

Mass is one of the most important quantities characterising stars, galaxies, clouds of dust, essentially everything that exists in the Universe, and also itself as a whole. Although it is hard to imagine, if we move away from our everyday surroundings, which consist of so many elements and interactions, if we found ourselves in cold and dark emptiness of the Cosmos, we would only be subject to one thing, which, in greater scales, rules the whole Universe - gravity. And the measure of the impact of this force is, as we all know, mass of objects. Obviously, it is not the one and only factor deciding on their fate. Without a doubt though, the mass is crucial to determine entire life of a star, its motion through the Galaxy and, finally, how spectacularly its evolution is going to end.

Determining masses in astronomy is a difficult task. One can sometimes infer this parameter from the motion of bodies and material around the particular object. Nonetheless, in the case of isolated objects, astronomers would be left only with mere estimates, based on stellar evolution models. Would be, but they are not, thanks to the gravitational microlensing effect. In principle, this phenomena is caused by the deflection of light ray from the background object (the source) due to the mass (the lens) lying on the way of photons. The closer object acts as a lens and causes change in brightness and shift of the position of the source. Nevertheless, for microlensing effect to occur, the observer, the lens and the source have to be almost perfectly collinear. Thus, such events are very rare. Thanks to the extensive monitoring of billions of stars, about 18000 microlensing events have been discovered to date. Unfortunately, the shape of the observed light curve depends not only on the mass of the lens, which is our main objective here, but also on other components. That is why, for so called standard events, which constitute most of the microlensing events population, it is not possible to determine the mass of the lens without any external information.

Given very precise astrometric measurements - the proper motions of lens and the source, as well as distance to the lens, it would be possible to solve for every parameter of the microlensing event, including desired mass. Thanks to Gaia, space mission led by European Space Agency, such information about motions and locations of billion of stars will be available in April 2018.

The goal of this project is to make good use of unprecedented accuracy of the new Gaia catalogue, to predict positions of stars in the galactic bulge and the disk. Then we will search for pairs of stars so close to each other, that microlensing effect is observable. Prediction of the time of potential events would allow for careful preparation of the observations, to get as much from the event as possible. Combining these observations with precise astrometric information from Gaia catalogue would provide masses of objects acting as a lens. Among the weighed objects will be mostly ordinary stars, but also faint and exotic objects such as white dwarfs or brown dwarfs from the nearest area of the Sun.

Measurements provided by Gaia mission will also be used as a key to past microlensing events. For some of those, which were observed at the beginning of the third phase of the OGLE project (around 2001), due to long time that elapsed, we can expect measurable separation between source and the lens. In such case, it will be possible to derive precious masses of lenses for those, one might say, already forgotten objects. Archival events, for which we do not identify lenses in the Gaia catalogue, will become candidates for lensing black holes and neutron stars.