ECLIPTICAL COORDINATE SYSTEM AS THE BASIS OF REGATTA-ASTRO SPACE ASTROMETRY PROGRAM

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One of the most important problems of modern astrometry is constructing of an ideal inertial coordinate system. A bulk of up-to-date star catalogues is referenced to an equatorial frame, which is far from being really inertial. Some attempts were made to remove this defect by excluding both nutation and precession in right ascention [Guinot 1979, Murray, 1990]. This proposal seems to be a compromise between the existing tradition and the new requirements met by the modern astrometry.

Perhaps, the use of non-rotating ecliptical coordinates would be more practical. There are two reasons at least supporting this idea. First, this frame is physically defined much better than the equatorial one due to a pure knowledge and variability of the great number of parameters involved in the Earth's rotation. Secondly, many basic problems of astronomy and astronautics deal with the ecliptical coordinates rather than the equatorial one. Take for instance the theories of the orbital motion of planets and minor selestial bodies. In addition, resent space-born astrometrical instruments provide the data which can be more conveniently referenced to the ecliptical frame. Furthemore, the equatorial plane cannot be defined in principle from the extraterrestrial astrometric measurements, while the ecliptical plane is "peculiar" because of its connection with the heliocentric orbital motion of the observatory. Note that historically the very first star catalogues by Ptolemeus and Hipparchus did use the ecliptical coordinates. Thus, what we propose is a return to origin.

The central idea of the approach considered herein is the observability of the ecliptical plane and thus the straightforward availability of ecliptical coordinates of stars. Practically, one can do it by simultaneous observations of stars and the Sun. A location of a spacecraft carrying the astrometrical instrumentation and orbiting around the Earth may be determined very accurately by means of radio tracking. Continuous on-board obserations of the Sun provide the heliocentric orbital plane of the spacecraft (generally, it is quite near to the ecliptical plane). Necessary reductions may be computed from the radio tracking data. Following this way, the true ecliptic plane will be defined. There is no problem to reduce it to the mean ecliptical plane. Unlike the interrelation between the true and mean equators, it may be easily calculated.

An approach described will be implemented in REGATTA-ASTRO project of Space Research Institute, Moscow [Avanesov et al, 1990]. An astrometric module will be mounted onboard the Small Space Laboratory a lightweight spacecraft rigged with the solar seil providing the attitude mode with one spacecraft axis permanently pointing the Sun. The spacecraft is rotating slowly (about 1 revolution per day) around this direction. The instrument consist of four rigidly connected star telescopes and a solar telescope (Fig.1). The astrometric module is involved into the complicated angular motion. Following it, the field of view of the star telescopes scan the celestial sphere and cover it totally during half of year (Fig.2). The Sun is staying permanently inside the FOV of the solar telescope. An attitude mode is highly benefit for the constanty of temperatures onboard. The spacecraft is designed in a way minimizing the perturbing torgues, thus providing an extremely high degree of smoothness of its rotation. The choice of an operating orbit is meeting the same requirement (it is so-called quasy-satellite orbit). These means make it possible to process long measure arcs and achieve a significant updating of the star positions. The a priori appraisals forecast the output accuracy of the ecliptical star positions, proper motions and parallaxes to be about 10 mas for approximately 100000 stars.

In addition to the astrometric program, an experiment on the solar physics is planned for the REGATTA-ASTRO mission. It includes the measurements of the apparent diameter of the solar disc, it oblatness, it brightness and their temporal variations with the resolution of some 10 seconds. The level of accuracy will overcome the ground-based measurements by order of magnitude as minimum. The result anticipated may spread light on problems of helioseismology.

It seems to be evident that the technical implementation of the project is not more sophisticated than that of other spaceborn experiments, while its benefits may be very significant. For example, the information of the solar telescope simplifies greatly the data processing and catalogue compilation. Besides, the whole procedure of catalogue orientation may be excluded.

1. Guinot B: 1979, Time and Earth's rotation, IAU Symp. 82
2. Murray C.A.: 1990, Inertial Coordinate system on the sky, IAU Symp. 141
3. Avanesov G. et al: 1990, Inertial Coordinate system on the sky, IAU Symp. 141

