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Trajectory determination of medium size meteoroids

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Abstract

During 8 years Polish Fireball Network was able to record a large number of fireballs using sensitive video equipment. Three of them were presented. The deceleration of velocity and heights was discussed. On 2010.10.13 fireball lasted nearly 10 seconds with continuously growing deceleration. On 2012.04.08 fireball had constant deceleration. Deceleration of 2012.02.02 fireball was variable and very rapid. Statistical analysis could be useful for checking of small meteoroid entry models.

1. Introduction

Polish Fireball Network was created by Comets and Meteors Workshop in 2004. The network is operated mainly by amateurs in collaboration with scientific institutions such as Astronomical Institute at the University of Zielona Góra, Warsaw University Astronomical Observatory and Nicolaus Copernicus Astronomical Center. Observations are based on standard resolution, low light, non intensified cameras with wide fields of view and photographic all sky cameras. Typical limiting magnitude of the system is +2 magnitude for meteors [1].

We use RecoStar and UFOAnnalyzer software for astrometric reduction of video recordings. We use PyFN software for trajectory and orbit calculation. PyFN utilizes the Celpeha method described in [2].

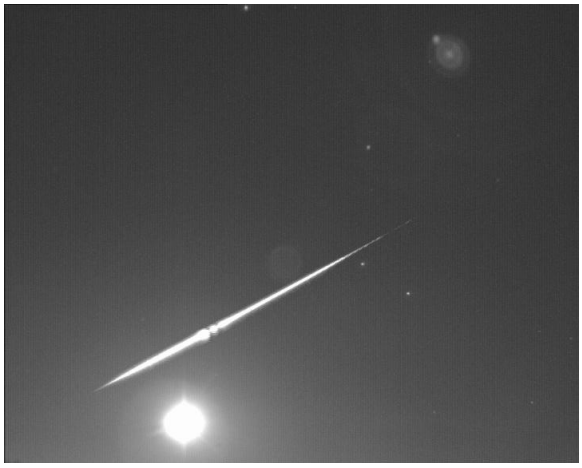
2. Observations

High sensitivity with typical resolution of 5 minutes per pixel gives a chance to observe and analyse dynamics of long fireballs from the early beginnings to the last moments of visual path on the sky. If the fragmentation occurs, the video recordings helps to track each of the fragments separately. We present three examples of small fireball events for which it is possible to see see different cases of trajectory and characteristics of deceleration.

Figure 1: Fireball 2010.10.13 velocity (solid line) and height (dashed line). Image from PFN37 station

2.1. Fireball 2010.10.13 at 2:52:28 UT

This fireball was observed by 3 stations. It lasted nearly for 10 seconds. Absolute magnitude at maximum was –4.5. For first two seconds the deceleration was not present. After that meteoroids deceleration increased along trajectory. At the ending point located on height 28 km, the velocity was 8 km/s. Whole mass of meteoroid evaporated.



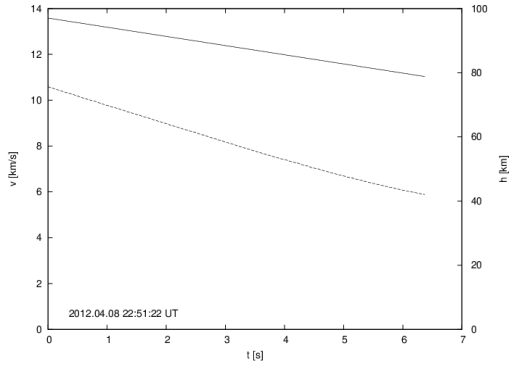


Figure 2: Fireball 2012.04.08 velocity (solid line) and height (dashed line). Image from PFN41 station.

2.2. Fireball 2012.04.08 at 22:51:22 UT

Fireball was recorded by 3 stations. It had beginning velocity, the absolute brightness and inclination of the trajectory. similar to the previous one. Also the time of the event was very long. Despite this, we can observe the different behavior of the meteoroids. Deceleration is almost constant during whole flight.

2.3. Fireball 2012.02.02 at 23:13:46 UT

Firebal was recorded by 4 stations. The beginning velocity was 32 km/s but after only 3 seconds body slowed down to only 4 km/s and ended at 25 km. Fast deceleration begins at the height about 50 km after 1.5 of the flight. Probably whole body was evaporate and there was no meteorites from this event. It is very unusual case, because for such fast entry velocity terminal height lays much higher.

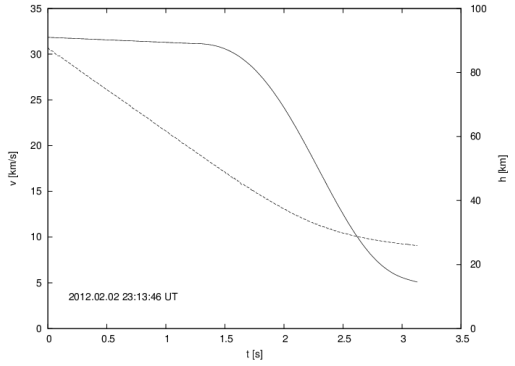


Figure 3: Fireball 2012.02.02 velocity (solid line) and height (dashed line). Image from PFN42 station.

6. Summary and Conclusions

We shows that low light wide field camera systems could provide large number high quality data about dynamic of medium fireballs. We would like to use our data for checking of small meteoroid entry models.

References

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