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Proof-of-principle experiment to reconstruct the trajectory of dust grains interacting with the LHC beams

Monday 2 June 2025 16:00 (2 hours)

Interactions of dust grains with the LHC beams cause particle losses that can trigger pre-mature beam aborts and even cause quenches of superconducting magnets. While the simulated dynamics and ionisation of dust grains inside the proton beam are in good agreement with measured beam-loss data, a direct measurement of the dust trajectory is currently not possible. A method was developed to reconstruct the trajectory based on the differences of bunch-by-bunch beam losses caused by transversely displaced bunches. A proof-of-principle experiment to validate the method was performed in June 2024 at the LHC. The particle bunches were transversely displaced by the beam-beam force and by electric deflection while a thin wire was passed through the beam to simulate particle losses similar to beam-dust interactions. The paper describes the experiment, compares the achieved displacements with simulations, and shows the reconstructed trajectories. An outlook is given on how the method can be applied to actual dust events occurring during LHC operation.

Footnotes

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