From Lunar Meteors to Dark Meteors

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Abstract

TV observations of a possible Lunar impacts was carried out in the night before Perseid's maximum in 2001. No lights effects were registered. However three cases of other discussible phenomenon — dark meteors — were recorded. In this article dark meteors are discussed.

1 Introduction

According to the observers of lunar star occultations, some bright effects on dark part of the Moon were observed using the television cameras. From two independent observations at different locations it was confirmed that bright phenomenon has an origin on the Moon's surface and is caused by impact of a meteoritic body. Possibility the observation of such phenomena was described in (Sigismondi, Imponente 2000).

Moon phase and its elongation from the Perseid's radiant gave a relatively good geometrical position for an experiment. The situation is drawn on Figure 1.

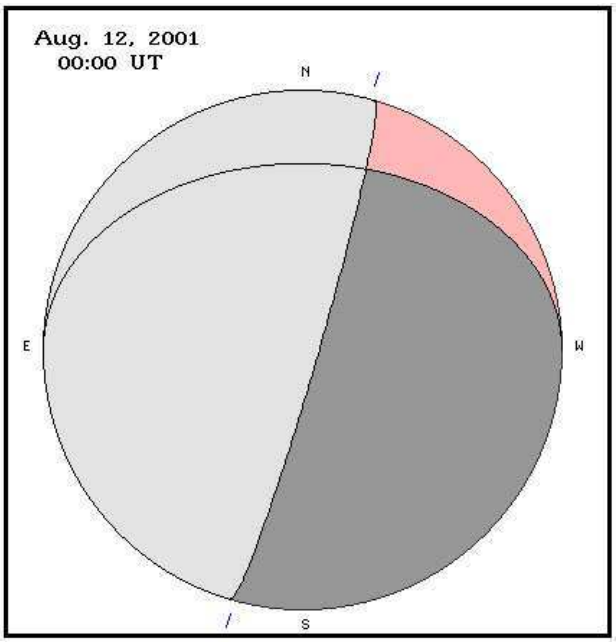

Figure 1: *The Moon phase on August 12, 2001.*

2 Observational equipment

For the observation a black and white TV camera Oscar was used. The sensitivity of the camera (according to users manual) is 0.02 lx. The camera was fixed in a reflector 100/750 mm focal plane. The limiting magnitude of equipment at excellent conditions is almost +10 magnitude. The telescope was drown with the speed of the Moon on the sky by a paralactical mounth. Observed field of view was around 20×15 arcminutes. For a control similar camera on a telescope (100/1000) was used. The television images were registered by a VHS videorecorders.

3 Observation

The observation was carried out at Zavada, Slovakia (λ =19°44′01″ E, φ=48°32′31″ N, h=810 m) in the night August 11-12, 2001. It started at 22^h44^m UT and finished at 01^h24^m UT. The air conditions were not excellent. The dispersed moonlight was seen on thin clouds. Due to automatic sensitivity control of the camera, almost all illuminated part of the Moon was out of the observing field of view. In the majority of the observing interval the ash-grey light of the Moon was visible. During the observations and revision of the records after the observations, no light effect on the dark part of the Moon were found. But three dark fast-moving objects were found on the videorecords. According to McBeath's (1995, 2001) talk about "dark meteors", we will present a rough analysis of them to find out the type of objects which may causes phenomena like this.

4 Analysis

During the observing interval three fast dark moving objects were registered. The objects were found on records made by the second camera, too. All recorded "dark meteors" moved across the observed field of view almost horizontally. The situation is presented on Figure 2. Paths of dark bodies on single frames were measured directly from the TV screen.

