HIGH ALTITUDE SOUNDING ON MARS WITH AN INFLATABLE HYPERSONIC DRAG BODY (BALLUTE)

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ABSTRACT

Presented in this paper is a concept to probe the tenuous upper atmosphere of planet Mars by means of a hypersonic drag balloon, a device known as a “ballute”. This concept has been under active development for the past seven years by the Mars Society Germany and the University of the Federal Armed Forces of Germany in Munich, with further support by the AMSAT-DL .e.V. organization, the DLR and several other research institutions and industrial companies.

The concept has been developed for project ARCHIMEDES, an atmospheric sounding ballute mission proposed for the AMSAT’s P5-A Mars satellite. The concept foresees that the probe is released from the spacecraft, when in orbit around the planet and the inflatable drag body deployed well before atmospheric entry. The vehicle may then enter the atmosphere either once (direct EDL) or several times (aerobreaking), depending on mission requirements, until it slowly descends towards the ground, taking continuous atmospheric and other readings across a large altitude and ground range. The scientific scope of project ARCHIMEDES is to obtain measurements of the Martian atmosphere, magnetic environment and surface throughout almost the entire altitude range reaching from outer space to ground. Engineering experiments were also suggested, that are designed to record important parameters of the hypersonic flow field and flight dynamics of such a novel configuration.

In addition to the application already mentioned, the concept was also studied for applications in other fields, specifically emergency low Earth orbit recovery and delivering payloads to high altitude landing sites on Mars, such as Tharsis.

In this paper, the theory behind such a mission will be discussed, along with experience gained during its practical implementation. Development and flight tests done in space simulation chambers, on parabolic flights and in space will also be presented.