Our solar system, apart from eight well known planets, contains a lot of "minor bodies", which are mainly asteroids. These have been studied only in a very small fraction. For most of them we don't even know their sizes. Diameters of big planets are easy to determine, because they are extended objects in the sky. From their angular size and distance we infer their true dimensions. However, to measure how large minor bodies are is quite challenging. A small target reflecting much light looks the same viewed through a telescope as a large target with dark surface, because due to their small sizes and huge distances all look like a point of light. However, there are smart ways to measure asteroid sizes.

One of them are stellar occultations by minor bodies. An asteroid, occulting a star that is further away, casts a shadow on the Earth, which can be measured. It results in precise size determination of the occulting body, and also can give some idea on its shape, when multiple observations are available. Such measurements are quite simple: all that needs to be measured is the exact time of star disappearance and reappearance.

Another method to measure asteroid sizes are infrared observations. There the difference between bright and dark targets is evident. The dark one has to absorb most of the solar radiation, and it heats it up. Thus asteroids that are dark in the visible range are much warmer than their bright companions. So thermal data help to determine the amount of light reflected off asteroid surface types, so that the remaining brightness difference between objects are only caused by difference in their size. But in order to determine the surface temperature distribution one needs an asteroid model: its approximate shape and spin axis orientation in space. One also needs to know how fast this body is spinning around its axis.

However, here we come across the selection bias - fast spinning asteroids are much easier to study than slow rotators. As a result little is known about the latter. This way our knowledge on asteroid properties is based on skewed sample, and so can be our theories of the planet formation and later evolution of the solar system, with the events like late heavy bombardment caused by planetary migrations, sweeping through the minor bodies reservoirs, but also much more subtle thermal effects acting on asteroid spin axis orientations and spin periods.

In this project we are going to focus on slowly rotating asteroids, observe how they change their brightness, both in the visible and infrared range, to construct their consistent, scaled physical models.

In cases where there is not sufficient infrared data from spacecrafts, we are going to measure asteroids via rare events of stellar occultations. Still, the majority of our targets will be scaled via both methods, to check their mutual relations and correct other size determinations for larger number of asteroids. Thanks to this project we will know shapes, thermal properties, surface regolith features, and even densities of asteroids that have not been studied before, and also verify if thermal inertia indeed grows with depth under the surface. This will complement the general knowledge on the solar system primordial building blocks.

Asteroids are the oldest remnants from our solar system "construction site". It is them that joined to build all the planets, including the Earth. Among asteroids larger than 100 km in size there still exist primordial planetesimals, not much changed since the time when similar bodies coalesced to create planets. Thus studying asteroids we study the bricks of matter that built e.g. the Earth. The features of their composition, and how they react to the heating by the Sun will help to better understand the features of planetesimals and to improve the theories of planetary formation, not only in our solar system, but also in numerous other, extrasolar planetary systems. In some of them large planets never managed to form, and all we see today are debris disks, full of dust, comets and small asteroids.