Interaction between massive stars and the interstellar medium in Galactic HII regions

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This thesis focuses on a comprehensive study of the interplay between the massive stars and their surrounding ionized interstellar medium in two Galactic HII regions. Two different studies are presented: the comparison between stellar and nebular abundances for the star forming region associated with the Orion nebula (M42), and the effect of considering different hypothesis on the modeling of the ionized nebula M43, comparing the output of the models with as many observational constraints as possible.

We have compiled a set of different types of observational data for the aims of this thesis. These consist of long-slit stellar optical spectroscopy of the massive stars inside the nebulae M42 and M43, along with narrow band imagery of the Galactic HII region M43. Additionally, we have recovered some nebular optical spectroscopy of M43 from a previous study by M. Rodr\'{\i}guez.

We have used the state-of-the-art stellar atmosphere code FASTWIND to derive the stellar parameters and oxygen and silicon abundances of the Orion stars. The reliability of the derived abundaces is based on a very detailed abundance analysis developed for the star τ\,Sco, a B0.2V star with a very low v\,sin$i$. We have found very good agreement between the stellar oxygen abundances and those obtained by Esteban et al. (2004) for the gas-phase, suggesting a lower dust deplection factor of oxygen than previous estimations for the Orion nebula. The stellar silicon abundances are larger than that predicted from the FUV spectrum of M42. This result is compatible with some nebular silicon being depleted onto dust grains.

M43 is an apparently spherical HII region ionized by a single star (HD\,37061, B1V). The resulting stellar parameters from the analysis of the ionizing star of M43 with FASTWIND have been used as input of the stellar atmosphere model WM-$basic$ to derive a detailed ionizing flux distribution. This spectral energy distribution, along with the nebular abundances derived from the analysis of the optical spectrum of M43, and the photometric and morphological nebular parameters obtained from narrow band imagery, have been used to build a tailored
photoionization model of the nebula with CLOUDY. Two types of spherical models, either with constant density or a density law derived from the H$_{\alpha}$ surface brightness distribution are considered. Additionally, the predictions of these models are compared with those resulting from a blister model generated with the pseudo-3D code CLOUDY-3D (Morisset et al. 2005).

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