METEOR OBSERVATIONS WITH MINI-MEGATORTORA WIDE-FIELD MONITORING SYSTEM

S. Karpov,[1,3] N. Orekhova[2] G. Beskin,[1,3] A. Biryukov[3,4] S. Bondar,[2] E. Ivanov,[2] E. Katkova,[2] A. Perkov,[2] and V. Sasyuk[3]

RESUMEN

Favor de proporcionar un resumen en español. If you are unable to translate your abstract into Spanish, the editors will do it for you. Here we report on the results of meteor observations with 9-channel Mini-MegaTORTORA (MMT-9) wide-field optical monitoring system with high temporal resolution. During first 1.5 years of operation more than 90 thousands of meteors have been detected, at a rate of 300-350 per night, with durations from 0.1 to 2.5 seconds and angular velocities up to 38 degrees per second. The faintest detected meteors has the peak brightness about 10 mag, while the majority - from 4 to 8 mag. Some of the meteors have been observed in BVR filters simultaneously. Color variations along the trail for them are determined. All parameters of detected meteors are published online. The database also includes the information on 10 thousands meteors detected by our previous FAVOR camera in 2006-2009 years.

ABSTRACT

Here we report on the results of meteor observations with 9-channel Mini-MegaTORTORA (MMT-9) wide-field optical monitoring system with high temporal resolution. During first 1.5 years of operation more than 90 thousands of meteors have been detected, at a rate of 300-350 per night, with durations from 0.1 to 2.5 seconds and angular velocities up to 38 degrees per second. The faintest detected meteors has the peak brightness about 10 mag, while the majority - from 4 to 8 mag. Some of the meteors have been observed in BVR filters simultaneously. Color variations along the trail for them are determined. All parameters of detected meteors are published online. The database also includes the information on 10 thousands meteors detected by our previous FAVOR camera in 2006-2009 years.

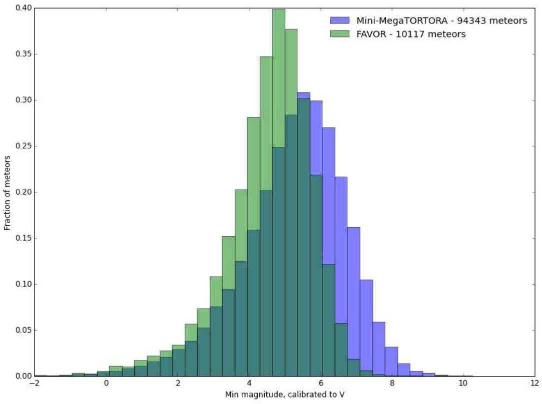
Key Words: meteorites, meteors, meteoroids — astronomical databases: miscellaneous

Wide-field monitoring systems with sub-second temporal resolution are optimal instruments to look for and study of rapid transient events of unpredictable localization, which may be of both cosmological (gamma-ray bursts, supernovae), Galactic (flaring stars, novae, variable stars) and near-Earth origin (meteors, asteroids, artificial satellites). FAVOR camera what we developed in early 2000-s (Karpov et al. 2005, 2010) was able to detect a lot of faint meteors what can't be typically observed using other means. Indeed, typical TV observations imply a fish-eye cameras with high frame rate, have low angular resolution and are able to detect only brighter events and fireballs . On the other hand, ten thousand meteors observed with FAVOR camera from Aug 2006 till Mar 2009, have been significantly, by several magnitudes, fainter. Unfortunately, these meteors were not published until now and were mostly unavailable to the analysis by scientific community.

In mid-2014 we started the observations with Mini-MegaTORTORA (MMT-9), which is a novel multichannel wide-field monitoring camera, placed at Special Astrophysical Observatory, near Russian 6-m telescope (Beskin et al. 2010; Karpov et al. 2013; Beskin et al. 2014; Biryukov et al. 2015). It continuously monitors the sky with 0.1 s temporal resolution in 900 square degrees field of view, detecting various kinds of transient events on the fly using the real-time data processing pipeline. The meteors are extracted by its elongated shape and all the images containing them, obtained by either one or several channels, are analyzed automatically to derive its brightness along the trail, light curve, trajectory, angular velocity and duration. The majority of events are observed in white light (the brightness is then calibrated to V magnitude), while some are being observed in Johnson-Cousins B, V and R photomet-

[1]Special Astrophysical Observatory of Russian Academy of Sciences, Russia.
[2]Research and Production Corporation "Precision Systems and Instruments", Russia.
[3]Kazan Federal University, Russia.
[4]Sternberg Astronomical Institute, Moscow State University, Russia.

