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THE ROLE OF FUNDAMENTAL ASTROMETRY IN ASTRONOMICAL RESEARCH

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Abstract. The role of Fundamental Astrometry in astronomical researches in general is considered. One of its crucial tasks is the setting up of suitable coordinate system affording high accuracy of positiion determination of celestial bodies of the order of 10^{-8} to 10^{-10} radians.

1. INTRODUCTION

Astrometry is primarily concerned with the positions and geometric and kinematic properties of the celestial bodies, their groupings and distribution throughout the Universe. The wealth of astrometric data is turned to account in the studies of structural, kinematical and dynamical problems of the stellar systems, the solar system bodies being the object of particular attention.

One of Astrometry's foundations is the system of astronomical constants whose outstanding quality must be the highest possible accuracy coupled with its complete intrinsic concordance.

The first and the most important task of Astrometry is the setting up of suitable coordinate system, allowing the study of the solar system bodies as well as the other objects in the Universe. Such a system cannot but be embodied by, and be dependent on, celestial bodies, the Earth, the Sun, the stars and extragalactic objects inclusive. (Yatskiv, Gubanov 1980).

The requirements put on such a coordinate system are :

1. The system must be strictly and unambigueusly defined. Methods of its setting up must be simple and mutually independent.

2. The setting up of a fundamental coordinate system should not, if possibly, depend on any hypotheses whatever.

3. The accuracy inherent in a fundamental coordinate system ought to be of the order of $0\overset{''}{.}001$ or better, i.e. 5 10^{-9} radians.

4. The fundamental coordinate system must be inertial, i. e. its only permissible motion is rectilinear uniform one.

2. INERTIAL FUNDAMENTAL COORDINATE SYSTEM

Historically, it is by steps, logically following each other, that the fundamental coordinate systems have been materialized. Their origin, by force of circumastances, had to be ascertained through intermediary of stars. The stars proper motion imposed the need to look toward the pointlike extragalactic nenulae, which are devoid, through their enormous distances, of a perceptible proper motion. However, great difficulties were met due to their poor definition on account of their faintness and indistictiveness (Yatskiv 1983).

The quasars, whose extragalactic position was discovered in 1963, appeared at once as a welcome help. Some of them were observable in both the optical and radio wave-length band.

The application of the VLBI (very long base interferometry) technique for angular position determination of these objects marks the beginning of a new era in dealing with the problem of the inertial coordinate system. Nowadays, it is considered that such a coordinate system, to be inertial, must have the directions of its axes defined by extragalactic radio sources, its origin coinciding with the barycentre of the solar system. Still, it cannot but be quasi-inertial in consequence of its origin being subjected to a slight acceleration and the directions of its axes, in principle, are not strictly steady. Due to such a state of affairs this coordinate system bears appropriate name : it is called "conditional inertial coordinate system" (Mueller 1981).

Nor is the realization of such a system in practice, in the sense of the theory of relativity, rigorous, but it proved highly convenient in the everyday actual work. Many astronomers took such a practical approach. In reductions it is necessary to take into account the small, so called relativistic, corrections.

Currently, the setting up of an inertial coordinate system is feasibly with an accuracy of 10^{-8} to 10^{-9} radians. This meets the requerements of the contemporary fundamental and applied researches in Astronomy and related sciences. Mostly used is the equatorial coordinate system, i.e. the one whose basic plane is given by equator and is materialized by star positions and their proper motions as given in the fundamental catalogues, allowing for the composite motion of the observer. By applying the astronomical constants involved, such as that of precession, as well as others, one achieves a fairly satisfactory approximation of an inertial coordinate system.

References

Yatskiv, Ya. S., Gubanov, V. S. : 1980, "Ob osnovnykh koordinatnykh sistemakh, primenjaemykh v astrometrii i geodinamike", *Geodinamika i astrometriya*, Kiev, 110–120.

Yatskiv, Ya. S. : 1983, "O sostojanii i tendeciyakh razvitiya astronomicheskikh issledovanij", *Astrometriya i astrofizika*, **49**, 3–9.

Mueller, I. I. : 1981, "Reference Coordinate Systems for Earth Dynamics : A Preview (Review)" in *Procc. of the 56-th Colloq. of the IAU*, Varsaw, 1980, Dordrecht, 1-22.