

The Updated IAU MDC Catalogue of Photographic Meteor Orbits

V. Porubcan · J. Svoren · L. Neslusan · E. Schunova

Abstract The database of photographic meteor orbits of the IAU Meteor Data Center at the Astronomical Institute SAS has gradually been updated. To the 2003 version of 4581 photographic orbits compiled from 17 different stations and obtained in the period 1936-1996, additional new 211 orbits compiled from 7 sources have been added. Thus, the updated version of the catalogue contains 4792 photographic orbits (equinox J2000.0) available either in two separate orbital and geophysical data files or a file with the merged data. All the updated files with relevant documentation are available at the web of the IAU Meteor Data Center.

Keywords astronomical databases · photographic meteor orbits

1 Introduction

Meteoroid orbits are a basic tool for investigation of distribution and spatial structure of the meteoroid population in the close surroundings of the Earth's orbit. However, information about them is usually widely scattered in literature and often in publications with limited circulation. Therefore, the IAU Comm. 22 during the 1976 IAU General Assembly proposed to establish a meteor data center for collection of meteor orbits recorded by photographic and radio techniques. The decision was confirmed by the next IAU GA in 1982 and the data center was established (Lindblad, 1987).

The purpose of the data center was to acquire, format, check and disseminate information on precise meteoroid orbits obtained by multi-station techniques and the database gradually extended as documented in previous reports on the activity of the Meteor Data Center by Lindblad (1987, 1995, 1999 and 2001) or Lindblad and Steel (1993).

Up to present, the database consists of 4581 photographic meteor orbits (Lindblad et al., 2005), 63.330 radar determined orbit: Harvard Meteor Project (1961-1965, 1968-1969), Adelaide (1960-1961, 1968-1969), Kharkov (1975), Obninsk (1967-1968), Mogadish (1969-1970) and 1425 video-recordings (Lindblad, 1999) to which additional 817 video meteors orbits published by Koten et al. (2003) were added.

V. Porubcan (✉)

Astronomical Institute of the Slovak Academy of Sciences, 059 60 Tatranská Lomnica, Slovakia; Faculty of Mathematics, Physics and Informatics, Comenius University, 84248 Bratislava, Slovakia. E-mail: porubcan@fmpb.uniba.sk

J. Svoren · L. Neslusan

Astronomical Institute of the Slovak Academy of Sciences, 059 60 Tatranská Lomnica, Slovakia

E. Schunova

Faculty of Mathematics, Physics and Informatics, Comenius University, 84248 Bratislava, Slovakia

2 Photographic Orbits

In 2001 the MDC was moved from the Lund Observatory to the Astronomical Institute of the Slovak Academy of Sciences in Bratislava. As it is operating for about twenty years and collecting data acquired already since 1936, it accumulated a large number of meteoroid orbits obtained from different sources providing them to researchers for various studies.

The last but one version of photographic data, the 1990 version, contained data on 3518 meteors with precisely reduced orbits, but only of about 90% of them had also at disposal also complete geophysical data (Lindblad, 2001). In many cases the orbital and geophysical data were not published at the same time and in some cases one set was not published and the data had to be obtained by correspondence with the investigator or are remain missing. This was also the case with the last 2003 version of the catalogue containing 4581 precisely reduced meteor orbits (Lindblad et al., 2005), where originally not all orbits were published with all the catalogued parameters.

The data for the 2003 version were compiled from 17 different stations or investigators listed in Table 1, where *Code* in the first column is the letter code assigned to the investigator and the catalogue comprises the orbits obtained over the period of sixty years (1936-1996).

Traditionally, the previous versions consisted of two independent files separately with the orbital file (*orb.dat*) and geophysical file (*geo.dat*). In the new version and for convenience of further treatment with the data both files were also merged, introduced in a new format and writing the data in a single file designated *all2003.dat* and sorted by the date of meteor detection.

The database can be downloaded from the IAU MDC site from the address: <http://www.astro.sk/~ne/IAUMDC/Ph2003/database.html> together with relevant documentation.

Table 1. IAU MDC catalogue of photographic orbits. Code – investigator or station code letter, N – the total number of reduced orbits per station / investigator.

