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CRYOGENICS TASKS IN PERSPECTIVE RUSSIAN SCIENTIFIC SPACE PROJECTS

Abstract

Over the past 20 years, our understanding of the Universe and the Solar system has greatly expanded thanks to progress in science and technology. Currently, automatic space vehicles are exploring the Moon, Mercury, Venus, Mars, Saturn's system, the primitive bodies, and are on the way to Jupiter and Pluto. Service and scientific systems of space vehicles are becoming more improved. But this is only the beginning of a long journey of space exploration. New tasks for scientific spacecrafts require to use of cooling and cryogenic onboard systems. There are some interesting space scientific projects in Russia, where the success or failure a whole will depend on the work of active cryogenic systems. Functionally, these projects can be divided into 3 groups. First, there are space telescopes. Good illustration is the next generation space observatory of a millimeter, submillimeter and infrared wavelengths with a cryogenic telescope of 12 m diameter. The overall and very massive objects, including the main mirror, to the mass of about 2-tons are subject to cryostatting up to 4K. It is very difficult and energy-consuming task. The solution is achieved by a combination of passive radiation protection of the telescope with an additional actively cooled shield. Secondly, there are descent and landing module on the planets surface, moons and the primitive bodies. Last year on that session was reported about the active thermal control system for perspective Venusian lander, based on the refrigerating machine, working on the return recuperative Brayton cycle, with argon as a working fluid. Currently, main components of the cooling machine, such as a turbomachine (compressor and expander) and heat exchangers, are under construction. Application of active thermal control system will allow to significantly increase the life-time of the lander on the surface of Venus. Thirdly, there are various technical systems. One of interesting questions is cryogenic drilling, for example on the Moon. The temperature in always in shadow craters near the Moon poles is estimated at a level -240. Russian lunar program supposes the return of soil from the polar region at the beginning of the next decade. Icy moons of Jupiter might to be another objects for researches. Now setup for drilling systems testing with conditions as much as possible approached to a reality is studied. It is supposed to freeze ices, including exotic, in volume nearby 1 m³ for definition of their properties and test drilling and sample take-up devices.