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SPACE COMMUNICATIONS AND NAVIGATION SYMPOSIUM (B2)
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DEVELOPMENT OF HIGHLY STABLE LASER SYSTEM FOR ADVANCED FREE SPACE COMMUNICATIONS

Abstract

First in the world ESA realized a regular laser data transmitions from the low Earth orbit satellite SPOT-4 to ARTEMIS geostationary satellite. Regular laser communication experiments were successfully performed between ESA Optical Ground Station, Canary Islands (altitude 2400 m) and ARTEMIS satellite. The first bi-directional laser communications demonstration between the Kirari (OICETS) and ARTEMIS was successfully carried out. International laser communications experiments were also performed between the Kirari satellite and four optical ground stations located in the United States, Spain, Germany, and Japan. The coherent Nd:YAG laser communication terminals developed by Tesat was tested in communication links between TerraSAR and NFIRE(NASA) satellites. The communication rate at 5.6 Gbit/s was achieved with using BPSK phase modulation. The new geostationary satellite Alphasat and European Data Relay System will use Tesat laser communication terminals. The Main Astronomical Observatory in Kyiv has developed a laser communication system and performed the acquisition phase of laser link with OPALE laser terminal of ARTEMIS satellite by using Cassegrain focus of 0.7 m ground telescope (altitude 190 m). In this work we have been continuing to improve previously development laser system for experiments with new satellites. Taras Shevchenko National University of Kyiv and the Institute of Physics are developing highly stable Nd:YAG lasers with BPSK phase modulation to be used in future with low Earth orbit and geostationary satellites. The design method consists of several stages. The design implies thermal stabilization system with thermoelectical stabilization at 263 K or liquid nitrogen at 77 K. Nd:YAG crystal has the type of pump transition at 808 nm and observed laser lines at 1061 or 1064 nm. We use stimulated emission of crystal for the wavelength 1064 nm from diode laser at 808 nm as a cheap and efficient pump source for Nd:YAG. In this work the reflection grating has been realized for adjustment of wavelength of pump laser. The laser crystal with its attachment with sensors during the experiment is in the sample space of a cryostat placed. Also, another embodiment of placing of ultrastabilized optical resonator is used as for thermoelectical stabilisation system or liquid nitrogen cryostat. The calculated short time stability of laser radiation is expected on level 10xE-10 – 10xE-11. We assume, it will be better than laser for space applications of Tesat. The results of design and development of highly stable cooled laser system for BPSK phase modulation are presented in the report.