Current work with the photoelectric transit instrument at the Observatory of Torino

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Anderlucci et al. (1983) describe a multislit photoelectric micrometer attached to the transit instrument of the Observatory of Torino and report some preliminary results.

This work is carried out within the framework of the international cooperation in the study of Earth's rotation (BIH, IPMS and MERIT).

These observations have been under way since February 1980 and some information about the performance of the instrument and the quality of our data is now available. Three hundred and thirty four groups of stars have been observed up to December 1983. Each night a set of ten FK4 stars is observed. UTO is calculated from these observations and compared to UTC.

Since the instrument is reversible, each star is observed with the instrument in two positions for a given transit, and from each slit we have an observed transit instant t_i whose precision corresponds to a standard error of $\varepsilon_i = 0\overset{''}{.}218 = 0\overset{s}{.}0145$ as already published. From a set of 10 slits and a group of 10 stars, the expected precision should thus be 10 times better, i.e., it should correspond to a standard error of $\varepsilon_{exp} = 0\overset{s}{.}0015$. Plotting all residuals RT=UT1 (OAT) - UT1 (BIH), we obtain a reasonably random distribution (fig. 1). The mean square error for each night is $\varepsilon_{obs} = 0\overset{s}{.}0072$, almost $5\varepsilon_{exp}$. This discrepancy is due to a small degree to residual inaccuracies in FK4 stellar positions, and to residual errors associated with the instrument, such as inclination readings; inertia of the bubble in the level, azimuth instability occurs as a consequence of the instrument reversion, since an error of $1\mu m$ in the mechanical adjustment corresponds to $0\overset{s}{.}02$.

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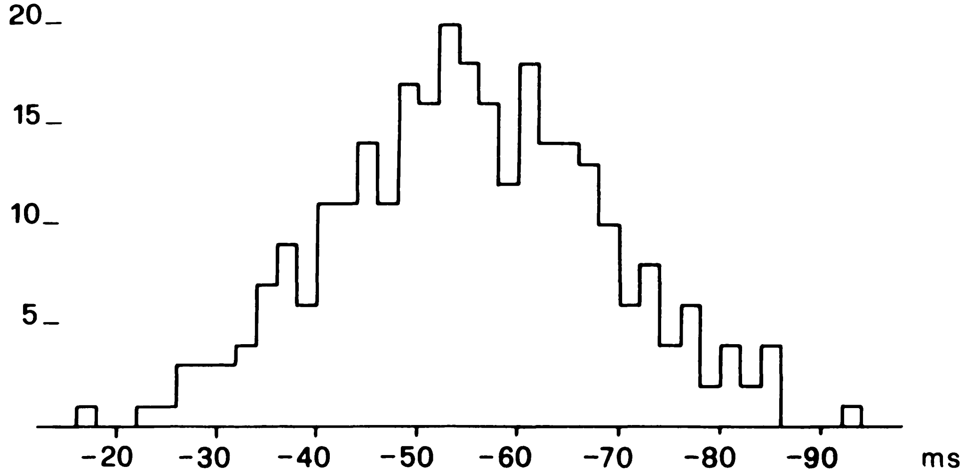

FIGURE 1

In fig. 2a, the preliminary monthly results are reported. Most of these lie between $-0^{s}.04$ and $-0^{s}.07$, the mean, approximately $-0^{s}.053$ originates from the difference between the assumed and the actual longitude of the instrument. The accuracy of our results appears to be comparable to that of other PZT and PTI (cfr. fig. 2b, adopted from H. Enslin, 1978, fig. 4 on p. 34).

Finally, fig. 3 shows the trend of the residuals with time: dots correspond to the average of 10 nights and circles to smoothed averages.

A few comments on the improvements obtained and obtainable from impersonal treatment of ground based transit instrument data appear in order. During each transit, a certain number of photons is collected which are analysed in a certain number of steps. Whatever the adopted procedure, the precision of the estimated transit instant t_i will depend on the total number of photons, in effect the magnitude of the star. Note, however, that some photons may for various reasons (e.g., light scattering) degenerate from signal to noise.

On the other hand, it should always be kept in mind that we can only observe the instant when the star image crosses the instrument meridian. Earnest efforts are made to keep this instrument meridian stable, the various adjustments having a natural limit in the wavelength of the light employed to adjust the optical and/or mechanical part of the instrument. For instance, as we said above, a random error of 1 μ m in the mechanical adjustment of our transit instrument after each reversion corresponds to an error of $0^{s}.02$ in the observed instant of transit. Carrying out 10 reversions for the set of 10 stars, we get an error of $0^{s}.007$.

