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**METHODS AND INSTRUMENTS
IN ASTRONOMY: FROM GALILEO
TELESCOPES TO SPACE PROJECTS**

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ABSTRACT BOOK

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intervals of 10, 20, 30 and more years showed, what and how one can get using these intervals for calculation of proper motions in astrometric sense.

For all the plates within 1895-1993 years there were calculated coordinates and proper motions of 60 common stars. The calculations were carried out in the ICRF system, J2000.0 using the reference stars from the Tycho-2 and UCAC3 catalogues. A number of reference stars was chosen from 12 to 22, reduction errors varied from 0.1" to 0.3". The best reduction precision appeared for the measurements of stellar images for all types of astronomical plates obtained before 1941. Besides the calculations using the classical schemes for astrometric reduction, positions and proper motions of stars were calculated with taking into account atmospheric dispersion according to the author's method. The coordinates and proper motions were obtained for more than 80 stars from 7 to 11 magnitude on the mean epochs using:

- different time intervals of observations;
- different selections of stars according to brightness and spectrum;
- different catalogues (Tycho-2 and UCAC3).

The results were compared between themselves and also with coordinates and proper motions from the space catalogues Hipparcos and Tycho-2. There were analyzed the results of transition from one type of photographic plates to others during the last 50 years of photographic observations. All results are presented in the form of a catalogue, and figures of (O–C).

A COMPILED CATALOGUE OF THE REFERENCE STARS FOR OPTICAL OBSERVATIONS OF EXTRAGALACTICAL RADIO SOURCES NEW INCLUSIONS

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Ground-based astrometry was based mainly on optical observations, and up to XX century the fundamental catalogues, as FK3 – FK6, were the basis of this astrometry. When space mission HIPPARCOS have been finished, Hipparcos Celestial Reference Frame

(HCRF) was adopted as the main coordinate system. Hipparcos Celestial Reference Frame realizes ICRF system, based on the VLBI observations of the ERS (extragalactic radio sources). HCRF system is linked to the ICRF through the system of stars, radio stars and visually observational ERS. However, the estimates of the system stability show that errors of the stellar proper motions and positions of the Hipparcos catalogue have to be a reason of the system rotation about $0,25 \text{ mas yr}^{-1}$.

For establishing a link between optical and radio astrometrical coordinate systems, observations of the same objects in both radio and optical wavelength are considered as a priority problem in ground-based astrometry. The problems will be solved with telescopes using CCD-detectors because most of ERS are very faint ($18\text{-}20^m$). A magnitude equation adds errors to the system stability. High precise system of reference stars around ERS is needed. The reference system is needed to improve fundamental systems FK4-FK6 for obtaining high accurate coordinates of ERS.

We earlier compiled a catalogue of reference stars of $11\text{-}17^m$ for 235 fields around ERS to make a link with VLBI-observations. The catalogue includes 3 photographic catalogues (from Pulkovo – PulkERS, from Bucarest - Buch (188), from Kiev - Kiev (115)) and a catalogue obtained with AMC in Nikolaev Observatory, using CCD-detector (208 fields around ERS). A catalogue obtained with the telescope with the CCD detector have been included (192 – KMAC1) for several fields. Moreover, Chinese and Turkish observations (Shanghai, 1.2 m with a CCD-detector and Antalya, 1.0 m with a CCD-detector) have also been included.

Since the link of the reference systems is a problem of primary importance, many catalogues with stellar positions around ERS appear in the last years. We include new observations of the stars around ERS into our compiled catalogue. At the present stage we include several other catalogues into the compiled catalogue. Samples from these catalogues allow increasing a number of stars around ERS for 25-30% within the same sizes of our fields. So, we included catalogues CMC-9 and CMC-14 from observations with Carlsberg Meridian Circle. We made samples from Lazorenko catalogue (KMAC1) for all the fields with ERS. This catalogue was made with Kiev Meridian Axial Circle using a CCD-matrix 1040×1060 .

Also we have used the XC1 catalogue from Kharkov. This enormous catalogue contains stellar positions up to 19^m for the Northern

sky in 255 fields of 1 degree radius around ERS (856421 stars). It is based on the measurements of the photo plates ROSS-I и ROSS-II made with the PMM measuring machine of USNOFS. We plan to use proper motions for calculation of stellar positions to the mean epoch of observation for stars from other constituent catalogues without proper motions and identification with XC1. We use UCAC3 for the same task, but we have not include it into the compiled catalogue. Individual star coordinate errors will be decreased and the number of the stars with proper motions in the compiled catalogue will be increased. Moreover, we included the photographic catalogue ERLCat – USNO. The observations have been made with two small telescopes in the Northern and Southern hemispheres from 1976 till 1991. This catalogue contains 89422 stellar positions from 12^m to 14^m for 398 fields around ERS; but it has not proper motions. Moreover, we included new observations with Pulkovo Normal Astrograph using a CCD-detector. These observations allow increasing the number of stars around ICRF ERS.

Several tens of thousands of observations are being using. Compilation and classification were made. Systematic analysis of the star coordinate accuracy has begun. We use the total version of UCAC3 for analyzing precision. Currently we have 11 catalogues for this project. We shall obtain a compiled catalogue from for 241 fields of 40 x 40 minutes.

POSITIONS OF PLUTO CALCULATED AT PULKOVO FOR 1930 – 1996

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More than 300 positions of Pluto were obtained and calculated in the astronomical fundamental system ICRF (J2000.0). They were photographed from 1930 till 1994 with an exception of 1942-1949, the War and the after the War years. The basic series of observations were carried out with Pulkovo Normal Astrograph (33/346) beginning from the discovery of Pluto in 1930 up to it going to the Southern hemisphere. Exposure of plates should have reached one hour for the faint magnitude of Pluto and the great zenith distances made impossible taking images of the planet on the Normal Astrograph in Pulkovo. By this time at Pulkovo there were obtained 230 plates in 1930-1941 and