TWO LIKELY METEORITE-DROPPING BOLIDES RECORDED BY A NEW HIGH-RES ALL-SKY CCD CAMERA. J.M. Trigo-Rodríguez[1,2], A.J. Castro-Tirado[3], M. Jelínek[3], S. Vitek[3], J. Llorca[2,4] and J. Fabregat[5]. [1] Institut de Ciències de l'Espai-CSIC, Campus UAB, Facultat de Ciències, Torre C5-p2. 08193 Bellaterra, Spain. E-mail: trigo@ieec.uab.es, [2] Institut d'Estudis Espacials de Catalunya, Gran Capità 2-4, Ed. Nexus. 08034 Barcelona, Spain. [3]Instituto de Astrofísica de Andalucia (IAA-CSIC), P.O. Box 3.004, E-18.080 Granada, Spain. [4]Institut de Tècniques Energètiques, Universitat Politècnica de Catalunya, Diagonal 647. Ed. ETSEIB, 08028 Barcelona, Spain. [5]Observatori Astronòmic, Universitat de València, Spain.

Introduction: For several decades an important effort has been made to detect and record fireball events from the ground by using photographic cameras [1, 2, 3]. There was a much larger gap between the typical masses of the meteoroids detectable by ground-based camera networks. We think that this gap can be narrowed by using the new available technology. Among the new possibilities, the application of charge coupled devices (CCD) cameras to the detection and trajectory reconstruction of bright fireballs is an area under development. During 2005 continuous meteor and fireball observations were carried out by the first two stations of the SPanish Meteor Network (SPMN) that are currently located in Huelva and Malaga provinces (Spain). As a result of this continuous monitoring two extraordinary bolides were recorded. We describe the preliminary results obtained in studying both events and the implications for future meteorite recovery when the planned additional stations will be operative.

Methods: Since August 2005 all-sky CCD double-station observations have been performed from two stations of the SPMN located in Andalucia (Spain). We used a CCD detector of 4096×4096 pixels with a fish-eye lens described in [4, 5] for full-sky monitoring. The cameras were operated during night time (including during cloudy or Moon-illuminated skies) for 30 s in alternate exposures remotely sincronized. The location of the stations in the South of Spain assures night-sky monitoring during about 300 nights/year. The stellar limiting magnitude of the images is +10 in the zenith, and +8 below ~65º of zenithal angle. The extraordinary amount of images generated every night under the present configuration has required to develop strategies for data reduction. Low-resolution jpg images of the 33Mb-sized original images are created automatically in order to detect on-line the brightest fireball events. A movie of the images taken every night is automatically created and the fireballs are identified by visual inspection of the created sequences. Software development for fireball automatic detection is in progress. Unfortunately the cameras during 2005 were operated without rotating shutters and detailed information on the fireball velocities were not obtained. We are currently developing rotating shutters to solve this problem in the next future.

Results and discussion: The Ceuta superbolide appeared on June 30, 2005 at 2h21m22s±8s UTC. The event reached absolute magnitude -17±2 and was recorded by our two all-sky stations located in Andalusia. Astrometric measurements of the fireball trail in reference to the stars were made following the same procedures and methods described in [6]. The fireball entered into the atmosphere with an angle with the horizontal of ~66º and exhibited an extraordinary flare at the end of the trajectory (Fig. 1). Such a flare is likely linked with nearly complete desintegration of the meteoroid at an height of 62±2 km. The luminous trajectory length was 51±3 km. As a result of the accurate astrometric measurements, trajectory and radiant data were obtained (Table 1). The radiant provides a possible clue for the origin of this bolide. The June Lirids have a very similar radiant although the radiant is inactive for this data and typically produces faint meteors. On the other hand the estimated radiant seems too far away from the June Bootids radiant associated with 7P/Pons-Winnecke. However, the fireball was of the cometary type IIIB, as suggested by its light curve and early fragmentation. Despite of this, without velocity data is difficult to identify clearly the source of the event.

Trajectory data			
	Longitude (º)	Latitude (º)	Altitude (Km)
Begin	5.152 ±0.007	36.037 ±0.006	95.7 ±0.3
End	4.925 ±0.005	36.029 ±0.004	49.4 ±0.2
Radiant data (2000.0)			
R.A. (º)	279.2 ±0.1		
Dec. (º)	+33.5 ±0.1		

Table 1. Trajectory and radiant of the Ceuta superbolide (SPMN010605).

