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Instrumental Space Astronomy

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Abstract

The article explores instrumental space astronomy as a direction in space research. Instrumental space astronomy is closer to space geodesy and space geoinformatics than to astronomy. The trend of transformation of earth sciences into space sciences has been noted. The structure of instrumental space astronomy is shown. Instrumental space astronomy is a development of the direction of observational astronomy. However, observations are complemented by measurements and modeling. Instrumental space astronomy differs from classical astronomy in the use of spatial logic, geomonitoring and spatial modeling. Classical astronomy studies celestial objects from great distances. Instrumental space astronomy studies planets from short distances comparable to several planetary radii. Classical astronomy studies celestial objects from the surface of the earth using radio telescopes. Instrumental space astronomy explores planets from spacecraft. Classical astronomy examines celestial objects using angular measurements and navigational estimates. Instrumental space astronomy explores planets using linear and angular measurements, models and simulations. Instrumental space astronomy studies objects using the methodological apparatus of space geoinformatics and space geodesy. Instrumental space astronomy provides tools for studying planets and therefore it is also close to comparative planetology.

Keywords: space research, space astronomy, instrumental space astronomy, space geoinformatics, space geodesy, geodetic astronomy.

1. Introduction

Astronomy is one of the oldest sciences. It arose from the practical needs of navigation and determining the exact time. Classical astronomy studies stars, planets of the solar system and their satellites, exoplanets, asteroids, comets, meteoroids, interplanetary matter, interstellar matter, pulsars, black holes, nebulae, galaxies and their clusters, quasars, and more (Surdin, 2021; Karttunen et al., 2007). The main general directions of classical astronomy are four sections (Surdin, 2021; Karttunen et al., 2007): 1. The study of the visible and actual positions of celestial bodies in space, the determination of their size and shape. 2. The study of the structure of celestial bodies, the study of the chemical composition and physical properties (density, temperature, etc.) of the substance in them. 3. Solving the problems of the origin and development of individual celestial bodies and the systems formed by them. 4. The study of the most general properties of the Universe, the construction of the theory of the observable part of the Universe – the Metagalaxy.

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2. Results and discussion

For classical astronomy, the term "distant" can be introduced. For instrumental space astronomy, the term "local" can be introduced. Instrumental space astronomy belongs to the first section. It deals with the study of the visible and actual sizes and shapes of celestial bodies, as well as their characteristics, volume and area. Classical astronomy focuses on terrestrial observations. Instrumental space astronomy is focused on observations from spacecraft. Instrumental space astronomy is closely related to a number of special sciences: geodetic astronomy (Gospodinov, 2018; Gospodinov, 2022), space geodesy (Oznamets, 2023), space geoinformatics (Bondur, Tsvetkov, 2015), computer science (Gospodinov, 2023) and applied informatics (Polyakov, Tsvetkov, 2002).

Instrumental space astronomy (Gospodinov, Tsvetkov, 2023) is close in methods to applied geoinformatics and applied informatics. Space research is aimed at studying the external environment in the form of near and far space. The modern peculiarity of space research is that it is based on methods and knowledge obtained in terrestrial conditions and in the course of the study of the planet Earth. Earth sciences make a significant contribution to the development of space research.

Figure 1 shows the trend of transformation of earth sciences into space sciences.

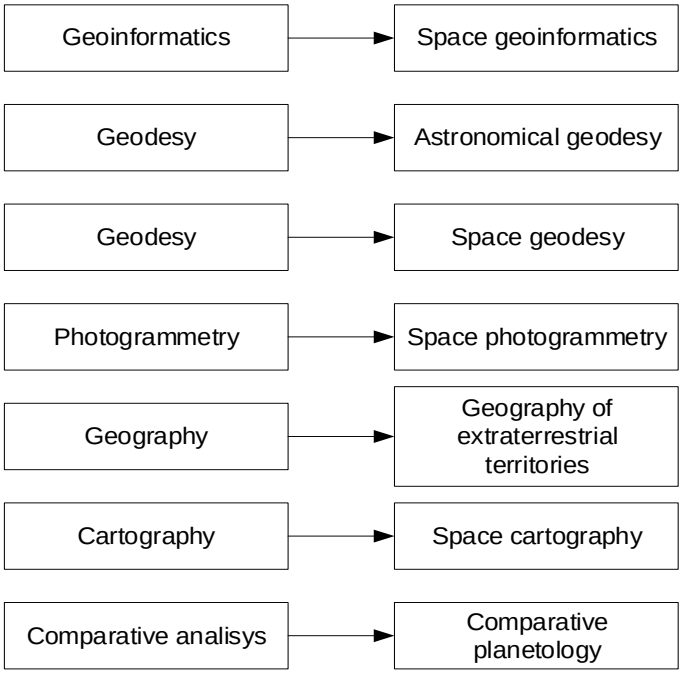

Fig. 1. Transformation of terrestrial sciences into space directions.

Modern space research and the construction of a picture of the world are associated with the use of "terrestrial" sciences of geoinformatics, geography, geodesy. Space geodesy, space geography (Savinykh i dr., 2009), space geology (Katz, Ryabukhin, 1984), geodetic astronomy exist and are used. Geoinformatics as a science that integrates the Earth sciences (Maksudova et al., 2000) also has every basis for the term space.

