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Steepened magnetosonic waves upstream from the bow shock of Saturn

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Low-frequency upstream waves associated with Saturn's foreshock have been observed by the Cassini spacecraft. A classification based on their frequency in the spacecraft frame (s/c) yielded two groups: (1) a large majority of waves with frequencies below the local proton
cyclotron frequency and (2) waves with frequencies above this frequency. The waves within the first group are usually phase steepened and have a left-hand polarization in the spacecraft frame. In addition, they present left hand-polarized (s/c) dispersive wave packets attached to the steepening front. An analysis of these waves suggests that these are sunward propagating ion/ion resonant righthand mode waves that steepen and emit a whistler precursor to stop the
steepening. These waves seem to populate the deep ion foreshock. Within the second group we find quasi monochromatic and steepened waves with a right-hand polarization (s/c). Among the first we find non compressive and slightly compressive waves, whereas the steepened ones are very compressive, show oblique propagation, and also display dispersive wave packets. These waves contribute to Saturn's quasi-parallel shock reformation and are compared to those reported around the Earth, Mars and comets.