DALO: MSIT-FUNDED SCIENCE PAYLOADS FOR LUNAR LANDERS. Chae Kyung Sim[1], Young-Jun Choi[1], Dukhang Lee[1], Seul-Min Baek[1], Jehyuck Shin[1], Jongho Seon[2], Sungsoo S. Kim[3], Minsup Jeong[1], Sung-Joon Ye[4], Ho Jin[2], [1]Korea Astronomy and Space Science Institute, 776 Daedeok-daero, Yuseong-gu, Daejeon 34055, Republic of Korea (cksim@kasi.re.kr), [2]Department of Astronomy and Space Science, Kyung Hee University, 1732 Deogyeong-daero, Giheung-gu, Yongin-si, Gyeonggi-do 17104, Republic of Korea, [3]Humanitas College, Kyung Hee University, 1732 Deogyeong-daero, Giheung-gu, Yongin-si, Gyeonggi-do 17104, Republic of Korea, [4]Department of Applied Bioengineering, Graduate School of Convergence Science and Technology, Seoul National University, 1 Gwanak-ro, Gwanak-gu, Seoul 08826, Republic of Korea.

Introduction: DALO, or the Discovery Across Lunar Observations, is a brand name that refers collectively to the research and development projects focused on the Moon by the Korea Astronomy and Space Science Institute (KASI). These projects aim to understand the lunar environment not only from a scientific perspective but also in terms of future human-related experiments.

To further our understanding of the lunar surface through in situ scientific measurements, KASI is developing four payloads that are proposed to be on-boarded onto lunar landers through the Commercial Lunar Payload Services (CLPS) initiative, based on the KASI-NASA Exploration Working Group.

The Ministry of Science and ICT (MSIT) of Korea is supporting the development, mission operation, and data analysis processes for payloads that have been selected based on their scientific merit and expected technical readiness. The knowledge, technology, and experiences gained from this project will be applicable to Korea's future space exploration missions.

LUSEM: Consisting of two pairs of solid-state telescopes (SST), the Lunar Space Environment Monitor (LUSEM) is designed to detect high-energy particles in the tens of keV to tens of MeV range, such as solar energetic protons and secondary radiation, as well as materials in the geomagnetic tail that have mostly been measured from the lunar orbit rather than on the lunar surface. Each pair consists of a nadir-viewing and zenith-viewing SST, which take measurements of incoming and reflected high-energy particles at the same time.

LUSEM will be onboard the Nova-C lander of Intuitive Machines (IM) as part of the IM-3 mission and will be operated on the Reiner Gamma swirl on the Moon in 2024. Its measurements will contribute to understanding space weathering on the Moon and the way geomagnetic materials are transported to the lunar surface. When used in the CLPS program during the ascending phase of the solar cycle, these measurements will supplement the Apollo data that was collected during the descending phase.

GrainCams: The GrainCams consists of two light-field cameras, SurfCam and LevCam, that will explore the dust particles on and near the lunar surface [1-2].

SurfCam will take microscopic images of the three-dimensional structure of the highly porous upper regolith, known as the 'fairy castle', using its own light source to minimize shadowed areas. Mounted on a rover or similar mobile vehicle, SurfCam will take images of the regolith structure at various locations on the Moon, including inside and outside of the landing blast zone. A dust mitigation module placed at the front end of the optics to mitigate the potential adherence of fine regolith grains is currently being considered [3].

LevCam will detect regolith grains that are levitating and/or lifted above the surface and measure their movements. We also plan to operate it during local sunset while the rover is stationary to measure the particles' diurnal variations and motion and to estimate the influences of the electric and magnetic fields.

GrainCams will offer unprecedented, undisturbed observations of the lunar regolith and dust that cannot be replicated on Earth or retrieved through a sample return mission.

LVRAD: The Lunar Vehicle Radiation Dosimeters (LVRAD) is a suite of four radiation detectors designed to quantify the radiation environment on the lunar surface and assess its potential impacts on biology in preparation for future human-related activities on the Moon. The Particle Dosimeter and Spectrometer (PDS) [4] and the Tissue-Equivalent Dosimeter (TED) will be used to measure the radiation energy. The Epithermal Neutron Spectrometer (NS-E) will measure epithermal neutrons emanating from the surface, which may be evidence of subsurface water, using Lithium Iodide-Silver (^{6}LiI:Ag) crystals. The Fast Neutron Spectrometer (NS-F) will measure fast neutrons, which are less frequent but have a greater impact on biological systems, using Lanthanum Chloride ($LaCl_3$) and Stilbene ($C_{14}H_{12}$) crystals [5]. The $LaCl_3$ scintillator will also provide gamma spectroscopy, which will be utilized to investigate the radioisotopes present on the lunar surface.

LSMAG: The Lunar Surface Magnetometer (LSMAG) will measure the magnetic field on the lunar surface in situ. LSMAG consists of two fluxgate magnetometers and an accelerometer including a three-axis AMR sensor. LSMAG's measurements will be useful for investigating the magnetic field environment of the lunar surface and modelling the strength and direction of dipole sources buried near the lunar surface. It will also track the time variation of the magnetic field in order to study the space weathering of the magnetic field. Its data will also be used to estimate the magnetic field strength of the lunar paleo-dynamo using the magnetic field strength on the surface and the corresponding direction and depth of the source.

LSMAG will also provide multipoint in-situ observation possibly in conjunction with other magnetometers onboard orbiters at different altitudes such as those onboard the ARTEMIS and the Korean Pathfinder Lunar Orbiter (KPLO or Danuri), as well as those onboard other lunar landers.

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