

# ARTIFICIAL MINI-MAGNETOSPHERE AS A MEANS OF CONTROLLING SPACECRAFT MOTION IN THE EARTH IONOSPHERE

*Institute of Technical Mechanics*

*of the National Academy of Sciences of Ukraine and the State Space Agency of Ukraine  
15 Leshko-Popel St., 49005, Dnipro, Ukraine; e-mail: yu.kuchugurnyi@gmail.com*

Based on the results of a series of experimental studies of the interaction of spacecraft models with a hypersonic rarefied plasma flow, this paper demonstrates the possibility of controlling spacecraft motion in the ionosphere with the use of a device of the “magnetic sail” type and proposes an idea of an experiment onboard a CubeSat microsatellite in a near-Earth orbit. If a spacecraft is equipped with a source of a strong magnetic field, then in a hypersonic rarefied plasma flow a nonuniform plasma structure called an artificial mini-magnetosphere, which is similar to a planetary magnetosphere, will form in the vicinity of the spacecraft. In this case, part of the plasma flow momentum will be transferred to the magnetic field source, thus resulting in additional forces acting on the spacecraft. This principle forms the basis for the “magnetic sail” – a jetless magnetohydrodynamic propulsion unit that uses the kinetic energy of the solar wind. Experimental studies of the interaction of spacecraft models with a plasma beam were conducted on a plasmaelectrodynamic setup. The drag and lift acting on the models were determined as a function of the flow parameters and the magnetic field. It was shown that an artificial mini-magnetosphere may be an effective means of controlling spacecraft motion in the Earth ionosphere. The experiment to be conducted in near-Earth space envisages equipping a microsatellite with permanent magnets encased in a controllable enclosure that shields the magnetic field and determining the satellite orbit variations after removing the shield as a function of the magnetic field parameters. The experiment might be a first verification of the concept of the “magnetic sail” as a spacecraft propulsion unit. Controlling the motion of a “magnetized” body by using the long-term interaction of the body’s magnetic field with the ionospheric plasma may be the key component of a radically new technology for space debris removal from the ionosphere.

**Keywords:** *spacecraft, CubeSat, YuzhSat, ionosphere, mini-magnetosphere, plasma, magnetic sail, solar wind, physical simulation, plasmaelectrodynamic setup.*

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