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## Lunarleaper – Unlocking a Subsurface World

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We present LunarLeaper, a robotic explorer concept in response to the ESA 2023 Small Missions call. Pits, volcanic collapse features with near-vertical walls, have been identified across the lunar and Martian surface. These pits are high priority exploration destinations because some, referred to as skylights, might provide access to subsurface lava tube systems. Lava tubes are of particular interest for future human exploration as they offer protection from harmful radiation, micrometeorites and provide temperate and more stable thermal environments compared to the lunar surface. We propose to use a small legged robot (ETH SpaceHopper, <10 kg), to access and investigate the pit edge, using its ability to access complex and steep terrain more safely than a wheeled rover. LunarLeaper will land in Marius Hills within a few 100 m of the pit and traverse across the lateral extent of the hypothesized subsurface lava tube. On its traverse it will take measurements with a ground penetrating radar and a gravimeter, measurements that will allow us to survey the subsurface structure and detect and map lava tube geometry if present. The robot will approach the pit edges and acquire high resolution images of the pit walls containing uniquely exposed layers of the geophysically mapped lava flows and regolith layers. These images will allow not only scientific advances of lunar volcanism and regolith formation, but also enable assessment of the stability of the pit structure and its use as a possible lunar base. The mission is expected to last 1 lunar day. The robot could be delivered to the surface by a small lander, as they are currently developed and planned by various national and commercial agencies and hop off the landing platform without the need for a robotic arm. It is highly flexible in accommodation and can thus make full use of the new international lunar ecosystem.