theoretical techniques to obtain the values. The underlying assumption is that the spectrum synthesis code ADRSL under LTE, must be iterated on *gf* till the observed and calculated absorption peaks match.

The input abundances were from Anders & Grevesse (1989) and Grevesse & Noels (1993). Holweger & Muller (1994) model atmosphere was used. The synthetic spectrum was convolved with a depth independent gaussian macroturbulence of $V_{mac} = 1.52$ kmsec^{-1} Microturbulence is assumed to be 1.00 kmsec^{-1} and depth independent. Hyperfine splitting is not taken into account and van der Waal's broadening parameter was calculated using Unsold's (1995) formula.

III. DISCUSSION OF RESULTS

We do not wish to present the derived solar log *gf* values on an absolute scale, may be because of our ignorance of an accurate laboratory determination of the same quantity for a large number of lines. The accuracy of solar *log gf* derived depends on

1. Adopted photospheric model and the computer code used,
2. Choice of the velocity fields V_{micro} and V_{macro},
3. Accuracy of observations,
4. Placement of continuum and
5. Choice of damping parameters.

Points (1) and (2) are discussed by Gurtovenko & Kostik (1981) and Stalin et al. (1996) and point (3) has been covered by RSB. We draw attention to the fact that different central depths were noticed by us for one and the same line in the Liege - 81 and KPNO - 91 atlases. In the Liege -81 atlas a continuum marked in the atlas was used to define the central line depths. To find the error introduced in *log gf* due to the placement of the continuum we have repeated the calculations by varying the continuum by $\pm$ 1%. As is expected the weak and strong lines are affected most, and for lines with moderate central depths the differences remain within 25% of the uncertainity.

The advatage of the line depth fit method is that they are practically insensitive to the adopted damping parameter (Kostik et al., 1996). An effort was made to estimate the dffect of damping on the derived *log gf* by repeating the calculations with various enhancement factors to Unsola's (1955) formula. It is found that the differences in *log gf* show a tendency to vanish as the line strength increases and the weak lines are in general affected in a small way.

The sources of error need not be cummulative, but they may compensate for each other. The detailed results are available with the authors and they can be obtained upon request.

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