

# FEASIBILITIES OF SPACE-ROCKET COMPLEXES FOR CREATION OF NEAR ECHELON OF THE EARTH PROTECTION SYSTEM

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**V.G.Degtiar**, *Doctor, Professor, IAA academician,*

**S.T.Kalashnikov, G.B.Pozin, S.S.Saitgarayev**

*All authors work at the Open Joint Stock Company "Academician V.P. Makeyev  
State Rocket Centre" (Makeyev GRTs) ,  
Turgoyakskoye shosse, 1, Miass, Chelyabinsk Region, 456300  
Tel. (351-3) 28-63-70.*

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The theme of space rocketry development in terms of Hazardous Space Objects (HSOs) mitigation has become actual and popular in the recent years.

Impact of the Chelyabinsk meteorite on February 15th, 2014 in the highly industrialized region showed that even a small meteorite impact on such region can cause catastrophic consequences.

It is efficient to create the Earth protection facilities by the system of three-echelons:

- Far echelon, protecting against large, long-period comets;
- Middle echelon, protecting against large, short-period asteroids;
- Near echelon, protecting against small HSOs (less than 100 m).

The Launch Vehicles (LV) with heavy launching weight and heavy mass of a payload, low boiling propellant components and long period of launch preparation can be used to intercept HSOs of large sizes due to possibility of early detection (far and middle echelons).

Small HSOs are featured by late detection. Complexes with rockets of a small class based on Intercontinental Ballistic Missiles with minimal time for launch preparation are feasible for their interception.

In particular the DNEPR-type LV can be used after fitting it up with an additional stage, which is capable to accelerate a payload to the second cosmic speed. Such LV will be able to deliver an interceptor to a meteorite at a safe distance from the Earth by its detection 5-7 hours before an impact.

Hence, additionally to the LVs it is necessary to create the system of operational detection and monitoring of small HSOs. For this purpose, monitoring of the entire near Earth space in real time is needed and this can be achieved only by means of a space-based system.

We propose to create such system by locating a couple of space telescopes in the neutral points  $L_4$  and  $L_5$  of the Earth orbit, inspecting the near Earth space of up to 2-3 mln km around the Earth, and detecting HSOs of 20 m in diameter and up, and from 10 m in prospect.

The second couple of telescopes at points  $L_1$  and  $L_2$  will identify the detected objects and define their trajectory, mass and dimensions, and other parameters with high accuracy. The information provided by this system will be transferred to a special center for its processing and making decisions.

By a command and target destinations of the center the LV will be taken-off to deliver the interceptor toward an HSO. Final guidance of the interceptor will be made by means of its onboard equipment.

The near interception complex can be used also for affecting objects of larger sizes to collect information about small objects passing the Earth by, and for launching scientific vehicles to research these objects and approach some of them.

Now specialists of the Makeyev GRTs are performing preproject research to elaborate key technical decisions and main parameters of the system. Makeyev GRTs are ready to commence an engineering design phase.

The system is designed to protect the entire planet, therefore for its creation wide international cooperation is needed to combine technical and financial capabilities of different countries.