FINDING OF THE OBSERVATIONS OF EXTERNAL PLANETS' SATELLITES USING THE PLATE ARCHIVE. FIRST RESULTS

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The first efforts were made to find observations of the external planets and their satellites using the database of photographic observations of celestial bodies at the Main Astronomical Observatory in Kyiv (MAO NASU).

One of the programs of observations performed at the Main Astronomical Observatory of the NAS of Ukraine (MAO NASU) during the last years was the program of photographic observations of the external planets of Solar System and their satellites.

Almost during 30 years (from 1963 to 1990) more than 1275 positions of the satellites of Saturn, Uranus, and Neptune were received at Golosiiv (Ukraine) and at Majdanak (Uzbekistan) [3]. Unfortunately, their significant part is garnered in 1980–1990. The best observational accuracy was obtained at Majdanak (the standard deviations σ_α, σ_δ of both coordinates are equal to 0.22 and 0.23 arcsec, respectively), an enough good one – with the Double Long-Focus Astrograph (DLA) (σ_α, σ_δ are equal to 0.27 arcsec) and a poor one – with the Double Wide-Angle Astrograph (DWA) (σ_α, σ_δ are equal to 0.37 and 0.27 arcsec, respectively).

All the external planets' satellites observations which were obtained worldwide, are well completed and accessible: the first visual ones (from 1874) are presented in the catalogue of Stragnell and Taylor; the photographic ones gathered till 1988–1989; and observations with the use of CCD-receivers obtained in the last decades. As a rule, the greater part of these observations is obtained in 1980–2000.

Unfortunately, there are not enough observations from 1960–1970. And this fact till now does not allow one to prolong into the past the exact theories of movement of the satellites.

It is possible to try "to get" these observations in the past using databases of observations, and, in particular, our archive of plates created at the MAO NASU.

During 60 years of the existence of our observatory, over 20 thousand various photoplates were taken, on which astronomical objects and events are fixed since 1948. This information can be used for the decision of various scientific tasks and including the detection of images of the external planets' satellites.

For this purpose, the electronic archives of observations performed with the telescopes DLA and DWA were just used [1, 2, 4]. Numbers of plates involved are 6445 (for 1960–1986 with the telescope DLA) and 4597 (for 1976–1997 with the DWA). (See in Fig. 1 the distribution of observations on time for both telescopes).

On the one hand, the DLA plates have a small scale (37.48 arcsec/mm) that allows one to divide the close located images of satellite and planet and to achieve a good accuracy by the determination of their coordinates. On the other hand, a DWA plate has the large star field for search for objects.

Figures 2 and 3 illustrated the results of searching the plates with the satellites. Trajectories of movement of the planets (Saturn, Uranus, Neptune, Pluto) on each coordinate are shown in dependency on time. The points present the centers of plates available in the archive for the telescopes DLA and DWA.

There are a few objective difficulties which influence on a successful searching the necessary plates: 1) negative planets' declinations; 2) simultaneous finding the necessary plate for an given area and exposing date in accordance with ephemeris; 3) astrometric suitability of the found plate.

We developed a program for plate search using the database with data records and planet's (satellite's) ephemeris. Then, we verified this search method. As a result, we have found a small number of plates (15) with the exception of those, which were processed within the framework of the program of observations of the external

