ARMADILLO – A DEMONSTRATION FOR LOW-COST IN-SITU INVESTIGATIONS OF THE UPPER ATMOSPHERE OF PLANETARY BODIES

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ARMADILLO (Attitude Related Maneuvers And Debris Instrument in Low Orbit) is a low Earth orbit small satellite mission under development by the Satellite Design Lab (SDL) of the University of Texas at Austin in collaboration with the Center for Astrophysics, Space Physics and Engineering Research (CASPER) of Baylor University and the Institute of Space Systems of the University of Stuttgart. The project was recently selected to participate in the University Nanosatellite Program UNP-7 to be designed and built in the 2011-2013 timeframe with the goal to target a 2014 launch opportunity.

The 3-unit cubesat will demonstrate the combination of precise attitude control for nanosatellites, a cold-gas micro-propulsion system and a miniaturized dust/debris detector. The attitude control system consists of GNC computer, IMU, GPS receiver, sun sensors, magnetometer, reactions wheel, magnetorquers and low-cost optical navigation star tracker with the goal of achieving 0.1 degree 3-axis attitude control. The cold gas propulsion system is based on an Aerospace Corporation design and will provide approximately 50 m/s impulsive capacity and a delta-v resolution of around 0.1 m/s – during the ARMADILLO mission used for the end-of-mission de-orbit from low Earth orbit. The Piezo Dust Detector (PDD) is a miniaturized in-situ measurement instrument of around 0.5 kg to detect dust and debris particles of up to 1 mm size. The detector is a joint development of CASPER (Baylor University) and the Institute of Space Systems (University of Stuttgart) in partnership with the Cosmic Dust Group at the Max-Planck- Institute for Nuclear Physics, Heidelberg based on the experience from preparation and tests of the Mercury Dust Monitor for the European BepiColombo mission.

ARMADILLO will demonstrate the capabilities necessary for a mission to perform in-situ investigations of the upper atmosphere, e.g. of the Earth. At least two – preferred is a constellation of more than two – ARMADILLO-like spacecraft would travel piggyback with a carrier probe, separating at some point in orbit. Using its own chemical or electrical micro-propulsion system for de-orbit, the nanosatellites would lower their altitude performing in-situ plasma and dust measurements before being destroyed. The paper will present the ARMADILLO satellite and possible instrument design (e.g. the PDD and plasma instrumentation from partners such as UT Dallas and Institute of Space Systems, Stuttgart), Also the required adjustments for planetary upper atmosphere investigation missions (e.g. in the AOCS subsystem) will be addressed as well as the scientific results expected from that missions.