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Stability analysis of whistler-mode chorus using measurements of waves and particles on board the Cluster spacecraft

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We analyze the data from wave and particle instruments on board four spacecraft of the Cluster project to estimate stability of whistler-mode waves in the source region of chorus. The source is identified by the Poynting flux and electromagnetic planarity analysis using multicomponent wave measurements of three magnetic and two electric antennas. During the analyzed intervals the spacecraft are located close to the geomagnetic equatorial plane at a radial distance of 4 Earth radii. To investigate time-frequency properties of whistler-mode chorus/hiss emissions we analyze high-resolution waveforms recorded in the chorus source. We estimate possible source mechanisms of these waves using simultaneous measurements of the distribution functions of electrons with energies up to 27 keV. These distributions are extended to energies up to 400 keV using measurements of energetic electrons. The data show the presence of time-energy dispersed injected electrons at energies of tens to hundreds of eV with a large temperature anisotropy, and a loss cone distribution due to the radiation belt electrons with energies above 20 keV. We estimate parameters of a model of the electron distribution function from the measurements by a nonlinear maximum likelihood method. We find that the growth of the whistler-mode waves can be in some cases explained by the instability of the derived model of the electron distribution.