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Electronic catalogue of the cometary physical characteristics

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Lack of the new catalogues of the physical characteristics of comets (the last one was published in 1985) was the reason of our work. Vsehsvyatskiy and Andrienko catalogues of the physical characteristics of comets from 1950 to 1985 and the data on the comets orbital elements of Jet Propulsion Laboratory NASA were used for compilation of our electronic catalogue. The special software was developed for this task. The input data were identified, corrected and transformed to the unified format. The data from IAU Central Bureau for Astronomical Telegrams from 1969 to 2008 years were used for determination of the comets visual magnitudes. We obtained the apparent magnitudes for 943 comets. Some of them were used for the comet absolute magnitude calculation. The main criterion for determination of the absolute magnitude was the presence of enough data on their apparent magnitudes. We also obtained the light curves for some comets.

Key words: astronomical data bases, comets, catalogues

INTRODUCTION

In cometary astronomy the specialized catalogues are used. They contain only the parameters of cometary orbits or information about groups of comets selected by the certain attribute such as an observer name. Sometimes it is useful to know the photometric parameters of comets for each of them approaching the Sun. Such the data were published in Vsehsvyatskiy and Andrienko catalogues of the physical characteristics of comets. They contain information about 1166 passages of comets since 466 BC to 1985 [1]-[7]: name, orbital elements, absolute magnitude $H10$, photometric parameters H_y and n, diameter of the head, tail length. The values were reduced to a standard distance to the Earth. The number of estimates of cometary brightness that were used to determine the $H10$, H_y and n is given also. For the comets with perihelion passage after 1985 no catalogues of physical parameters were published. To fill this gap we created a new general electronic catalogue of comets with photometric, geometric and orbital characteristics of all known comets of XIX, XX and early XXI century.

DATA PROCESSING

The special software was developed for creation of the catalogue and testing it. Software allows to process large volumes of the data. Catalogues [1]-[7] were digitized, verified and have used as a basis for a new electronic catalogue. The electronic catalogues of the orbital elements of comets from NASA[1,2] were used to extend and refine the previous data. As a result of comparison of common parts of the available catalogues some inaccuracies and their errors were found. To resolve ambiguities arose in the catalogue, the comparison of observed data with information from outside sources[3,4] were used. The comet's names were corrected, they were changed according to a modern standard. Names that are not used now were also preserved.

The resulting catalogue is presented in tabular form. It consists of fields similar to the published version and contains information about 3597 observed passages of the comets that passed or will pass perihelion since 1801 to 2012. 2341 of them are aperiodic comets and 1256 are periodic ones that returned (see Table 1).

Table 1: Statistics of the comets observation

Period	Total	$P > 1000$ years	$1000 > P > 15$ years	$P < 15$ years
1800-1849	94	63	9	22
1850-1899	223	129	19	75
1900-1949	275	120	25	130
1950-2000	1145	554	91	500
2000-2010	1860	1379	107	374

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[1] http://pds-smallbodies.astro.umd.edu/comet_data/comet.catalog

[2] http://ssd.jpl.nasa.gov/dat/ELEMENTS.COMET

[3] http://ssd.jpl.nasa.gov/sbdb.cgi

[4] http://ssd.jpl.nasa.gov/horizons.cgi

Distribution of the number of comets which approach to the Sun is shown in Fig. 1. There are noticeable achievements in recent years in comets discovery. Huge amount of the comets was discovered in the mid of nineties after the launch of SOHO and STEREO spacecraft for study the Sun.

In Fig. 2 the dependence of the comet's inclination on their argument of perihelion is shown. Here some groups of comets can be seen. One of that rgoups (marked with arrow) is Kreutz comet family.

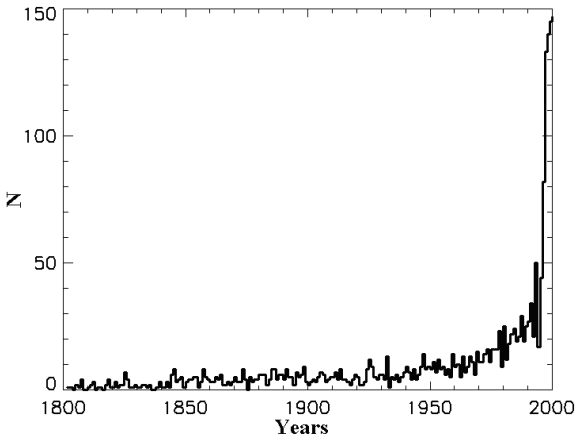

Fig. 1: Distribution of the number of comets approaching to the Sun.

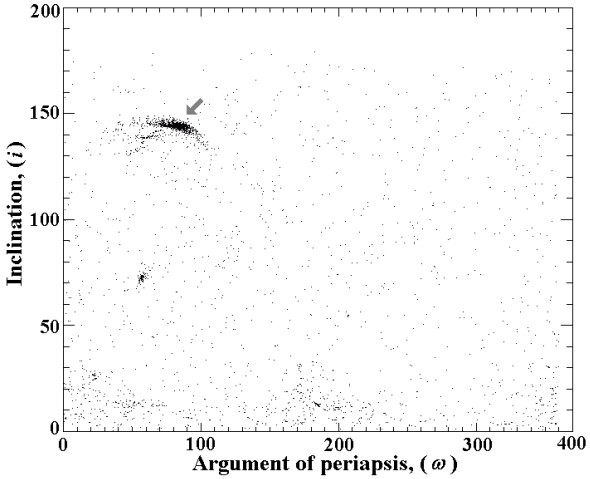

Fig. 2: Dependence inclination – argument of periapsis.