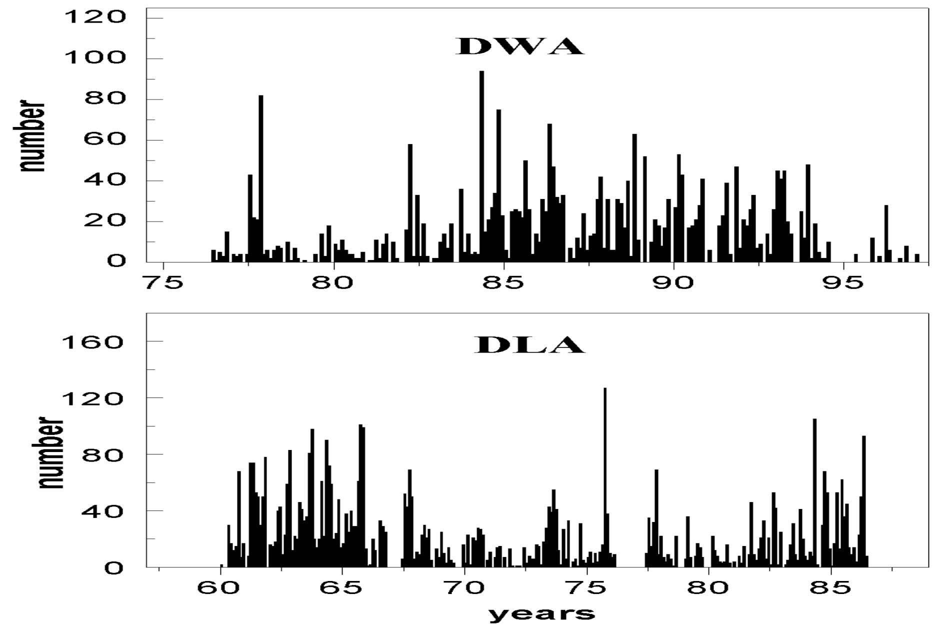

Figure 1. The distribution of observations on time for the DLA and DWA telescopes

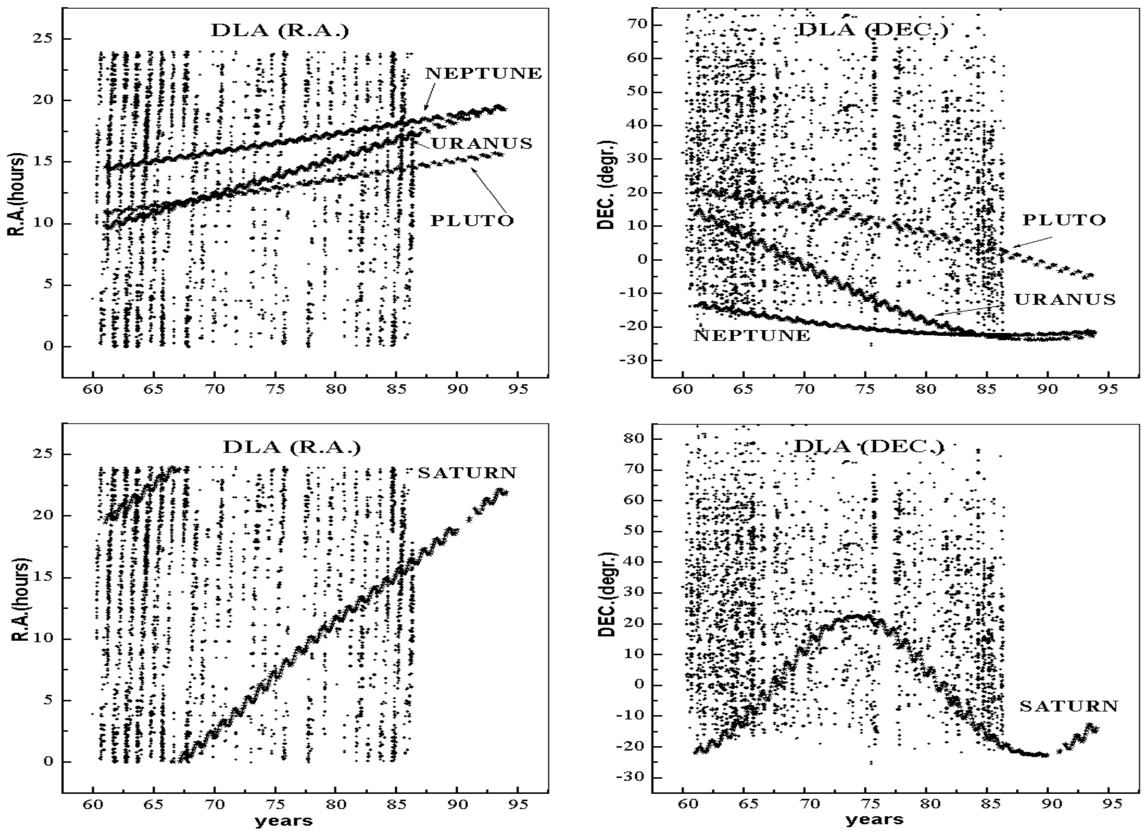

Figure 2. The trajectories of the planet's movement and the dispersion of observations on time for telescope DLA

