PANIC lander to revolutionize asteroid research

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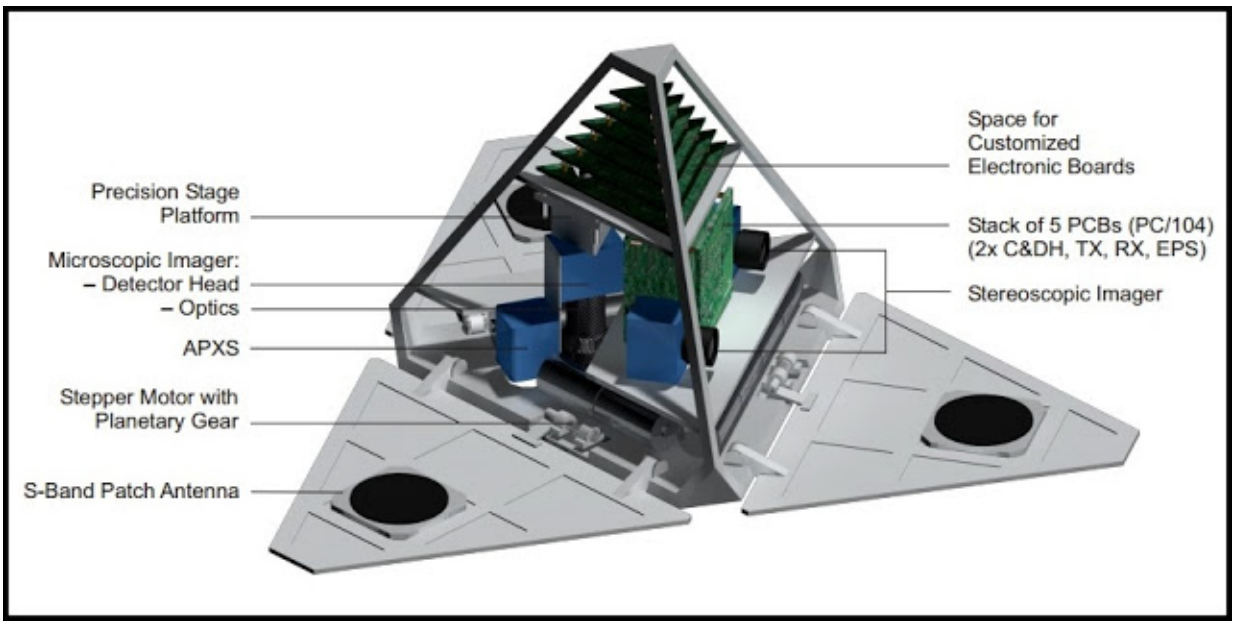


A US-German team of researchers has proposed developing a micro-scale, low-cost surface lander for the in situ characterization of an asteroid. The tiny spacecraft, called the Pico Autonomous Near-Earth Asteroid In Situ Characterizer (PANIC), could be a breakthrough for the scientific community, offering a simple, cheap solution for asteroid research.

The concept of the PANIC mission envisions a tetrahedron-shaped lander with an edge length of just 13.78 inch (35 centimeters) and a total mass of some 26.5 lbs. (12 kilograms). The spacecraft's size and structure will allow it to host four scientific instruments. The lander itself will be delivered to an asteroid aboard an interplanetary probe, and once on the surface of a space rock, will utilize hopping as a locomotion mechanism in microgravity.

According to the authors of the paper describing the PANIC mission concept, one of the biggest advantages of the project would be its simplicity and cost effectiveness.

"We aimed at a simple and low-cost concept, mitigating potential risks. I believe it is possible to build a PANIC lander within a cost budget of $5 to $10 million, also given that the lander would be powered solely by non-rechargeable primary cells providing a life time of 24 to 36 hours," Karsten Schindler of the Technische Universität Dresden (TUD) in Germany and lead author of the paper, told Astrowatch.net.

