ACTIVE EXPERIMENTS IN SPACE AND AT THE EARTH'S SURFACE

«Ablation» Experiment

MODELING OF THE PROCESSES AND PHENOMENA IN THE NEAR SPACE USING THE COMPLEX OF CHARGE-PARTICLE SOURCES AND EHF-GENERATOR

Egorov A. M., Fainberg Ya. B., Karas' V. G., Kharchenko I. F.

Institute of Plasma Electronics and New Methods of Acceleration,
NSC «Kharkiv Physical-Technical Institute»
1 Akademichna St., Kharkiv 61108 Ukraine
tel: (380) +572 +356140, fax: (380) +572 +353564, e-mail: egorov@kipt.kharkov.ua

Nazarenko O. K.

E. O. Paton Electric Welding Institute, NAS of Ukraine
11 Bozhenko St., Kyiv-150, 03680 Ukraine
tel/fax: (380) +44 +2654319

Sitalo V. G.

Yangel State Design Office «Pivdenne»
3 Kryvoriz'ka St., Dnipropetrovsk 49008 Ukraine
Tel: (380) +562 +925113, fax: (380) +562 +925041

Nowadays the problem of the debris removal from the near space and protecting the Earth from asteroids has assumed great importance. The great number of debris of different origin, even when their mass is small, become highly dangerous because of their high velocities (about the first space one), for launching and normal operation of spacecraft in the future.

We consider the laser to be a rather efficient technique of the orbital debris elimination. It was proposed by the scientific teams from Los-Alamos National laboratory (G. Canavan, J. Solem, J. Rother, R. Hunter, C. Patel et al.), NASA (J. W. Campbell et al.), Tauson University (H. E. Bates), Shtutgard Institute of Technical Physics (W. O. Shall) and others. The main idea of these proposals consists in changing the small space object orbits by the laser ablation.

The goal of the «Ablation» experiment is to model some phenomena and processes in the near space based on the developed and built system of charge-particle sources and powerful Expremely High Frequency (EHF) generator. The intent is to perform a number of theoretical and laboratory experiments and optimization of the laser radiation parameters, in order to use the advantages of the charge-particle beams and avoid their disadvantages in transmitting a pulse to an object through ablation. Taking into account the nature of interaction of the regular and stochastic radiation with the environment, the advantages of each of them in identification of the space objects will be also studied.

The following results of the project are anticipated:

— scaling of the orbit change due to ablation of

the object irradiated by the laser and electron, ion and neutral particle beams;

— modeling the collisions of space objects moving at hypersonic velocities by means of charge-particle beams;

— identification of space objects using regular and stochastic radiation produced by a plasma-beam EHF-generator.

The on-board experimental unit will include the electron accelerator generating beams with electron energies E_b = 1 MeV, electron current I_b = 25 kA, and pulse duration τ = 15 ns. The beams will have the following main parameters: beam cross-section S_b = 1 cm^2; beam power $P_b = 25 \cdot 10^9$ W; beam energy per impulse W_b = 375 J. The efficiency of the electron accelerator is η = 50 %. The total energy, which is necessary for producing 10 pulses, is W_s = 7.5 KJ.

We suggest that a plasma channel can be used for transfer of a powerful relativistic beam to the object. This plasma channel will be immediately created by the electron beam during its propagation in the gaseous medium. We propose using a metallic tube to provide the optimal current and charge compensation. It should be filled by gas with the pressure of 1-2 Torr and should have the diameter larger than the beam diameter. Such conditions of the experiment will also prevent charge accumulation in the spacecraft, where the electron accelerator is situated. If this tube is made of duraliminium, the application of the electron beam under the above conditions will provide the needed pulse of J = = 0.06 N·s. The above parameters allow achieving the most efficient energy conversion of the electron beam into vapours which ensures the maximal recoil momentum.

References:

1. Antonov A. N., Bliokh Yu. P., Dekhtyar Yu. A., et al. Plasma beam generator based on the interaction between charge-particle beams and plasma-wave structure of a chain of inductively coupled resonators // Plasma Physics.—1994.—**20**, N 9.—P. 777—781.
2. Karas' V. I., Moiseev S. S. On the possibility of resonance effect of laser radiation on solid bodies // Voprosy Atomnoj Nauki i Tekhniki, KhPTI.—1977.—P. 77—17, 13—18.
3. Golota V. I., Karas' V. I. Excitation mechanisms of elastic oscillations by charge-particle beams // Ukr. Phys. Zhur.—1985.—**30**, N 7.—P. 1093—1097.
4. Bludov S. B., Gadetskij N. P., Kharchenko I. F., et al. Ultrashort microwave pulse generation and its effect on electronic devices // Plasma Physics.—1994.—**20**, N 7.—P. 712—717.

«Approach» Experiment

APPROACH OF SPACE DEBRIS TO THE ORBITAL SPACECRAFT

Khizhnyak A. I.

Institute of Applied Optics, NAS of Ukraine
10-G Kudryavska Sr., Kyiv 03053 Ukraine
tel: (380) +44 +2122158, fax: (380) +44 +2124812,
e-mail: knizh@lomp. ip.kiev.ua

Didkovskij L. V.

Crimean Astrophysical Observatory, Ministry for Education and Science of Ukraine
Naukove, Bakhchisarai, 98409 Crimea, Ukraine
Tel: (380) +6554 +71161, Fax: (380) +6554 +40704,
e-mail: postmaster@crao.crimea.ua

Dangerous approach of space debris to the «Mir» OSS and catastrophic damage to the French «Ceriese» spacecraft (1996), give evidence of practical necessity of prediction of such phenomena, especially in the cases of manned missions and nuclear sources presence onboard the spacecraft. Radar observations permit prediction of only the dangerous approaches (< 3 km) of large space debris (> 10 cm). However, collisions with centimeter-sized objects can also have a disastrous effect, taking into account their multiplicity and velocity. Ground-based registration of these objects