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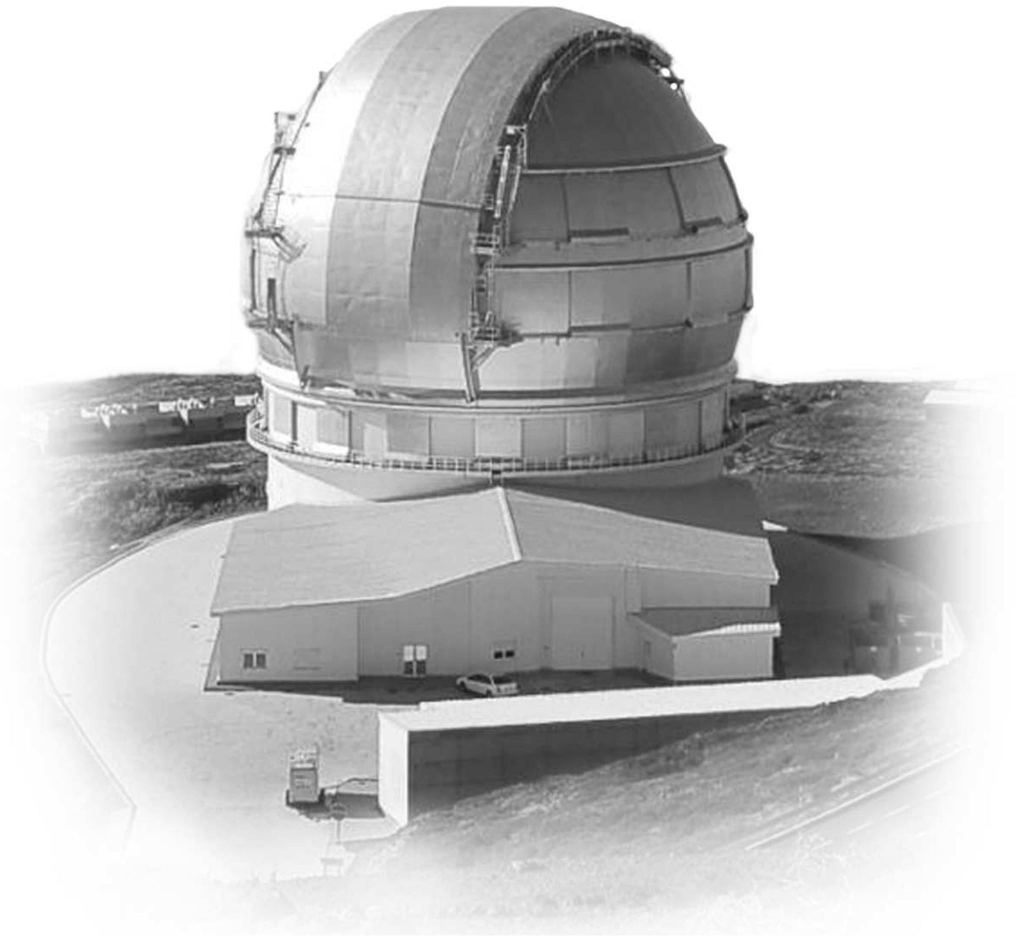

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Quadrantids 2012

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We present some results from our observations of the 2012 Quadrantid meteor shower, and we explain our way to process the data. The radiant position is obtained from photographed meteors.

1 Introduction

There is no human being on Earth who is not charmed by the magic of the starry sky, but only few of them attempt a more serious in-depth investigation of space objects. Astronomy is the most democratic science. Together with professional scientists, a huge number of amateur astronomers all over the world contribute significantly to its development. Modern digital techniques to obtain photographic images of space objects give incredible opportunities not only to professional astronomers, but to amateurs as well.

Since not everyone can afford to buy a video camera for observing meteors, we present a way to observe meteor showers with a still camera. In our case, we have used a Sony SLT-A55VL. We also explain how to process the data.

2 Acquiring the data

During observations at the public astronomical observatory in Avren, Bulgaria, in the night of January 4-5, 2012, we (Georgi Georgiev, Mihail Enimanev, and Antoaneta Avramova) observed the Quadratid meteor shower using a Sony SLT-A55VL camera with a focal length of 18 mm, sensitivity of 800 ISO, light power of 3.5, and field of view of $71° \times 47°$ without guiding mechanism. The average exposure time was 20 seconds. The exposure time was carefully determined, for if it were shorter, there would not be any visible stars, and if it were longer, the stars would no longer be point-like because of the Earth's rotation. Every image obtained is carefully examined for meteors. If we have an image with a meteor, we determine if the meteor is a likely member of the observed shower. Then, we start processing the image.

