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Long-term program of fundamental scientific research "Plasma Crystal" aboard the Mir and ISS orbital space stations

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A gas discharge with a dust component is a very interesting laboratory object for physical investigations. Under the influence of plasma fluxes, the dust particles are rapidly charged to significant charges and begin to interact with each other and with plasma fields and fluxes. When there are many dust particles present, they substantially change the ionization equilibrium and the distribution of the plasma parameters. By this way, the dust particles become a full-fledged plasma component, and the plasma becomes "dusty" or complex plasma. The presence of the dust component leads to a number of new specific phenomena that do not occur in an "ordinary" plasma. The structuring of the dust subsystem, non-Hamiltonian dust grain dynamics and a set of new type plasma-dust instabilities are among them. The microgravity conditions are necessary to perform a full-fledged experiment in the gas-discharge dusty plasma, since under the effect of gravity dust particles settle on the bottom of the plasma chamber. To this end, a long-term ROSCOSMOS program of the fundamental scientific research "Plasma Crystal" was carried out onboard the Mir and ISS (International Space Station) orbital stations, beginning in 1998. In this paper we will present: a brief history of the creation and operation of Russian experiments "Plasma Crystal-1" and "Plasma Crystal-2", Russian-German experiments "Plasma Kristall - 3" and "Plasma Kristall - 3 Plus" in the period from 1998 to 2012; exploitation of the modern Russian-European apparatus of "Plasma Crystal-4" equipment aboard the European Columbus Laboratory; the creation of a new generation equipment "EKoPlasma", intended for launch on the ISS in 2020.

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