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Title

Photoionized Herbig-Haro objects in the Orion Nebula through deep high-spectral resolution spectroscopy.

Abstract

We analyze the physical conditions (density and temperature), chemical abundances, dynamics and kinematics of gas in HH529II, HH529III and HH204, photoionized Herbig-Haro objects in the Orion Nebula. By using very high resolution spectroscopy obtained with UVES@VLT, we separate the Doppler-shifted emission of the velocity outflows from the main nebular emission, studying each object independently. To study the 3D dynamics and kinematics we complement our spectroscopic study with 20 years of archival of the Hubble Space Telescope (HST) imaging. In all cases, we were able to determine the physical conditions through several diagnostics. We analyze the chemical composition by using both recombination lines (RLs) and collisional excitation lines (CELs). We study one of the most important problems in the photoionized nebulae: the discrepancy between abundances based on CELs and RLs. In HH204 we did not observe such discrepancy, while in HH529II and HH529III we did. Despite of the different physical conditions and ionization degrees, the chemical composition of HH204, HH529II and HH529III, based on CELs is consistent, presenting abundances of metals around 0.1 dex greater than those derived in the Orion Nebula. We also found direct evidence of destruction of dust in the shock fronts, releasing elements such as Fe, Ni and Cr in the gas phase, increasing their abundances in these objects by several times the content of the Orion Nebula. Through the radial and tangential motions, we explored the dynamics and kinematics of each outflow, concluding that HH529II is an internal working surface of the HH529 flow.