3 Preprocessing

Together with the regular frames, we make some technical frames: the so-called dark, bias, and flat-field frames. They are used in further processing for reducing the noise created by the heating of the matrix and the noise appearing in the process of reading the image, and for correcting for the uneven distribution of the light flux across the frame.

When an image is saved in JPG format, the information of every four neighboring pixels is averaged, so that the corresponding file occupies less space in the computer's memory. Of course such images are not useful for our purposes. Therefore, we save the frames in RAW format, in which the information is more complete.

For the preprocessing of the images, we used the free software Iris. We carried out the standard work—subtracting the bias frames and dark frames, and dividing by the flat field frames.

4 Processing

When the image noise is reduced, we move on to determine the coordinates of the begin and end points of the meteor using the astrometry function of Iris. Of these two points, the begin point is the one that is closer to the precalculated radiant. Although we did not use any guiding mechanism, the error is approximately $30''$. In addition, we can determine the speed of the meteor from its angular distance to the radiant and its height above the horizon.

Finally, the data are entered in VisDat (Richter, 1999) where the information is stored in a format usable by the program Radiant (Arlt, 1992) with which we can obtain the radiant that we observed.

5 Quadrantids 2012

The Quadrantid meteors take their name from an obsolete constellation, *Quadrans Muralis*, found in early 19th-century star atlases between Draco, Hercules and Bootes. The source of the Quadrantids was unknown until December 2003 when Peter Jenniskens found evidence that the Quadrantid meteoroids come from 2003 EH1, an "asteroid" that is probably a piece of a comet that broke apart some 500 years ago (Jenniskens, 2004).

Table 1 – Data from the 2012 Quadrantids.

Nr	Time (UT)	Begin		End		Error	
		α	δ	α	δ	α	δ
1	$2^{h}59^{m}07^{s}$	179°.06	+64°.23	175°.79	+64°.45	28″.58	21″.64
2	$2^{h}59^{m}29^{s}$	189°.18	+63°.12	185°.80	+63°.59	26″.87	22″.96
3	$3^{h}07^{m}09^{s}$	202°.79	+25°.79	205°.92	+30°.36	30″.94	18″.67
4	$4^{h}20^{m}26^{s}$	169°.72	+25°.42	165°.29	+21°.21	32″.14	14″.58

