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Electrostatic dust lofting: a possible cause for beam losses at CERN's LHC

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Dust particles interacting with the proton beams have caused many thousand beam-loss events at CERN's Large Hadron Collider (LHC), some of which led to premature beam dumps and even magnet quenches. It has been hypothesized that dust particles on the vacuum chamber wall of the LHC are negatively charged due to electron clouds and can detach from the chamber wall by the electric field of the beam. To test this hypothesis, we performed experiments to study the electrostatic lofting of dust particles from a conducting surface. A monolayer of SiO₂ particles with a diameter of <44 μm is deposited on such a surface and exposed to an electron beam of 80-140 eV. An external electric field of up to 3 kV/cm is then applied. The properties of dust charging and levitation are characterized from recorded high-speed videos. We observed that dust particles are lofted both during electron beam charging and during the application of the external electric field. Our results provide experimental evidence that dust particles can be detached from a conducting surface and help to understand the mechanism of how dust particles can enter the LHC beam.

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Footnotes

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Yes

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