HIGH RESOLUTION DETECTION OF GEMINIDS 2010. S. Bouley [1], P. Atreya[1], J. Vaubaillon[1], F. Colas[1], P. Koten[2], D.Capek[2] [1] Institut de Mécanique Céleste et de Calcul des Ephémérides, UMR8028, Paris, France. [2] Astronomical Observatory of Academy of Sciences, Ondrejov 251-65, Czech Republic.
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Introduction: Every year, there are about this 30,000 metric tones of rocks falling on our planet, which origin is highly unknown for most of them. There is a lack of precise meteoroids orbit from video observations as most of the meteor stations use off-the-shelf CCD cameras. Few meteoroids orbit with precise semi-major axis are available using film photographic method. Precise orbits are necessary to compute the dust flux in the Earth's vicinity, and to estimate the ejection time of the meteoroids accurately by comparing them with the theoretical evolution model. During the Geminids 2010, we tested and used CaBeRNet (Camera for Best Resolution Network, currently in development at IMCCE) using large CCD sensors to observe multi-station meteors in south of France. In the future these observations will allow to compute the most accurate orbit ever calculated of these video-meteoroids.

Camera: During this Geminid campaign, we used two CABERNET systems using two Lheritier cameras and two Canon 55mm F1.2 lenses. Lheritier, a French camera and system vision company, has developed a interline progressive scan camera LH11000. It uses Kodak KAI 11002 sensor with 4032×2688 effective pixels of 9 μm size. The readout noise is ~30 e−, with gain of 0−30Db.

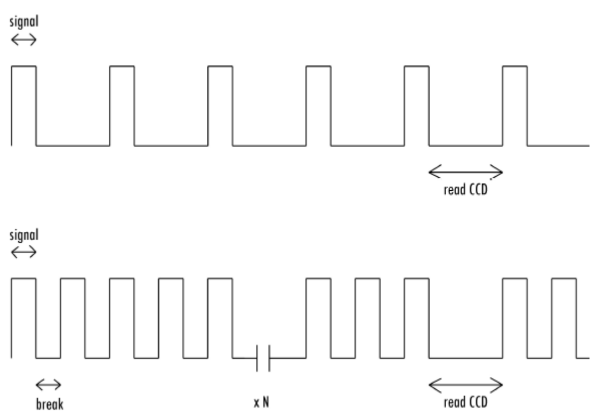

Figure 1 Modification of basic CCD readout method to mimic electronic shutter system.

Figure 1 shows the modification of CCD readout-method to mimic electronic shutter system. The top part of the figure shows the basic procedure of CCD system. The signal denotes the exposure duration (20 ms), all the images are stored separately. This is not ideal because of the "dead time" of 149 ms after to read each image. A modification to the camera was made by introducing a "break" period (20 ms) which means that during this period the CCD does not store photo electrons as shown in the bottom section of the figure. A typical observation cycle is made of 25 breaks, during this period the photo electrons produced are stacked into the masked storage array of the interline CCD, it is read at the end of the cycle, so every 1 second. This method not only decreases the dead time of the camera, but it mimics an effect very similar to the external rotating mechanical shutter. The "signal" and "break" of 20 ms and a total exposure duration of 1 second were used during the Geminids campaign but it can be modified easily to suit meteors apparent sky speed. Figure 2 shows an example of meteor detected (raw image) with LH11000 camera, modified shutter system and Canon 55mm F1.2 lens (FOV 40°×27°). The spatial resolution is of 0.01° or 36″ per pixel.
During the Geminids campaign, we used also two watec 902H camera with Pentax 6mm F1.2 lens (FOV (60°×40°), in order to test and compare the CABERNET system.

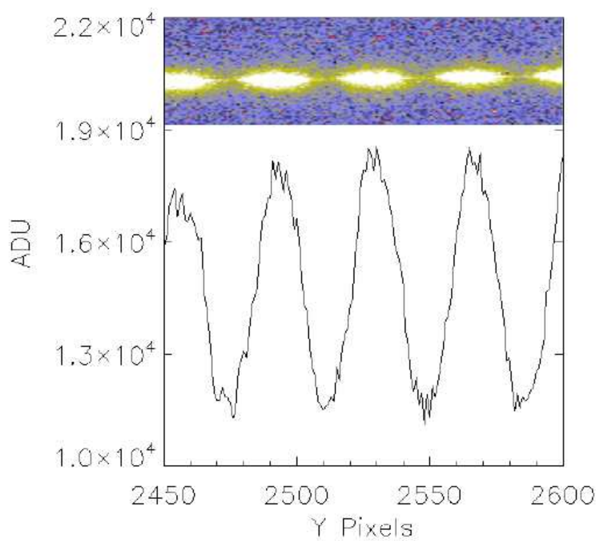

Figure 2 Top, Example of a meteor (raw image) with 20 ms signal, 20 ms break and total exposure of 1 seconds. Bottom, The intensity of meteor breaks along X axis.