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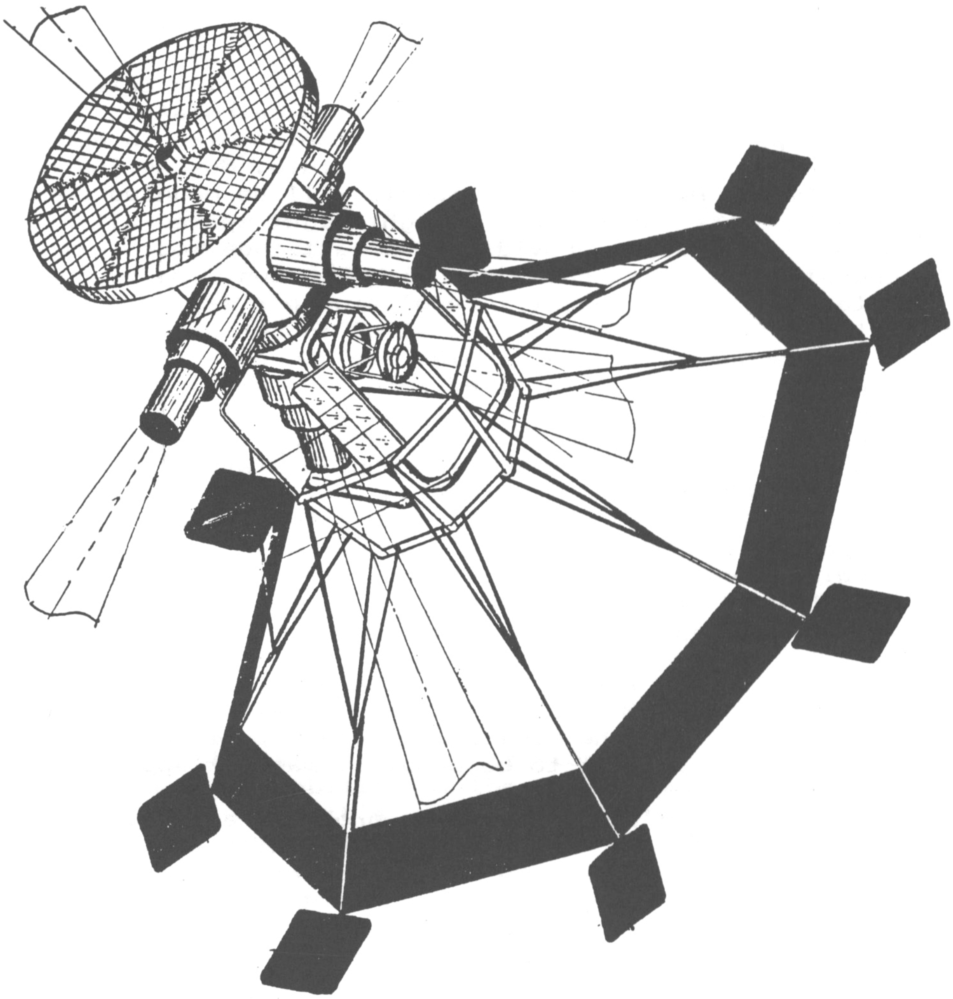

Fig. 1

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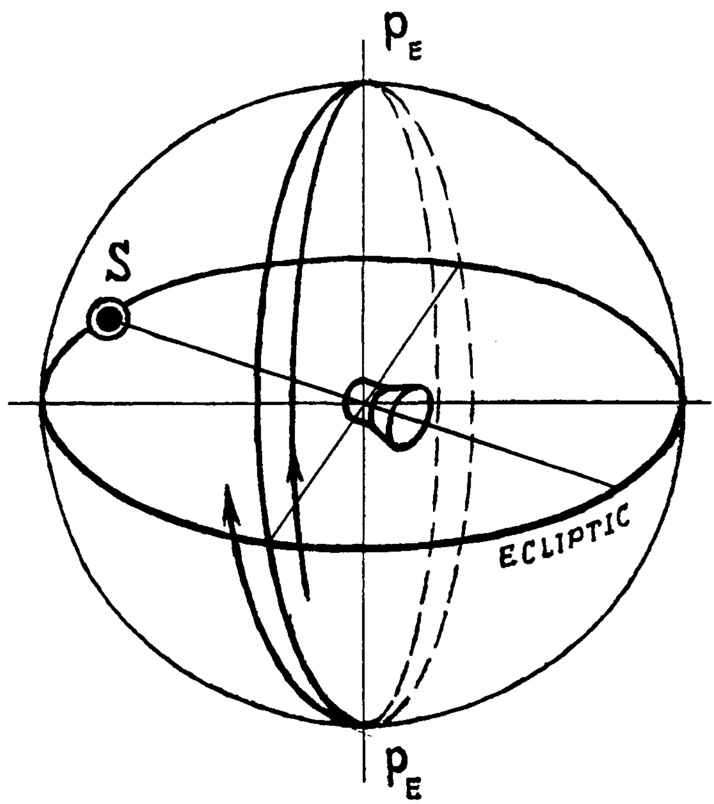

Fig. 2

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