On July 30, 2005 at 0h03m15s±15s UTC another impressive event catalogued as SPMN010705 was recorded from La Mayora (Fig. 2). Fortunately, the event was also marginally recorded by a security video camera from Almeria. The estimated absolute magnitude of the fireball was -14±2. The meteoroid suffered continuous break-ups decreasing its luminosity. The images and visual reports suggest that it was a meteorite-dropping event. This is also supported by the fact

that the fireball exhibited light below 30 km and, additionally, several eyewitnesses reported a sonic boom probably associated with the bolide fragmentation in several pieces at the end of the trajectory.

Conclusions: The all-sky CCD system developed by our team have demonstrated excellent performances for fireball detection and trajectory reconstruction. The system is accessible remotely, providing a real time information on the fireball activity and it can be also used as cloud detector. In fact, remote access to the images will allow us to track meteorite falls in short time. The astrometric accuracy of ~1.5 arcminutes can provide detailed information of fireball trajectories. In the next future fireball velocities will be obtained by measuring the cuts produced by using rotating shutters. Assuming geocentric velocities for both bolides among 15 and 30 km/s the energy released in the atmosphere is one to two orders of magnitude below the Villalbeto de la Peña superbolide (a 0.02 kton event) recently studied by our network [7, 8]. Additional research on both bolides described here is in progress. The excellent performances of our all-sky CCD cameras will allow continuous monitoring of the night sky even under unfavorable circumstances. We hope that it will significantly increase the atmospheric volume covered for bolide detections around the world.

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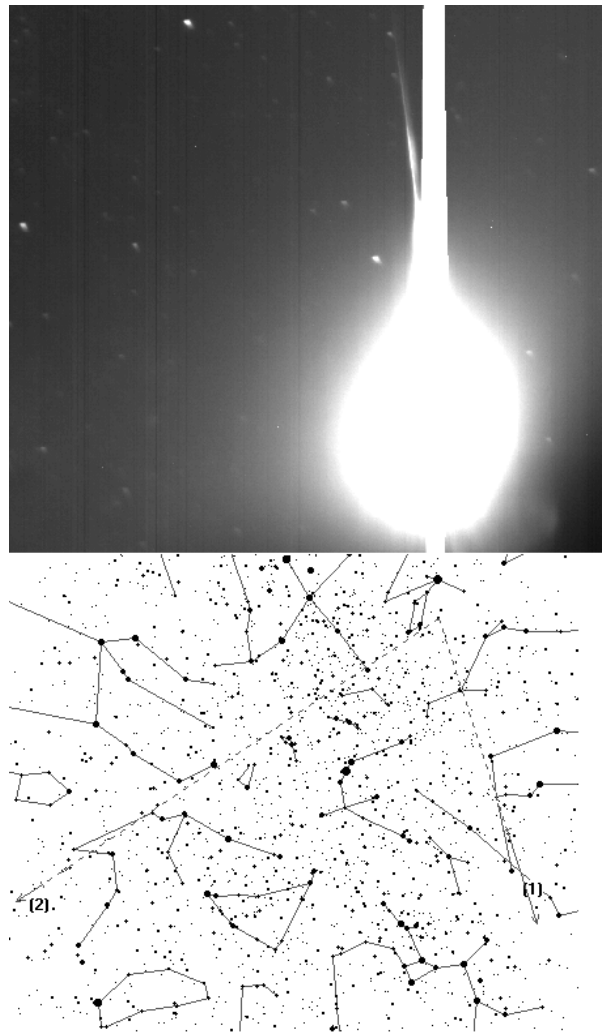

Figure 1. Top: A view of Ceuta superbolide as seen from El Arenosillo. Bottom: Apparent trajectory recorded from both SPMN stations: (1) El Arenosillo (2) La Mayora. From (2) was only recorded the bolide's beginning.

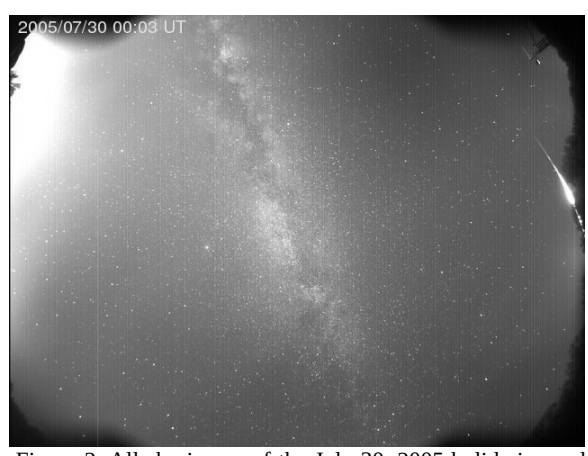

Figure 2. All-sky image of the July 30, 2005 bolide imaged from La Mayora station.