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Characterization of gyrating upstream ions observed by Cluster: $\theta_{\rm Bn}$ dependence

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Upstream-traveling ions in foreshock regions associated with oblique shock geometries typically include intermediate distributions, which are field-aligned, but with a large spread in pitch-angles; and gyrating ions, which have phase space density peaks at non-zero pitch angles. Both of these populations are observed in the presense of large-amplitude ULF waves. To date, no study has extensively characterized gyrating ions, particularly with a goal of separating the effects of $\theta_{\rm Bn}$ (the angle between the magnetic field and the shock normal at the ion source) from other parameters, such as $\theta_{\rm vn}$ (the angle between the plasma flow and the normal) and upstream Mach numbers. We accomplish this by individually examining brief periods when IMF rotations change $\theta_{\rm Bn}$, while other parameters are nearly fixed. Rather than characterizing the thermal characteristics of these gyrating distributions by their parallel and perpendicular temperatures, we determine the peak pitch angles and pitch angle extents. Results are compared to those from a similar field-aligned beam study, with a view towards determining the likelihood of the former evolving from the latter under the influence of ULF waves.