ABSTRACT

In an atom radiation energy is absorbed or emitted under certain conditions. When the frequency of absorption is same with the frequency of emission, the scattering is said to be coherent. This process is the most possible one in stellar atmosphere. The equation of radiative transfer for the case of coherent scattering has been developed by Woolley and Stibbs[1963].

Woolley and Stibbs solved the equation of transfer for coherent scattering by Eddington's method. Karanjai and Deb considered the same problem in an exponential atmosphere and solved it by Eddington's method. Latter Karanjai and Dev applied few other methods to solve the equation of Transfer for coherent scattering.

Wilson and Sen applied the modified double interval Spherical Harmonic Method to solve the certain problems of radiation and Neutron transport. We have successfully used the same method to solve the equation of transfer for isotropic as well as anisotropic coherent scattering.

The essential idea of the method is that the solution of the equation of transfer, which is an integro-differential equation, $I(\tau, \mu)$ is expressed in a series of functions each of which is product of a function of τ and a Legendre polynomial in μ of different order. More generally we seek a solution of the transfer equation so that $I(\tau, \mu)$ can be expressed by two different expressions $I_+(\tau, \mu)$ and $I_-(\tau, \mu)$ for μ in the interval (0, 1) and (-1, 0) in the form

$$I_+(\tau, \mu) = f(\tau) + \sum_{l=0}^{l_0}(2l+1)I_l^+(\tau)\mu P_l(2\mu - 1)\ ,\ 0 \leq \mu \leq 1\ ;$$

$$I_-(\tau, \mu) = f(\tau) + \sum_{l=0}^{l_0}(2l+1)I_l^-(\tau)\mu P_l(2\mu + 1)\ ,\ -1 \leq \mu \leq 0.$$

The term $f(\tau)$ ensures the continuity of intensities at $\mu = 0$ and as a first step we take $f(\tau)$ of the type $A\tau$ where A is a constant to be determined. Also from the recurrence formulae

$$\mu P_l(2\mu \pm 1) = \frac{1}{(2l+1)}\left[\frac{l+1}{2}P_{l+1}(2\mu \pm 1) \mp \frac{2l+1}{2}P_l(2\mu \pm 1) + \frac{l}{2}P_{l-1}(2\mu \pm 1)\right],$$

it is clear that the advantages due to orthogonality of $P_l(2\mu - 1)$ in (0, 1) and $P_l(2\mu + 1)$ in (-1, 0) obtained in Yvon's method are still retained. Then intrigro-differential equation reduces to differential equation. We try a solution of the form

$$I_l^+(\tau) = A[g_{l,\alpha}e^{-k\tau} + g_{l,\beta}],$$

$$I_l^-(\tau) = A[h_{l,\alpha}e^{-k\tau} + h_{l,\beta}]$$

and we have a set of linear equations,which are to be solved to get $I(0, \mu)$.

In chapter 2, problem of isotropic coherent scattering atmosphere is considered and solved by means of double interval spherical harmonic method (DISHM). Throughout this chapter we have used this particular form of intensity and obtained the results for first and second approximation and the constant A is determined.

In chapter 3, coherent anisotropic scattering problem is considered and solved by DISHM. Here also we used the same form of intensity and use different types of phase functions like (i) Planetary Phase Function, (ii) Rayleigh Phase Function, (iii) Pomraning Phase Function, (iv) General Phase Function and obtained various results for first and second approximation.

In chapter 4, we have solved the transfer equation considering Pomraning phase function taking the above said form of intensity and calculated emergent intensity, law of darkening and the constant A.

Finally in chapter 5, we have studied different approximate forms of H-functions for anisotropic scattering particularly for Pomraning phase function.