ON THE ASTROMETRICAL METHODS

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ABSTRACT. In this paper some problems are discussed concerning the connection between the highly accurate optical and radio observations in the case when the waves propagate in an anisotropic medium.

There are several particular circumstances that justify the discussion given in this paper. These are the HIPARCOS satellite project, the results from interferometry in radio and optical wavelengths and the discussion of ESA Workshop on Interferometry in Space held in Granada (June 16–18, 1987), [1], [2], [3]. However, the general circumstance is the significant increase in the accuracy of astrometrical observation (<0".001). As some other authors [4], remark, this will be relevant to the discussion of some traditional definitions in astronomy. In the paper we discuss some problems of the connection between the high-accuracy optical and radio observations in the case when the waves propagate in an anisotropic medium.

The question of "What is an exact location?" has been put by E. Preuss [4]. If we start from the electromagnetic nature of the light, the direction $\hat{\mathbf{r}}^0 = \mathbf{r}/r$ to the heavenly body S will be determined from $\hat{\mathbf{r}}^0 = -\hat{\mathbf{g}}$ where $\hat{\mathbf{g}} = \mathbf{G}/G$, with $\mathbf{G}$ being the well known Poynting vector. The direction of $\mathbf{G}$ gives the direction of the energy flux F and its magnitude is the amount of the energy F crossing an unit area normal to the direction of propagation of the flux in one second.

In optical astronomy we consider electromagnetic waves with different frequencies which are time averaged. Until now, optical astronomy has used idealized conditions for the determination of $\hat{\mathbf{r}}^0$. In this sense, astrometry takes into account only the refraction in the lower layers of the Earth's atmosphere and the phenomena associated with the light transmission through the optics of the telescope. This has been acceptable because of the low accuracy with which $\hat{\mathbf{r}}^0$ is determined.

The new accuracy of $\hat{\mathbf{r}}^0$ achieved in observational astrometry needs a new method for analysis. Probably it is essential to derive a general theory to connect $\hat{\mathbf{r}}^0$ with the electromagnetic nature of the light more definitely than it is now.

References

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