THE 2016 QUADRANTIDS BALLOON-BORNE MISSION OVER SPAIN: FULL HD AND COLOUR VIDEORECORDING.
A. Sánchez de Miguel[1], F. Ocaña[1], C.E. Tapia Ayuga[1], J.M. Madiedo[2,3], J. Zamorano[1], J. Izquierdo[1], M. A. Gómez Sánchez-Tirado[4], F. Ortuño[4], D. Mayo[4], R. Raya[4], A. Conde[4] and P. León[4].
[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]Proyecto Daedalus – Asociación AstroINNOVA, C/Poeta Mohammed Iqbal, 6 1º4, 14010 Córdoba, Spain, astroinnova@astroinnova.org.

Introduction: The observation of meteors from ground is limited by weather conditions and atmospheric extinction. Several airborne (plane and balloon) missions have already detected meteors from stratosphere and demonstrated the proof of concept. For Quadrantids 2016 the UCM-Daedalus collaboration has sent to the stratosphere a new high-definition colour camera with increased sensitivity. In 7 minutes of recording, a total of 12 Quadrantids were recorded from magnitude 1 to magnitude 6. This mission has successfully tested new active and passive stabilisation configuration to avoid fast spinning, alongside with new GPS and radio frequency (RF) tracking systems to increases payload recovery probability.

The collaboration between Meteor and Fireball Observing Group of Universidad Complutense de Madrid and Proyecto Daedalus have already acquired images of meteors from the stratosphere in balloon-borne missions [1]. In previous 5 missions the payload were B&W low-resolution low-light CCTV cameras. The results were promising and the missions were a success in the case of Geminids 2012 [1] and Camelopardalids 2014. However failures were also present, like the Draconids 2011 mission, when the control computer stopped working still in the troposphere, or the Geminids 2015, when the battery supply was damaged in the launch. Thanks to the low cost of balloons and high-sensitivity cameras there are several groups using stratospheric balloons to record meteors [1] [2] [3] [4].

For the Quadrantids 2016 we changed the payload to increase the scientific output of the mission. The new camera has 7 times more pixels and increased sensitivity. Moreover colour provides basic spectral information from the objects [5].

Instrumental setup: The probe was equipped with a GPS, a GSM and a RF tracker providing contact with the balloon during the whole mission. The new GPS and RF trackers proved to increase the payload recovery chances (Geminids 2015 failed mission was recovered 10-miles off coast).

It was lifted by a 2 kg balloon filled with 9 m^3 of helium, and stabilised actively with gyroscopes and passively thanks to a new probe design (increasing the moment of inertia).

The scientific payload consisted of an EVIL (Electronic Viewfinder with Interchangeable Lens) camera with a backlit sensor and self-recording system included. It was recording full HD colour frames, at 30 fps, with 1/50 s exposure length and sensitivity of 20000 ISO. The lens was a Sigma 30 mm f/1.4, producing slight vignetting in the corners of the full-format chip. The resulting images have a plate scale of 3,5 arcmin/pixel, and the chip covers a FoV of 110 degrees by 60 degrees.

Quadrantids 2016 mission: The launch was delayed due to the rain and wind, with a cold front pushing through the Iberian Peninsula. The launch finally took place at 01:42 UT the 4th of January, with moderate wind blowing drizzle. The flight lasted 90 minutes and the ground track was around 150 km long. Maximum height was 22 km, so the total useful period with stabilised video was shortened to 7 minutes (usual missions reach up to 32 km yielding 40 to 60 minutes of good video). The premature burst of the balloon was likely related to the water fell over the balloon before launching, that got frozen in the ascent and ruined the elasticity of the latex.

Bad weather on ground prevented the double station detection with any of the Spanish Meteor and Fireball Network (SPMN) cameras.

Preliminary results: For the analysis we have selected 7 minutes before the burst of the balloon due to its good stability. During this period the camera recorded 12 meteors. Out of them, all were Quadrantids (QUA).

The limiting magnitude in the frames is estimated at magnitude 6.5 (according to the faintest star visible). In each frame more than 400 stars are detected, providing enough references for good astrometry (astrometric resolution ~1 arcmin).

Relative mission time	Mag	Radiant
00m17s	4.5±0.5	QUA
01m57s	>5	QUA
02m42s	>5	QUA
02m51s	2.5±0.5	QUA
03m25s	2.0±0.5	QUA
03m58s	4.5±0.5	QUA
05m41s	3.5±0.5	QUA
05m54s	>5	QUA
06m01s	3.0±0.5	QUA
06m02s	>5	QUA
06m49s	1.0±0.5	QUA
06m55s	4.0±0.5	QUA

Table 1. First phometric measures of the meteors detected. At the 07m05s the balloon burst.

Figure 1. Sample frame taken during this mission. The image is centered in Sirius. Orion is the top and middle right part of the image.

Conclusions: Quadrantids 2016 UCM-Daedalus mission included some new hardware elements that were tested successfully. New GPS and RF trackers, plus new active and passive stabilisation systems proved to increase the scientific result of the mission.

The new payload with a higher resolution camera employing a Bayer matrix and with increased sensitivity also yielded very good results. Preliminary results confirm that 12 QUAs were recorded in 7 minutes.

References:

[1] Sánchez de Miguel, A., et al. (2013). LPS XLIV, abstract #2202. [2] Moser, D. et al. (2013). Proceedings of the International Meteor Conference, 31st IMC, Vol. 1, pp. 146-149. [3] Earth to Sky Calculus - http://earthtosky.net/ . [4] Koukal, J. et al. (2016), WGN the Journal of IMO, in press. [5] Ocana, F., et al. (2012). Proceedings of the International Meteor Conference, 30th IMC, Vol. 1, pp. 48-52.

Additional Information: The video summarizing the mission (from launch to recovery) can be found at https://www.youtube.com/watch?v=-z3V8jpJwq8 .