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# The SMA automated station for meteor research

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In this paper, we summarize the presented poster regarding the active meteor tracking method and investigation of the SMA since 2006, with a specially devised automated station. We also discuss our collaboration with other tracking stations belonging to the Spanish Meteor and Fireball Network (SPMN), as well as with the Bootes 2 Station (owned by IAA-CSIC, Spain).

## 1 The all-sky camera

The camera is a non-refrigerated version of the ST-402ME (Figure 1), coupled for a focal distance of 246 mm,  $f/16$ . The box contains a USB extension, plus a 12 V power source. The box's upper window over the camera mounts a RG-630 red filter, designed to reduce light pollution. It is also heated to reduce dew condensation. The USB extension allows operating the camera from 50 m away, at the controlling computer.



Figure 1 – The all-sky camera. (SMA)

The power source of PC and cameras is controlled by a device with four relay outputs, controlable via the Internet with a specially designed dedicated web server (IP Relays). The connections between the PC and the camera (USB) are managed by 2 USB to Ethernet converters. The network cable, CAT-5 class, permits to manage everything from the PC, at a distance of 30 m from the camera, without any problems (Figure 2).

### 1.1 Image capturing

The camera software enables all-night automatic image capturing. Each image is compared with the preceding one and its record. In case some differences in the characteristics are detected, a visual inspection is required.

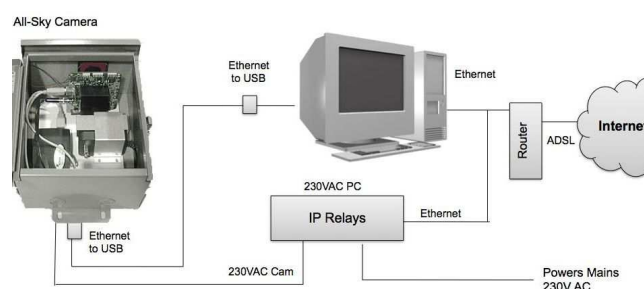


Figure 2 – Connections diagram.

The METEOR CAM software monitors the sky automatically all-night, with a 30-s exposure time. After one extra second for integration, the system starts the next recording. The images which appear to be different after being software-compared with the preceding one, are stored for subsequent study. The camera records meteors, artificial satellites, airplanes, bright comets, clouds, and other meteorological phenomena.

## 2 Turning on and off the camera and conversion to other image formats

We have developed a software that, depending on the date, calculates the sunrise and sunset times to start and end the observing program at optimal times. We also developed a script to activate the software in charge of launching the meteor capture application. This software can set operating parameters in such a way that the image recording starts in a completely automatic way. Each morning, after the camera's switched off, the software performs the conversion of the images from the SBIG format to the JPG format. The original size and proportions are maintained and enable the visualization from a web browser.

## 3 Accessing and working techniques

The IP address of the controlling computer is dynamic, but it is accessed through a dynamic DNS manager.

(a) THE, 2010-06-13.  $21^{\text{h}}47^{\text{m}}49^{\text{s}} \pm 15^{\text{s}}$  UT,  $-9$ .(b) DAU, 2010-09-06.  $04^{\text{h}}19^{\text{m}}50^{\text{s}} \pm 15^{\text{s}}$  UT,  $-8$ .(c) SPO, 2011-11-22.  $05^{\text{h}}58^{\text{m}}57^{\text{s}} \pm 15^{\text{s}}$  UT,  $-7$ .(d) QUA, 2012-01-05.  $06^{\text{h}}06^{\text{m}}06^{\text{s}} \pm 15^{\text{s}}$  UT,  $-3$ . Two explosions.

Figure 3 – Examples of fireballs photographs from the automated SMA observatory “El Pinillo” at Torremolinos, Málaga.

The methods of access to the control computer are as follows:

1. VNC: completely remotely controlled computer;
2. HTTP: web portal to visualize and view images;
3. FTP: for downloading images;
4. Dropbox folder to share images.

After that, images are reviewed by the members of the Working Group.

## 4 Conclusions and results

The remotely controlled automated astronomical observatory “El Pinillo” of the SMA is located at Torremolinos, Málaga. It has been operated since 2006. We have obtained images of meteors and fireballs associated with

38 different meteor showers as well as sporadic meteors of magnitude  $-2$  or brighter.

Photographed examples are shown in Figure 3.

We are currently engaged in improving the connection between the all-sky camera and the computer, and in meteor astrometry.

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