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Author: Mr. Alexander Wolf
University of Stuttgart, Germany, AlexanderWolf85@web.de

Dr. Rene Laufer
Baylor University, United States, rene_laufer@baylor.edu
Mr. Ralf Srama
Max-Planck-Institute for Nuclear Physics, Germany, ralf.srama@mpi-hd.mpg.de
Dr. Georg Herdrich
University of Stuttgart, Germany, herdrich@irs.uni-stuttgart.de
Dr. Glenn Lightsey
The University of Texas at Austin, United States, lightsey@mail.utexas.edu
Dr. Carsten Wiedemann
Technical University of Braunschweig, Germany, c.wiedemann@tu-braunschweig.de
Mr. Truell Hyde
Baylor University, United States, Truell_Hyde@baylor.edu
Prof. Hans-Peter Röser
University of Stuttgart, Germany, roeser@irs.uni-stuttgart.de

A MODULAR, MINIATURIZED, LOW-MASS IN-SITU DUST DETECTOR FOR PIGGYBACK PAYLOAD OPPORTUNITIES ON SMALL SPACECRAFT, LANDERS AND ROVERS.

Abstract

Hazard and system degradation due to small and smallest particles (micro meteoroids, space debris and cosmic dust) are of major concern for space probes and human spacecraft missions in Earth orbit and beyond (e.g. missions to comets, asteroids, planets and moons). Small particle hazard mitigation is one of the identified risks and also specified in technology roadmaps of many space agency programs as part of space situation awareness. Current dust and debris models provide sufficient data for risk mitigation of particles above 1 millimeter size in Earth orbit. Dust models of comets, asteroids and the Moon can benefit from additional in-situ measurements especially of sub-millimeter particles to characterize the dust environment.

The Piezo Dust Detector (PDD) is a modular, miniaturized, low-mass in-situ measurement instrument currently under development by the Center for Astrophysics, Space Physics and Engineering Research (CASPER) of Baylor University in collaboration with the Cosmic Dust Group at the Institute of Space Systems of the University of Stuttgart and the Dust Accelerator Laboratory at the Max-Planck-Institute, Heidelberg.

With less than 1 kg mass of the smallest detector size the design of the Piezo Dust Detector provides the opportunity to be flown on a variety of spacecrafts and exploration missions including orbiter, landers and mobile vehicles. The detector will provide physical parameters of impacting dust particles such as velocity, direction, impact energy, date and time and therefore allows to determine mass, size and flux of sub-millimeter dust particles. The PDD is selected for a demonstration flight on a low Earth orbit cubesat to be launched in 2013/2014.

The paper will describe the design, operation and expected results of the PDD and will also discuss possible applications on lunar and planetary missions.