A Massive Star Odyssey, from Main Sequence to Supernova
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A spectroscopic analysis of the Trapezium Cluster stars

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Abstract. We consider the Orion Nebula (M 42) within a project aimed at studying the interaction between massive stars and their surrounding ISM. This is an H II region ionized by θ^1 Ori C, one of the four massive stars in the Trapezium Cluster. θ^1 Ori C has the earliest spectral type (O7Vp) among them, emitting an ionizing flux several orders of magnitude larger than those of the other stars. We present a spectral analysis of the Trapezium Cluster stars to determine their stellar parameters. We use spectra between 4250 - 4750 Å and compare them with synthetic spectra obtained by means of an updated version of FASTWIND that includes an approximated treatment of metal-line blanketing.

1. Introduction

H II regions offer the possibility to derive accurate chemical abundances at large distances, thanks to the radiative energies emerging from the nearby ionizing stars. These are young, massive stars, recently born from the ISM, and therefore should share the same chemical composition. However, abundance determinations have not always given the same results for stars and the ISM. Recent agreement in our Galaxy (Smartt & Rolleston 1997) has been followed by consistency in M 33 (Monteverde, Herrero & Lennon 2000) and differences in M 31 (Smartt *et al.* 2001). See, however, Daflon & Cunha (these Proceedings).

Recent developments in stellar atmosphere models predict lower $T_{\rm eff}$ and luminosities than previously accepted (see Herrero, these Proceedings). We plan to use FASTWIND (Santolaya-Rey, Puls & Herrero 1997), to derive more accurate abundances and emergent fluxes from stars ionizing H II regions. The ionizing fluxes will be used as input to a program of radiative transfer in ionized media, to derive H II region abundances and compare with those of the ionizing stars.

2. The Orion Nebula and the Trapezium Cluster

The Orion Nebula is one of the best studied H II regions. Its proximity (450 pc) has allowed us to resolve its structure and physical properties, and to obtain its element abundances accurately (Esteban *et al.* 1998; O'Dell 2001). The Trapezium Cluster, located in the central part of the nebula, is formed by four massive stars of OB spectral type. The star θ^1 Ori C is the hottest one (O7Vp, Conti 1972), producing an ionizing flux several orders of magnitude greater than the other three (θ^1 Ori A, B, D). It is the star ionizing the nebula.

3. Spectral characteristics of the Trapezium Cluster stars

3.1. θ^1 Ori B

Due to fast rotation, H and He lines are very broad and metal lines are diluted. H and He I lines are strong and no He II lines appear in the spectrum. The star seems to be a B5V star with a high projected rotational velocity (200 - 250 km s^{-1}).

3.2. θ^1 Ori A, D

These B0.5V stars show Si, Mg, O, C and N lines, being perfect targets for the stellar abundance study proposed.

3.3. θ^1 Ori C

We have found those spectral features mentioned in the literature for this star, but also evidence suggesting a composite spectrum (broad He I, already known, together with possible Si III lines). More work is needed to understand the nature of this star, before we can apply spherically symmetric mass-losing models to derive its stellar parameters.

4. Data analysis

For the analysis we use FASTWIND, a stellar atmosphere code developed by Santolaya-Rey *et al.* (1997), that has been updated by Puls *et al.* (2002), considering metal-line effect over the atmosphere structure and emergent flux (line-blanketing and -blocking). The parameters derived for θ^1 Ori A are $T_{\rm eff}$ = 30 000 $\pm$ 2500 K and $\log g = 4.2 \pm 0.2$, and for θ^1 Ori D, $T_{\rm eff}$ = 32 500 K and $\log g = 4.4$ (same errors). Other analyses are presently under work.

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