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Role of nonlinear wave-particle interaction in the production of backstreaming gyrating ions in a planetary foreshock

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Detailed observations of backstreaming ion distributions in the Earth's foreshock often reveal the existence of gyrating ions with well-defined pitch-angle and gyrophase organization around the local magnetic field. These gyrophase-bunched ions are always associated with large amplitude quasi-monochromatic right-hand mode low-frequency waves. Different mechanisms have been put forward to explain these ion features. The production by a specular reflection at the quasi-parallel bow shock itself has been first proposed. This non-local mechanism at the ion source itself has been shown consistent with very few observations and cannot be considered for large distance from the bow shock because of the anticipated gyrophase mixing. The possibility of local nonlinear wave-particle interaction involving initially field-aligned beam ions have been quantitatively shown from some case studies. From a larger data set including Wind observations and mainly multi-spacecraft observations by Cluster, the physical properties of the gyrophase-bunched ions are used to test and discriminate these possible production mechanisms. The relative occurrence of wave trapping will be particularly emphasized.