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Saturn ring structure inferred from comparison of Cassini observations with laboratory simulations

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Cassini spacecraft investigated the Saturn environment more than 13 years. In course of this long period, the RPWS (Radio Plasma Wave Science) experiment not only mapped electric fields in the Saturn's magnetosphere but also registered a large number of sharp spiky signals caused by hypervelocity dust impacts within Saturn rings. We have identified more than 140 000 such waveforms recorded by electric antennas with 10 or 80 kHz cadence in a close proximity of the ring mid-plane (up to 0.2 Rs). Among them, shapes and amplitudes of more than 100 000 non-saturated impacts were corrected on the Cassini WBR (Wide Band Receiver) transfer function.

Our laboratory experiment with the 1:20 reduced model of Cassini positioned in the test chamber of the dust accelerator allowed us to determine dependences of the signal shape and amplitude on the dust parameters (velocity and mass) and spacecraft potential. We apply these results on calculations of the mass and size distributions of dust particles detected by the electric field antennas within the Saturn ring system. The core of the paper is devoted to relation between dust characteristics (determined from impact signals and local plasma parameters) and ring mass profiles at distances ranging from 2 to 60 Rs from the surface.