1.3.4 METHOD FOR THE DETERMINATION OF THE INTENSITY OF SCATTERED SUNLIGHT PER UNIT-VOLUME OF THE INTERPLANETARY MEDIUM.

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The knowledge of the functions which give the intensity of the scattered sunlight is important in order to establish the models of the zodiacal cloud.

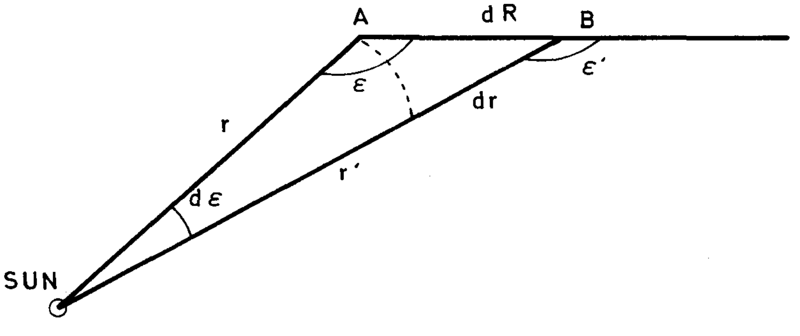
This paper pretends following the idea exposed by Dumont(1973), to develop a method for the calculation of the functions which yield the intensity of the ligth scattered by each unit-volume of the interplanetary medium. The functions obtained will account for the averaged local properties of the zodiacal cloud (Scattered phase function and spatial density).

The quantities used are the luminance Z and the degree of polarization, P.

Two assumptions are made:

a) On the symmetrical plane of the zodiacal dust cloud (practically the ecliptic plane) the properties of the interplanetary medium depend only on the distance to the sun.

b) The luminance, $Z(r,\varepsilon)$, is a differentiable function.



For a photometer situated on A and angular elongation ε measurement of the luminance $Z(r,\varepsilon)$, is obtained. If the point of the observation is now taken to B, a close point to A, on the same line of observation, another measurement will be obtained $Z(r',\varepsilon')$. The difference between these two measurements is caused by the scattered light in the medium between

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A and B, for a scattering angle which is identical to the elongation angle. Therefore

$$dZ = -J\,dR \qquad (1)$$

where J is the intensity scattered by a unit-volume of interplanetary matter.

On the other hand, $Z(r,\varepsilon)$ being differentiable

$$dZ = \frac{\partial Z(r,\varepsilon)}{\partial r}\,dr + \frac{\partial Z(r,\varepsilon)}{\partial \varepsilon}\,d\varepsilon$$

and the relations

$$dr = -\cos\varepsilon\,dR$$

$$d\varepsilon = \frac{\sin\varepsilon}{r}\,dR$$

give

$$dZ = \left(-\cos\varepsilon\,\frac{\partial Z(r,\varepsilon)}{\partial r} + \frac{\sin\varepsilon}{r}\,\frac{\partial Z(r,\varepsilon)}{\partial \varepsilon}\right)dR \qquad (2)$$

Comparing (1) and (2):

$$J(r,\varepsilon) = \cos\varepsilon\,\frac{\partial Z(r,\varepsilon)}{\partial r} - \frac{\sin\varepsilon}{r}\,\frac{\partial Z(r,\varepsilon)}{\partial \varepsilon}$$

If r and ε are looked upon as the polar coordinates in a plane, then $Z(r,\varepsilon)$ can be considered as a scalar field, and one can write:

$$J = \mathrm{grad}\,Z.\vec{u} \qquad \vec{u}\,(\cos\varepsilon, -\sin\varepsilon)$$

Therefore the calculation of J depends on the knowledge of Z. We can measure $Z(1,\varepsilon)$ and we know also, by experiments of Pionner X, how the function $Z(r,\varepsilon)$ varies when ε takes two fixed values.

It seems reasonable to put.

$$Z(r,\varepsilon) = Z(1,\varepsilon)\,f(r) \qquad f(r) = Z(r, C^{te})$$

With this Z we obtain the function J. To check this Z we can calculate theoretically the luminance with the expression

$$Z = \int_0^\infty \mathrm{grad}\,Z.\,\vec{dR}$$

The values obtained with this integral are in good agreement with the experimental ones. Therefore the assumption on Z seems well founded.

In a similar way we can obtain the local degree of polarization

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