Observations of Near-Earth Objects

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Abstract. Near-Earth Objects (NEOs) include both comets and asteroids whose orbits can get them to the vicinity of our Earth. They are of particular interest: due to their proximity, are ideal targets for space missions, and we can even collect material from their surfaces and bring it back to Earth for its study. Also, they represent impact hazards and therefore, knowing their orbit and their physical properties is key for planetary defense. The large majority of NEOs are small (tens to hundreds of meters), and so are best studied when they get close to the Earth using a variety of techniques, i.e., time-series photometry, colors and spectra in the optical and near-infrared, radar observations, etc. Other regions of interest need to be observed using space-based telescopes, as the Earth's atmosphere blocks (totally or partially) the radiation, like the UV or the 3-μm region. In this presentation I will review our current knowledge on NEOs from an observational point of view, both from ground-based and space-based telescopes. I will particularly focus on the work that is being carried out by our group at the Instituto de Astrofísica de Canarias in the frame of the EU project NEOROCKS.

Keywords: Solar System · Asteroids · NEOs · Observations

1 Introduction

Asteroids are the remnants of the formation of the Solar System and so they provide very valuable information on the conditions on its early stages and subsequent evolution. Among the asteroid population, those that have orbits that get them close to the orbit of the Earth, or near-Earth objects (NEOs), are of the most interest. Due to their proximity we can not only study them in detail using ground-based telescopes, but we can also send spacecrafts to orbit them, explore them in situ and even take samples from their surfaces and bring them to Earth. In addition near-Earth asteroids constitute an impact hazard to our planet and so, it is extremely important that we identify and characterise them with as much precision as possible.

2 Discovery statistics

The first near-Earth asteroid was discovered in 1898, and it was asteroid 433 Eros [1]. The number of NEOs continued slowly increasing, but it was with the

apparition of the CCDs in the mid-80s and the start of operations of all-sky surveys like LINEAR, Catalina Sky Survey or LONEOS in the late 90s that the discovery rate peaked [2]. Today, about 30 000 NEOs have been identified so far: with the upcoming of the LSST, we expect this number to increase by one order of magnitude in the following years.

3 Characterization

Despite the increasing number of NEOs, only 15% of the current population have some physical (shapes, rotational periods) or compositional (colours, spectra) properties determined in the literature [3]. This is mainly due to the fact that a large fraction of NEOs are small, and so their observation is more feasible at their discovery apparition, when they are brighter, turning observations opportunistic rather than planned. In addition some of these techniques require long-term monitoring and so are time consuming. Our group at the IAC is making a significant contribution to enlarge the number of NEOs with known physical properties. We are obtaining visible spectra of newly discovered NEOs in the frame of the NASA NHATS initiative, as well as Potentially Hazardous Asteroids. Among these initiatives, is the NEOROCKS project [4].

4 NEOROCKS project

The NEOROCKS (NEO Rapid Observation, Characterization and Key Simulations) project is funded (2020-2023) through the H2020 European Commission programme to improve our knowledge on near-Earth objects by connecting expertise in performing small body astronomical observations and the related modelling needed to derive their dynamical and physical properties. The Solar System Group of the IAC leads one specific task: to collect observational data in the optical to complement high signal-to-noise ratio radar data obtained with the Arecibo Planetary Radar and Goldstone Solar System Radar. Our observations include spectroscopy, colour photometry and lightcurves. They are performed using the facilities located at the *Observatorios de Canarias* (OOCC), using a variety of facilities, from the 46-cm TAR2 telescope, to the 10.4-m Gran Telescopio Canarias (GTC). So far we have observed more than 100 NEOs.

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