ON THE CHEMICAL COMPOSITION AND ORBIT OF A DIURNAL FIREBALL. F.M. Toscano[1], J.M. Madiedo[2], J.L. Ortiz[3], A.J. Castro-Tirado[3], J.M. Trigo-Rodríguez[4], S. Pastor[5] and J.A. de los Reyes[5]. [1]Facultad de Química. Universidad de Sevilla, 41012 Sevilla, Spain. [2]Facultad de Ciencias Experimentales, Universidad de Huelva, Huelva, Spain. [3]Instituto de Astrofísica de Andalucía, CSIC, Apt. 3004, 18080 Granada, Spain. [4]Institute of Space Sciences (CSIC-IEEC). Campus UAB, Facultat de Ciències, Torre C5-p2. 08193 Bellaterra, Spain. [5]Observatorio Astronómico de La Murta. Molina de Segura, 30500 Murcia, Spain.

Introduction: In general, meteor and fireball imaging systems operate during the night, as these mostly employ high-sensitivity recording devices that get fully saturated even under twilight conditions. Low-sensitivity video cameras can be an option to monitor fireball activity in broad daylight [1], although the calibration of the images to get precise astrometries is more complex. But some high-sensitivity CCD cameras with attached autoiris lenses can also operate for some period of time before sunset and after sunrise. These have the advantage that image calibration is straightforward, as these cameras can reach a limiting magnitude of +3/+4 and, so, stars recorded by the same devices during the night can be used as a reference for the astrometric calibration of fireballs recorded during the day. This can be very useful to get precise trajectory, radiant and orbital information of very bright bolides that occur in daylight conditions.

Some of the meteor observing stations operated by the SPanish Meteor Network (SPMN) are currently monitoring the night sky with high-sensitivity CCD video cameras configured in such a way that they can also operate during a part of the day. In this context, we present here the preliminary analysis of a three-station sporadic diurnal fireball with an absolute magnitude of about -8±1 imaged at dawn on June 1, 2011.

Methods: We have employed high-sensitivity CDD video cameras (Watec Co., Japan) endowed with fast (f1.0) aspherical autoiris lenses to image the three-station fireball analyzed here. The operation of these systems has been described elsewhere [2, 3]. Two of the monitoring stations (Sierra Nevada and La Hita) work in an autonomous way by means of proper software [4]. The third station that recorded this event (La Murta) operates from the province of Murcia. Besides, some of these CCD video cameras have attached holographic diffraction gratings (1000 lines/mm) to obtain chemical information from the emission spectrum produced during the ablation of meteoroids in the atmosphere [5, 6, 7, 8]. Although these devices were designed to monitor the night sky, they can also work under daylight conditions for about 1-2 hours after sunrise and before sunset, depending on their orientation. Thus, cameras pointing far from East can extend their operation period during the first hours of the day while those pointing far from West are favoured before sunset. As this fireball occurred during the day, no stars appear in the corresponding images. Stars recorded by the same cameras during the night have been used to perform the astrometric calibration of the images. This has been done with our software Amalthea [9, 10]. The atmospheric trajectory and orbital parameters were obtained as usual [9].

Results and discussion: The mag. -8 sporadic fireball analyzed here (code SPMN010611) was simultaneously recorded from three SPMN meteor observing stations on June 1, 2011 at 4h09m06.3±0.1s UT, a few minutes after sunrise (Fig. 1). The radiant and orbital parameters of the fireball are shown on table I. The preatmospheric velocity calculated from the velocities measured at the beginning of the meteor trail was V_∞=30.0 ±0.3 km/s. Its heliocentric orbit has been plotted in Figure 2.

The emission spectrum could also be imaged from Sierra Nevada. Although it was obtained under unfavourable conditions because of daylight, major features can still be recognized. It was calibrated in wavelengths by using typical metal lines (Ca, Fe, Mg, and Na multiplets) and corrected by taking into account the efficiency of the imaging device. The raw spectrum is shown on Fig. 2, where the processed spectrum obtained by our recently developed CHIMET software is also included. Most prominent lines correspond to Fe I-5 (374.5 nm), Ca I-2 (422.6 nm), Mg I-2 (516.7 nm) and Na I-1 (588.9 nm).

Radiant data			
	Observed	**Geocentric**	**Heliocentric**
R.A. (º)	256.2±0.3	253.8±0.3	-
Dec. (º)	16.4±0.3	15.0±0.3	-
Ecliptical longitude(º)	-	-	-162.7±0.4
Ecliptical latitude(º)	-	-	24.9±0.3
V_∞ (km/s)	30.0±0.3	28.2±0.3	40.5±0.3

Orbital data			
a(AU)	8.4±1.5	**ω (º)**	249.5±0.6
e	0.91±0.01	**Ω (º)**	70.1934±10^{-4}
q(AU)	0.698±0.004	**i (º)**	30.2±0.4
Q(AU)	16.2±3.0		

Table 1. Radiant and orbital data (J2000) for the SPMN010611 fireball.

Conclusions: We employ high-sensitivity CCD video cameras with fast lenses and attached holographic diffraction gratings to monitor meteor and fireball activity during the night. But these devices can be also used to image bright fireballs during the day when autoiris fast lenses are employed. Thus, we have obtained radiant, orbital and chemical information for a three-station mag. -8 sporadic diurnal fireball.

