

## Supernovae Analysis and Spectral Classification by Fuzzy Systems

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Supernovae are extreme events characterized as large-scale explosions that occur in stars that have reached their final evolution cycle. These explosions are defined by the core collapse of a star or by the trigger of a thermonuclear reaction in a binary system composed of stars in the state of white dwarf and red giant. The classification of this phenomenon is not trivial and is conditioned to the expertise of an astronomer who, in a short range scenario, evaluates the main features of the optical spectrum observing the absorption and emission of certain chemical elements. The importance of the phenomenon classification lies in the applications related to the measurement of astronomical distances, for the observational cosmology field, in studies of the universe expansion. These features are related to the thermonuclear supernovae, denominated Supernovae Ia. In this way, this work presents an automatic system, able to perform the spectral analysis processing without the interference of a specialist. The proposed system called Fuzzy System Appraiser of Supernovae – SUZAN, from the Portuguese Language “Sistema fUZZy Avaliador de superNovas”. This system is based on the fuzzy logic paradigm models a human specialist performing a spectral analysis. This modeling is made through a set of fuzzy rules which simulate the knowledge to define the main components and characteristics of the supernovae spectrum, such as the qualities of spectral lines and the chemical composition of the stars. As initial results about 4341 spectra of 809 supernovae of various types were classified reaching a 97.0% score of supernovae Ia (thermonuclear) identification, in the period next to the maximum brightness. The fuzzy modeling built in SUZAN allows the applicability of spectral and signal analysis to other phenomena, provided that the rules for the formation of these phenomena are established.

Supernovae Ia. Classification. Automatic System. Fuzzy Logic. Spectral and Signal Analysis.