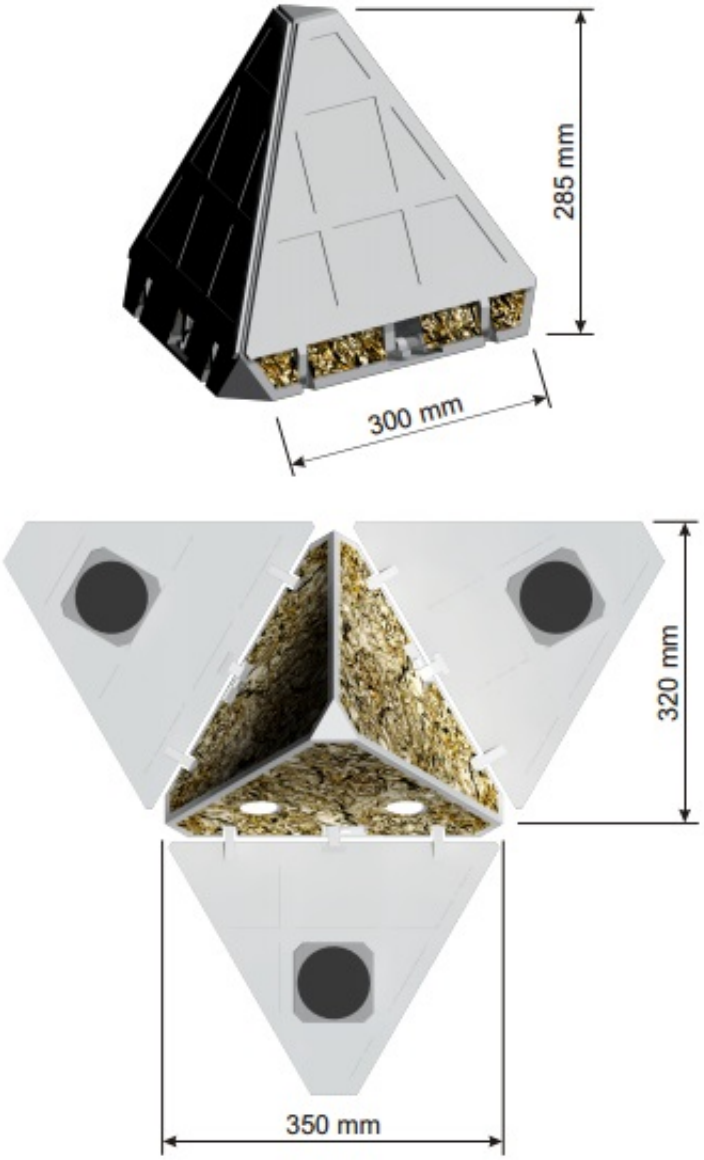
The authors of the study believe that PANIC would be a great alternative to complex and expensive traditional landers. It could be a real milestone in the history of asteroid research as no landing attempt of a dedicated lander has so far been successful on an asteroid. NASA's NEAR Shoemaker probe's landing at the end of its mission in 2001 on the near-Earth asteroid (NEA) Eros and the two touchdowns of Japan's Hayabusa on the NEA Itokawa in 2005 provided only very limited information.

"Both probes touched the surface, but they did not have instruments on board for an in situ analysis. A dedicated lander would be an important addition to any future asteroid exploration mission as it allows us to measure the 'ground truth' that is required to calibrate remote sensing data; a problem that each spacecraft mission faces, no matter which celestial body it explores, either remotely from orbit or during a fly-by,"

Schindler said.

The researchers argue that it is feasible to acquire this "ground truth" data with very modest expenses in spacecraft weight, cost and operations in the micro-gravity environment of a small body. They note that the idea of the PANIC lander is to sample the surface at multiple locations, something a sample return mission would likely not be able to do.

"All this information will contribute to our understanding of the composition and structure of asteroids, which is also vital in terms of the impact hazard of NEAs, and any potential countermeasures that might need to be taken one day," Schindler noted.



The PANIC lander's design as a proof-of-concept CAD-model. Credit: Schindler et al., 2011

Four instruments were proposed by the authors as the PANIC lander's scientific payload. According to the researchers, in order to get the most out of the craft, it should carry two spectrometers, one microscopic imager and one camera.

The Alpha Particle X-ray Spectrometer (APXS) will be used to directly determine elemental abundances at the landing site, while the Near-Infrared Spectrometer (NIRS) will be used to study the mineralogy and optical properties at wavelengths of 0.8 – 2.5 μm. With a spatial resolution of 6 μm/pixel, the Microscopic Imager (MIC) will investigate the grain size distribution and search for evidence of rims formed by nano-phase. The stereo camera (SC) system will enable imaging of the surrounding terrain in one direction from the lander using its wide-angular optics and measure the distance and size of geological surface features.

"We feel the minimum payload should be a combination of a near-infrared spectrometer and a microscopic imager. Why? Spectral properties are significantly influenced by particle size, surface temperature, phase angle and irradiation," Schindler said.

For instance, NIRS using a calibrated light source and a well defined viewing geometry close to the surface, would help to interpret remotely acquired spectra.

"To validate various techniques to model spectra, we need an information about the average particle size that can only be obtained from microscopic images. Likewise, these images could allow us to see changes in the optical characteristics that result from space weathering," Schindler added.

The concept of PANIC lander was inspired by Hayabusa's MINERVA lander as well as by CubeSats. MINERVA was a model to follow for them, as it was built entirely from commercial, off-the-shelf components on an extremely low budget. This Japanese mini-spacecraft demonstrated a life time of 18 hours at Itokawa, despite its fate of escaping the asteroid's gravity field.

In 2008, during NASA's summer study workshop known as the Small Spacecraft Summer Study Project (S4P), the idea of the PANIC lander evolved. The workshop, aimed at designing missions to near Earth objects (NEOs), resulted in the "Didymos Explorer" binary rendezvous mission concept and PANIC was included in this study, boosting the interest in this low-cost small asteroid characterizer.

"After the end of the program, we continued with an in-depth study of the lander as a stand-alone instrument, whose science objectives apply to any mission to an asteroid, independent of the final target selection. We finished our study in September 2009, and published all findings subsequently in *Acta Astronautica*. We had interested parties at NASA, DLR (German Aerospace Center), the Max Planck Society and JAXA (Japan Aerospace Exploration Agency), all studying missions to near-Earth asteroids at that time, and presented this concept at various meetings (e.g. the European Planetary Science Congress and the Planetary Defense Conference), receiving multiple inquiries from different sides," Schindler revealed.

Although the PANIC concept is currently in early stages of development, it can be seen as a finished Phase 0 study that can be easily transformed into the basis for a proposal to acquire funding and build hardware for a future flight opportunity. Notably, a similar concept, the MASCOT lander, was studied independently and has eventually been realized for the Hayabusa 2 mission launched in December 2014. It proves that such an idea can be implemented relatively quickly.

Provided by Astrowatch.net

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