FOLLOW-UP OF COMET-ASTEROID TRANSITION OBJECT 107P WILSON-HARRINGTON DURING ITS 2009 RETURN TO PERIHELIUM

J. M. Trigo-Rodríguez[1,2], J. Lacruz[3], A. Sánchez[4], D.Rodriguez[5] and D.A. García-Hernández[6]. [1]Institute of Space Sciences (CSIC). Campus UAB, Facultat de Ciències, Torre C5-2[a] planta. 08193 Bellaterra, Spain; [2]Institut d'Estudis Espacials de Catalunya. Gran Capità 2-4, Ed. Nexus. 08034 Barcelona, Spain; [3] La Cañada Observatory, Ávila, Spain; [4] Gualba Observatory, Barcelona, Spain; [5] Guadarrama Observatory, Villalba, Madrid, Spain. [6] Instituto Astrofísico de Canarias, La Laguna, Tenerife, Spain.

Introduction: An important fraction of the Near Earth Objects (NEO) population is formed by dark bodies that are suspicious of being dormant comets. It is roughly estimated that about a 10% of the NEOs are Jupiter-family comets (JFCs) [1]. These transition objects that represent the last stages of cometary evolution are among the most fascinating objects that we can find in the Earth's vicinity, and are important contributors to present impact hazard [2]. In fact, they are particularly dangerous projectiles because they have extremely low albedos with surface reflectivity typically below 0.04. Our research group is monitoring some of these bodies with medium-sized telescopes in order to identify unusual outgassing activity or sudden outbursts [3].

The main goal is obtaining opportunity of observing these unexpected events with bigger telescopes, and performing high resolution spectroscopy when feasible. One of our currently selected targets is comet 107P/Wilson-Harrington that can also be a target of the Marco Polo mission. This comet was discovered in November 19, 1949 by Albert G. Wilson and Robert G. Harrington at Palomar Observatory. Only three photographic sessions on Nov 19, 22 and 25 1949 were obtained. In just one of the plates the body exhibited a clear cometary aspect (see Fig. 1), after that, the comet was lost. Thirty years later, on November 15, 1979 an Apollo asteroid was found by Eleanor F. Helin also from the Palomar survey. The object received the designation 1979 VA, but when re-observed on Dec. 20, 1988 received the permanent number 4015. On 1992 Brian Marsden [5] noted the orbital similitude between both, the active comet observed on 1949 and "asteroid" 4015.

The geometry of this return is similar to that of the comet's discovery in 1949, although the minimum geocentric distance is in this apparition somewhat larger (see Fig. 2). No signs of activity have been identified since the discovery in 1949, where the comet exhibited an evident tail, but no distinguishable coma [4]. As a consequence, it has been proposed that the 1949 activity was impact-moduled [6].

Methods: We are conducting a monitoring program of ground-based photometry by using standard Johnson-Cousin filters. Guided exposures are stacked to achieve good signal/noise ratios in order to determine the presence or absence of cometary activity from the FWHM statistics (see e.g. Fig. 4) and photometric growth curves.

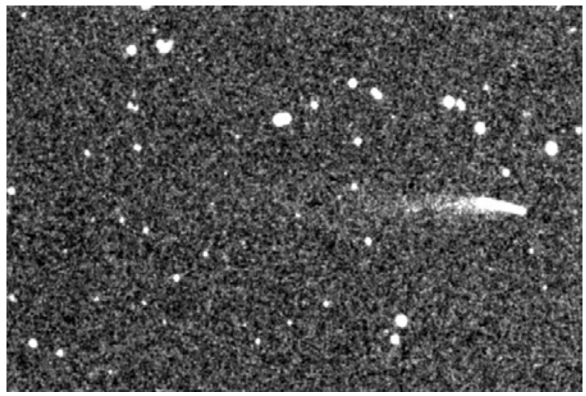

Figure 1. The only image where the object has been recorded showing cometary activity is this POSSI Blue plate taken 19 Nov 1949. [7]

We have been monitoring this object on different nights from four observatories (see Table 1). Our photometric coverage for simplicity has been focused in standard measurements in V and R filters. Photometry is standardized to an aperture of 10 arcsec and photometric growth curves have been studied using increasing photometric apertures, the growth curve of an extended object soon departs from that of a point like source. Using that approach we plan to cover the photometric and full width at half maximum evolution of the comet on its passage by the perihelium to try and detect possible traces of cometary activity.

Observatory (MPC code)	Instrument
Gualba, Barcelona (442)	SC 36.0 f/7
Guadarrama, Madrid (458)	SC 25 f/10
La Cañada, Ávila (J87)	RCT 40.0 f/10
Teide, IAC	IAC80

Table 1. Observatories involved in the present studies.

