PROCEEDINGS OF SCIENCE

Computer simulation of a new deployment system for precise solid space reflector

V. I. Bujakas,[a] **M. D. Glotov** [a,*]

[a] *P. N. Lebedev Physical Institute of the Russian Academy of Sciences*
53, Leninsky prospekt, Moscow, 119991, Russian Federation

E-mail: bujakas@yandex.ru, maxglotov1998@yandex.ru

To create next-generation large space radio telescopes operating in the short-wavelength region of the spectrum, it is necessary to ensure the high accuracy of the reflecting surface of the main mirror of the instrument and the high rigidity of the open reflector. The use of solid-state transformable petal mirrors is considered as one of the possible ways to solve emerging problems. The paper describes a new scheme for opening a petal mirror and presents the results of computer simulation of the deployment kinematics in the SolidWorks package.

The Multifaceted Universe: Theory and Observations - 2022 (MUTO2022)
23-27 May 2022
SAO RAS, Nizhny Arkhyz, Russia

*Speaker

PoS(MUTO2022)008

1. Introduction

There are a lot of publications [1]-[5] devoted to the study and use of transformable solid petal reflectors of space radio telescopes. This work is a continuation of the new design development [3] of a deployable mirror, in which a new deployment system and a new system for fixing the working state of the transformed reflector are proposed to improve the quality of work in the short-wave region of the spectrum. In the new design, linear actuators are replaced by rotational ones. This technical solution makes it possible to carry out preliminary opening and fixing of the operating state of the transformable mirror with one rotary movement. The results of a computer simulation of the deployment kinematics in the Solid Works package are presented.

2. Disadvantages of the classic petal mirror

The main aim of a number of works [3][4] is to eliminate the following design disadvantages of the classical petal mirror:

- In the assembled state, the long petals are cantilevered on the central mirror, which results in the low stiffness of the large reflector in the open state.
- Cylindrical hinges and actuators are placed at the base of the long petals, and small deviations in the installation of the hinge axes and in the actuator movements result in significant position deviations of the outer petal edge from the design state.

To increase stiffness and accuracy, a transfer of the actuators and connections to the upper edges of the petals was proposed.

3. New petal mirror design

The set of petals and the central mirror are connected in the new design by spherical hinges (Fig.1). The deployment is performed by small-sized rotary actuators mounted on the upper edges of the petals using a lever system. This technical solution makes it possible to open the transformed reflector in one synchronous movement of the levers on the upper edges. The rotation of the lever is shown in Figure 2.

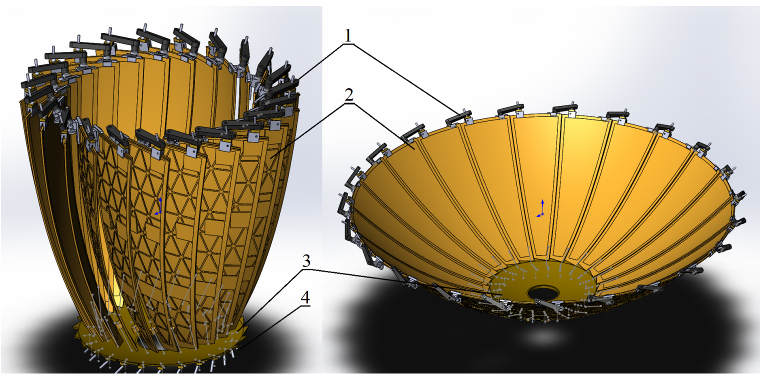

Figure 1: Petal mirror. 1 — rotary levers and spherical hinges on the petal edges, 2 — petals, 3 — central mirror, 4 — spherical hinges on the central mirror base.

