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Detailed properties of gyrophase-bunched ion distributions in the Earth's foreshock

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Among the different types of backstreaming ion distributions reported in the Earth's foreshock, gyrating ions with well-defined pitch-angle and gyrophase organization around the local magnetic field have been frequently observed in association with large amplitude quasi-monochromatic right-hand mode low-frequency waves. These waves reveal the existence of coherent wave-particle interaction which is an efficient process to dissipate the energy of the particles reflected at the collisionless bow shock. It has been shown recently from a large data set including multi-spacecraft observations by Cluster that the gyrophase-bunched ion distributions are mainly produced by such a process from cyclotron-resonant field-aligned beams (FABs) observed just both at the edge of the gyrating ions region and the onset of the waves. The parallel and perpendicular velocities of the gyrophase-bunched ion beams have been used to qualify a theoretical model of nonlinear "pitch-angle" trapping by the waves. The detailed analysis of the reduced parallel and perpendicular distributions reveal that they are not Maxwellian and often exhibit a well-developed high energy tail. The same property has been reported recently for on type of FAB distributions. Results of the analysis of the characteristics of the gyrating ion distributions and the role of local geometrical conditions are discussed and compared to the results for the FABs.