



Observations of Ion Cyclotron Waves in the Solar Wind from 0.3 to 1 AU

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We report the in situ observations of the ion cyclotron waves in the solar wind from 0.3 to 1 AU, using the high-resolution magnetometer data from STEREO, Helios, Venus Express, and MESSENGER missions. These waves are circularly-polarized transverse waves, propagating nearly parallel to the magnetic field, and below the local proton gyro-frequency in the solar wind frame. Since we avoid planetary flybys and interplanetary shocks in our investigation, these waves are unlikely to be generated by planets or shocks. Because these waves often occur when the field is close to the radial direction, the angles between the magnetic field and the solar wind velocity are small, these waves are unlikely to be generated by pickup ions. Although the waves appear both left-handed and right-handed in the spacecraft frame, their characteristics suggest they are all intrinsically left-handed waves in the solar wind frame. We propose these waves are all generated closer to the Sun and carried out by the super-Alfvénic solar wind, and the different handedness is due to inward or outward propagation with respect to the solar wind. We analyze the wave properties of each event to obtain the statistics of the wave power and wave frequency from 0.3 to 1 AU. By comparing these wave properties at different distances, we try to constrain further their evolution and their generation mechanism.