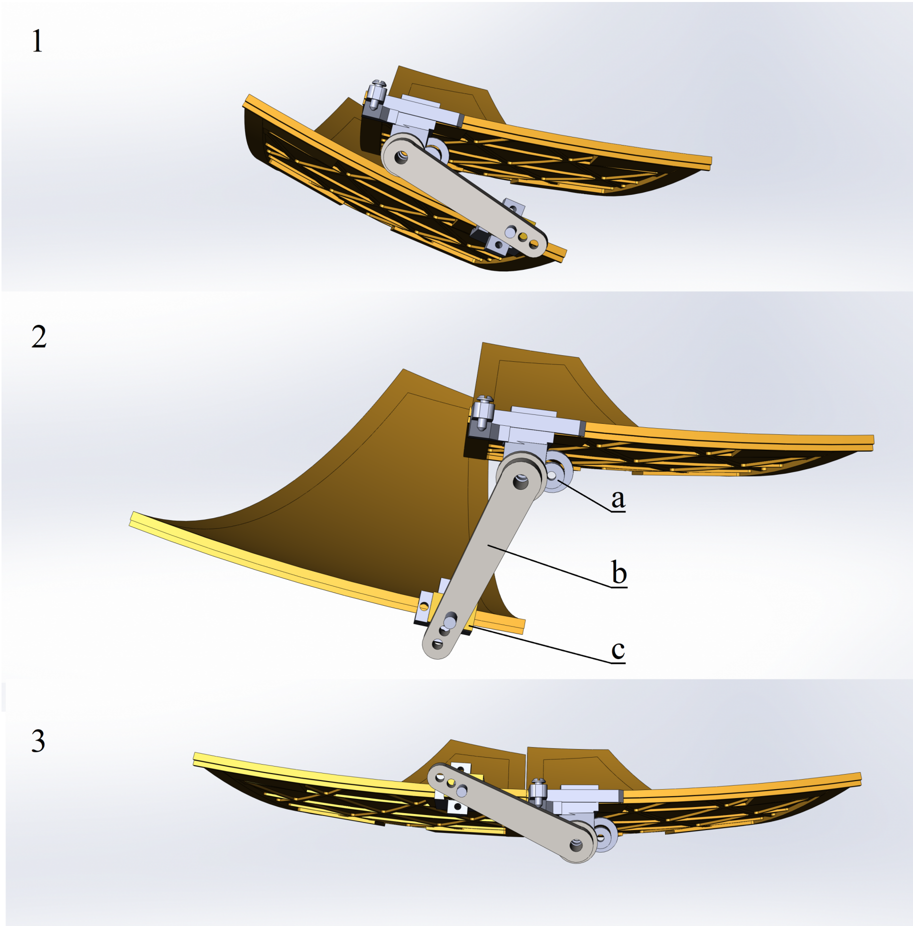

Figure 2: The mirror opening stages. 1 — transport state, 2 — preliminary deployment, 3 — fixation; a – actuator, b – rotary lever, c — spherical hinge.

The construction remains statically definable, and, consequently, not stressed at any moment of deployment. The petals are connected by levers along the upper edge, which increases the accuracy and stiffness of the unfolded reflector.

Precise fixation of the opened reflector is performed by self-setting locks placed on the neighboring petal edges (Fig. 3).

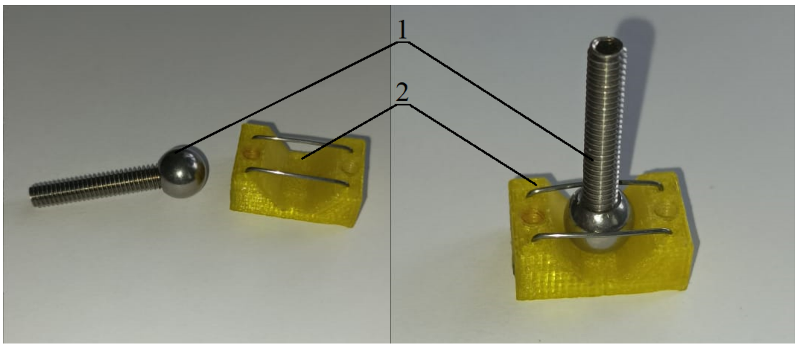

Figure 3: Self-setting lock. 1 — spherical support, 2 — V-groove with spring grips.

4. Conclusions

Simulation in the SolidWorks software package confirms the feasibility of the offered technical solution. The next step of the planned work is the creation of a working physical model.

References

[1] Kardashev N. S. et al., 2013 *"RadioAstron" – A telescope with a Size of 300000 km.* Astron. Reports 57(3), 153[10.1134/ S1063772913030025].

[2] Tao An et al., 2020 *Space Very Long Baseline Interferometry in China, Adv*. Space Res. 65, 850 [1901.07796].

[3] Bujakas V. I., Glotov M. D., 2021 *Physical Simulation of the New Petal Reflector Deployment System for Space Radio Astronomy.* Bulletin of the Lebedev Physics Institute. 48 (9), 3-9 [10.3103/S1068335621090025].

[4] Bujakas V. I., 2022 *Isostatic adjustable structure for new petal space reflector deployment.* International Journal of Solids and Structures. 238 (1), 123-134 [10.1016/j.ijsolstr.2021.111383].

[5] He Huang et all: 2018 *Design and deploying study of a new petal-type deployable solid surface antenna.* Acta Astronautica. 148, 99-110 [10.1016/j.actaastro.2018.04.042].