

PRESENT STATUS OF WORK ON THE FK5 EXTENSION

THOMAS E. CORBIN

*U.S. Naval Observatory
34th and Massachusetts Ave., NW
Washington, D.C. 20392
U.S.A.*

HEINER SCHWAN

*Astron. Rechen-Institut
Mönchhofstr. 12-14
D-6900 Heidelberg 1
F.R.G.*

ABSTRACT. The FK5 Extension, consisting of 3117 new fundamental stars selected from the FK4 Sup catalogue and the IRS list, will extend the FK5 system to about 9.5th visual magnitude. The construction of the FK5 Extension is briefly described and the main characteristics are given.

1. INTRODUCTION

The Fifth Fundamental Catalogue (FK5) will consist of two parts, namely the "Basic FK5" (Fricke et al., 1988) and the "FK5 Extension". The Basic FK5 contains the classical 1535 fundamental stars already given in the FK4. Systematic and individual corrections to the mean positions and proper motions of the FK4 have been derived and the IAU(1976) System of Astronomical Constants has been introduced. The Basic FK5 defines the system of the new fundamental catalogue; it has been constructed with the aim to represent an inertial system as far as possible. Details are given in the introduction to the Basic FK5 as well as by Schwan (1987) and in the literature quoted there.

One important shortcoming of the FK4 is the predominance of bright stars. Only about 100 stars are fainter than magnitude 6.5 and thus the FK4 is not well defined at magnitudes fainter than this. The extension of the optical system to fainter magnitudes was therefore an indispensable task in constructing the FK5.

2. SELECTION OF THE NEW FUNDAMENTAL STARS

It was realized by Fricke (1973) that there are essentially two star lists from which the new fundamental stars could be selected: the International Reference Stars (IRS) for extending the system to about magnitude 9.5 and the FK4 Sup stars which had to fill a remaining gap in the magnitude distribution from about 5th to 7th magnitude.

Mean positions and proper motions were determined for all IRS at the U.S. Naval Observatory (Corbin and Urban, 1990) and for all FK4 Sup stars at the Astronomisches Rechen-Institut (Schwan, 1987). On the

basis of the mean errors of the positions and proper motions and the distribution over the sky coupled with the distribution in magnitude we have selected 992 stars from the FK4 Sup and 2125 stars from the IRS, altogether 3117 new fundamental stars. These new fundamental stars represent the FK5 Extension and they are to define the FK5 system for fainter stars up to about 9.5th mag.

It seems to be worth mentioning that the FK5 Extension includes 12 FK4 Sup stars not yet in the tape version of the bright stars in the FK5 Extension which has been distributed since 1988.

3. DERIVATION OF MEAN POSITIONS AND PROPER MOTIONS

The FK5 Extension was primarily derived in the system of the FK4. All observations which could be used for the derivation of mean positions and proper motions had therefore to be referred to that system. This transformation was comparatively easy in the case of the FK4 Sup stars since most of them do not exceed seventh magnitude. On the basis of the FK4 stars in an observational catalogue the systematic relations Cat-FK4 were determined and the observed positions were directly transformed to the FK4 system.

In the case of the IRS, in particular of the southern IRS, this simple procedure was not possible, since most of these stars are outside the limit of FK4 magnitudes. The systematic relations Cat-FK4, determined on the basis of the FK4 stars alone, could not be directly applied to the fainter stars. It was necessary to construct first an intermediate system which represents the FK4 system for fainter magnitudes. The observations which could be used for that purpose had either to be free of magnitude dependent errors or their systematic errors at faint magnitudes had to be determined. North of -30 degrees the catalogues observed with screens (which eliminate magnitude equations) could be used to derive such an intermediate system. There was, however, an insufficient number of appropriate catalogues for deriving a corresponding system south of -30 degrees. In that region an extrapolation of the magnitude equation from northern declinations to the southern region was necessary. This extrapolation could be performed by making use of southern catalogues observed with a moving-wire micrometer. Such catalogues have been found to have magnitude equations that are not declination dependent.

The construction of an intermediate system extending the FK4 system to about magnitude 9.5 was the essential step in deriving the astrometric data for the IRS stars. This extended FK4 system could be used to reduce many other catalogues with observed faint stars to the FK4 (see also Corbin and Urban, (1990)).

After having transformed all relevant observations to the FK4 system we have performed weighted least squares solutions for deriving the mean positions and proper motions from the various observed catalogue positions.

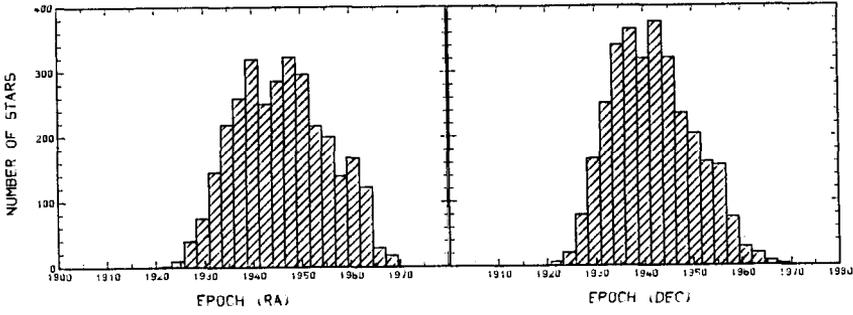


Fig. 1: FK5 Extension: Distribution of mean epochs.