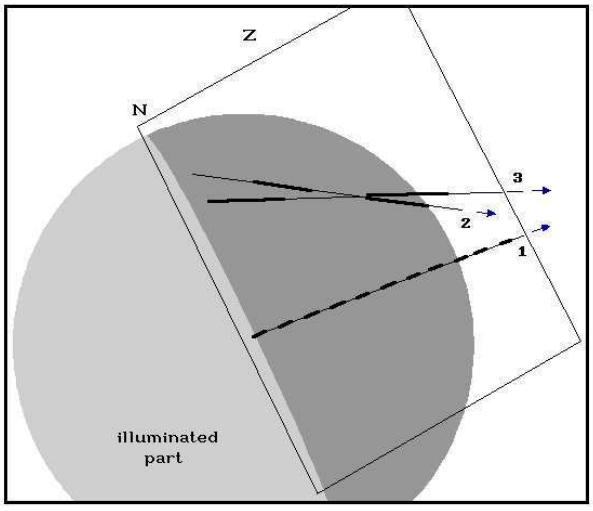

Figure 2: *Observed "dark meteors".*

The television technique gives us an opportunity to measure the angular velocities of moving objects with relative high accuracy. Scanning video records frame by frame the time resolution of 1/25 of the second was obtained. Therefore, we may calculate the apparent angular velocities of meteors or other moving objects. If we measure the width of the object, we know the apparent angular diameter of that body. Only the distance to the objects is unknown. If we assume a distance to the object, we can calculate the real velocity (its tangential part) of the object from the angular velocity and from apparent size the real one. For single "dark meteor" we calculated a table of tangential velocities and sizes for various distances. That table is not presented here. It is clear that real velocity and size of the object are linear functions of the objects distance.

The changes in real velocity and size are shown in Figure 3. The diagram is given in a logarithmic scale. Areas which represent different groups of flying objects are plotted. The lines 1, 2 and 3 correspond to observed dark bodies. The line V represents the theoretical characteristics of a "dark meteor" observed visually. In the diagram are roughly given areas of different groups of flying objects.

