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Measurement of Rose Indices on a Kiso 4-Degree Objective Prism Plate

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Abstract. In order to check the utilisation of 4-degree objective prism spectra for the deep spectroscopic galactic structure study, Rose's (1984) seven indices between 3500 Å and 4400 Å for 19 Hyades stars were measured on a Kiso Schmidt prism plate, L3496. By comparison with those of Rose (1984), it is found that his spectral indices, Hδ/FeI, Hγ/P(4325), and P(3912)/P(CN) measured on these low dispersion spectra, are still usable. This result gives good prospects for a deep spectroscopic galactic structure program with the 4-degree objective prism and narrow band interference filters.

1. Introduction

With an interference filter, objective prism plates can reach to stars with $B = 13$ for the case of a 10° prism and provide information on log g and [Fe/H] for F - K stars using three spectral indices measured from the digitized spectra in the vicinity of SrII 4077 and Hδ (Rose 1991). It would be valuable for work on galactic structure if this information could be extracted from lower dispersion objective prism plates, reaching to fainter stars. We have therefore tested all the spectral indices of Rose (1984) to determine whether they can be measured on a 4° prism plate.

2. Index Measurement on a 4° Kiso Schmidt Plate

Since the original index measurements of Rose (1984) were done for 85 stars including 35 Hyades dwarfs, 4° Kiso plates were searched to find plate L3496, which contains some Hyades stars. Nineteen Hyades spectra and four wedges on plate L3496 were scanned with the Kiso observatory PDS 2020 GMS microdensitometer with a 20μm square aperture. The scan speed used 100 csu (conventional scan units) for the Hyades spectra and 200 csu for the wedges.

A system of spectral indices has been defined by Rose (1984) that measures the ratio of the residual central intensities of two neighbouring spectral lines or the ratio in intensity of two neighbouring pseudo-continuum peaks. Spectral indices are Hδ/FeI, SrII/FeI, Hγ/P(4325), Hγ/G band, CaII H/CaII K, P(3912)/P(CN), and P(4045+Hδ)/P(4063). All seven spectral indices were remeasured to check the objectivity of the index measurements from the original Rose digital data for the Hyades stars, which were kindly provided by Dr. J. Rose.

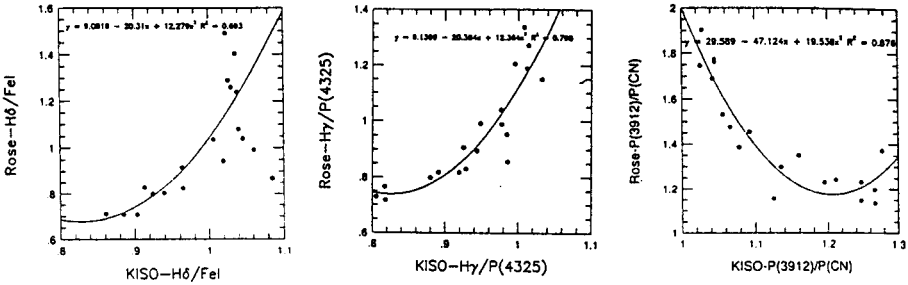

Figure 1. Relations between two measurements of Hδ/FeI, Hγ/P(4325), and P(3912)/P(CN).

We compared the remeasured values with the original index values of Rose (1984) and found that all spectral indices except CaII H/CaII K have excellent linear relations with correlation factors larger than 0.94. It implies that the index measurements are fairly objective except CaII H/CaII K.

The original Rose data were digitized from slit spectra with a dispersion of around 50 Å/mm. The spectra were obtained using an image intensifier on the standard Cassegrain spectrograph of the University of Hawaii 2.24 m telescope at Mauna Kea Observatory. The Kiso plate, L3496, which was taken with the 105 cm Schmidt telescope with the 4° objective prism, has a dispersion of approximately 170 Å/mm at Hδ. The emulsion of this plate is 1-N and the plate quality is classified as an intermediate image shape, an underexposed wedge density, a uniform development, and an intermediate surface quality. The overall quality of the Kiso prism spectra is far inferior to the slit spectra of Rose. The characteristic curve for L3496 was derived from the scanned wedge data and used to convert the stellar scans from density to relative intensity.

The identification of positions of Rose indices on the 4° prism plate is not as easy as on the slit spectra. The CaII K, CaII H, Hδ, G band, λ3912, and P7 of Rose (1984) are easy to identify, but FeI(λ4045), SrII, Hγ, CN band(P1,P2, and P3 of Rose(1984)) are quite difficult to identify on the 4° prism spectra. The most difficult ones are FeI(λ 4063), FeI(λ 4325), P5 and P6 of Rose (1984).

The indices measured on the 4° prism plate are compared with those of Rose (1984). The two are correlated for Hδ/FeI, Hγ/P(4325), and P(3912)/P(CN) among seven indices. These are shown in Fig. 1.

However P(3912)/P(CN) of this study is inversely related with that of Rose (1984). It seems that on 4° prism spectra, it was measured from the systematically different positions, because it was quite difficult to identify P1, P2, and P3 for P(CN). As long as there exists a relation between them, we could use this index for the determination of the stellar surface gravity.

3. Results

The Hδ/FeI, Hγ/P(4325), and P(3912)/P(CN) indices measured on a 4° prism plate, which is not excellent in quality, are found to be usable. The former two are sensitive to spectral type and the later is related to surface gravity.

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Using a relation of Rose (1991) between Hδ/FeI and spectral type and a relation between his values and those of this study, we can classify spectral types for 19 Hyades stars with an accuracy of less than two subclasses. It is found that there is a linear relation between Hδ/FeI and Hγ/P(4325) so that Hγ/P(4325) could also classify stars with the same accuracy. Since our data are quite small and limited to dwarfs, the P(3912)/P(CN) index cannot be tested for the determination of the stellar gravity.

However these results give good prospects for the use of the 4° prism plate for a deeper spectroscopic study, although our data are quite small and incomplete.

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