OBJECTIVE-PRISM REDSHIFTS OF FAINT GALAXIES

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ABSTRACT: A large sample of spectra of faint galaxies has been obtained using COSMOS measurements of UKST objective-prism plates. Computer software has been developed to obtain the radial velocities of large numbers of these galaxies automatically over a magnitude range of about B = 16 to 19. Initial tests have been performed on a sample of about 1400 galaxies from an area of about 5 x 4 degrees square.

INTRODUCTION

Plates taken using the low-dispersion prism (2480 $\text{Å}\,\text{mm}^{-1}$ at Hγ) on the UK Schmidt telescope (UKST) were measured using the COSMOS measuring machine by the Image and Data Processing Unit (IDPU) in the Royal Observatory Edinburgh (ROE). The plates were exposed to give a sky background density of about 0.9, to obtain a good signal-to-noise ratio in the machine measurements; only plates taken in good seeing ($\sim$1 arcsecond) have spectra of sufficient quality. The authors have written software to extract the spectra from raw COSMOS data.

The spectra from an area of UKST plate UJ4529P covering part of the Indus Supercluster were measured by Beard (1983). From these spectra Beard isolated a large sample of objects (about 2000 in total) which he identified as galaxies from their spectra. This sample has been used as a sample of galaxies with 'known' redshifts (determined interactively from objective prism spectra, not from slit spectra) for the development of algorithms designed to determine galaxy redshifts automatically.

AUTOMATED REDSHIFT MEASUREMENTS

Details of the ideas and techniques behind redshift measurement from objective prism spectra are given elsewhere (Cooke et al 1982). The automated technique basically uses a pattern match between the processed spectrum and a set of processed masks, which consists of a standard galaxy spectrum (Oke and Sandage 1968) reproduced at redshift

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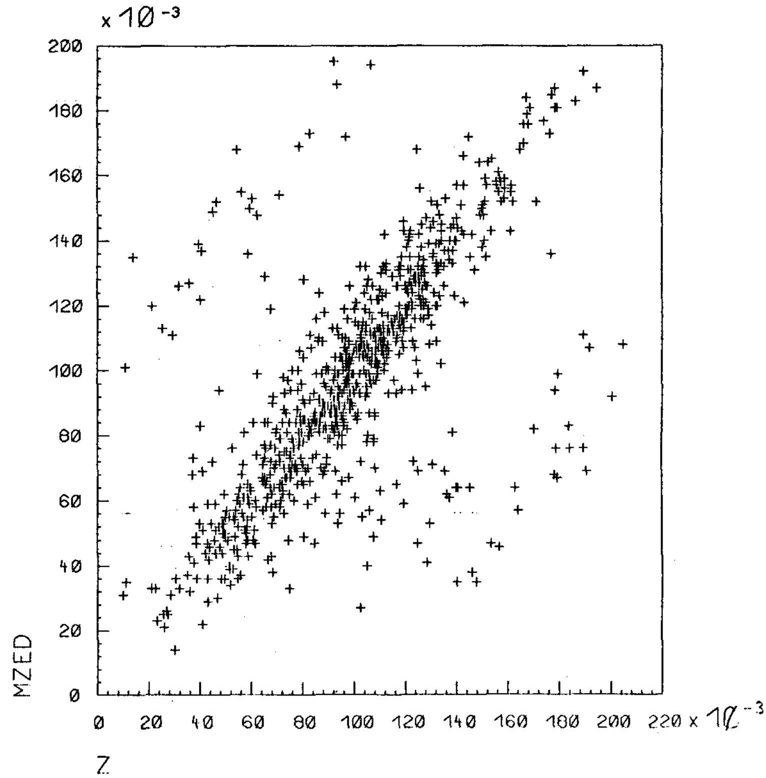

Figure 1. The comparison of automatically derived redshifts (MZED) with redshifts obtained interactively (Z). The range for pattern matching is from redshift 0 to 0.2; a selection criterion is applied which removes faint objects that have been assigned low redshifts by machine (this is justified on number-magnitude grounds). From an initial sample of 1400 objects (a subset in area of Beard's sample), about 800 appear here.

intervals of 0.001 in z. Parameters produced for the match include a signal-to-noise parameter for each spectrum. The system has been applied to Beard's Indus data, and to simulated galaxy spectra. Figure 1 shows how the system can be used to duplicate the manual measurements well.

This approach is useful, in that it replaces a lot of tedious interactive work at a computer terminal. However, the simulations show that, from signal-to-noise considerations, not all the redshifts obtained automatically can be accepted as correct; typically with the signal-to-noise parameter (SNR) defined as the mean continuum level around 4500Å divided by the rms noise per pixel, some objects are assigned incorrect redshifts for SNR = 8 and about half the objects have incorrect redshifts for SNR < 5. In 'real' data the results appear to be somewhat worse; further work is needed to establish detailed numbers.

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CURRENT WORK

The problem becomes even harder when a mixed sample of stars and galaxies is the starting point. In a typical sample, the majority of the stars might be expected to have late-type spectra (Reid and Gilmore 1982) and so might be expected to correlate quite well with a late-type galaxy spectrum at zero redshift. This is not the case, and the faint, noisy stellar spectra match the galaxy standard at a range of redshifts. A better solution is needed and two approaches are being investigated: (a) initial star/galaxy separation of the sample (e.g. Parker et al, this colloquium) to enable the stars to be completely removed from the sample; and (b) a more complex pattern match, in which stars of various spectral types (as well as the galaxy) are matched. The software is structured so that it will be possible to use patterns of several spectral types of both galaxies and stars. This method has the advantage of producing a sample independent of star-galaxy separation, and also would produce an initial rough stellar spectral classification.

Astronomical results from this particular sample are presented by Beard et al (1983).

CONCLUSION

The present system can be used to produce redshifts of galaxies from objective prism spectra in a more consistent way than can be done using manual techniques. However for data with poor signal-to-noise it must be emphasised that the redshifts produced are not totally reliable; this applies also to the manual measurements. The velocities obtained can be used as distance indicators and hence used to give information on large-scale structure in the Universe.

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