THE 2012 GEMINIDS BALLOON-BORNE MISSION OVER SPAIN.

A. Sánchez de Miguel[1], F. Ocaña[1], J.M. Madiedo [2, 3], F. Ortuño [4], A. Conde [4], P. León [4], M. A. Gómez Sánchez-Tirado [4], D. Mayo [4], R. Raya [4], J. Zamorano. [1], J. Izquierdo[1] and J.M. Trigo-Rodríguez [5].
[1]Dpto. de Astrofísica y CC. de la Atmósfera, Facultad de Ciencias Físicas, Universidad Complutense de Madrid, 28040 Madrid, Spain, alejasan@ucm.es. [2]Facultad de Ciencias Experimentales, Universidad de Huelva, 21071 Huelva, Spain, madiedo@uhu.es. [3]Dpto. de Física Atómica, Molecular y Nuclear, Facultad de Física, Universidad de Sevilla, 41012 Sevilla, Spain, [4]Asociación AstroINNOVA, c/Poeta Mohammed Iqbal, 6, 1º4, 14010 Cordoba (Spain), astroinnova@astroinnova.org, [5]Institute of Space Sciences (CSIC-IEEC). Campus UAB, Facultat de Ciències, Torre C5-p2. 08193 Bellaterra, Spain, trigo@ice.csic.es.

Introduction: Observing meteors from the stratosphere improves detection efficiency thanks to much lower extinction. Previous airborne missions have already monitored meteor outbursts. However due to their cost these missions are not suitable for annual meteor shower maxima. Thus meteor video detection with low-light cameras on-board weather balloons is a good approach to observe meteors in such ideal conditions [2].

The SPanish Meteor Network (SPMN) has 25 video and CCD observing stations currently operational [3-5]. The recording of multi-stations meteors and fireballs each night is only jeopardised by bad weather conditions. However the addition of balloon observations can improve observational results with bad weather during meteor maxima.

During the Geminids 2012 activity peak the Fireball and Meteor group of the Universidad Complutense de Madrid[6] launched a balloon in collaboration with *Proyecto Daedalus* [1]. During that night the sky was unfortunately covered in several SPMN stations of central Spain. However the camera on-board our balloon detected several Geminids from the troposphere and the stratosphere, allowing double-station detection with stations with clear skies located over more distant SPMN stations in the Iberian Peninsula.

Balloon and instrumentation: In order to have as much stable flight time, the mission used two balloons. One is intended to raise the probe to the stratosphere, and the other to maintain almost neutral buoyancy during the mission and to perform a soft landing.

The probe consisted of a control and recovery system, equipped with a set of micro processors, an Arduino board and an Android cell phone. The scientific payload was two redundant recording systems.The first one was a 902H Watec low-light camera and a "fanless" computer to avoid overheating. The camera fed also a backup DVR. The ground station had two-way communication for transmission of GPS position and condition monitoring systems (camera temperature, temperature of the computer, etc.). The phone gave us 3-axis position with its accelerometers and GPS position up to 18,000 m. The use of GPS beyond this level is illegal and we used models to estimate the probe position.

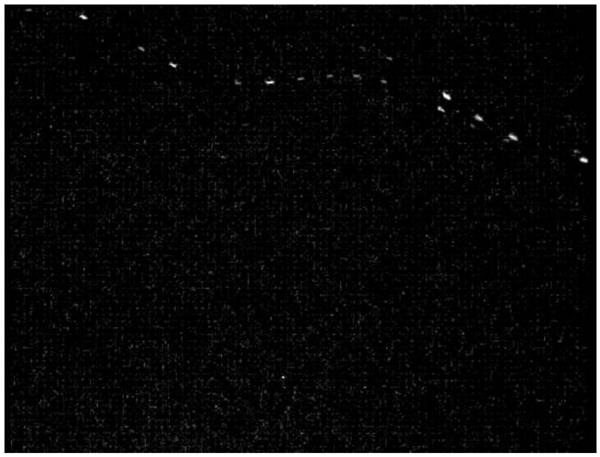

Figure 1. Composition of stack frames, with a bright star and a meteor trailing along the FoV in a wobbly phase of the flight (14 frames 1/50 s).

The probe was launched at 22:56:30 ±20s UT. Because of a human error, the control system turned off at 23:04 UT. The phone auxiliary system worked until 00:38 UT when it suffered a thermal shock at -17 ºC. Only the auxiliary recording system worked throughout the mission. The prove landed 3h 13m after launch with all the recovering system non-operative except for a sticker with contact information. Models indicate that the probe has been dropped in an area without cell coverage. The following day a citizen spotted the probe and the Guardia Civil contacted us with the recovered box. All the content of the probe was found in good condition.

Results and discussion: The auxiliary recording system gives compressed video, with much lower quality than raw one. However it shows stars up to magnitude four, producing images suitable for astrometrical measurements. Nonetheless the compression reduces all the information related to brightness.

The identification of the meteors has been done manually, searching new objects that do not follow the stars movements (fig. 1). In stable moments it is possible to see the meteors in the usual way (fig. 2). At this moment we have been able to detect at least 16 meteors in the first 40 minutes of the record. The astrometric and photometric analysis of meteor trails was performed with software developed by us. This code was specifically designed to process images characterized by showing unstable fields of view and, so, it is suitable to analyze data taken by CCD cameras operating from airborne missions.

Figure 2. Trace of a SPO meteor on a registered and stack image. The brightest star is Beta Peg.

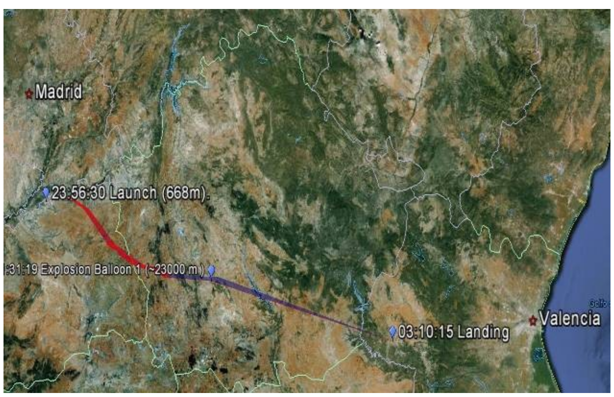

Figure 3. Ground track of the probe through Spain. Total length of 210 km (In red the data. In blue, the model).

Preliminary measurements

Time (UT)	Magnitude	Radiant	Altitude(m)
23:51:50	2,6	SPO	14282
00:11:47	0,5	GEM	18500
00:16:29	-0,5		20000
00:26:28	2,0	ECA	21900

Table 1. First measurements of some of the meteors detected.

Figure 4. Launch images: (Bottom, left, center) D8 Draconids: two balloon configuration . D12-Geminids: (Up right) configuration diagram. (Up left) Watec 902H2 + Avenir 12mm F1.2. (Bottom right) Recovering stick.

Conclusions: Video recording from the stratosphere using weather balloons is an excellent technique for meteor research. Apart from the launch and recovering problems associated to the technique, the lack of stability is the main disadvantage of this method. However it can be minimize and produce astrometrical measurable frames, beating detection capabilities of ground stations.

Previous attempts in October 2010 and for the 2011 Draconids outburst [3] gave us the expertise to achieve this successful mission. Next improvements will try to increase video stability.

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