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Monte-Carlo Modelling of Mercury's Sodium Exosphere

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The aim of this work is to explain the contribution of the release processes behind the presence of sodium in the exosphere of Mercury. We do this by comparing the tangential column density profile of the sodium exosphere derived from MESSENGER MASC/UVVS measurements by Cassidy et al.(2015), to the results of our Monte-Carlo (MC) exosphere model and Chamberlain theory (1963). We simulate the trajectories of sodium atoms ejected from Mercury's surface using thermal desorption and photon-stimulated desorption as the main release mechanisms. These two processes explain the derived tangential column density profile as follows: close to the surface thermal desorption dominates with a surface temperature of 700 K, whereas at higher altitudes photon stimulated desorption prevails with a characteristic energy of 0.11 eV. Close to the surface and up to 500 km the MC model results agree with the Chamberlain model. At higher altitudes the MC model using release via photon stimulated desorbed particles explains the observations well, whereas for the Chamberlain model a second thermal component with 2500 K has to be assumed. This study is a crucial step towards fully understanding the release mechanisms that contribute to the formation of the Hermean sodium exosphere.