The TRAPPIST comet survey

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TRAPPIST (TRAnsiting Planets and PlanetesImals Small Telescope) is a 60-cm robotic telescope that has been installed in June 2010 at the ESO La Silla Observatory [1]. Operated from Liège (Belgium) it is devoted to the detection and characterisation of exoplanets and to the study of comets and other small bodies in the Solar System. We describe here the hardware and the goals of the project and give an overview of the comet production rates monitoring after three years of operations.

The telescope and observatory — TRAPPIST's optical tube unit is a Ritchey-Chretien 0.6 meter telescope with a focal length of 4.8 meter. It is associated with a German equatorial mount that is, thanks to its direct drive system, extremely fast (up to 50 deg/s), accurate (tracking accuracy without autoguider better than 2" in 10 min), and free of periodic error. The instrument is a Peltier cooled commercial camera equipped with a Fairchild 3041 back-illuminated 2k×2k chip. The pixel scale is 0.64"/pixel. Three read-out modes are available, the shortest read-out time being 2s. The total field of view of the camera is 22'×22'. It is associated to a custom-made dual filter wheel. One of the filter wheel contains broad band filters (Johnson B, V, R, Cousins Ic, Sloan z, and a special I+z filter), while the other contains the narrow-band NASA HB cometary filters (OH, NH, CN, CO+, C3, and C2 gaseous species; UC, BC, GC and RC solar continuum windows and a NaI D filter) [2]. The telescope is protected by a 5 meter diameter dome that was totally refurbished and automatized. The observatory is fully robotic and equipped with a weather station, an UPS and webcams. The la Silla site is excellent with more than 300 clear nights per year and the telescope has proven to be very reliable with a small amount of technical downtime.

Comet monitoring — For relatively bright comets ($V < 12$) we measure several times a week the gaseous production rates (using a Haser model) and the spatial distribution of several species among which OH, NH, CN, C2 and C3 as well as ions like CO+. The dust production rates (Afrho) and color of the dust are determined through four dust continuum bands (UC, BC, GC, RC). Such regular measurements are rare because of the lack of observing time on larger telescopes. Yet they are very valuable as they show how the gas production rate of each species evolves with respect to the distance to the Sun. Those observations allow to determine the composition of the comets and the chemical class to which they belong (rich or poor in carbon for instance [3]), possibly revealing the origin of those classes but also if there are some changes of the abundance ratios along the orbit (evolutionary effects). Indeed with half a dozen of comets observed each year — and as long as possible along their orbit — this program will provide a good statistical sample after a few years. We will present the results of this monitoring after three years of operations.

Thanks to the way the telescope is operated, follow-up of split comets and of special outburst events is possible right after an alert is given and can bring important information on the nature of comets. In addition to providing the productions rates of the different species through a proper photometric calibration, image analysis can reveal coma features (jets, fans, tails), that can lead to the detection of active regions and measure the rotation period of the nucleus. The monitoring is also useful to assess the gas and dust activity of a given comet in order to prepare more detailed observations with larger telescopes. Such data can be obtained at any time under request. Finally a dozen of faint comets ($V < 20$) are monitored once a week through B, V, Rc, Ic filters and magnitudes and positions are sent to the MPC.

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References: [1] Jehin et al., The Messenger, 145, 2–6, 2011. [2] Farnham et al., Icarus, 147, 180–204, 2000. [3] A'Hearn et al., Icarus, 118, 223–270, 1995.