DESCRIPTION FOR THE GENERAL PUBLIC (IN ENGLISH)

Our familiar planets are not the only celestial bodies that orbit around our Sun. The ranks of such bodies also include a huge number of much smaller objects: comets and asteroids. Comets have been known to humanity for millennia. While most of them can only be seen in images taken with large telescopes, every few decades a comet appears in the sky that is sure to catch the eye of anyone willing to take a look at a starry night sky. Asteroids have been known for a shorter time, as the first one was only discovered a little over 200 years ago. Even though comets and asteroids may appear to belong to entirely different classes of objects, science has revealed a good many similarities between them. Both comets and asteroids formed about 4.5 billion years ago, at the very beginning of the Solar System. Because the matter contained within them has remained mostly the same to this day, researching them tells us not only about the material from which the Solar System emerged, but, in a sense, about our own past as well. What is more, it is most likely the small bodies of the Solar System that brought to our planet the water and organic compounds needed for life to emerge. Thus, the value of investigating comets and asteroids can hardly be questioned.

Based on the observational results from recent years (especially the discovery of asteroids that behave like comets), our project treats these two groups jointly, as small bodies of the Solar System, which is an innovative approach. Asteroids and comets still hold many secrets. One of their most interesting and, at the same time, least investigated aspects is their spontaneous disruption. Recent research has indicated that disruption can be caused by a rapid rotation or a collision with another body of the Solar System. The main aim of this project is to investigate these processes and their effects in detail.

During his previous research, the team leader observed a never-seen-before formation of a family of asteroids, which emerged as a result of the disruption of a larger object. The cause of this disruption remains uncertain, but rapid rotation is the main suspect. Our team plans to continue the previous research in order to verify the cause through observations made using the Hubble Space Telescope. Following a successful application by the team leader, 30 orbits of the Hubble telescope between 2015 and 2018 have been allocated for these observations. Previous observations have revealed the exceptional character of objects that have formed through this disruption, with the largest fragment showing the properties of a binary asteroid. And while it is true that such asteroids have already been discovered, the process that leads to their formation was thought to take millions of years. In this case, however, we are dealing with an object merely several years old. Further research is also expected to establish the detailed directions in which the fragments travelled after the disruption. If these directions are found to occupy the same plane, this will confirm that the disruption was caused by the high rate of rotation of the parent object.

Observations have shown that some asteroids rotate around their axis at a rate high enough to enable a potential disruption. Objects that have already undergone disruption indicate that in addition to larger fragments, disruption also creates a narrow dust feature, referred to as a dust trail, which can be visible for a very long time. This project will entail observations of objects with a high rotation rate in order to find trails that would signal past disruptions. Slowly rotating asteroids will also be observed to enable comparison. Since trails contain only small amounts of matter and are dim, they usually cannot be easily seen. For this reason, the project will take advantage of some of the largest telescopes, and the obtained results will be analyzed using our own computer software.

The rotation rates of objects that have already undergone disruption will also be determined as part of the project, which will help establish whether the disruption was caused by a rapid rotation or a collision with another object. Furthermore, we will measure how rapidly the period of rotation changes in selected small bodies of the Solar System over time. Thus, the results of the project will not only improve our understanding of the rotational disruption of comets and asteroids, but may also be used to predict the time of disruption for some of these bodies.