Título: TÉCNICAS DE DETECCIÓN Y CARACTERIZACIÓN DE LA MATERIA INTERPLANETARIA PRÓXIMA A LA TIERRA DESDES OBSERVATORIOS EN TIERRA.//TECNIQUES FOR NEAR-EARTH INTERPLANETARY MATTER DETECTION AND CHARACTERISATION FROM OPTICAL GROUND-BASED OBSERVATORIES.

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Resumen: Interplanetary matter covers a wide range of mass and size in the Universe, from micrometric dust to multi-kilometre asteroids. This matter plays countless roles in planetary sciences. Dust fills the space in the Solar System, but also in a myriad of exoplanetary systems. Indeed, the interplanetary dust usually outshines the planets in infrared and these hot debris disks have already been observed in several exoplanetary systems. The near-Earth interplanetary matter is also relevant for Earth sciences and space exploration. Extraterrestrial dust plays several roles in the upper atmosphere. Moreover the asteroids are a threat for humankind due to the energy they release in the case of impact against the planet. Asteroids larger than 1 km could produce global devastation and 90 % of them are already catalogued. Current efforts are focused on the population larger than 140 m, able to produce an impact of regional proportions. Beyond Earth's atmosphere, these bodies pose a hazard to spacecraft, especially the small particles that are the most numerous but still carry enough energy to jeopardise their systems.

This dissertation undertakes the research of the interplanetary matter near the Earth using two different observational approaches. The first one is based on the detection of the sunlight reflected by the bodies. Individual bodies can be observed with the use of telescopes, they are the asteroids. For objects close to the Earth the accessible range in size is wider, down to the decametre size and consequently this population are a probe to general population of asteroids in the Solar System. Especially if we consider that recent works suggest that objects larger and smaller than 200 m could be two different populations, being the smaller monolithic bodies while larger ones are more likely rubble piles. And we only have access to the smaller population if they come close enough to be observable. The detection and characterisation of this nearby population require networks of medium-sized telescopes to survey and track them. We design a robotic system (the TBT telescopes) for the European Space Agency as a prototype for a future network. The first unit is already installed in Spain and we present the results of the commissioning. Additionally we evaluate the expected performance of such an instrument using a simulation with a synthetic population. We consider that the system designed is a powerful instrument for nearby asteroid discovery and tracking. It is based on commercial components and therefore ready for a scalable implementation in a global network.

Meanwhile the bodies smaller than asteroids are observed as meteors, using the atmosphere as a detector. We conduct the investigation of these meteors to study the meteoroids. On one hand we explore the size/mass frequency distribution of meteoroids using flux determination when they collide into the atmosphere. We develop a method to determine this flux using video observations of meteors and analyse the properties of meteors as an optical proxy to meteoroids in order to maximise the detection. First we design and develop a meteor all-sky detection station for Observatorio UCM and use the Draconids 2011 campaign as a showcase for the flux determination, with successful results. Then we investigate the observation of meteors with instruments in stratospheric balloons, overcoming troposphere handicaps like weather or extinction. We have designed and tested instrumentation for balloon-borne missions, and analysed the data of the Geminids 2016 campaign, determining the flux of meteoroids in a moment close to the maximum. On the other hand we design a filter set for narrow-band photometry for meteoroid characterisation, equivalent to low-R spectroscopy. We find the V-R colour to have a significant dependence to meteor speed and meteoroid composition, what implies a significant detection bias for unfiltered or broadband instruments.