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A continuous follow-up of Centaurs, and dormant comets: looking for cometary activity.

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MOTIVATION FOR THIS MONITORING

To better understand the origin, nature and evolution of the Kuiper Belt Objects (hereafter KBOs) it is needed a characterization of the physical properties of these primitive bodies. We expect that these remote and pristine bodies are rich in ice and other volatiles. They also probably played an important role in the enrichment in volatiles of the solar system inner planets. In fact, the dynamic patterns and the structure of the KB, populated by large ice-rich bodies probably subjected to complex collisional histories are opening new questions. They are for example suspicious of being the source of Centaurs, and Jupiter Family Comets (JFCs) [1]. In fact, the present day known Centaurs are ice-rich bodies that follow unstable orbits crossing those of Saturn, Uranus, and Neptune. On the other hand, modelling of JFCs evolution suggests that some are able to get incorporated into the NEO population via a close encounter with Jupiter. These presumably weak bodies are subjected during their inner solar system stays to solar irradiation, collisions, and close approaches that are probably disrupting them in short timescales [2, 3]. To perform a continuous monitoring of Centaurs, and other unusual bodies is interesting because they are little-studied bodies that are probably representing a transition among the different populations [4, 5].

The recent discovery of the activity of some Centaurs (like e.g. C/NEAT 2001T_4, 174P/2000 EC_{98}, P/2004 A_1 (LONEOS), and 2004 PY_{42}) suggests that many of these bodies exhibit cometary activity [6, 7, 8]. As they are located to moderately large heliocentric distances, the detection of activity can provide interesting constrains on the sublimation mechanisms that originated such activity. During the last 6 years we have been monitoring one of the most famous Centaurs, comet 29P/Schwassmann-Wachmann 1, that exhibits unusual changes in their coma appearance and brightness [9].

Encouraged by our previous results of Centaur 29P/ and 17P/Holmes [10], and knowing that many Centaurs are bright enough for being followed by using medium-sized telescopes, we are currently developing a continuous monitoring of several Centaurs. Our group is also including in this follow-up some unusual objects that seem to exhibit a cometary behaviour, but were initially catalogued as asteroids belonging the NEO populations. These studies are clearly complementary of our searches for dormant comets on the basis of the meteoroid streams that they (or their progenitors) produced [11].

METHODS

We are currently performing this monitoring by using medium aperture telescopes and a standardized photometric method for a 10 arcsec aperture in order to detect cometary activity in different filters (typically V, R, I and CO) of the Johnson-Kron-Cousins system. Our photometric coverage consists of a continuous study of the magnitude, and FWHM of these objects in the above mentioned filters with instruments ranging from 0,3 to 1.5m in diameter (Table 1). We use the USNO A2.0 for photometry [9].

Observatory	Instrument
Gualba, Barcelona	SC 36.0 f/6
Guadarrama, Madrid	SC 20 f/10
Fundació Observatori Esteve Duran (FOED), Barcelona	C 61 f/6
IAC80, Obs. Teide, Tenerife.	C 80 f/11.3
Montsec Astronomical Observatory (OAdM)	SC 80.0 f/10

Table 1. Observatories involved in the present studies.

PRELIMINARY RESULTS

Among the Centaurs that we have selected for a continuous coverage with different filters are 29P/Schwassmann-Wachmann 1 (hereafter SW1), 52872 Okyrhoe, and 2005 WY_3. We have previously reported that after a 6 year coverage comet SW1 exhibit a outburst occurrence with a frequency of 7.3 outbursts/year [7]. Such value is almost twice than the previously thought. SW1 outbursts are typically characterized by the sudden increase of 1 to 4 magnitudes in the brightness of the object. We have found no clear periodicity in the outburst production. Highly changing surface processes (perhaps associated with transition from amorphous to crystalline water ice) are suspected to be responsible for the observed behavior.

Other interesting object is the Centaur 52872 Okyrhoe. Light curves obtained by the Hubble Space Telescope of this object [9] are showing a period of 16.6 hours with a complex double-peaked curve. The object shows a stellar-like appearance in our images (see e.g. Fig. 1), but exhibited important magnitude variations during March and April of 2008. We found that such magnitude variations are following an amplitude of 0.2 magnitudes as was previously reported [6, 12]. In any case, the object was significantly brighter than expected during April 2008.

