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Effects of the alpha-proton drift velocity on alpha firehose instabilities in the solar wind
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In situ measurements have shown that the less-abundant alpha particles are characterized by temperature anisotropy which could drive the anisotropy-driven kinetic instabilities in the solar wind. In the collisionless limit, the differential alpha-proton flow velocity usually has finite value of the order of the local Alfven velocity. The presence of such differential flow may affect the properties of dispersion relations for anisotropy-driven instabilities. By making use of linear Vlasov theory, the present study investigates the effects of the alpha-proton drift velocity on firehose instabilities driven by parallel temperature anisotropy of alpha particles. It is found that for parallel firehose mode the dispersion properties are asymmetric in that the maximum growth rate is larger for forward propagating mode than for backward propagating one in the proton rest frame. For both parallel (forward propagating mode) and oblique firehose instabilities overall growth rates increase as the alpha-proton drift velocity increases. Consequently, the firehose instability thresholds are distinctly influenced by the presence of the alpha-proton drift velocity.

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