LARGE METEOROIDS FROM THE 2P/ENCKE COMPLEX: ORBITAL DATA OF 2010 TAURIDS RECORDED IN THE FRAMEWORK OF THE SPANISH FIREBALL NETWORK. J. Dergham[1], J.M. Trigo-Rodríguez[1], J. Cortés[1], J.Alonso-Azcárate[2], P. Pujols[3], J.L. Ortiz[4], A.J. Castro-Tirado[4], J.M. Madiedo[5], J. Montanyà[6], and O. van der Velde[6]. [1] Institute of Space Sciences (CSIC-IEEC). Campus UAB, Facultat de Ciències, Torre C5-p2. 08193 Bellaterra, Spain (trigo@ieec.uab.es). [2] Universidad de Castilla-La Mancha (UCLM) Campus Fábrica de Armas, 45071 Toledo. [3] Agrupació Astronómica d'Osona (AAO), Carrer Pare Xifré 3, 3er. 1a. 08500 Vic, Barcelona. [4] Instituto de Astrofísica de Andalucía (IAA-CSIC), PO Box 3004, 18080 Granada. [5] Facultad de Ciencias Experimentales, Universidad de Huelva, Huelva, Spain [6] Electrical Engineering Dept. Universitat Politècnica de Catalunya 08222 Terrassa, Barcelona.

Introduction: Cometary disruptions are though to be an important source of Near Earth Objects (heareafter NEOs). A continuous monitoring of meteor showers from multistation networks on the ground allows to get valuable orbital information of large meteoroids producing fireballs. From such orbits can be established conections with the orbital elements of diferent asteroids or comets. In 2010 we started a program to get precise orbital information of very bright Taurid bolides in order to try to identify possible associations with members of the NEO population [1]. We have already identified some meteoroids that could be dynamically associated with some NEOs currently identified as members of the Taurid complex. This group of bodies is formed by about 20 NEOs that presumably formed by the fragmentation of a giant comet over the past 20-30 kyr [2-4]. Some of these bodies have orbital affinities to comet 2P/Encke, but recent studies have found other asteroids in Apollo-like orbits that can be good candidates to trace a progressive cometary disruption that at different stages as a by-product produced the Taurid meteoroid branches [3, 4]. It is important to remark that the NEOs associated with the Taurid meteoroid streams are presumably dark, as seems to confirm the spectral information obtained for the largests members (e.g. 16960 belongs to the B spectral class [5]). Consequently these bodies are among the most difficult and hazardous NEOs that remain to be discovered. In fact, the Tunguska object has been temptatively associated with the Taurid complex [6]. A recent paper also links the Earth's intersection with the debris produced by the disruption of the cometary progenitor with a possible Palaeolithic extinction occurred around 12,900 BP [7]. Our orbital studies of Taurid meteoroids could also identify other members of the complex by using association criteria and backwards integration of their orbits. In fact we have found some Taurid complex members that are exhibiting orbits not directly linked with the two main branches. Obviously, having the Taurid complex some members with about 100 meters in diameter [4], we suspect of the existence of much more bodies in such a range of sizes not discovered yet. These objects could also produce meteorite-droping bolides in determinate favourable geometric circumstances [1].

Technical procedure: A continuous monitoring of the night sky all over Spain is being made currently from 29 high-sensitivity video and CCD stations. This observational challenge involves the recording over a very large surface area of about 500,000 km^2. In order to achive this goal, state-of-the-art CCD and video cameras are operated by members and collaborators of the Spanish Meteor and Fireball Network (SPMN). We have used high-sensitivity 1/2" black and white CCD video cameras (Watec, Japan) attached to modified wide-field lenses covering a 120×80 degrees field of view. Coordinate measurements on the images were obtained for comparison stars and the bolide by using our implemented software package [8]. The fireballs studied here were imaged by high-resolution video cameras located in different SPMN nodes in Andalusia, Castilla-La Mancha and Catalonia. From the sequential measurements of the video frames and the trajectory length, the velocity of the bolide along the path was obtained. The pre-atmospheric velocity V_∞ was found from the velocity measured at the earliest part of the trajectory. An example of a –8 magnitude North Taurid recorded on Nov. 3 2010 at 00h07m45.5s UTC is given in Fig.1. The astrometric reduction from 20 stars was completed (Fig.2). Finally the orbit was computed using our recently developed Amalthea package [9].

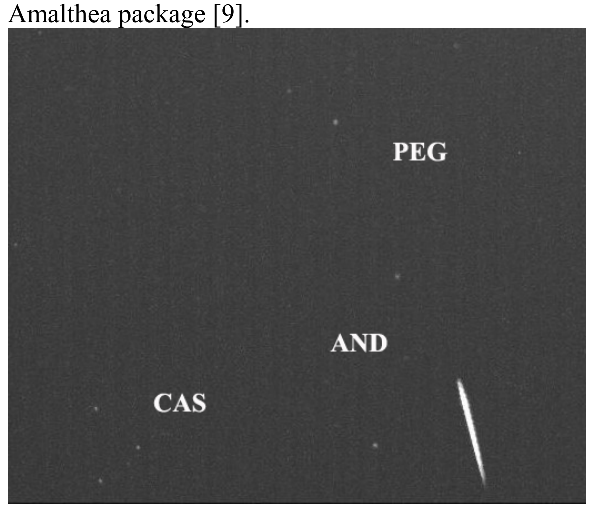

Figure 1: Composite image of SPMN031110 North Taurid as recorded from the (1) Folgueroles video station in Barcelona province operated by AAO.

