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Hydrogen-line emission from accreting planets: fluxes, line shapes, and a new correlation

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Recent direct evidence for ongoing accretion at gas giants such as PDS 70 b and c and Delorme 1 (AB)b make theoretical models of hydrogen-line emission timely. For the shock at the planet's surface, we present fluxes in the strongest indicators (H alpha, H beta, Pa beta, etc.) using the non-LTE, chemical-kinetics code of Aoyama et al. (2018). We consider the relevant large parameter space in accretion rate, mass, and radius. We show that our correlation between accretion luminosity and line luminosity differs from extrapolations from fits to Young Stellar Objects, which bears on the interpretation of (non-)detections. Also, we study systematically how much the accreting matter can absorb the H alpha radiation. We find that in most cases the gas barely absorbs, but that the increase in extinction with accretion rate eventually leads to a maximum H alpha luminosity. We estimate appropriate dust opacity values, which are found to cover a wide range. Finally, we show that the accreting gas can leave a imprint visible in the line profile at high resolution (R ~ 15'000, like VIS-X), providing complex signatures of the accretion geometry.

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