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Evolution of alpha particle properties across stream interaction regions

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The relative helium abundance (A_{He}) is believed to be one of solar wind source identifiers. For the fast solar wind emanating from coronal holes, it is about 4 % and independent on the solar wind speed. On the other hand, it is lower, very variable and increases with the bulk speed in the slow solar wind coming from closed field regions. As expansion time increases, a fast solar wind stream catches up and collides with the slower stream ahead. Since both streams are threaded by different frozen-in magnetic field lines, they cannot mix. As a result, pressure perturbations form regions of the compressed solar wind around the stream interface and corotating interaction region (CIR) is created. If only compression is considered, composition of both solar wind streams would not change and A_{He} would be the same in compressed as well as in corresponding undisturbed streams. However, using in-situ Wind and Helios observations we show that AHe profile across CIRs is usually much more complex. A large enhancement of A_{He} often occurs in the compressed and decelerated fast solar wind stream near the CIR leading edge. On contrary, a depletion of A_{He} can be present in the compressed and accelerated slow solar wind. These local A_{He} variations are also accompanied with changes in the alpha-proton relative drift. We explain these observations in terms of magnetic mirroring of the multi-component solar wind in a converging magnetic field which develops within stream interaction regions. In order to support this explanation, we prepared case as well as statistical studies and a superposed-epoch CIR analysis and discuss different A_{He} profiles that we observe at Wind and Helios CIRs in various phases of different solar cycles.