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A high-resolution search for the Hα emission line of the accreting companion GQ Lup b with ESPRESSO

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In the current theories of planet formation, the amount of energy that a forming gas giant retains from its accretion flow is still unknown. This unconstrained parameter has a large impact on the post-formation evolution of the new planet, as it defines its initial temperature and luminosity. Models have been developed, ranging from “hot-start” models assuming that all the energy is retained internally, to “cold-start” ones assuming that everything is radiated away, and "warm-start" ones in between. Their coexistence introduces large degeneracies on the determination of age and mass in direct imaging observations, as these studies use the cold or hot-start models to infer these parameters from the observed luminosity of a planet. A promising way of solving this problem is the study of atomic emission lines originating from the hot gas shocked by the accretion flow. Recently, Aoyama et al. (2018, 2020) presented simulations of hydrogen lines emitted by the accretion shock onto the circumplanetary disk and the planetary surface. They showed that the line luminosity and width can be used to infer the protoplanet mass, thus giving an estimation that is independent from the evolution models. They applied it to the case of PDS70 b and c (Aoyama & Ikoma 2019, Hashimoto et al. 2020), but were ultimately limited by the spectral resolution of the MUSE observations they used (R ~ 2500). In this context, our team recently proposed and carried out a pilot program using the VLT/ESPRESSO fiber-fed spectrograph, equipped with very high resolution (R = 190 000), to characterize the Hα line of the young substellar companion GQ Lup b. We will present in this poster how these observations were conducted, the methods used to remove the contamination from the host star, and the results we obtained.