Recent progress in understanding Pc-1 pearl formation

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We discuss recent progress in understanding mechanisms of formation of Pc 1 pearl emissions. This problem remains unsettled in spite of many years of experimental and theoretical studies. Modern satellite observations by e.g. Polar and Cluster still do not reveal the whole picture experimentally since they do not stay long enough in the generation region to give a full account of all the spatio-temporal structure belonging to a single Pc 1 event. Ground-based observations have also been extremely helpful, especially in combination with spacecraft data, but still existing experimental information allows one to advocate different scenario of Pc 1 nature.

On the other hand, a complete self-consistent theory taking into account all factors significant for Pc 1 generation remains to be developed. Several mechanisms are discussed with respect to formation of Pc 1 pearl spectrum, among them are nonlinear modification of IAR properties by precipitating energetic protons, modulation of ion-cyclotron instability by long-period (Pc4/5) pulsations, reflection of waves from layers of heavy-ion gyroresonances, and nonlinearities of wave generation process. We show that each of these mechanisms have their attractive features and explain certain part experimental data but any of them, if taken alone, meets some difficulties when compared to observations. We conclude that development of a refined nonlinear theory and further correlated analysis of modern satellite and ground-based data is needed to solve this very intriguing problem.