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A mechanism of frequency spectrum formation for VLF chorus and its verification by Cluster data

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Formation of VLF chorus spectrum is considered on the basis of a Backward Wave Oscillator model of chorus generation. Within the framework of this model, chorus elements are generated by a step-like velocity distribution of energetic electrons at the small region of a magnetic flux tube near its equatorial cross-section. The chorus frequency is determined by the local cyclotron resonance of a whistler wave with electrons whose velocity equals the step velocity. The wave frequency spectrum is formed in the process of a nonlinear deformation of the step under the action of chorus emission. The theory yields the spectral form dependence of a separate chorus element on the wave energy flux direction and on the position of observation point inside the generation region. These parameters are verified on the basis of multi-satellite Cluster data. The chorus source is localized using multicomponent measurements of the electric and magnetic fields. Inside the source region, we analyze high-resolution frequency spectra of chorus wave packets based on the data of the WBD instrument. The analysis confirms that spectrum of detected chorus indeed varies depending on the satellite position with respect to the source region. These variations are in qualitative agreement with the theoretical model.