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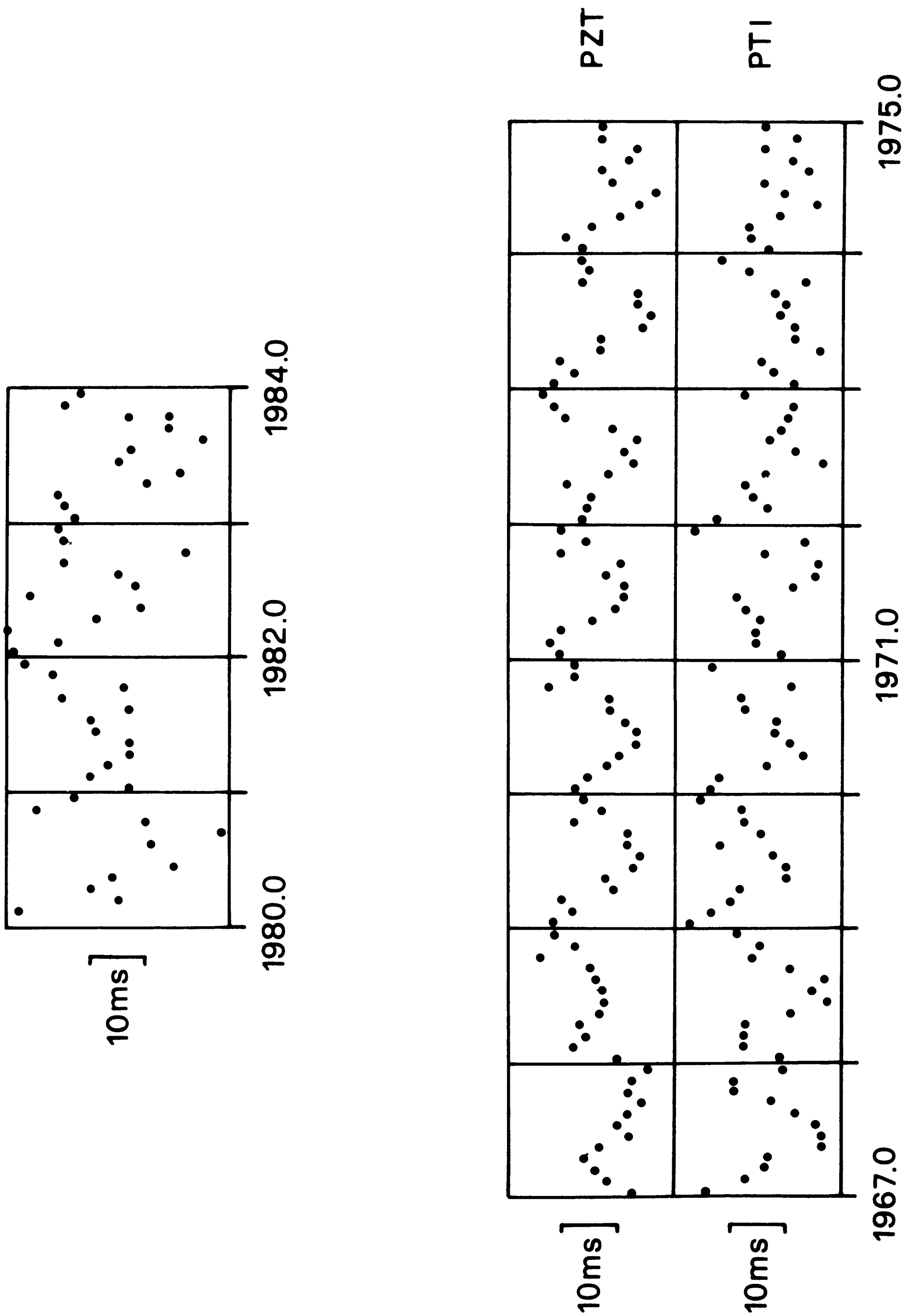