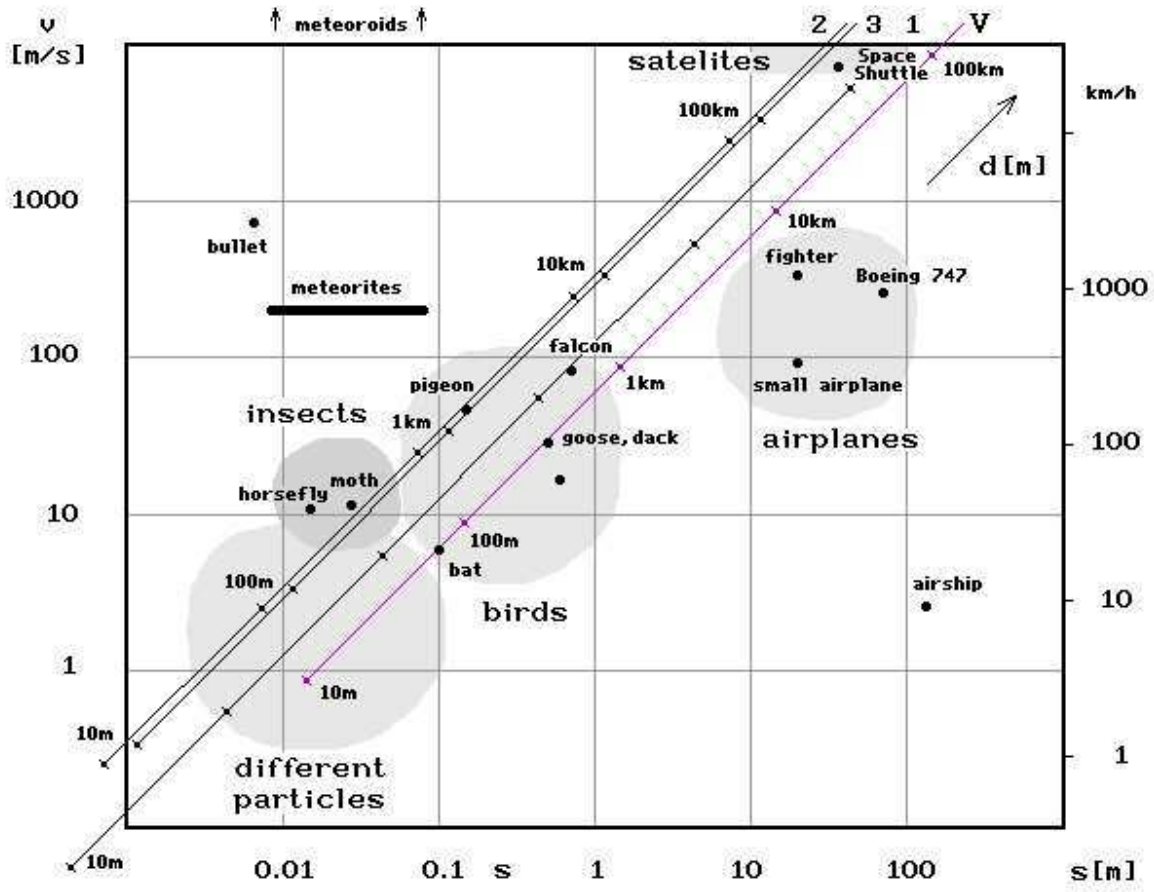

Figure 3: *The changes of real velocity and a size of the object.*

The first is a group of different natural or artificial pieces (dry leaves, seeds and various papers or plastic refuse) which may be distributed high in atmosphere by hot raising air

streams during the summer day. That pieces fall back to the Earth's surface in the night with relatively low velocities. The second group are insects. Some species of insects are active in the night. The third group represents the birds. After them, there is a group of airplanes and a group of artificial satellites. In all groups some of their representatives are plotted. The data about those flying objects was taken only from the popular literature.

Meteoritic bodies may be theoretically plotted on the diagram in two ways. As meteoroids, which are out of scale (too small and too fast) and as meteorites (line), where we assume the body has the velocity of free fall. Looking to this diagram, it is necessary to have in mind some fact. The velocities of objects are given as absolute velocities, but observed velocities may be lower. The velocities of here presented "dark meteors" are tangential, therefore the absolute velocities may be higher. The apparent size measured from TV set may be higher, as the consequence od backlight diffusion. The altitude of dark bodies over surface is about one half of distance, according to altitude of the observed field of view (the Moon was around 30 degrees above horizon).

5 Discussion

On the diagram we may see simple groups of objects in the lines of observed and theoretical phenomena. Starting with meteors — to see effect caused directly by meteoroids is not possible. The size of meteoroid is too small according to its velocity. So, meteoroids will be, of course, visible as bright meteors and not as dark meteors. In principe the observation of falling meteorite is possible, but it has very low probability. It must be very large and should fallow extremely bright fireball near the zenith, what in our event was not the case. The group of satellites (here represented as Space Shuttle) is in very good coincidence with observed bodies. Velocities on low near circular orbits and characteristic sizes give theoretical possibility to observe them as dark objects by used equipment. In the time of the observation the region of those near satellite orbits was in the Earth's shadow. But, there was no light on the background, to see them as the dark bodies. It would be possible to see them on lunar disk, of course, but all three bodies were observed beyond the lunar disc, too. The diffusion of moonlight is very efficient in the low part of the troposphere, therefore the black bodies must be in this atmospherical layer.

Other groups of flying object exists in troposphere, too. Airplanes lie too far from observed bodies in the diagram. They could correspond to the observed dark meteors if they moved in the direction to the observer. But in this case, the apparent motion will be seen as vertical. It was not. Moreover, airplanes flying without signal lights are very rare, so not very likely.

The group of birds and insects lies near the lines of observed dark meteors. But they should fly in relative high altitudes to correspond to the observed velocities and sizes. A typical bird should be around 1 km away, what is about 500 m over surface and insects should be some 500 m away (250 m over the ground). This values seems to be to large. Moreover the observations were carried out from a hill, which rapidly decreases to the south, just in direction to the observed Moon, what means that birds and insects should fly even higher over the ground to see them.

So the most probable seems to be the last group, which consist of different bodies in sizes and materials. As it was writing above, this things may be distributed in atmosphere by warm air current and are slowly falling to the surface during the night. Existence of this small parts can be confirmed by glider's pilots.

Our three observed bodies were not like other dark meteors reported by visual meteor observers. There is no objective record of the visual event, yet. Assuming the fact that dark meteors seem to be as normal as bright meteors, we may describe them as: apparent angular velocity is in order of some degrees per second and apparent size must be higher as 1 arcminute, but not to large, so that the silhouette of the body is not seen. We drew to the diagram the angular velocity of 5 degrees per second and angular size of 5 arcminutes. The line V in the diagram represents body like this, which is in very good correspondence with almost all groups of flayers in the troposphere.

6 Conclusion

According to circumstances described above, the dark meteors may have an origin in practically all natural and artificial flying objects, but they are in no relation with meteor astronomy. In opposite to "dark meteors", the lunar impacts, the original interest of our observation, seems to be very real and therefore suitable for further observations.

References

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