A 5-YEARS FIREBALL MONITORING EXPERIENCE OF AN ASTRONOMICAL ASSOCIATION OPERATING A HIGH-SENSITIVITY VIDEO STATION IN THE FRAMEWORK OF THE SPANISH METEOR NETWORK.

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Introduction: A continuous monitoring of meteors and fireballs appeared all over Spain is being made currently from 25 stations operated in the framework of the Spanish Meteor and Fireball Network (SPMN) [1-4]. 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 SPMN. Only few stations are operated by amateur astronomers that have demonstrated its capacity to keep a continuous work and sometimes capable to find their own fundings to set up the stations. One nice example is the Folgueroles video station operated by the Agrupació Astronómica d'Osona (AAO) that is monitoring the night sky for meteor and fireball events since 2009. Ours is only one of the seven stations currently operational in Catalonia, but one of the most productive thanks to the human effort provided by AAO members. The other Catalan stations of the SPMN network are operated by the Institute of Space Sciences (CSIC-IEEC), and a research group of the UPC Electrical Engineering Departament.

Methods: Folgueroles video station uses a system of 3 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 as is nicely exemplified in the figures shown in this abstract. These video cameras generate 25 frames/s that are used to perform accurate astrometry of detected meteor and fireballs. To have enough stars to perform astrometric measurements the different frames are added in order to create a composite image that under dark skies show stars until +7/+8 magnitude (see e.g. Fig. 1). Coordinate measurements on the images are obtained from the stars, while the bolide evolution is measured frame by frame using our implemented software package [9]. This is a crucial operation that requires experienced eyes in order to distinguish the evolution of the meteor head in the atmosphere. 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_∞ is found from the velocity measured at the earliest part of the fireball trajectory.

Preliminary results and discussion: The stations are continuously monitoring the night sky and then provide direct information on the meteor and fireball activity. Arrival of large meteoroids is noticed by extremely bright fireballs (Fig. 1-3). Detection of meteor outbursts has been also achieved with the example of an interesting Aurigid (AUR) outburst detected in 2012 produced by a unexpected dust trail of comet C/1911 N1 Kiess (see a bright AUR bolide in Fig. 4). Detection of extremely bright bolides gives clues on the origin of meteoroid streams produced in unusual ways, like e.g. after cometary breakups. That was the case of fireballs detected from several meteoroid streams [3-4].

Figure 1. A composite image of a –12 magnitude sporadic bolide recorded from Folgueroles station on Sept. 24th 2009 at 19h38m50.8s UTC (SPMN 240909). The fireball luminosity produced a reflection in the internal lenses (see the light tracks appeared on the upper part of this image).

Obviously, fireball detection is not the unique goal of our monitoring effort. From the astrometric measurements of the images taken from multiple stations the atmospheric trajectory, velocity and height are computed [2-5]. From the atmospheric trajectory and the measured initial velocity and geocentric radiant, the heliocentric orbit of the incoming meteoroids are determined. It is important to remark that as a by-product of all our effort in these years several undergraduate and PhD students have been able to specialize in the Institute of Space Sciences (CSIC-IEEC). In fact, this field of research and produce significant scientific contributions [4-8].

Figure 2. Composite image of a –12 magnitude North Taurids bolide associated with comet 2P/encke. It wa recorded from Folgueroles station on Oct. 19th 2010 at 04h40m30.3s UTC (SPMN 191010 "La Jonquera"). The trajectory, and the heliocentric orbit of this bolide was previously reported [8]

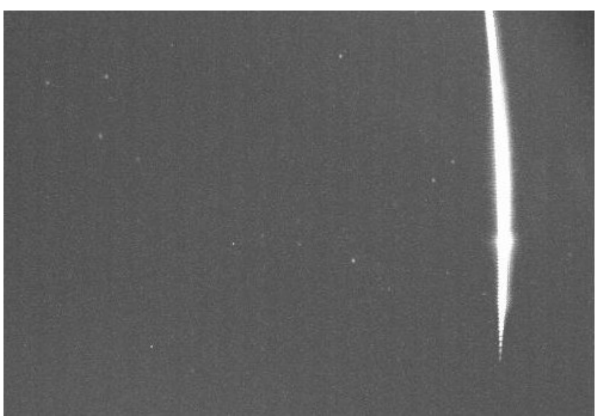

Figure 3. Composite image of a –10 magnitude October Capricornid bolide associated with a large meteoroid from disintegrated comet D/1978 R1 Haneda-Campos. Recorded from Folgueroles station on Oct. 12th 2011 at 22h45m27.3s UTC (SPMN 121011). Cassiopeia, and Perseus constellations are easily identifiable constellations.

Conclusions: We are really satisfied of this experience sharing knowledge with SPMN scientists. We will keep future operation of Folgueroles station for identifying probable meteorite-dropping bolides, and meteor outbursts. Meteorites are valuable samples of other solar system bodies, but usually are recovered without information regarding their progenitors. Our effort tries to increase the available number of recovered meteorites with orbital information. Such information is crucial to better understand the dynamic processes behind the delivery of meteorites to Earth. Recent results suggest that the main asteroid belt might not be the only source, Near Earth Objects (NEOs) and Jupiter Family Comets (JFCs) populations may also be significant. We hope that our common effort provide new scientific highlights in this regard.

Figure 4. Composite image of a –9 magnitude Aurigid bolide recorded from Folgueroles station on Sept. 1st 2012 at 02h19m24.8s UTC (SPMN 010912). The summer triangle is clearly seen around the image center while the full Moon is visible in the left border. It is a good example of cameras capabilities.

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