Scientists propose a new method for assessing the evolution of stars

An international group of scientists which included an employee of Siberian Federal University conducted a study where they proved the efficacy of a new method for studying the origin and evolution of stars. The object of study was system Kepler 11 located 2,000 light-years from Earth.

According to Nikolay Erkaev, a professor of the Department of Applied Mechanics of the Polytechnic School of Siberian Federal University, the study shows that the proposed method allows determining and clarifying many important properties and patterns of planet formation, and Kepler 11 itself is a lucky object for such an investigation. Indeed, it consists of six planets that revolve around a sun-like star and is the largest planetary system known to date (excluding the solar system). A curious feature of this system is that five of the six planets are in orbits located closer to their star than Mercury to the Sun. And the sixth, the farthest, at the same time, is at a distance equal to the distance of Venus from the Sun.

> *'The atmospheres of the planets revolving in orbits close to the star undergo an intense mass loss under the influence of high-energy radiation (x-ray and ultraviolet) of their star, which is especially pronounced in the initial stages of their evolution. In previous works, we have outlined an effective method for modelling this phenomenon. It allows restoring the history of the evolution of high-energy radiation of the star thanks to the information about today's properties of its planets. Moreover, this method is suitable for determining the initial masses of the planetary atmospheres. At the same time, the more planets are simultaneously analyzed the higher the information value and accuracy of the results turn out to be,'* said **Nikolay Erkaev**.

Modelling showed that the star evolved quite leisurely — 85 % slower than those stars with similar masses. This is what was told by the atmosphere of the six planets orbiting around it. The scholars were also able to calculate the initial atmospheric masses of these planets and determine the temperature of the protoplanetary disk which formed them.

Backed by the new method, the scholars could also theoretically evaluate the initial masses of their planetary atmospheres. For planet g, the mass of which was previously nebulose, a lower mass limit of 10 Earth masses was set. In addition, they were able to determine the temperature of the system's protoplanetary disk — it was approximately 550 degrees kelvin. According to the scholars, this disk had been existing for about 1 million years before the Kepler 11 system began its formation and acquires its habitual form. The results of the study have been published in Astronomy and Astrophysics.

17 march 2020