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Phase space holes in the Earth's environment

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Phase space holes have been suggested thirty years ago to exist in collisionless plasmas as a consequence of the micro-scale dynamics of the charged plasma particles and the possibility of generation of quasi-stationary localized electric fields and potentials. Various forms of such structures are known, solitons and its variants, BGK modes, and microscopic double layers. The development of sophisticated high resolution instrumentation has meanwhile sharped the eyes of the experimentalists and observers to detect such structures in space plasma. By now, holes of different properties and sizes have been detected almost in every place in the Earth's environment indicating that phase space holes are indeed a common property of the collisionless plasma. As a consequence of their existence it is now realized that the dynamics of the plasma will be heavily affected by their presence. Localized electric fields are much stronger than expected and can contribute to particle acceleration and further structuring of the plasma, excite other waves, and even cause radiation. In this talk we will review theory and the most intriguing theoretical and observational consequences of phase space holes.