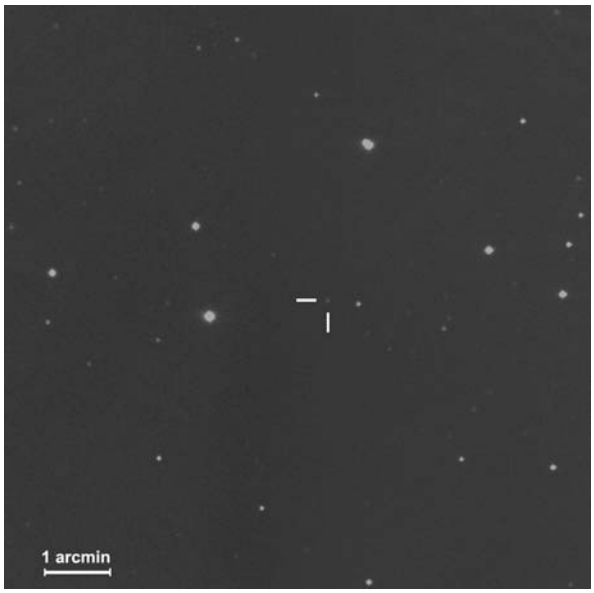

Fig. 1 Infrared image of 5 minutes of exposure of Centaur 52872 Okyrhoe obtained from IAC80 telescope (IAC) on Apr.21.932, 2008.

Figure 2 is a graph showing these magnitude variations, and how this body was even one magnitude brighter than expected from [13]. We plan to continue monitoring this object in order to understand if this pattern would be associated with sublimation of volatiles. In fact, the pristine nature of 52872 Okyrhoe has been recently revealed by spectroscopy. The reflectance spectrum has been modelled with a mixture of kerogens, olivines, and water ice [14].

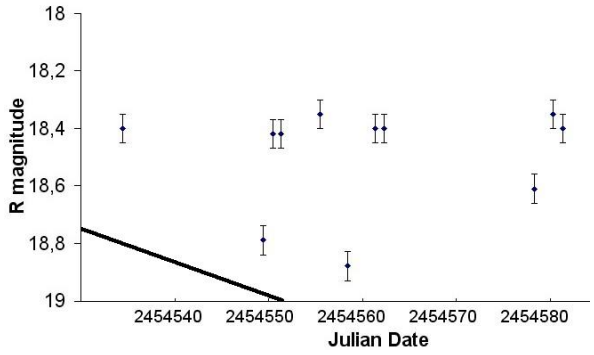

Fig. 2 R magnitude observations of Centaur 52872 Okyrhoe during March and April of 2008. The line indicates the V magnitude predicted by the *Minor Planet Ephemeris Service*.

Among the unusual asteroids that we are following we have recently noticed a possible cometary behaviour of 2003TS9 (also designated as K03T09S). On May 28 (Fig.3) this object exhibited a diffuse appearance (FWHM of 4.2), possible indicating the presence of a comma. On that night its R magnitude was 18.3, about one magnitude brighter than expected from [13].

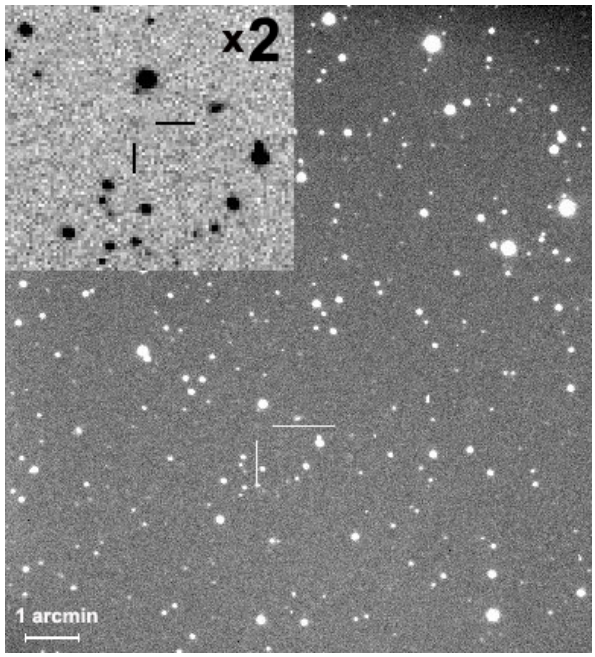

Fig. 3 Sum of three images of 2 minutes of exposure of 2003TS9 taken from Gualba Observatory (MPC442) on May 27.9202, 2008.

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