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https://doi.org/10.1017/S0252921100104245 Published online by Cambridge University Press

AUTOMATIC SPECTRAL CLASSIFICATION - PRESENT STATE AND FUTURE DEVELOPMENTS

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ABSTRACT

A survey is given of the present state of digitization and automation of spectral classification from low and intermediate dispersion objective prism plates and an outlook to automatic classification work by a photoelectric multi-element detector scanning system.

I was very reluctant to accept the task of describing the present state and future developments of automatic spectral classification not so much because it is very hard to foresee the really relevant lines of future research but much more so because no great progress can be recorded since the Grenoble meeting of IAU Commission 45 in 1976. The experimental state of affairs in automatic classification contrasts very unfavorably with the great success of classifiers like N. Houk, R. Garrison and others who keep on producing large amounts of MK spectral types by visual inspection. Of course, as soon as the automatic methods are out of the experimental phase and really do work the automatic classifiers can sit back and be lazy. But many of those experimenting with automatic classification became interested in other problems, perhaps because they seemed less exasperating: "Contrary to what some astronomers seem to think, spectral classification is a field where automatic methods are very difficult to apply. The reason is that the human classifier is able to see patterns that cannot readily be described mathematically" (Lynga 1975). People classifying by visual inspection are executing a partly artistic approach, somewhat like the restoration of old pictures - an art which is not easily told a computer. The spectral types from automatic classification will certainly reflect this situation.

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1. THE PRESENT STATE OF DIGITIZATION OF SPECTRAL CLASSIFICATIONS

In the following I am restricting myself essentially to the problem of automation of classifying low dispersion photographic spectra. This does not mean that automation is useless for high dispersion spectra. As a matter of fact digitization of spectra and automation of reductions will make it much easier to determine and to apply a two-dimensional photographic calibration curve for the intensity $I = I(T, \lambda)$, where T is the transparency, and will make the determination of equivalent widths and of profiles more accurate and more objective especially in the case of weak lines and flat profiles; also, the work will be done faster. But there are only a few spectra on one plate and the time spent on programming and on looking at displays (which is unavoidable since at high dispersions practically every star is an individual) is not a small percentage of the whole effort.

At low dispersion, however, automation is next to indispensable. On a single Schmidt plate taken with an objective prism under good seeing and correspondingly small widening (typically with 500 A/mm linear dispersion near H_γ, 0"7 seeing and 0.1 mm widening) there may be more than 10^4 recognizable spectra containing an immense amount of information. And nobody wants to spend a whole life in looking at a very few plates. To make it quite clear: I do not consider spectral classification as a goal in itself, I want to use it as the most powerful tool in stellar statistics, galactic structure, dynamics and evolution. I want to derive, by using spectral classification, absolute magnitudes, reddenings and extinctions, population criteria like ages and chemical composition. I want to sort out by spectral classification those stars deserving more careful or special investigation such as supergiants, Wolf-Rayet stars, peculiar stars, spectroscopic doubles, white dwarfs, etc. to gain better insight into the structure and dynamics of the Galaxy and into the evolution of its stellar components. Furthermore, I want to know the member stars and the stellar composition of the nearby galaxies.

2. EXAMPLES OF DIGITIZATION AT HIGH AND INTERMEDIATE DISPERSIONS

Examples of partial automation of spectral work at higher dispersions have been given by Thompson (1967, 1971), Cassatella, Gratton and Nesci (1975), and Barry, Cromwell and Schoolman (1977). Barry et al worked on 47 A/mm image tube spectra of F and G stars with 2 A resolution. As much as 15 minutes were necessary to determine the pseudo-equivalent widths of 20 features on one spectogram because the operator defined the local continuum and the integration limits for each line by interaction on the display of

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