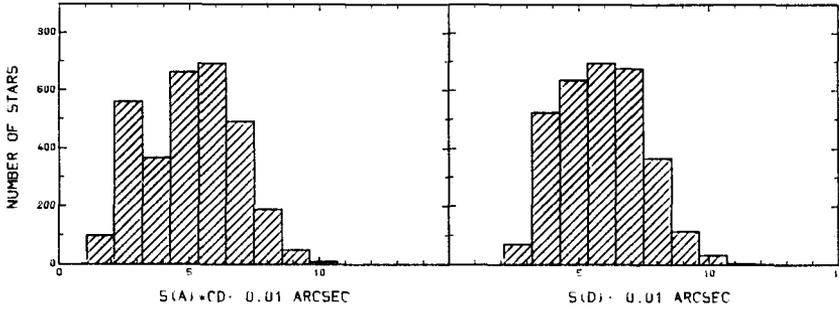


Fig. 2. FK5 Extension: Distribution of mean errors of mean positions in RA (left) and DEC (right), respectively; units: 0.01 arcsec.

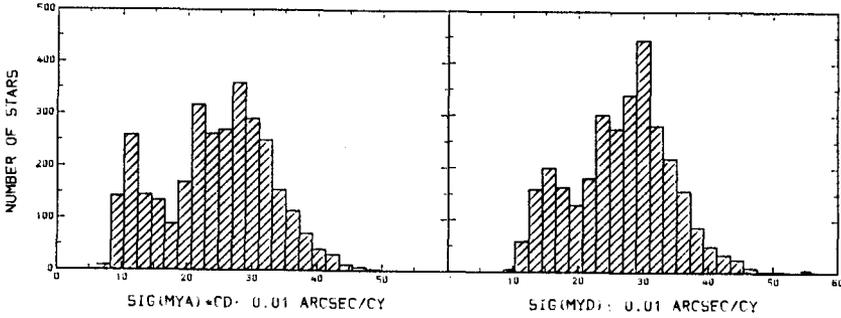


Fig. 3. FK5 Extension: Distribution of mean errors of the proper motions in RA (left) and DEC (right), respectively; units: 0.01 arcsec/cy.

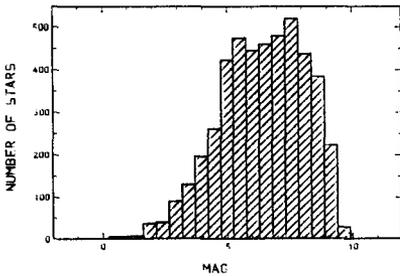


Fig.4. Distribution of apparent magnitudes of the whole FK5 (Basic FK5 plus Extension)

4. MAIN CHARACTERISTICS OF THE FK5 EXTENSION

The main characteristics of the FK5 Extension are presented in the four figures. In Fig. 1 we show the distribution of mean epochs in right ascension (left) and declination (right), respectively. There is a small dip in both distributions indicating that the FK4 Sup stars in the FK5-Extension have, on the average, more recent mean epochs than the IRS. This is a consequence of the fact that the Sup stars were preferentially observed after 1955 when they had been proposed as candidates for a future extension of the fundamental system. The two subgroups can more or less also be identified in Fig. 2 and Fig. 3. The average mean epoch of the FK5 Extension is 1944.

In Fig. 2 are given the distributions of the mean errors of mean positions in right ascension (left, multiplied with $\cos(\delta)$) and declination (right), respectively, and in Fig. 3 one finds the corresponding distribution of the proper motion errors. The FK4 Sup stars are a little more precise than the IRS. The overall precisions are 0.055 arcsec for the mean positions and 0.255 arcsec/cy for the proper motions.

In Fig. 4 we present the distribution of apparent visual magnitudes of the whole FK5 (Basic plus Extension). Preliminary magnitudes were used in the star selection and also in Fig. 4. It is, however, unlikely that the final magnitudes will alter this distribution significantly.

5. PRESENTATION OF THE FK5 EXTENSION

The FK5 Extension will be given, as far as possible, in the same format as the Basic FK5. We plan to publish the following data for each star: FK5 number, apparent visual magnitude, spectral type, position and proper motion for the epoch and equinox J2000 in accordance with the IAU (1976) System of Astronomical Constants, the corresponding values transformed to epoch and equinox B1950, mean epochs of observation, mean errors of position and proper motion at the mean epochs, and identifications with some other important star lists. Parallaxes and radial velocities will be given in the catalogue for all stars with significant foreshortening terms.

We hope that a tape version of the FK5 Extension can be made available around the beginning of the next year.

REFERENCES

- Corbin, T., Urban, S.E.: 1990, in IAU Symp. 141, Inertial Coordinate System on the Sky, eds. J.H. Lieske, V.K. Abalakin, p. 433
 Fricke, W.: 1974, in IAU Symp. 61, New Problems in Astrometry, p. 23
 Fricke, W., Schwan, H., Lederle, T., and collaborators: 1988, Fifth Fundamental Catalogue (FK5); Part I: The Basic Fundamental Stars. Veröffentlich. Astron. Rechen-Inst., Heidelberg, No. 32
 Schwan, H.: 1990, in IAU Symp. 141, Inertial Coordinate System on the Sky, eds. J.H. Lieske, V.A. Abalakin, p. 371