The database of visual magnitudes obtained from IAU Central Bureau for Astronomical Telegrams (CBAT)[5] is added to the catalogue.

[5] http://www.iau.org

At the first step the special software was created that got data from International Comet Quarterly in digital form. The information is separated into files. Total amount of the files is 6800. Information about 941 comets was extracted from them. Every comet data are collected in a single file which contains the date of observation, apparent magnitude and observation device parameters that is enough to build the light curve. Periodic comet files contain apparent magnitude information for more than one perihelion passage.

The catalogue was extended with absolute magnitude $H10$ value and photometric parameters H_y and n using apparent magnitude data. The following equations were used for calculation:

$$H10 = m - 10 \lg r - 5 \lg \Delta$$

$$m = H_y + 5 \lg \Delta - 2.5n \lg r,$$

where r is the comet-Sun distance in AU, Δ is the comet-Earth distance in AU. Correction for aperture was not carried out.

In Fig. 3 the absolute magnitudes of the observed comets ($H10$) are presented. One can see that during last 200 years more and more weaker objects are detected.

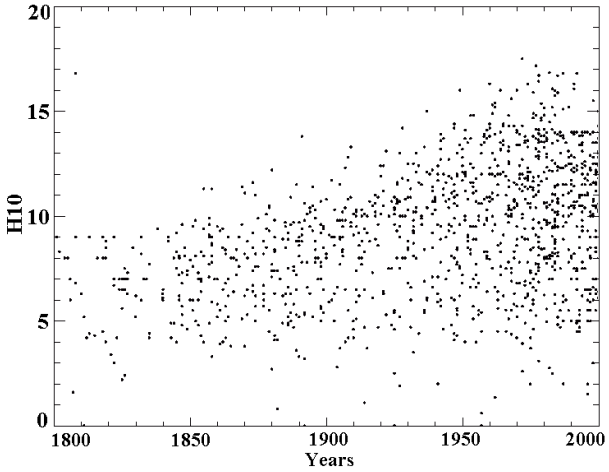

Fig. 3: Absolute magnitudes of the observed comets.

Light curves of some observed comets, 1P/Halley, C/1995 O1 (Hale-Bopp) and C/1996 B2 (Hyakutake), are shown as example of the obtained data in Fig. 4–6. The amount of the observed data is maximum near perihelion. The light curve form corresponds to the modern theoretical conception. The relative position of the comet, the Sun and the Earth explains the compound form of the light curve.

CONCLUSIONS

The special software was developed for the comet catalogue compilation. Our software identifies and corrects the input data. New electronic catalogue consists of the data about orbital and photometric parameters for 3597 comet passages. The apparent magnitude for 943 comets were obtained and used for the absolute magnitude comet calculation.

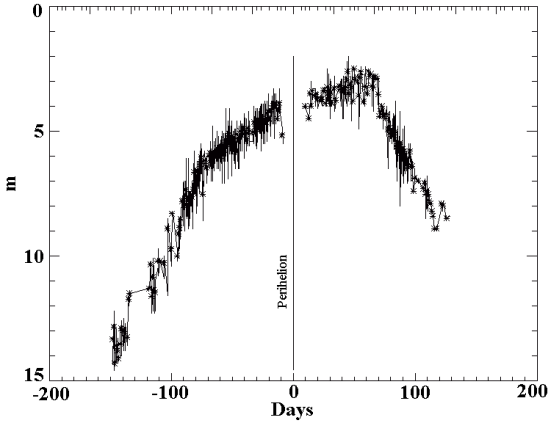

Fig. 4: Light curve of the comet 1P/Halley.

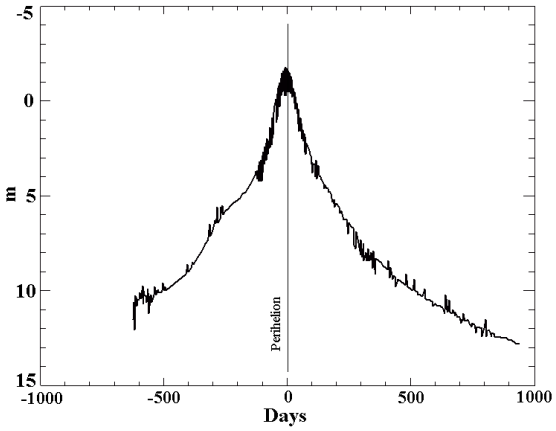

Fig. 5: Light curve of the comet C/1995 O1 (Hale-Bopp).

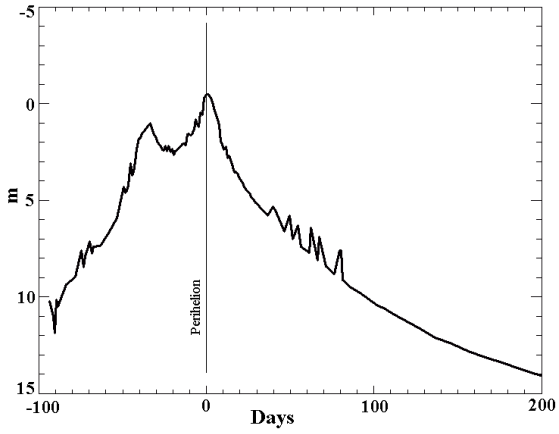

Fig. 6: Light curve of the comet C/1996 B2 (Hyakutake).

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