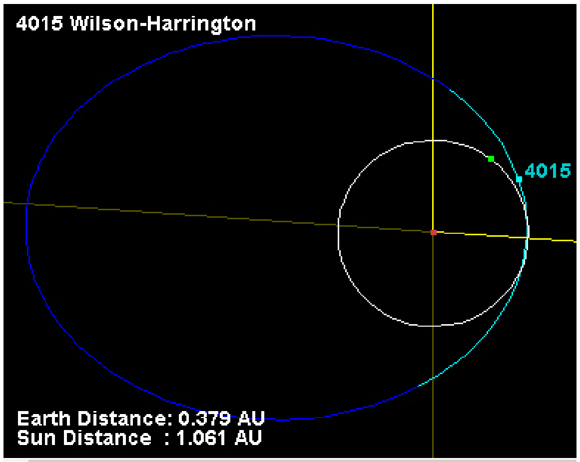

Figure 2. The geometry of the 2009 (2009 Nov 19) perihelium passage is quite favourable, in the 1949 apparition the heliocentric distance was 1.15 AU and the geocentric distance was 0.22 AU. (JPL Orbits)

Results and discussion:

No trace of cometary activity has been observed from the evolution of the measured magnitudes and from the analysis of the full width at half maximum and growth curves of the object compared to that of the surrounding stars. On the other hand, as an additional testing of this inactivity, a careful study of animations for the image sequences obtained every night was performed. No small features nearby the nucleus were found to rotate, so we conclude to the limits of the involved telescopes there has not been evidence of nuclear activity in this return (see Fig. 3).

Consequently, the detection of a strait tail during the 1949 discovery, and the absence of further activity since then supports an impact-induced origin for that behaviour. An impact would excavate the rubble mantle expected to cover these evolved comets [8], and produce significant debris to create a dust tail. Future monitoring of these objects will answer several open questions, particularly why some comets like 107P, Main Belt comet 133P/Elst-Pizarro, and NEO-comet 162P show a strait tail but no comma, and the limits of comma detection. We hope to contribute to the solution of these enigmas monitoring this and other intermittently active transition objects with a coverage without previous precedent.

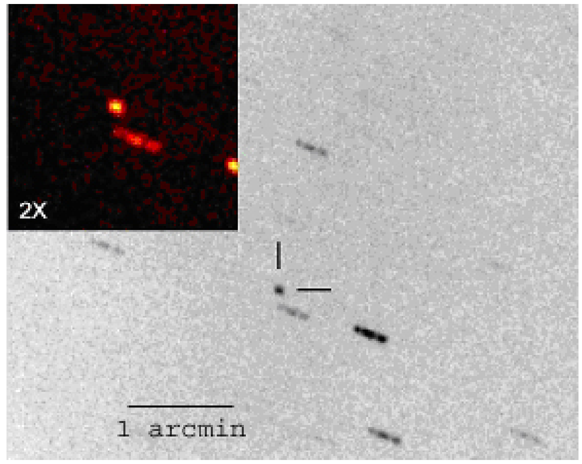

Figure 3. R filter image obtained from Gualba on Nov 28.76 UT, the object does not show any activity.

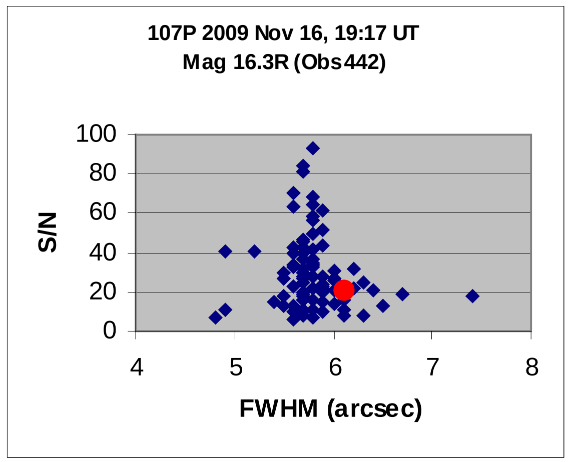

Figure 4. Statistics of the FWHM for the surrounding stars and the comet (red dot).

References: [1] Bottke, W.F. et al. (2002) Icarus 156, 399; [2] Bottke, W.F. and Morbidelli, A. (2006), *Planetary Chronology Workshop*, LPI publ., abstract #6019. [3] Trigo-Rodríguez et al. (2009) *EPSC* Vol.**4**, abstract #739. [4]Fernández, Y.R. et al. (1997), *Icarus* **128,** 114. [5] IAUC 5585 Brian G. Marsden. [6] Beech M., and Gauer K. (2002) *Earth, Moon, and Planets* **88**, 211. [7] POSSI 465_10_103aO USNOFS Image and Catalog archive, United States Naval Observatory, Flagstaff station. [8] Jewitt, J. (2008) in *Trans-Neptunian Objects and Comets*, SAAS-FEE adv. Course 35, Swiss Society for Astroph. & Astron., Springer, pp. 1-78