SPANISH METEOR NETWORK: 2006 ALL-SKY AND VIDEO MONITORING HIGHLIGHTS.

J. M. Trigo-Rodríguez[1,2], J.M.Madiedo[3], A.J. Castro-Tirado[4], J.L.Ortiz[4], P.S. Gural[5], J. Llorca[6], J. Fabregat[7], S. Vítek[4], P. Pujols[8], and B. Troughton[9]. [1]Institut d'Estudis Espacials de Catalunya. Gran Capità 2-4, 08034 Barcelona, Spain (trigo@ieec.uab.es), [2]Institut de Ciències de l'Espai-CSIC. Campus UAB, Facultat de Ciències, Torre C5-p2. 08193 Bellaterra, Spain, [3]Universidad de Huelva, Spain, [4]Instituto de Astrofísica de Andalucía (IAA-CSIC), PO Box 3004, 18080 Granada, Spain, [5]Science Applications International Corp. 14668 Lee Road, Chantilly, VA 20151, USA, [6]Institut de Tècniques Energètiques, Universitat Politécnica de Catalunya, Diagonal 647, 08028 Barcelona, Spain, [7]Observatori Astronòmic, Universitat de València, 46980 Paterna, Spain, [8]Grup d'Estudis Astronòmics and Agrupació Astronòmica d'Osona, Barcelona, Spain, [9]Sociedad Malagueña de Astronomía, Málaga, Spain.

Introduction: We previously reported [1] the first steps in the development of the SPanish Meteor Network (SPMN) by using innovative low-scan all-sky CCD cameras that are reaching +2/+3 meteor limiting magnitude [1]. During 2006 new progress has been made by setting up two additional all-sky CCD stations and three video stations in order to increase our atmospheric coverage of meteor and fireball activity [2]. During 2006, we have built the first cameras with (inner) rotating shutter in order to get measurements of meteor velocities. Additionally, for those all-sky CCD cameras still working without rotating shutter we have used video cameras for obtaining meteor velocities in the monitorized common fields. As a consequence of all this effort, valuable trajectory and orbital data of meteors and fireballs is being obtained. We focus here in a description of recorded activity of cometary meteor showers also including orbital information of one of the brightest fireballs observed last year. Particularly, we describe some Earth encounters with dense cometary meteoroid streams that can be useful for identifying a likely origin of recovered Interplanetary Dust Particles (IDPs).

Methods: CCD and video images of multiple-station meteors are astrometrically reduced by measuring the position of the meteors in reference to background stars. The astrometric measurements are then introduced into our *Network* software as described in [3], which provides the equatorial coordinates of the meteors with a typical all-sky astrometric accuracy of 0.01º. During high meteoric activity our software also allows us to predict the position of every reduced meteor from each one of the other working stations by assuming the typical values of ablation height. In this way, a quick search in the database for meteors appeared during the same observing interval in the predicted positions makes easy the identification of common multiple-station meteors. Once identified, the software estimates the atmospheric trajectory and radiant for each meteor. When a rotating shutter is used, from the position of the shutter breaks in the meteor path and the derived trajectory length, the velocity of the meteoroid in different points of the trajectory is derived. The preatmospheric velocity V_∞ is usually computed when the deceleration is measurable. Finally, in order to determine orbital elements from the measured radiant and velocity we are using the *MORB* program from the Ondrejov Observatory in the Czech Republic [4].

Results and discussion: From precise velocity determinations, we are obtaining orbital data from major meteor showers, but also from poorly-known meteoroid streams. Several low-velocity cometary showers were active during 2006. For example, between June 27 and July 4 we imaged four June Bootid fireballs associated with comet 7 P/Pons-Winnecke. Since the unexpected outburst detected in 1998 [5] this stream with geocentric velocity of only 14.1 km/s is a likely source of IDPs. Despite that the June Bootids exhibited in 2006 a low level of visual activity, the background of bright fireballs was remarkable. During July and August our cameras also recorded several α Capricornid fireballs that are typically associated with 45P/Honda-Mrkos-Pajdusáková [6], although other cometary sources have been suggested [7]. The brightest one occurred on July 20, 2006 at 22h24m41.5±0.1s UTC over Doñana Natural Park, reaching absolute magnitude -12±2. This interesting event is one of the brightest members of this stream ever recorded, with a estimated photometric mass of 500±200 kg. Fortunately, it was imaged from one all-sky CCD camera and one video camera that were monitoring the sky from La Mayora (Málaga) and Sevilla (Fig. 1). From the astrometric reduction of the double station images of the bolide we have estimated a geocentric radiant of RA= 300.95±0.14º and Dec=-14.44±0.12º and a V_∞=27.0±0.3km/s. The computed orbital elements (Eq. 2000.0) confirm its association with the α Capricornid stream (Table 1).

a (AU)	2.62 ± 0.09
E	0.798 ± 0.007
q(AU)	0.5273 ± 0.0026
ω (º)	274.77 ± 0.28
Ω (º)	117.97678 ± 0.00021
i (º)	4.96 ± 0.12

Table 1. Orbital elements of the Doñana bolide.

