THE USE OF THE HUBBLE SPACE TELESCOPE FOR GLOBAL REFERENCE FRAME WORK

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The Hubble Space Telescope (HST) will have the capability of making relative astrometric measurements with an accuracy of four to ten times better than similar ground based measurements. The instruments of choice will be the Fine Guidance Sensors (FGS's). Details of the instrumentation have been given elsewhere (c.f. Jefferys, 1980). Each FGS consists of two interferometer detectors which look at a small aperture located within a larger field of view (FOV). The raw data consist of encoder readings, from "star selectors", and error signals derived from the interferometer transfer functions. The star selector positions determine the position of the small aperture within the pickles. The precision is always less than 0.001 arcsec, with an expected accuracy of 0.002 to 0.003 arcsec per observation. Under optimum conditions, the best expected accuracy is 0.0016 arcsec per observation. An observation will consist of the relative positions of several objects in one pickle. Thus the highest accuracy observations will be relative observations within a relatively small field of view.

The question then becomes: What can HST observations using the FGS's contribute to the global problems of constructing a reference frame?

Consider the various HST instruments, the HST Optical Telescope Assembly, and its stability, i.e., the internal HST reference frames:

1) Within one FGS, the expected accuracy is of the order of 0.002 arcsec rms. The measurements are made with respect to the guide stars in the other two FGS's for stability. The time scale of the thermal-mechanical stability of one FGS with respect to the others is of the order of ten minutes.

2) Relative locations within the other Science Instruments (SI's) are also expected to have accuracies of the order of 0.002 arcsec (the Wide Field/Planetary Camera in particular).

3) The relative positions of the FGS and SI instrument boxes with respect to each other are expected to be known to about 0.01 to 0.02 arcsec, limited by thermal and mechanical motions.

J.-P. Swings (ed.), Highlights of Astronomy, 87–88.

Some projects which might help establish reference frames are:

1) Measurement of HIPPARCOS stars with respect to Extragalactic Radio Sources to derive a coordinate transfer from the radio reference frame to the HIPPARCOS instrumental system. (Kovalevsky, 1984)

2) Measurement of the apparent motion of HIPPARCOS stars with respect to Extragalactic Objects (EGO's) in order to tie the HIPPARCOS instrumental system to a (non-rotating) extragalactic system (Hemenway, et. al., 1985, for the expected accuracy, see Froeschle and Kovalevsky, 1982).

3) Measurement of minor planets at crossing points. By measuring the positions of minor planets relative to a common set of background stars as they pass through the same star field at different times, the system of orbital motions can be solved to the level of accuracy of the FGS observations themselves (Duncombe, et. al., 1984).

4) Measurement of the absolute positions of targets (e.g. planets), using a knowledge of the absolute positions of the guide stars and the relative locations of the FGS's and the SI's. Nominal accuracies will be limited to the accuracy of the knowledge of the guide star positions, which is now about 0.3 arcsec. The accuracy will be limited ultimately by the knowledge of the relative locations of the FGS's and the SI's, to about 0.01 arcsec, when the HIPPARCOS reference frame is established to the 0.002 arcsec level.

The final derivation of any "standard" reference frame, be it FK5, FK6, or HIPPARCOS, will be the combination of many observations by various techniques. We expect to make HST observations which will contribute to the formation of future reference frames.

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