Code	N	Investigator/Station
W	166	Whipple (small camera)
J	413	Jacchia (Super-Schmidt)
H	313	Hawkins and Southworth (Super-Schmidt)
P	353	Posen and McCrosky (Super-Schmidt)
S	314	McCrosky and Shao (Super-Schmidt)
G	25	Gale Harvey, New Mexico State University
D	636	Babadzhanov et al., Dushanbe (small camera)
O	459	Shestaka et al., Odessa (small camera)
K	206	Kiev (small camera)
C	103	Ceplecha (small camera)
E	335	Ceplecha and Spurný, European Network
F	334	McCrosky, Prairie Network
I	259	Halliday et al., MORP Network
N	259	Koseki, Nippon Meteor Society
T	85	Ohtsuka, Tokyo Meteor Network
U	66	Ochai et al., Nippon Meteor Society
B	435	Betlem et al., Dutch Meteor Society
R	22	Trigo-Rodriguez et al., Spanish Meteor Network
Sum	4792	

3 New Version of the Catalogue

Since 1996 additional new photographic meteor orbits are acquired and can be catalogued. Some of them are older and were not yet included in the catalogue and the rest are new orbits recorded in the last few years. Though the present catalogue of 4581 orbits is covering the whole year observations rather uniformly, dominant in the number of orbits are the Perseids and Geminids. The recent exceptional returns of the Leonids greatly improved their orbital statistics, but more of them were not yet published and cannot be included in the catalogue.

At the present, there are 211 new meteoroid orbits which can be included in the new version of the catalogue and thus the number of the orbits of the MDC catalogue increased to 4792. The new orbits are compiled from seven sources and consists of 27 Perseids recorded during the exceptional shower return in 1993 (Spurny, 1995), 75 Leonids observed during the 1998 shower outburst (Betlem et al., 1999), 10 Leonids from the 2002 storm (Trigo-Rodriguez et al., 2004), 19 bright fireballs recorded within the European Fireball Network between 1990-2004, 22 fireballs recorded within the Spanish Meteor Network in 1991-2004, 52 exceptional bolides from the EN observed in 2006-2007 (Spurny, 2010) and 6 fireballs recorded in Japan in the beginning of nineties.

In order to resolve any potential inconsistencies in the published orbital and geophysical parameters, these have been checked by a standard checking procedure as applied to the sets of orbits in the previous version of the catalogue.

The check of consistency of the orbital and geophysical data is made in two steps: (a) Assuming that the published radiant and velocity at the time of detection were correct, the orbital elements are recalculated; (b) As sometimes errors appear also in the published geophysical (encounter) data, the radiant coordinates and the geocentric velocity are recalculated from the published orbital elements utilizing the optimal method of theoretical radiant prediction for a given orbital geometry (Neslušan et al., 1998).

In the new version of the catalogue also the error bars of the orbital and geophysical parameters derived by individual investigators, if available will be added and included to the both data files.

At the next step we plan to innovate the catalogue more regularly that is after any new set of meteoroid orbits is published or submitted for inclusion in the catalogue and information about any updating of the database will be announced on web page of the IAU MDC.

Acknowledgements

The authors acknowledge support from VEGA - the Slovak Grant Agency for Science (grants Nos. 1/0636, 2/0022 and 2/0011).

References

- H. Betlem, P. Jenniskens, J. van't Leven, R. Ter Kuile, C. Johannink, H. Zhao, C. Lei, G. Li, J. Zhu, S. Evans, P. Spurny, Very precise of 1998 Leonid meteors. *Meteoritics and Planet. Sci.* **34**, 979 (1999)
- P. Koten, P. Spurny, J. Borovicka, R. Stork, Catalogue of video meteor orbits 1. *Publ. Astron. Inst. Sci. Czech Rep.* **91**, 1–32 (2003)
- B.A. Lindblad, The IAU Meteor Data Center in Lund. In: Z. Ceplecha, P. Pecina (eds.) *Interplanetary Matter, Proc. 10th ERAM. Astron. Inst. Czechosl. Acad. Sci., Prague*, 201–204 (1987)
- B.A. Lindblad, D.I. Steel, In: *Asteroids, Comets, Meteors*, Milani et al. (eds.), 497 (1993)
- B.A. Lindblad, The IAU Meteor Data Center in Lund. *Earth, Moon and Planets*, **68**, 405 (1995)

- B.A. Lindblad, A survey of meteoroid orbits obtained by two station video observations. In: Meteoroids 1998, W.J. Baggaley and V. Porubcan (eds.), Bratislava, 274 (1999)
- B.A. Lindblad, IAU Meteor Data Center. In: Meteoroids 2001, B. Warmbein (ed.), ESA SP-495, 71 (2001)
- B.A. Lindblad, L. Neslusan, V. Porubcan, J. Svoren, IAU Meteor Database of photographic orbits-version 2003. Earth Moon Planets, **93**, 249–260 (2005)
- L. Neslusan, J. Svoren J, V. Porubcan, A computer program for calculation of a theoretical meteor-stream radiant. Astron. Astrophys., **331**, 411 (1998)
- P. Spurny, EN Photographic Perseids. Earth, Moon and Planets, **68**, 529 (1995)
- P. Spurny (2010) *Private comm.*
- J.M. Trigo-Rodriguez, J. Llorca, E. Lyytinen, J.L. Ortiz, A.S. Caso, C. Pineda, S. Torrell, 2002 Leonid storm fluxes and related orbital elements. Icarus **171**, 219 (2004)