Observation sites and date of observations: During the 2010 geminids campaign, we observed for 3 nights from the 12th to 14th December with one cloudy night for both stations (14th December). The total time of double station observation was about 24 hours.

As shown in Figure 3, the first station (station 1) was set up at Pic du Midi observatory (42.94°N 0.14°E, 2800m elevation). The second station (station 2) was set up at Guzet (42.78° 1.3°, 1530 m above sea level) at a distance of 96 km to the Pic du midi observatory. Station 1 observed at an azimuth of ~N40°E and station 2 at an azimuth of ~N320°E. The center of the field of view was fixed to an elevation of 50 degrees above the horizon.

Figure 3 Location of the double stations (Station 1 Pic du midi – Station 2 Guzet)

Geminids detection: During the 12th and 13th December nights, we took for both stations around 180000 images. Thanks to the automatic software Meteorfinder [1] developed by IMCCE, we detected around 100 meteors observed simultaneously by the two CaBeR-Net stations. Because of the largest field of view of the watec camera, we detected around 250 meteors, which allowed us to calibrate and fine tune our MeteorFinder software.

Discussion: Starting a remote and automated camera network has many challenges. One of the most important factor in computing accurate orbits of meteoroids is to estimate the meteor position in the image with less than 1 pixel uncertainty. We will present the first results of orbit calcultation. In 2011, we will install 4 permanent stations in France in order to maximize the detection and accuracy of meteoroid orbits calculation.

[1] Sauli et al, 2010, Proceedings IMC 2010

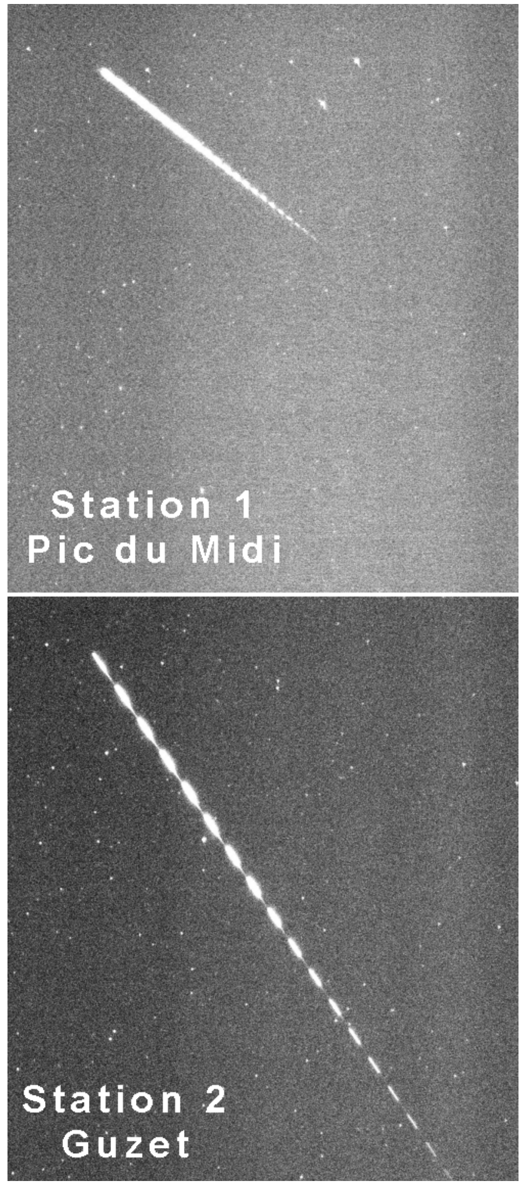

Figure 4 Example of one Geminid meteor observed by the double station the 13th December 2010 at 22h39m43s