Sulphur Abundances in Disk Stars from the Forbidden SI Line at 10821 Å

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1. Context

In this poster, we present an investigation of a new, preferred diagnostic tool for the determination of the sulphur abundance of disk stars, see also Ryde A&A (2006). We are in the process of analyzing a large set of stars both in the galactic disk and halo (Ryde et al. 2007, in prep.). This diagnostics, the forbidden sulphur line at 10821 Å (first observed in the Sun by Swings et al. 1968), is less sensitive to the assumed temperatures of the stars investigated and less prone to non-LTE effects than other tracers. In the Grotrian diagram (Figure 1), we have indicated the most commonly used tracers of stellar sulphur abundances, and three forbidden transitions. The forbidden line with the predicted largest strength is the $^3P_2 - ^1D_2$ transition at 10821 Å. It is an intercombination line, an M1 transition between the triplet ground-state and the first excited singlet state. The E2 transition is two orders of magnitude weaker. In the investigation presented here, we have studied a homogeneous set of sub-giant and giant stars ranging from spectral types of G5 to K4 (effective temperatures of 4000 – 5000 K). The reason why the [SI] has not been use before is that it lies beyond the reach of normal CCDs.

2. Method

High-resolution, near infrared spectra of the [SI] line are recorded using the Phoenix spectrometer on the Gemini South telescope. Our high signal-to-noise spectra have a resolution of $R = 60,000$. We have modelled our observed spectra with synthetic spectra based on MARCS model atmospheres. The stellar parameters of the stars are taken from the Elodie library (Soubiran et al. 1998), and the line strength of the [SI] line is taken from the NIST database. In Figure 2, we show an example of a spectrum of the [SI] line. The star, HD212943, has a metallicity of [Fe/H] = -0.34, a temperature of 4590 K, and log(g) = 2.8.

3. Results

We show that the [SI] line at 10821 Å is detectable and useful for an analysis of sulphur abundances in disk stars. Based on this line we can corroborate the alpha element-behaviour of sulphur in the disk, which can be seen in the [S/Fe] vs [Fe/H] plot in Figure 3 and from the discussion in Ryde (2006) and Chen et al. (2002).

REFERENCES

Swings et al. (1968). SoPh 6, 3.
Figure 1. Grotrian diagram of sulphur indicating spectral abundance-tracers which are possible to use.
Figure 2. The spectrum of HD212943 is shown as by dots. A full line shows a synthetic spectrum with $[\text{S}/\text{Fe}] = 0.21$. 
Figure 3. The [S/Fe] vs [Fe/H] plot, in which we also have plotted the determinations of Chen et al. (2002) by crosses. For details see Ryde (2006).