As our all-sky cameras are also able to record visual meteors [1], this advantage allow us to get privilegiated information on meteor showers activity. In fact, as a good example of our system capability, during October 2006 our all-sky cameras detected an unexpected Orionid outburst. While the typical Zenithal Hourly Rate (ZHR) of this meteor shower is 20 meteors/hour, the activity imaged during October 20-21 was three times higher [8]. This was confirmed by using the count rates obtained from the all-sky systems that had been corrected through a high fidelity meteor simulation. The simulation provides a means to account for sensor sensitivity characteristics, geometric loss terms, radiant position changes, and the meteor stream's particle distribution, as well a convert to a ZHR measure using a standard human observer's perception. The corrected SPMN counts were found to be 2.8 times stronger during the outburst than four hours later when the Orionid activity returned to normal yearly levels. However, a background of unusually bright Orionid fireballs was detected from Oct. 15-25. Being the parent body (1P/ Halley) far away when the activity increase occurred, outburst meteoroids seem to be trapped in a Jovian resonance. In the literature we found as only observed precedent the 1993 Orionid outburst observed from Holland by the Dutch Meteor Society [7]. Further reduction of all data will provide additional clues on the dynamics and origin of the outburst meteoroids [9].

The Earth crossed marginally the two-revolution dust trail of 55P/Tempel-Tuttle in the morning of Nov. 19, 2006. Our video cameras noticed an increase in the number of +1/+3 meteors at 4h45±10m UTC, just as theoretically predicted [10]. Several impressive bolides producing long-lasting (5-15 min.) trains were also recorded by SPMN all-sky cameras from Nov. 15-25. Finally, in December we recorded the display of the Geminid shower associated with 3200 Phaeton. Tens of multiple-station Geminid meteors have been obtained. After a first year of continuous SPMN operation the volume of data generated by CCD and video cameras is overwhelming. In any case, data reduction is in progress.

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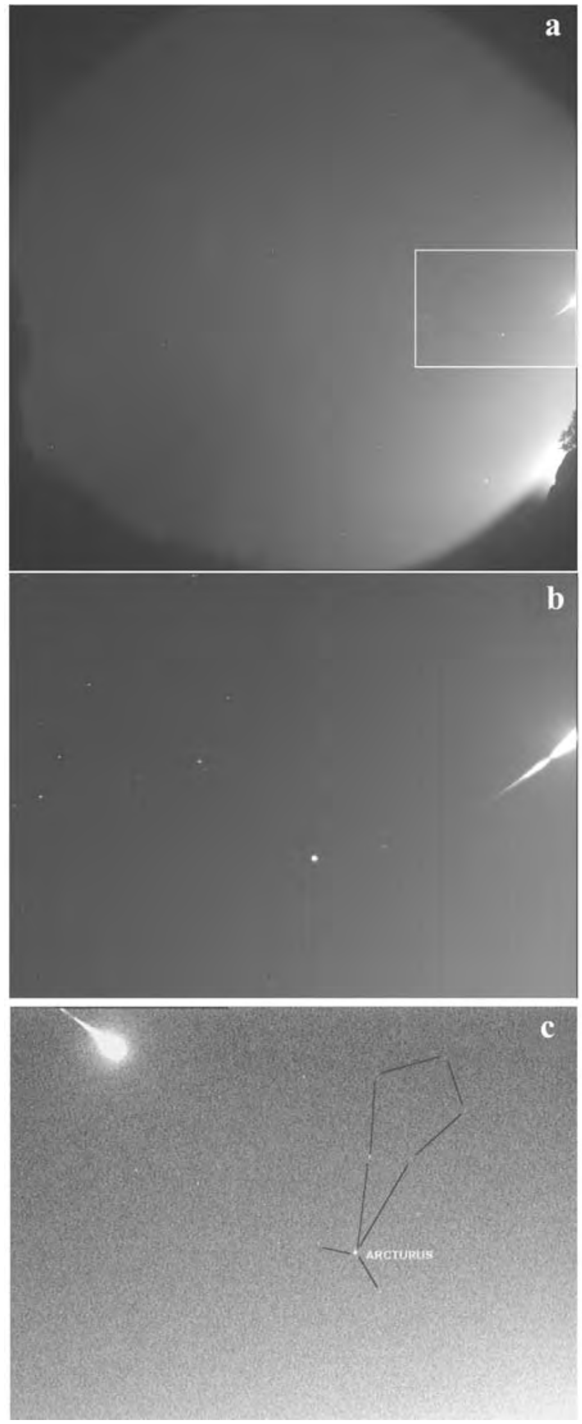

Figure 1. The SPMN010706 (Doñana) bolide imaged from the two stations. a) Full all-sky image from La Mayora (Málaga) showing the ending flares illuminating the western horizon. b) The area included in the white window of a) is magnified. c) Last frame recorded by the video system from Sevilla. Bootes constellation is clearly visible in *b* and *c*.