Reg. No: 2022/45/N/ST9/01403; Principal Investigator: mgr Karolina Jadwiga Dziadura

Improving orbits of Potentially Hazardous Asteroids

Karolina Dziadura

Asteroids are small rocky or rock-ice bodies orbiting the Sun. Every day, new asteroids are discovered and the number of discovered objects has already exceeded 1.2 million. Our Solar System is still full of undiscovered mysteries and studying it is important both for the history of its dynamics and for the study of external solar systems.

Of all of the asteroids, over 29,000 belong to the Near-Earth Asteroids (NEA) group and 2,277 of them are Potentially Hazardous Asteroids (PHAs). It is extremely important to observe, study and refine the orbits of such bodies because they may collide with the Earth. This is because the orbits of asteroids are constantly perturbed by gravitational and non-gravitational effects. At the moment, we believe that no such object will hit our planet in 100 years, but this has to be constantly checked because we are not able to determine the orbits of asteroids with such accuracy.

To determine the orbits, astrometric measurements from ground-based, satellite and radar telescopes are used. Such astrometric observations are subject to the photocenter-barycenter shift effect (the difference between the measured photocenter and the actual centre of mass of the objects). Such an effect has never been used to determine the orbits of a group of asteroids before. In this project, I will use the latest techniques and programs for determining the orbits of the asteroids of the PHAs and NAE groups.

We reached the precision in observations where the precision of astrometry allows us to observe the difference in photocenter and barycentre of asteroids. Therefore, it is a perfect time to develop this method and use it for the studied objects. It is certain that in the future this method and approach will be used for impact probability determination on a daily basis. Photocenter-barycenter offset was proposed many years ago, but finally, we have the data and the tools to use it in precise orbit determination.

The main result of this project will be the method for the orbit determination with the use of photocenter-barycenter offset and the new orbit for a number of asteroids from PHAs and NEA groups.