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Numerical simulations of hydrodynamic evaporation of short periodic giant exoplanets in the light of Roche lobe effects

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Theoretical studies and the recent observational evidence of atmospheric expansion up to several planetary radii of short-periodic hydrogen-rich giant exoplanets at orbital distances less than about 0.1 AU indicate that their upper atmospheres experience blow-off conditions caused by high X-ray and extreme ultraviolet heating due to their host stars. Because of the short orbital distance to their host stars, the expansion of the upper atmosphere is no longer radial symmetric, but depends on the direction to the central body, resulting to a deformation of the expanded atmosphere. We show the connection between atmospheric expansion, tidal forces, hydrodynamic evaporation, as well as effects of the Roche potential and found that the well studied Jovian-like exoplanet HD209458 b is most likely in a state of classical hydrodynamical blow-off, because the distance where blow-off can occur is less than the Lagrangian point L1, while other giant exoplanets with known mass and size like OGLE-TR-56 b, OGLE-TR-113 b, and OGLE-TR-132 b experience a geometrical blow-off defined by the Roche lobe. We discuss both evaporation scenarios in the frame of the planets evolution with age.