THE SAMPLING ACQUISITION INSTRUMENTATION FOR THE LUNAR MISSIONS. M. L. Litvak[1], T.O. Kozlova[1], I.G. Mitrofanov[1], M.I. Mokrousov[1], A.S.Kozyrev[1], A.G.Il'in[1], A.V. Nosov[1], V.I.Tretyakov[1], V. Yakovlev[1]
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Introduction: The Moon's south pole and high-latitude regions where deposits of different volatiles (including water ice) could be preserved, are now considered as the most perspective landing sites for the upcoming robotic and manned missions.

Thus, Russian lunar program includes several landing missions of Luna-25, Luna-27, Luna-28 which should be implemented step by step with increasing complexity of the science goals and implemented technologies [1,2]. They aimed to the exploration of mineralogical, chemical, and isotopic compositions of the lunar regolith, as well as the search for volatile compounds.

The successful implementation of these missions requires employing of excavation, drilling of lunar regolith to the different depths and extraction of soil samples for the farther analysis (in situ or sample return), see [3].

Robotic arm for Luna-25. The launch of Luna-25 is scheduled for October 2021. It will land at 43.5°, -69.5°, area located north of Boguslawsky crater [4]. For the surface operations this lander is equipped with robotic arm that should excavate lunar regolith in multiple locations to the depths 20-30 cm, take and deliver sample of lunar soil (1-2 cm^3) to the laser spectrometer for the elemental and isotopic analysis. The flight model of robotic arm is already developed and integrated on the Luna-25 lander for ATLO tests. The engineering model of robotic arm is using for the comprehensive functional tests in lunar like conditions with imitation of lunar pressure, temperature and lunar regolith with different content of water (see Figure 1). The performed tests have shown that robotic arm is capable to excavate lunar regolith at temperature minus150°C with content of water 0.1 – 1 % by weight and successfully take soil samples.

Deep Drill system for Luna-28. The Luna-27 and Luna-28 polar landers are developed to perform cryogenic sample analysis and equipped with deep drill systems (DDS) which are capable to drill lunar regolith enriched with water ice down to 1-2 m depths and deliver soil sample with preservation of volatiles for in situ analysis (Luna-27) or for sample return mission (Luna-28). The DDS PROSPECT for Luna-27 shall be contributed by ESA (see details in [4]).

The laboratory prototype of DDS was developed in Space Research Institute in Moscow, Russia, for lunar sample return mission Luna-28. It has successfully passed functional tests to verify its drilling capabilities (see Figure 2). It was shown that this prototype of DDS could drill lunar regolith to the depths 1-1.5 m, allowing to take probes from different depths.

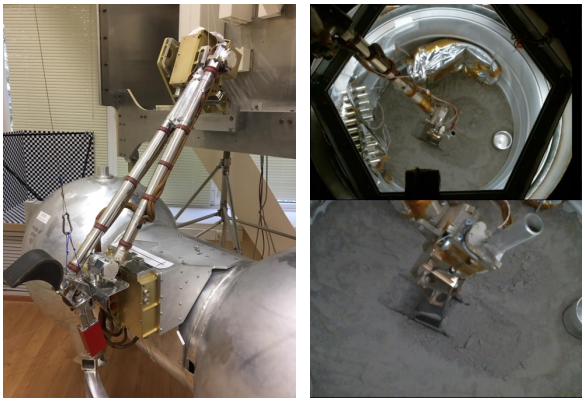

Figure 1. The Robitic arm flight model (Luna – 25) during functional tests (left); The tests with engienering model of robotic arm in lunar conditions (pressure, temperatures) with simulant of lunar regolith (right).

Figure 2. Prototype of DDS for Luna-28 (left) and its functional tests in ambient conditions (right).

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