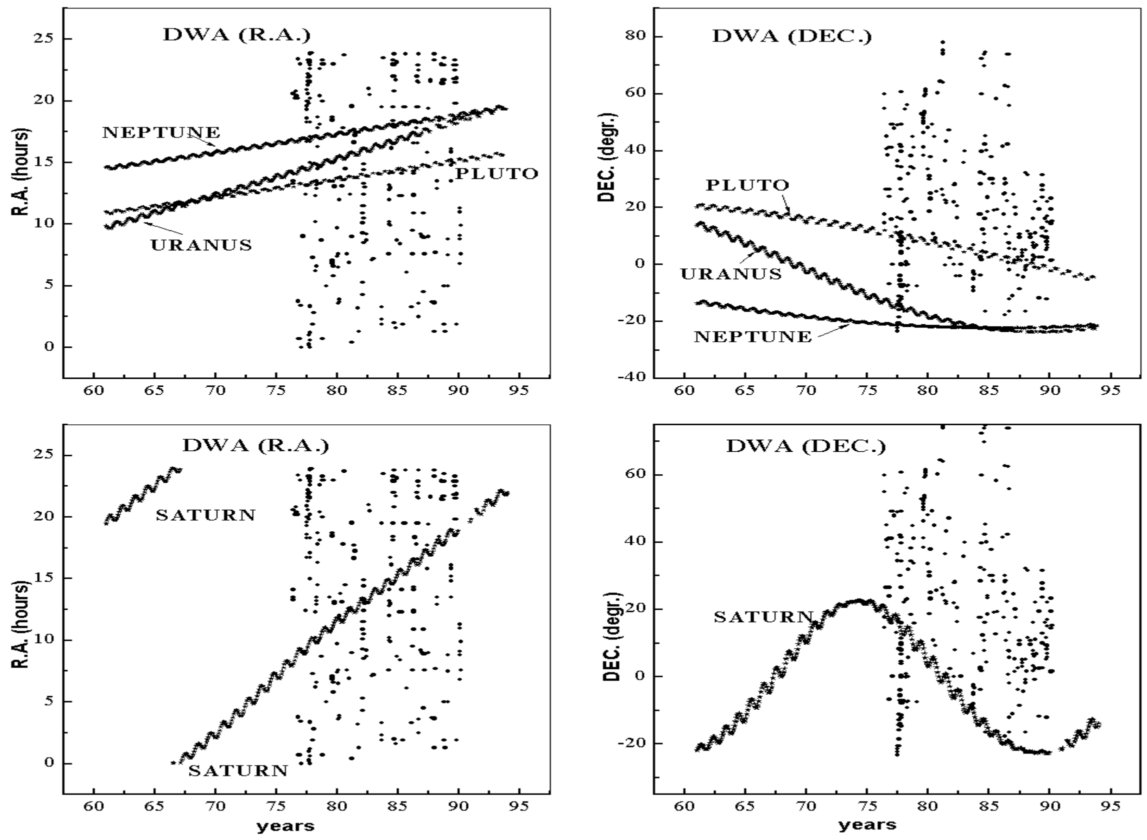

Figure 3. The trajectories of the planet's movement and the dispersion of observations on time for telescope DWA

planets and their satellites. Unfortunately, any of them is not acceptable for the precise astrometry. It is possible that the results would be more successful when we involve more plates obtained with the aid of other telescopes into the process of search.

[1] *Golovnya V. V.* The minor planets bank of plates obtained using the Zeiss Double Wide-angle Astrograph the MAO NASU in Kyiv. [`http://www.mao.kiev.ua/ast/minortxt.html`].

[2] *Pakulyak L., Kharchenko N., Izhakevich E., et al.* Data base of photographic observations of celestial bodies Golosiiv observatory in Kiev // Newsletter.–1997.–N 9.–P. 13–15.

[3] *Yizhakevych O., Kulyk I., Major S., Shatokhina S.* Catalogue of astrometric positions of the satellites of Saturn, Uranus, and Neptune at 1990 opposition. [`http://www.mao.kiev.ua/ast/sat1/90_txt.htm`].

[4] *Yizhakevych O., Shatokhina S.* The preliminary list (card-index) of photographic observations of some selected objects obtained using the Double Wide-angle Astrograph (DWA) of the Main Astronomical Observatory of the National Academy of Sciences of Ukraine (MAO NASU) in Kyiv during 1976–1996. [`http://www.mao.kiev.ua/ast/astrom.htm`].