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Activity processes fuelling the Main Belt Comets characterized via a "Large Program" at ESO

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Abstract

A "Large Program" was set up on the ESO NTT on La Silla to characterize a set of Main Belt Comets. This paper is a status report.

Introduction

The Main Belt Comets display cometary-like dust clouds, yet are believed to have formed in the asteroid Main Belt. Determining the nature of the processes releasing the dust will have fundamental implications on our understanding of the formation and evolution of the asteroid belt and of the Solar System. In particular, if some of these objects are genuinely cometary active, i.e. if the dust is released through the sublimation of water ice, this would indicate that there is a reservoir of water in the Main Belt, in addition to the Oort Cloud and the Kuiper Belt. As delivery from the Main Belt to Earth is much more efficient than from the two other reservoirs, the Main Belt Comets could have played a significant role in the origin of the oceans.

Observations

A program to characterize and monitor a set of these objects has been set up on the ESO 3.6m New Technology Telescope on La Silla. This program takes advantage of the ESO "Large Program" category, which extends over 4 years, i.e. covering almost a full revolution of the objects on their orbit. All the observations are performed with the visible spectro-imager EFOSC. They consist of long series of *R* exposures interleaved with other filters. These observations can be combined to produce rotation light-curves and very deep composites. As of today, 6 of the total of 8 runs covering a total of 4 years have been completed. About 35% of the observing time was lost to bad weather. All the data are processed and calibrated.

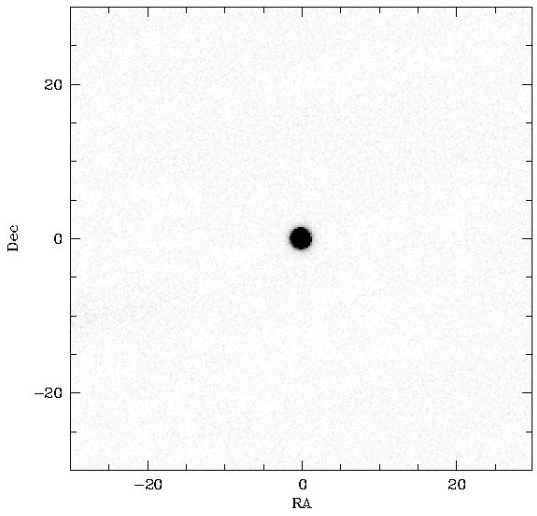

Figure 1: Comet 176P/LINEAR.
Deep *R* composite showing no sign of activity while the object was observed right after perihelion.

Highlights

Comet 133P/Elst-Pizarro was found inactive on two epochs at large heliocentric distances, as expected.

176P/LINEAR was also found inactive (Fig.1) while observed right after perihelion, at about the same position as when discovered active in 2005.

P/2010 R2 La Sagra, 238P/Read and 300163 showed dust features: 238P/Read, observed soon after perihelion, displays a small, compact coma suggesting it is undergoing cometary activity. 300163 has a tail/anti-tail structure, also indicating it was active at the time of the observations, but the second tail corresponding to larger dust grains ejected some times before the observations. P/2010R2 has a very long, very narrow tail (Fig.2). Its morphology and its surface brightness profile are compatible with recent cometary activity, that would have ceased before the observations.

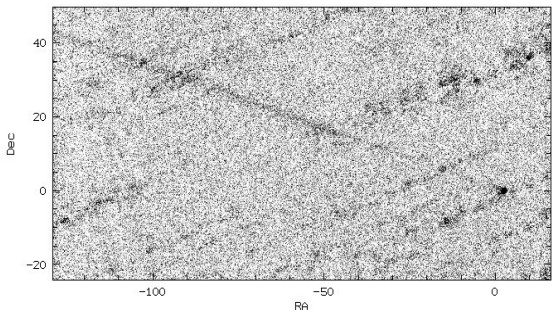

Figure 2: Comet P/2010 R2 La Sagra.
R composite from 2011-Dec, showing a long tail extending over 2.5'.

P/2010 A2 LINEAR was observed soon after its discovery, showing a long, narrow tail following a detached head displaying a complex structure of arcs and knots. While some of us modeled the appearance of the object with a extended period of water-driven cometary activity [1], other members of this team and other groups consider the tail and the complex structure to correspond to a very short release of material caused by the impact of a very small asteroid [2,3,4,5]. An impact was also considered as the source of the dust that was found surrounding 596 Scheila [6,7].

Summary

Some of the Main Belt Comets are clearly the result of recent impacts by small asteroids. As more are discovered and characterized, they will constrain the physics of impacts (in real-size, and not by extrapolating laboratory experiments over many orders of magnitude). They will also constraint dynamical models for collisions in the Main Belt, and give direct estimation of the dust grain content in the Zodiacal Light.

Other objects behave as honest, sublimating comets. In particular, 133P/Elst-Pizarro and 238P/Read have shown recurrent activity around perihelion. It is therefore very likely their activity is caused by water ice sublimation.

Finally, for some objects, the process causing the release of dust is still unknown. The fact that 176P/LINEAR was not active at its last passage through perihelion could indicate that the activity at the time of its discovery had been caused by a more exotic process, such as rotational ejection of dust, or even shaking by a minute collision [8].

Acknowledgements

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