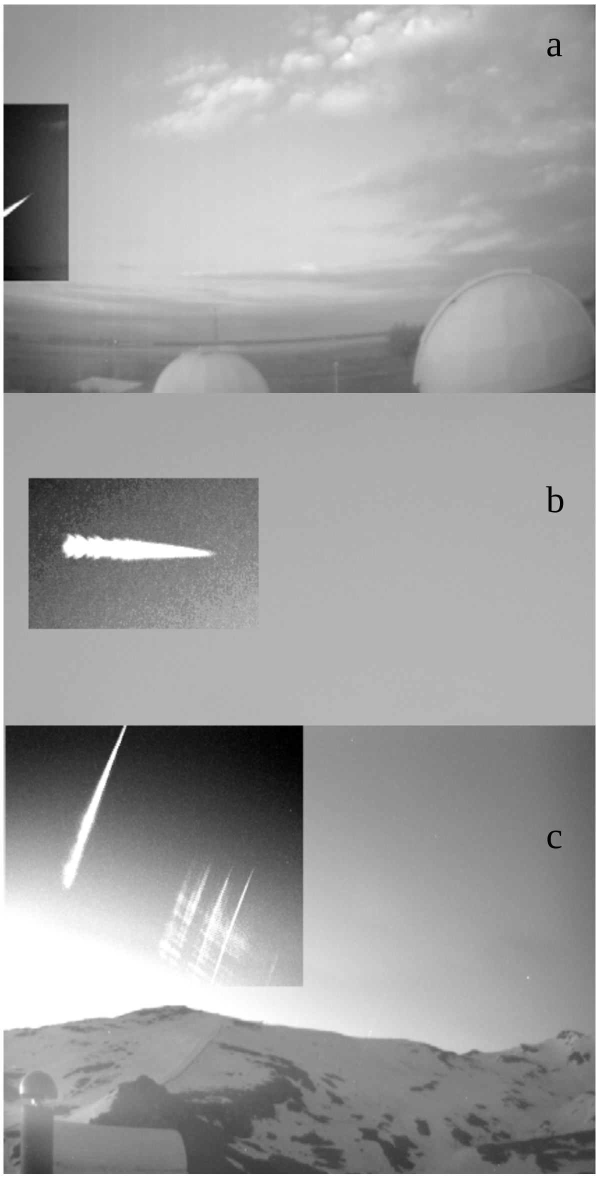

Figure 1. The SPMN010611 fireball imaged from a) La Hita b) La Murta and c) Sierra Nevada. The region containing the bolide has been contrasted for a better visualization of the event.

Acknowledgements:. We thank Fundación Astro-Hita for its support in the establishment and operation of the automated meteor observing station located at La Hita Astronomical Observatory (La Puebla de Almoradiel, Toledo, Spain). We also acknowledge support from the Spanish Ministry of Science and Innovation (projects AYA2009-13227, AYA2009-14000-C03-01, AYA2008-06202-C03-01 and AYA2011-26522) and CSIC (grant #201050I043).

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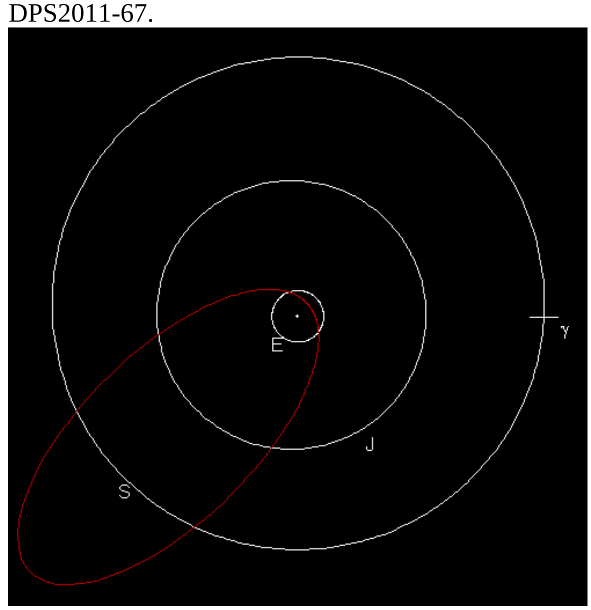

Figure 2. Heliocentric orbit of the SPMN010611 sporadic fireball. The orbits of Earth, Jupiter and Saturn have been included for comparison.

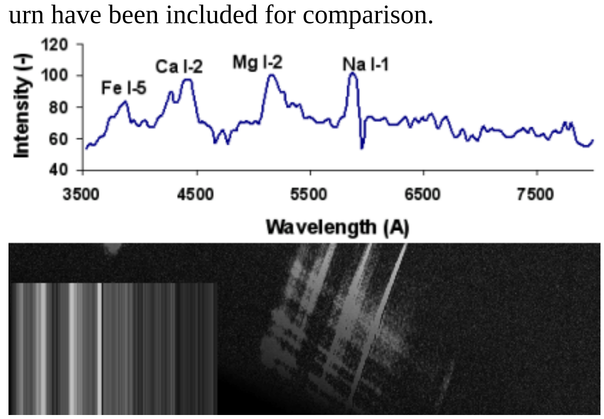

Figure 3. Raw and processed emission spectrum of the SPMN010611 fireball.