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Study of alpha particle properties across rarefaction regions

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Two large-scale interaction regions between the fast solar wind emanating from coronal holes and the slow solar wind coming from streamer belt are usually distinguished. When the fast stream pushes up against the slow solar wind ahead of it, a compressed interaction region that co-rotates with the Sun (CIR) is created. It was already shown that the relative abundance of alpha particles, which usually serve as one of solar wind source identifiers can change within this region. By symmetry, when the fast stream outruns the slow stream, a corotating rarefaction region (CRR) is formed. CRRs are characterized by a monotonic decrease of the solar wind speed, and they are associated with the regions of small longitudinal extent on the Sun. In our study, we use near-Earth measurements complemented by observations at different heliocentric distances, and focus on the behavior of alpha particles in the CRRs because we found that the large variations of the relative helium abundance (AHe) can also be observed there. Unlike in the CIRs, these variations are usually not connected with the solar wind speed and alpha-proton relative drift changes. We thus apply a superposed-epoch analysis of identified CRRs with a motivation to determine the global profile of alpha particle parameters through these regions. Next, we concentrate on the cases with largest AHe variations and investigate whether they can be associated with the changes of the solar wind source region or whether there is a relation between the AHe variations and the non-thermal features in the proton velocity distribution functions like the temperature anisotropy and/or presence of the proton beam.