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Measuring Electrostatic Charge Distribution in Turbulent Power Flows

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Abstract:

Particles or powders can become highly charged through triboelectrification during pneumatic conveyance in ducts or pipelines. Excessive accumulation of electrostatic charge can lead to significant challenges in industrial processes, such as increased deposit formation, duct blockages, or even dust explosions. While extensive experimental studies have been conducted on the triboelectric charging of particles in ducts and pipelines, the spatial charge distribution remains poorly understood.

In this study, we developed a novel test rig capable of measuring particle charges at both the inlet and outlet of a duct section. Using a particle tracking velocimetry (PTV) based measurement method, we resolved the average charge distribution along the spanwise direction within the measurement section. By comparing the charge distributions before and after the duct section, we gained deeper insights into the triboelectric charging behavior of pneumatically conveyed particles. Furthermore, our method revealed the probability density functions (PDF) of the particles' average charge at different measurement positions, as well as the changes in these distributions after passing through the test duct section.

This work provides new perspectives on triboelectric charging phenomena and offers valuable tools for analyzing and mitigating related challenges in industrial applications.

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