A real dust telescope for Cosmic DUNE

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The dust astronomy mission Cosmic DUNE aims at the simultaneous measurement of the origin and the chemical composition of individual dust grains in space by means of a dust telescope. A dust telescope consists of two major elements: a dust trajectory sensor and a high-resolution large-area chemical analyzer. Dust particles' trajectories are determined by the measurement of the electric signals that are induced when a charged grain flies through a position sensitive electrode system. The trajectory sensor has four sensor planes consisting of about 30 wire electrodes each. Two adjacent planes have orthogonal wire direction. An charge sensitive amplifier ASIC has been developed with a RMS noise of about $1.5 \cdot 10^{-17}$ C. The signals from 32 electrodes are digitized and sampled at 25 MHz rate by an transient recorder ASIC. The objective of the trajectory sensor is to measure dust charges in the range 10^{-16} to 10^{-13} C and dust speeds in the range 6 to 100 km/s.

Large Area Mass Analysers (LAMA) were developed at the Max Planck Institute Nuclear Physics in Heidelberg and at LASP, Univ. Colorado, Boulder. These spectrometers are used for the elemental analysis of interplanetary dust, interstellar dust or space debris particles in the Earth environment. The instruments consist of a target with a sensitive area of $> 0.1m^2$ and perform time-of-flight measurements of the impact plasma of hypervelocity dust impacts. The devices employ a reflectron for the improvement of the mass resolution which has values between 150 and 300. The mass resolution of these spectrometers is better than of any other known instrument with a comparative large sensitive area. Laboratory tests have been performed with the trajectory sensor and LAMA using lasers and dust particles of various materials with speeds up to 35 km/s which demonstrate the expected performance. A dust accelerator tests of a trajectory sensor combined with LAMA confirm that both trajectory and compositional information can simultaneously be obtained for an individual dust particle.