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Supernova Spectra Comparison Tool

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Abstract. In order to perform a thorough study of our spectroscopic archive, we developed a tool for automatic supernova spectra comparison. Results of the procedure are an objective classification of supernova spectra and their age determination. We present the first version of the tool together with preliminary results and discuss the future work. We expect to make the program available to a wide scientific community as a Web based application.

1. Introduction

The archives of Supernova (SN) spectra contain an enormous amount of information which consists of published and unpublished spectra of well studied SN but also sparse observations of poorly studied objects. With the aim to exploit such information a statistical approach should be taken. A comparative analysis of a set of spectra can provide information about possible tendencies or peculiarities. In order to perform such a study, we developed a tool for the automatic comparison of large amounts of SN spectra. In addition to the use mentioned above, the program is a convenient and powerful instrument for an objective classification of newly discovered SNe. As a starting point, and for the purpose of testing, we chose the approach originally developed for SN Ia and discussed by Riess et al. (1997, 1998), later extended by Rizzi (1998). Differently from the Riess et al. works, we want our program to be applicable to all SN types.

2. The Program

The program, written in Python, uses pCFITSIO wrapper (by N.Pirzkal) of the HEASARC CFITSIO library and the Python module of DISLIN data plotting software. Simply, it compares any given SN spectrum with a set of SN spectra of known type and age (template spectra). We kept the approach of dividing the spectrum in a number of intervals ($300\mathring{A}$ to $800\mathring{A}$ wide) followed by the independent comparison of each interval with the corresponding one of template spectra. As comparison templates the spectra of the Asiago Supernova Archive have been used. The Asiago Supernova Archive (ASA) (Barbon et al. 1993) consists of about 3000 spectra (in FITS format) of more than 300 supernovae. The ages of spectra range from 14 days before to 500 days after maximum. As an example we use the program to determine the age of a SN Ia spectrum. For this purpose we adapted as templates a number of well studied type Ia SNe spectra

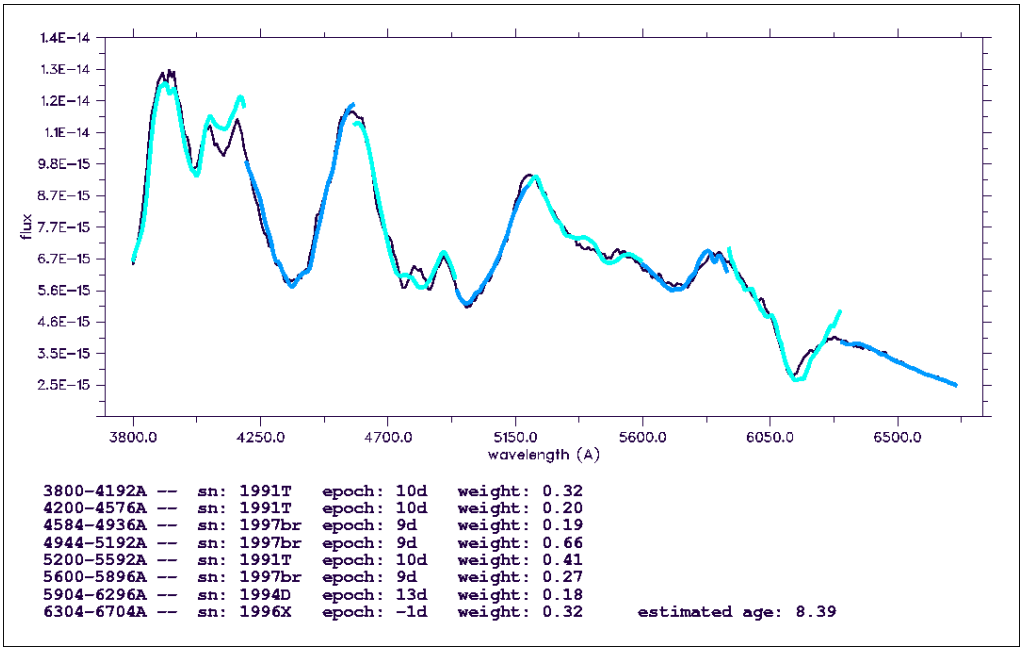

Figure 1. In order to estimate the age of the SN1999cw spectrum, we calculated the weighted mean of the ages of the template spectra found by the program for different parts of the spectrum. The weights assigned to each of the above mentioned spectral bins in Rizzi (1998) have been used. The age for this spectrum obtained from the light curves is 9 days (Bufano et al., these Proceedings) while the age we determined spectroscopically is 8.39 days.

with good temporal coverage. The graphical output of the program, showing the comparison of SN1999cw with these templates, is displayed in the Figure 1.

3. Work to do

We are working on a quantitative method of determining the goodness of the fitting with χ^2 tests. A major improvement in these calculations is the knowledge of signal-to-noise ratio of the spectra. Other improvements include a proper accounting of the reddening and extension of the comparison spectral range. From the point of view of comparative spectral study of our archive the division of the templates in smaller groups is expected to be useful. We intend to make the tool available to a wide scientific community and accessible as a Web application.

References

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