a



b

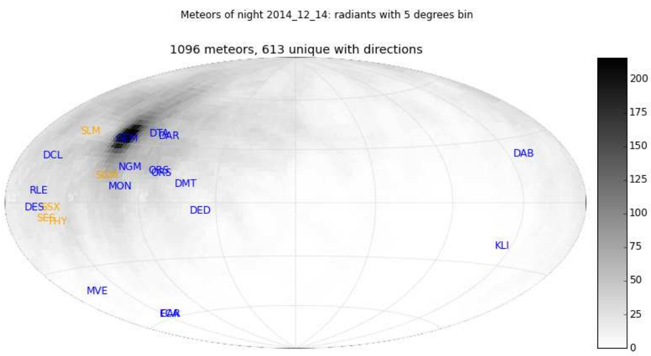


Fig. 1. (*a*)Peak brightness distribution for meteors detected by Mini-MegaTORTORA and FAVOR cameras. (*b*) Density of intersections of meteor trails from the night corresponding to the peak of 2014 Geminids.

ric filters simultaneously. For such events, the colors are also derived automatically. All these data for 94343 (as of Dec 9, 2015) events are stored to the database and are available online[5].

The database also contains the same information for 10117 meteors observed with FAVOR camera in 2006-2009 years, uniformly processed with the same software as being used for MMT-9 data analysis. Figure 1a shows the comparison of peak magnitudes (integral brightness of the meteor trail on a single frame where the meteor is brightest) of events observed with MMT-9 and FAVOR. The faintest detected meteors has the peak brightness about 10 mag, while the majority – from 4 to 8 mag, and are much fainter than ones contained in such meteor databases as SonotaCo(SonotaCo 2009) and EDMOND(Kornoš et al. 2014).

The database does not presently include any parallactic observation (though we are working on installing second version of Mini-MegaTORTORA which will allow us to measure meteor parallaxes). However, huge amount of meteors measured every night might in principle allow to detect the radiants of meteor streams using purely statistical methods. Figure 1b shows the density of intersections of meteor trails from the night corresponding to 2014 Geminids, and the radiant is clearly visible here.

We hope that the database of meteor observations what we publish will help in studying faint component of meteor showers.

Acknowledgements

This work was supported by the grants of RFBR (No. 090212053 120200743-A), by the grant of European Union (FP7 grant agreement number 283783, GLORIA project). Mini-MegaTORTORA belongs to Kazan Federal University and the work is performed according to the Russian Government Program of Competitive Growth of Kazan Federal University. Observations on Mini-MegaTORTORA are supported by the Russian Science Foundation grant No. 14-50-00043.

[5]The database is published at `http://mmt.favor2.info/meteors` and `http://astroguard.ru/meteors`

REFERENCES

Beskin, G., Karpov, S., Bondar, S., Perkov, A., Ivanov, E., Katkova, E., Sasyuk, V., Biryukov, A., & Shearer, A. 2014, in Revista Mexicana de Astronomia y Astrofisica Conference Series, Vol. 45, Revista Mexicana de Astronomia y Astrofisica Conference Series, 20–

Beskin, G. M., Karpov, S. V., Bondar, S. F., Plokhotnichenko, V. L., Guarnieri, A., Bartolini, C., Greco, G., & Piccioni, A. 2010, Physics Uspekhi, 53, 406

Biryukov, A., Beskin, G., Karpov, S., Bondar, S., Ivanov, E., Katkova, E., Perkov, A., & Sasyuk, V. 2015, Baltic Astronomy, 24, 100

Karpov, S., Beskin, G., Biryukov, A., Bondar, S., Hurley, K., Ivanov, E., Katkova, E., Pozanenko, A., & Zolotukhin, I. 2005, Nuovo Cimento C, 28, 747

Karpov, S., Beskin, G., Bondar, S., Guarnieri, A., Bartolini, C., Greco, G., & Piccioni, A. 2010, Advances in Astronomy, 2010

Karpov, S., Beskin, G., Bondar, S., Perkov, A., Ivanov, E., Guarnieri, A., Bartolini, C., Greco, G., Shearer, A., & Sasyuk, V. 2013, Acta Polytechnica, 53, 38

Kornoš, L., Koukal, J., Piffl, R., & Tóth, J. Proceedings of the International Meteor Conference, Poznan, Poland, 22-25 August 2013, ed. , M. GyssensP. Roggemans & P. Zoladek, 23–25

SonotaCo. 2009, WGN, Journal of the International Meteor Organization, 37, 55