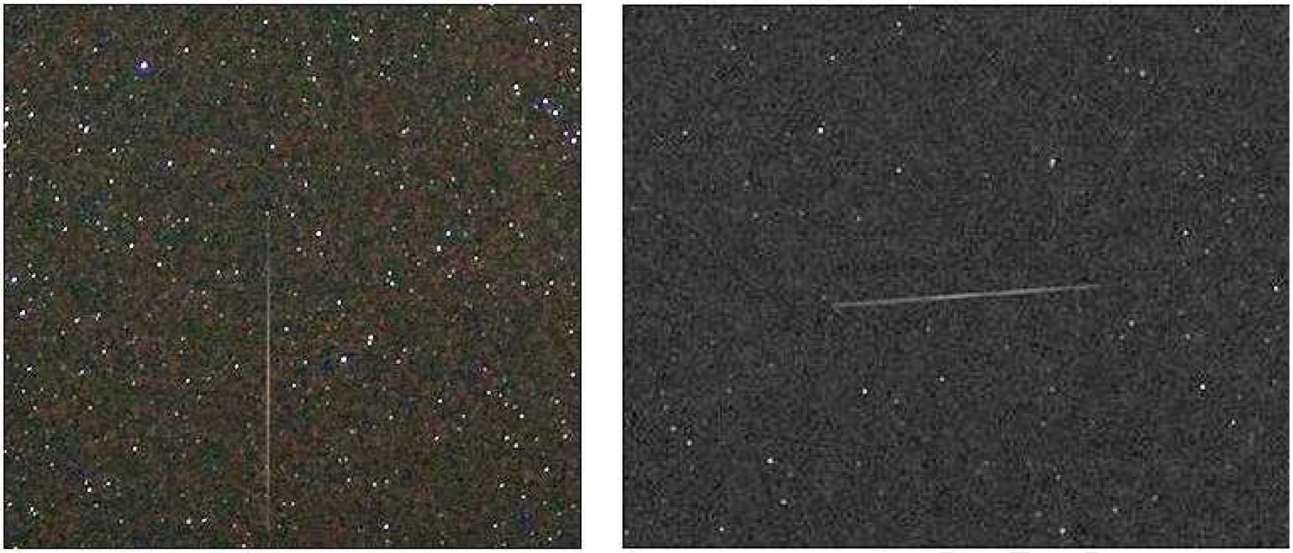

Figure 1 – Photographs of meteors 3 (*left*) and 4 (*right*) of Table 1 *Credit: Georgi Georgiev, Astronomical Club "Canopus", Bulgaria.*

Characteristics of the meteor shower (McBeath, 2012) are as follows: activity period, December 28–January 12; maximum, January 4, $7^{h}20^{m}$ UT ($\lambda_{\odot} = 283°.16$); ZHR = 120 (can vary—60–200).

6 The Quadrantid radiant we obtained

We used the images of Georgi Georgiev for our data. We got 34 images with meteors, but only four of them were Quadrantids. After processing them with the program Iris, we compiled Table 1 with the data obtained. Figure 1 shows meteors 3 and 4 of Table 1.

7 Results

In this project, we used both the method of probabilities and the method of backward prolongations provided by the Radiant software. In the method of probabilities, a region is determined where it is most probable to locate the radiant for the meteor. In the method of backward prolongations, the prolonged meteor traces are plotted and the values of the pixels are summed. Figures 2 and 3 show the results obtained by, respectively, the former and the latter method. The circles mark the radiant position according to the IMO (McBeath, 2012). As can be seen, there is very good agreement.

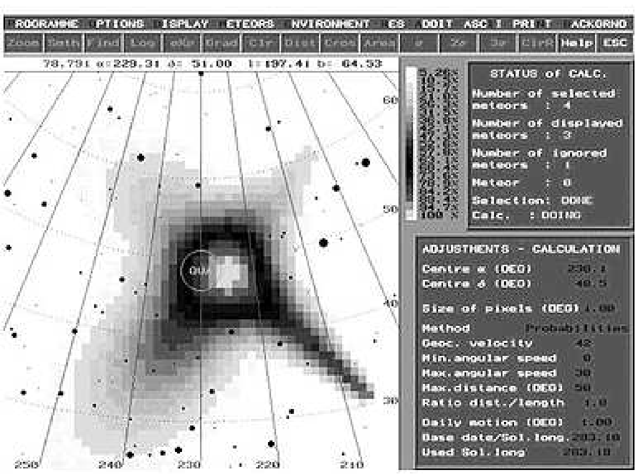

Figure 2 – Quadrantid radiant obtained with the method of probabilities.

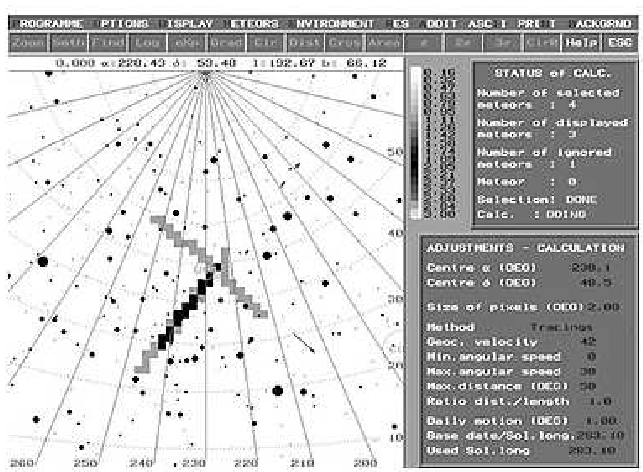

Figure 3 – Quadrantid radiant obtained with the method of backward prolongations.

8 Conclusion

With our project, we have shown it is possible to achieve relatively good results using tools and equipment available to all amateur astronomers.

We investigated in detail the potential of these tools and equipment (software and camera), which will allow us to cooperate with professional video meteor observers from all around the world.

It only remains to hope for cloudless nights!

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