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# Helium abundance and speed difference between helium ions and protons in the solar wind from coronal holes, active regions, and quiet Sun

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Two main models have been developed to explain the mechanisms of release, heating, and acceleration of the nascent solar wind, the wave-turbulence-driven (WTD) models and reconnection-loop-opening (RLO) models, in which the plasma release processes are fundamentally different. Given that the statistical observational properties of helium ions produced in magnetically diverse solar regions could provide valuable information for the solar wind modelling, we examine the statistical properties of the helium abundance (A_He) and the speed difference between helium ions and protons (v_$\alpha$p) for coronal holes (CHs), active regions (ARs), and the quiet Sun (QS). We find bimodal distributions in the space of A_He and v_$\alpha$p/v_A (where v_A is the local Alfven speed) for the solar wind as a whole. The CH windmeasurements are concentrated at higher A_He and v_$\alpha$p/v_A values with a smaller A_He distribution range, while the AR and QS wind is associated with lower A_He and v_$\alpha$p/v_A, and a larger A_He distribution range. The magnetic diversity of the source regions and the physical processes related to it are possibly responsible for the different properties of A_He and v_$\alpha$p/v_A. The statistical results suggest that the two solar wind generation mechanisms, WTD and RLO, work in parallel in all solar wind source regions. In CH regions WTD plays a major role, whereas the RLO mechanism is more important in AR and QS.