FIGURE 2

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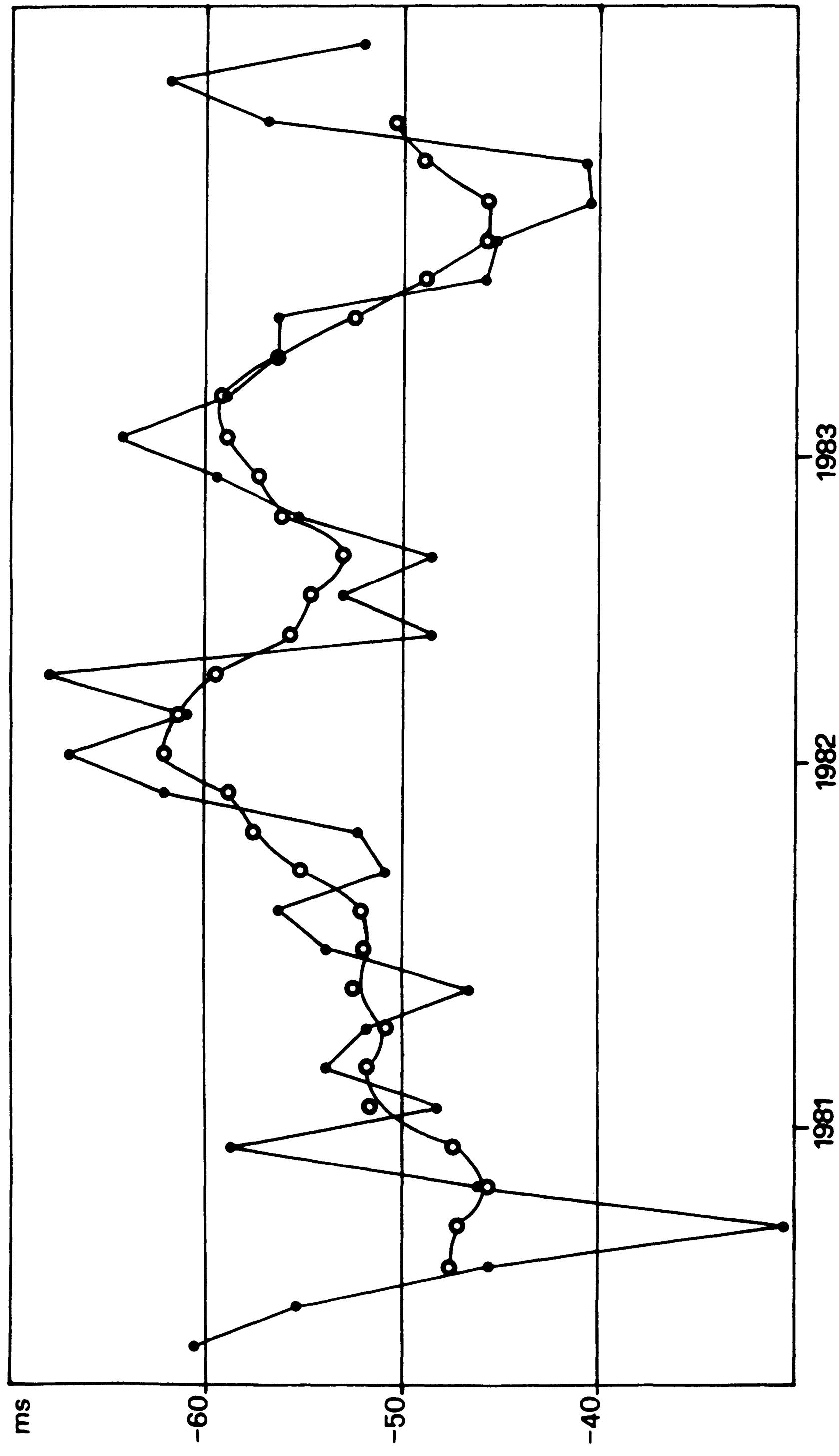

FIGURE 3

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Furthermore, we cannot get rid of the atmospheric deterioration of the signal arriving from the star, in particular of that part of seeing which has been called "dancing" (random oscillations of the instantaneous stellar image about the nonperturbed optical image). Assuming 1" as the amount of this dancing during an average night, one can expect the atmosphere to set an upper limit of 0".1 to the precision, which one hundred transits are accumulated 100 times (10 slits, 10 stars). This again correspond to $0^s.007$ and is almost precisely the observed mean square error found at Torino.

References

Anderlucci, E., Chiumiento, G., Fracastoro, M. G., Iervolino, R., 1983, Astron. and Astrophys. **121**, 142.

Bureau International de l'Heure - Annual Reports 1980, 1981, 1982. Circulars D, 1983.

Enslin, H., 1978, in "Tidal Friction and the Earth's Rotation" edited by P. Brosche and J. Sündermann.