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Development and tests of elements of a Dust Telescope

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A dust telescope is a combination of a dust trajectory sensor together with an analyzer for the chemical composition of dust particles in space. 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 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. The trajectory sensor has four sensor planes consisting of about 30 wire electrodes each. Two adjacent planes have orthogonal wire direction. An ASIC charge sensitive amplifier has been developed with a RMS noise of about 1.5 10^{-17} C. The signals from 32 electrodes are digitized and sampled at 20 MHz rate by an ASIC transient recorder. First tests with a laboratory set-up have been performed and demonstrate the expected performance.

The dust chemical analyzers will have a sufficient mass resolution in order to resolve ions with atomic mass number up to 100. The annular impact area of the mass analyzer will be > $0.1m^2$. The mass spectrometer consists of the target area with an acceleration grid and the single-stage reflectron consisting of two grids and the central ion detector. Simulations show that a mass resolution of $M/\Delta M >$ 150 can be obtained for impacts onto the annular target between 100 and 240 mm from the center. An Ion Detector of 50 to 110 mm radius is necessary to collect all generated ions. A lab model has been constructed and first dust accelerator tests are reported.

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