Earth sciences are the basis for research. The main object of comparison in space research is the Earth. As a planet, it is better studied and all possible measurements can be made on it. The use of Earth exploration data as an analogue for comparison with other bodies is most common in such sciences as comparative planetology, planetary geology, geomorphology and atmospheric sciences. Hence there was a tendency to transfer the methods of Earth sciences (geoinformatics, geodesy, geodynamics, photogrammetry, cartography) for use in space research. Space research is an important tool for studying the world around us (Stepanov, Aksenova, 2014). Space research is an important component in building a picture of the world (Savinykh, 2015; Tsvetkov, 2014a; Tsvetkov, 2014b).

Instrumental space astronomy arose on the basis of the integration of a number of sciences into this science. Figure 2 shows the components of the integration of instrumental space astronomy.

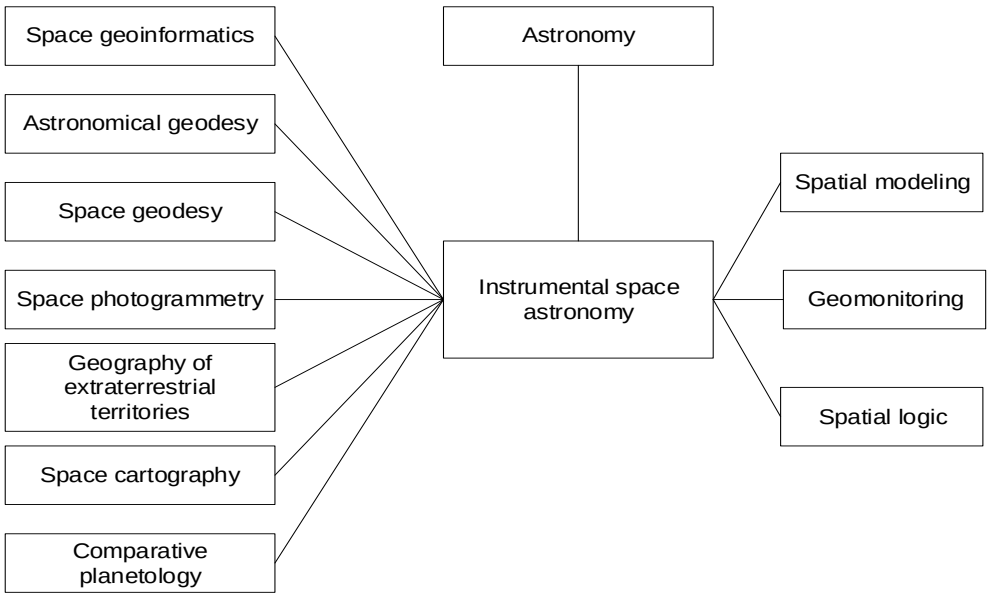

Fig. 2. Components of integration of instrumental space astronomy

In Figure 2 the difference between instrumental space astronomy and astronomy can be seen. It is expressed in the application of spatial logic and spatial modeling. In instrumental space astronomy, geomonitoring is used as a kind of comic monitoring.

Instrumental space astronomy is close to geoinformatics and space geoinformatics in terms of concepts and modeling methods

Geoinformatics and space geoinformatics, as instrumental space astronomy, is a tool for studying the world around us and building a picture of the world (Butko, 2017). This brings space geoinformatics and instrumental space astronomy closer together. Space research is aimed at obtaining new knowledge and finding tacit knowledge (Tsvetkov, 2014). Space geoinformatics and instrumental space astronomy explore tacit knowledge. Cosmic geoinformatics acquires new knowledge, spatial knowledge (Tsvetkov, 2015) and geoknowledge. Instrumental space astronomy does the same.

It also brings space geoinformatics and instrumental space astronomy closer together. There are a number of works in the field of geodesy, in which it is proved that geodesy is the science of space. This gives reason to believe that instrumental space astronomy can also be considered as a science of space. The specialization of astronomy in the instrumental study of outer space leads to instrumental space astronomy

This term has not yet found wide application. Therefore, in general, we can talk about instrumental space astronomy as a tool for space exploration. Instrumental space astronomy requires the introduction of new methods of analysis, due to new tasks and requirements. Instrumental space astronomy requires research and development of new analytical, algorithmic and technological methods. In contrast to space geodesy, space geography, geodetic astronomy, the peculiarity of instrumental space astronomy is an integrated approach to the study of outer space. This integrated approach is borrowed from space geoinformatics. Space geoinformatics provides model-level comparability and analysis. At the level of technology, instrumental space astronomy creates a tool for the exchange of methods of analysis and processing. At the level of cognition, instrumental space astronomy, a similar to astronomy and geoinformatics, contributes to the integration of sciences. This property is transferred to space astronomy and makes instrumental space astronomy a means of universal exploration of outer space.

3. Conclusion

Instrumental space astronomy is a new scientific direction. It aims to study planets from distances comparable to several radii of planets. Instrumental space astronomy complements classical

astronomy. It is a development of its direction of observational astronomy. Observational astronomy is concerned with obtaining observational data about celestial bodies, which are then analyzed. Instrumental space astronomy not only obtains data, but also carries out logical and geometric constructions and obtains the real dimensions of the bodies under study. Instrumental space astronomy is not only an observation tool, but also a measurement tool, calculations and modeling.

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