13.16: Topocentric-Geocentric Correction

In section 13.1 I indicated two small (but not negligible) corrections that needed to be made, namely the ΔT correction (which can be made at the very start of the calculation) and the light-time correction, which can be made as soon as the geocentric distances have been determined – after which it is necessary to recalculate the geocentric distances from the beginning! I did not actually make these corrections in our numerical example, but I indicated how to do them.

There is another small correction that needs to be made. The diameter of Earth subtends an angle of $17''.6$ at $1\ \mathrm{au}$, so the observed position of an asteroid depends appreciably on where it is observed from on Earth's surface. Observations are, of course, reported as *topocentric* – i.e. from the place ($\tau o\pi o\varsigma$) where the observer was situated. They must be corrected by the computer to *geocentric* positions – but of course that can't be done until the distances are known. As soon as the distances are known, the light-time and the topocentric-geocentric corrections can be made. Then, of course, one has to return to the beginning and recompute the distances – possibly more than once until convergence is reached. This section shows how to make the topocentric-geocentric correction.

We have used the notation $\mathfrak{x}, \mathfrak{y}, \mathfrak{z}$ for geocentric coordinates, and I shall use $\mathfrak{x}'$, $\mathfrak{y}'$, $\mathfrak{z}'$ for topocentric coordinates. In figure $\mathrm{XIII.3}$ I show Earth from a point in the equatorial plane, and from above the north pole. The radius of Earth is R, and the radius of a small circle of latitude ϕ (where the observer is situated) is $R\cos\phi$. The $\mathfrak{x}$- and $\mathfrak{x}'-$ axes are directed towards the first point of Aries, Υ.

It should be evident from the figure that the corrections are given by

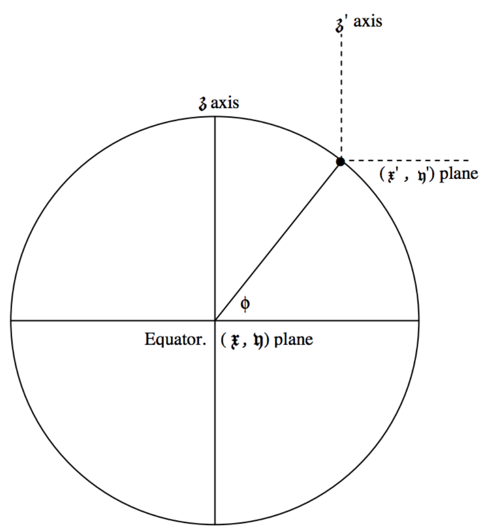
$$\mathfrak{x}' = \mathfrak{x} - R\cos\phi\cos\mathrm{LST}, \tag{13.16.1}$$

$$\mathfrak{y}' = \mathfrak{y} - R\cos\phi\sin\mathrm{LST} \tag{13.16.2}$$

and

$$\mathfrak{z}' = \mathfrak{z} - R\sin\phi. \tag{13.16.3}$$

Any observer who submits observations to the Minor Planet Center is assigned an *Observatory Code*, a three-digit number. This code not only identifies the observer, but, associated with the Observatory Code, the Minor Planet Center keeps a record of the quantities $R\cos\phi$ and $R\sin\phi$ in AU. These quantities, in the notation employed by the MPC, are referred to as $-\Delta_{xy}$ and $-\Delta_z$ respectively. They are unique to each observing site.



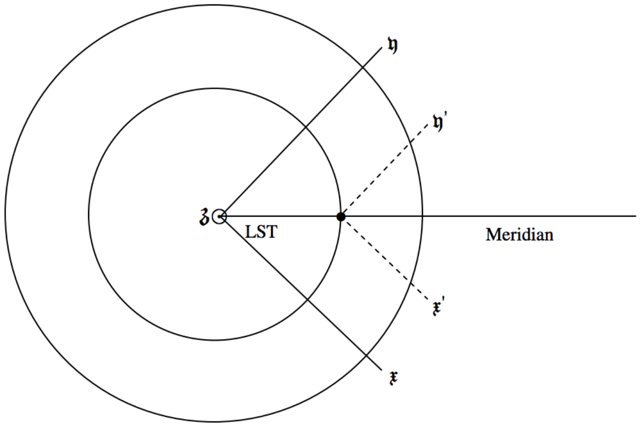


FIGURE XIII.3