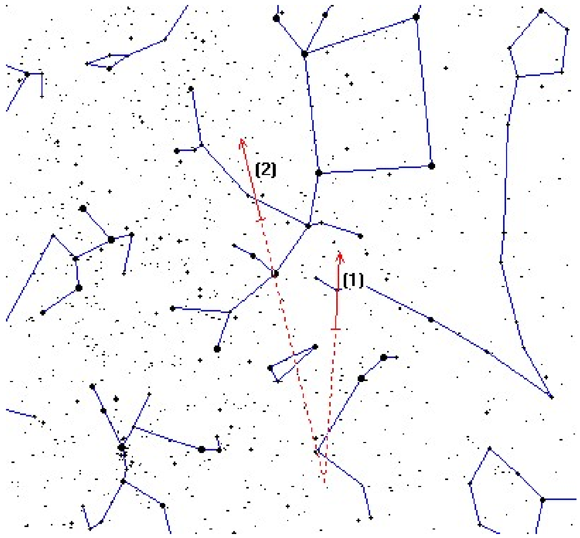

Figure 2. SPMN031110 as seen from (1) Folgueroles and (2) Montseny showing the apparent radiant determination.

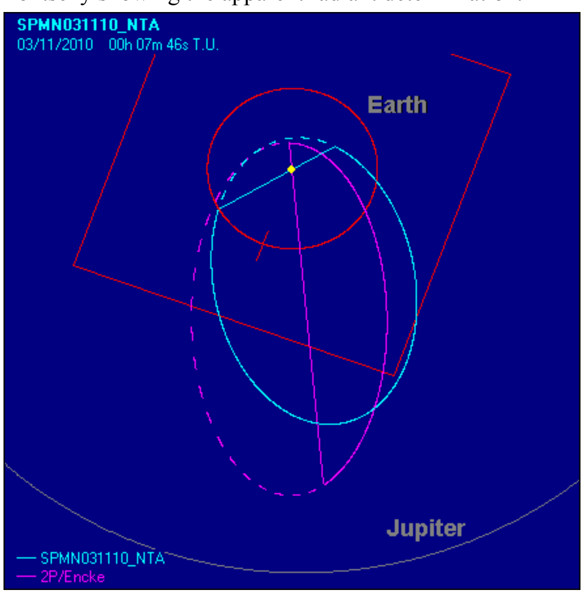

Figure 3. Comparison among the SPMN030110 and comet 2P/Encke orbits projected on the ecliptic plane (red square).

Discussion and conclusions: Orbital data for seven 2010 fireballs identified as Taurids in the SPMN imagery are presented. The main orbital elements of such orbits are compiled in Table 1. An accurate identification of the origin of the meteoroids producing these bright fireballs shows that most of the 2010 imaged Taurids were associated with the Northern Taurids branch. We plan to continue our program to increase the number of Taurid fireballs in previous and following years and confirm such type of asymmetries in the distribution of large meteoroids. Particularly we wish to find orbital evidence of the action of a mean motion resonance with Jupiter that presumably produce inhomogeneities in the flux arrived to Earth from the meteoroid streams [10]. As a following step of increasing the data sample we wish to average the orbits for the main branches, and perform backwards integration of selected events to found similitudes with other members of the Taurid complex.

References

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Code	Stream	Mv	q (AU)	a (AU)	e	i (º)
SPMN031110	NTA	-7	0.3936±0.0065	2.81±0.21	0.86±0.0011	8.57±0.49
SPMN031110	STA	-4	0.282±0.005	1.576±0.043	0.821±0.006	2.84±0.41
SPMN111110	NTA	-3	0.388±0.005	1.892±0.054	0.795±0.005	6.04±0.40
SPMN121110	NTA	-5	0.3253±0.0051	1.891±0.065	0.828±0.006	0.67±0.45
SPMN131110	NTA	-5	0.3126±0.0055	3.244±0.021	0.904±0.006	0.57±0.57
SPMN151110	STA	-6	0.4563±0.0071	1.185±0.023	0.615±0.009	7.37±0.37
SPMN161110	NTA	-4	0.3185±0.0048	1.857±0.066	0.828±0.007	0.95±0.39
2P/Encke	-	-	0.331	2.2144933	0.84833159	11.783072
16960	-	-	0.3135924	2.20344284	0.8576807	17.560493

Table 1. Orbital elements of selected 2010 Taurid fireballs compared with the largest members of the Taurid complex. NTA and STA makes reference to the North and South Taurid branches respectively. Mv is the estimated visual magnitude. All orbital elements are given for the 2000.00 Equinox.