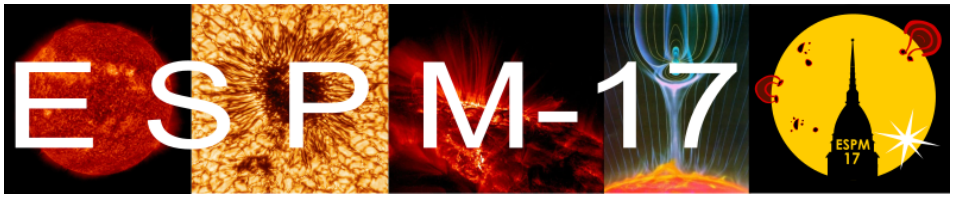

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What is the mechanism underlying the Parker Solar Probe's finding of the ion-acoustic waves near the Sun?

One of the most stunning discoveries of the Parker Solar Probe mission is the wealth of kinetic scale processes occurring in the low solar atmosphere (Bale et al. 2019). In this work (Afify et al. 2024), we investigate, with a combination of theoretical and numerical tools, the ion-acoustic waves observed by the Parker Solar Probe near the Sun (Mozer et al. 2021, 2023; Kellogg et al. 2024). These observations reveal characteristic sequences of narrow-band, high-frequency bursts exceeding 100 Hz embedded into a slower evolution around 1 Hz, persisting for several hours. Focusing on proton distributions comprising both a core and a beam component, we explore the potential role of the ion-acoustic instability (IAI) within the parameter regime relevant to PSP observations. Our findings indicate that the IAI can indeed occur in this regime, albeit requiring electron-to-core and beam-to-core temperature ratios slightly different from reported values during electrostatic burst detection. Furthermore, we validate the growth rates predicted by linear theory and observe the saturation behavior of the instability. The resultant nonlinear structures exhibit trapped proton beam populations and oscillatory signatures comparable to those observed, both in terms of time scales and amplitude. Ongoing work is focusing on the triggering mechanism behind the coupled high/low-frequency IAI observations.

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