The response of varying particle density and incidence angle on Polyvinylidene Fluoride dust detectors

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Abstract. Permanently polarized Polyvinylidene Fluoride (PVDF) films have been used on a variety of spacecraft as in-situ dust detectors measuring the size and spatial distributions of micron and sub-micron dust particles. The detectors produce a short, ~ns, electric pulse when impacted by a hypervelocity dust particle. The pulse amplitude depends on the mass and relative speed of the dust grain. This relationship has been studied both empirically and numerically to better understand the film's principle of operation, as well as the effects of film thickness, film temperature, and particle penetration depth. However, little work has been done to constrain the effects of particle density and oblique impacts despite the frequent occurrence of such configurations in most space-based applications. We present calibrations of non-penetrating impacts on 28 μm thick films at varying incidence angles ranging from 0° to 75° for iron and aluminum particles in the mass and speed range of $10^{-12} \leq m \leq 10^{-9}$ g and $0.7 \leq v \leq 9$ km/s, respectively. The study was carried out at the 3MV dust accelerator laboratory at the University of Colorado at Boulder. Results show that PVDF signals are largely independent of particle density and impact angle up to 75° for non-penetrating impacts.