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Advances in Space Research 60 (2017) 1101–1107

ADVANCES IN SPACE RESEARCH (a COSPAR publication)

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Use of long-term nongravitational force models for fitting astrometric observations of comet Encke

V. Usanin, Y. Nefedyev *, A. Andreev

Kazan Federal University, Kremlevskaya st., Kazan 420008, Tatarstan, Russia

Received 17 March 2017; received in revised form 22 May 2017; accepted 24 May 2017
Available online 1 June 2017

Abstract

Based on the equations derived in (Usanin et al., 2016) a new solution combining the observations of 30 apparitions of the comet Encke from 1911 to 2010 is obtained. For the first time in the worldwide practice the solution is obtained by using converging differential correction of all 60 observed returns of the comet, however, the deviations are still unsatisfactory. The single solution has allowed to draw some preliminary conclusions. The contributions of planetary and nongravitational perturbations to the change of the elements of the orbit during the entire period of observation are determined. The extrapolation of the solution shows that for the past two thousand years the elements of the orbit orientation could change for a half of turnover, which should be taken into account when identifying the comet and associated meteor showers in ancient records. The predictions made by Z. Sekanina and I. Ferrín about oncoming termination of the comet activity are confirmed.

Keywords: Comets; Celestial mechanics; Nongravitational forces; Marsden's model; 2P/Encke

1. Processing of observations of the comet Encke: dynamical model and weights determination

The data on the comet Encke ground-based optical astrometric observations from 1881 was taken from the "MPCOBS" base of the Minor Planet Center (Marsden et al., 1993). The information on the observations taken from 1786 to 1961 was provided at our request by B.G. Marsden who noticed that he could guarantee neither reliability of the observations nor their conformity with what the observers had originally published (Marsden, personal communication, 2010). The observations used in the present work had been already converted to the equator and equinox of J2000.0 and were represented according to the standard format of the Minor Planet Center by Marsden himself, therefore we could use them during the calculations on a par with the other ones without introducing any additional reductions. The orbital elements obtained earlier (Marsden and Sekanina, 1974) from these observations have not been reconsidered until now and are reproduced in all comet catalogues, therefore, we may certainly be sure that this data is as reliable as possible. From each pair of identical records one was deleted. Thus, the data on 2695 observations from 60 apparitions of the comet Encke from 1786 to 2010 (except 1868) was collected.

A set of computer codes were created for observations processing according to the derived equations (Usanin et al., 2016). Theoretical positions for the comet were calculated by numerical integration of the equations of motion with relativistic term and nongravitational effects in two options: with model of significant non-volatile mass without impeding the sublimation and the low-mass crust

* Corresponding author. Fax: +7 8432927797.
E-mail addresses: vusanin@yandex.ru (V. Usanin), Yura.Nefedyev@gmail.com (Y. Nefedyev), alexey-andreev93@mail.ru (A. Andreev).

http://dx.doi.org/10.1016/j.asr.2017.05.039