New catalogue of single-apparition comets discovered in the years 1901-1950. Part I

M. Królikowska[1], G. Sitarski[1], E. Pittich[2], S. Szutowicz[1], K. Ziołkowski[1], H. Rickman[3], R. Gabryszewski[1], and B. Rickman[1]

[1]Space Research Centre of the Polish Academy of Sciences, Bartycka 18A, 00-716 Warsaw
[2]Astronomical Institute of the Slovak Academy of Sciences, 845 04 Bratislava, The Slovak Republic
[3]Department of Physics and Astronomy, Uppsala University, Box 516, SE-75120 Uppsala, Sweden

A new catalogue of cometary orbits derived using a completely homogeneous method of data treatment, accurate methods of numerical integration, and modern model of the Solar System is presented. We constructed a sample of near-parabolic comets from the first half of the twentieth century with original reciprocals of semimajor axes less than 0.000130 au^{-1} in the Marsden and Williams Catalogue of Cometary Orbits (2008, hereafter MW08), i.e., comets of original semimajor axes larger than 7700 au. We found 38 such comets in MW08, where 32 have first-quality orbits (class 1A or 1B) and the remaining 6 have second-quality orbits (2A or 2B). We presented satisfactory non-gravitational (hereafter NG) models for thirteen of the investigated comets.

The four main features, distinguishing this catalogue of orbits of single- apparition comets discovered in the early twentieth century from other catalogues of orbits of similarly old objects, are the following.

1. Old cometary positional observations require a very careful analysis. For the purpose of this new catalogue, great emphasis has been placed in collecting sets of observations as complete as possible for the investigated comets. Moreover, for many observations, comet-minus-star-type measurements were also available. This type of data was particularly valuable as the most original measurements of comet positions and has allowed us to recalculate new positions of comets using the PPM star catalogue.

2. Old cometary observations were prepared by observers usually as apparent positions in Right Ascension and Declination or as reduced positions for the epoch of the beginning of the year of a given observation. This was a huge advantage of these data, because this allows us to uniformly take into account all necessary corrections associated with the data reduction to the standard epoch.

3. The osculating orbits of single-apparition comets discovered more than sixty years ago have been formerly determined with very different numerical methods and assumptions on the model of the Solar System, including the number of planets taken into account. This new catalogue changes this situation. We offer a new catalogue of cometary orbits derived using completely homogeneous methods of data treatment, accurate methods of numerical integration, and a modern model of the Solar System.

4. The osculating, original, and future sets of orbits are presented for each catalogue comet. In the case of a comet with detectable NG effects, we give both types of orbit: purely gravitational and non-gravitational. We concluded, however, that all thirteen NG orbital solutions given in the catalogue better represent the actual motions of the investigated comets. Surprisingly, the NG effects were detectable in data for five comets of second-quality-class orbits. Among these five are three comets with hyperbolic original, barycentric GR orbits.

This publication will be accompanied by an online catalogue available at `ssdp.cbk.waw.pl/LPCs`, providing entries to orbital elements of considered comets as well as to full swarms of original and future virtual comets that formed the basis for the further analysis of dynamical evolution.

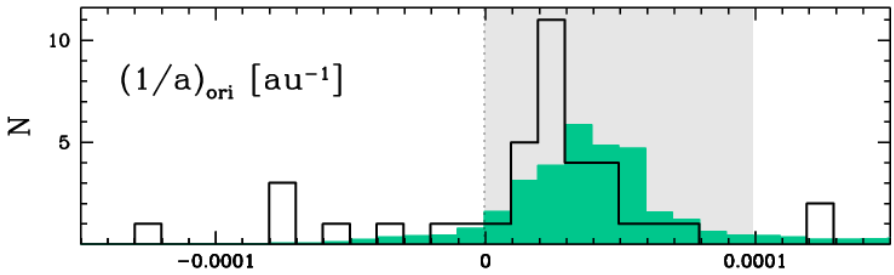

Figure: Distribution of original $1/a$ for considered long-period comets, where the green-filled histogram shows our results and the black histogram represents the distribution taken using the MW08. The uncertainties of $1/a$-determinations were incorporated into our $1/a$-histogram by taking the full cloud of virtual comets for each comet.