RevMexAA (Serie de Conferencias), **48**, 97–98 (2016)

METEOR OBSERVATIONS WITH MINI-MEGA-TORTORA 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

Describimos el resultado de la detección de bólidos y meteoros por medio del sistema de monitorización óptica de gran campo Mini-Mega-TORTORA (MMT-9) de alta resolución temporal. Durante los primeros 1,5 años de operación se han detectado más de 90.000 meteoros, a un ritmo de 300 a 350 por noche, con duraciones de 0,1 a 2,5 s y velocidad angular de hasta 38 grados/s. Los meteoros más débiles son de magnitud 10 mientras que la mayoría se sitúan en el rango de 4 a 8. Algunos de los meteoros han sido observados en los filtros BVR de modo simultáneo por lo que hemos determinado las variaciones de color durante la traza. Todos los parámetros se han publicado "on-line". La base de datos incluye los parámetros de decenas de miles de meteoros registrados por la anterior cámara FAVOR en el periodo 2006-2009.

ABSTRACT

Here we report on the results of meteor observations with 9-channel Mini-Mega-TORTORA (MMT-9) optical monitoring system with the wide field and high temporal resolution. During the 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 have peak brightnesses about 10 mag, while the majority have them ranging from 4 to 8 mag. Some of the meteors have been observed in BVR filters simultaneously. Color variations along the trail for them have been determined. The parameters of the detected meteors have been published online. The database also includes data from 10 thousands of meteors detected by our previous FAVOR camera during 2006-2009.

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

1. INTRODUCTION

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

2. OBSERVATIONS AND RESULTS

In mid-2014 we started the observations with the Mini-Mega-TORTORA (MMT-9), which is a novel multichannel wide-field monitoring camera, placed at the Special Astrophysical Observatory, near the 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, instantly detecting various kinds of transient events using the real-time data processing pipeline. The meteors are identified because of their elongated shape and all the images containing them, obtained by either one or several channels, are analyzed automatically to derive their brightness along the trails, the light curves, the trajectories, angular velocities and their durations. The majority of events are observed in white light (the brightness is then calibrated to V

[1]Special Astrophysical Observatory of Russian Academy of Sciences, Russia (karpov.sv@gmail.com).
[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

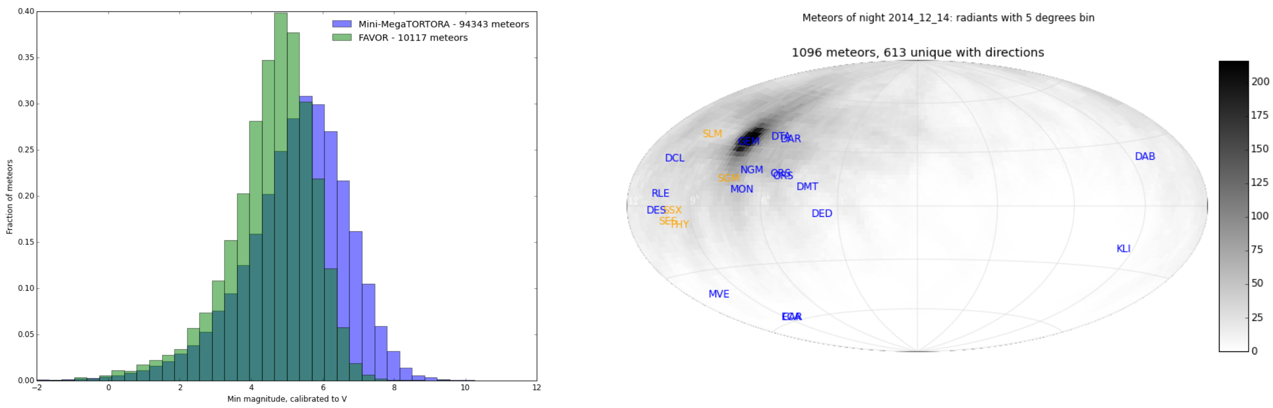

Fig. 1. (*a*)Peak brightness distribution for meteors detected by Mini-Mega-TORTORA and FAVOR cameras. (*b*) Density of intersections of meteor trails from the night corresponding to the peak of 2014 Geminids.

magnitude), although some of them have been observed in Johnson-Cousins B, V and R photometric filters simultaneously. For such events, the colors are also derived automatically. All these data for 94343 events (as of Dec 9, 2015) are stored in the database and are available online[5].

The database also contains the same information for 10117 meteors observed with FAVOR camera during 2006-2009, uniformly processed with the same software used for MMT-9 data analysis now. Figure 1a shows the comparison of peak magnitudes (integral brightness of the meteor trail on a single frame during the maximum brightness of the meteor) of events observed with MMT-9 and FAVOR. The faintest ones have a peak brightness about 10 mag, while the majority have the magnitudes in the range of 4 to 8 mag. and significantly 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 a second version of Mini-Mega-TORTORA which will allow us to measure meteor parallaxes). However, the huge amount of meteors measured every night might in principle allow us 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 the 2014 Geminids, and the radiant is clearly visible there.

We hope that this database of meteor observations what we publish will be helpful in the study of the faint component of meteor showers.

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

Acknowledgements. This work was supported by the grants of RFBR (No. 09–02–12053 12–02–00743-A), by the grant of European Union (FP7 grant agreement number 283783, GLORIA project). Mini-Mega-TORTORA 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-Mega-TORTORA are supported by the Russian Science Foundation grant No. 14-50-00043.

REFERENCES

Beskin, G., Karpov, S., Bondar, S., Perkov, A., Ivanov, E., Katkova, E., Sasyuk, V., Biryukov, A., & Shearer, A. 2014, RMxAC, 45, 20

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

Biryukov, A., Beskin, G., Karpov, S., Bondar, S., Ivanov, E., Katkova, E., Perkov, A., & Sasyuk, V. 2015, BaltA, 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, AdAst, 2010

Karpov, S., Beskin, G., Bondar, S., et al. 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. Gyssens, P. Roggemans, & P. Zoladek, 23–25

SonotaCo. 2009, WGN, JIMO, 37, 55

IV Workshop on Robotic Autonomous Observatories (Torremolinos, Málaga, Spain, September 28- October 2, 2015)
Editors: M. D. Caballero-García, S. B. Pandey, D. Hiriart & A. J. Castro-Tirado