CONTRIBUTIONS

velocity $V_{\lambda}$ and the static source function, shows similar
trends, but lies below its counterpart $I_{\lambda}$. This reflects
the enhancement of $S_{\lambda}$.

It is interesting to note the slight emission peak in $I_{\lambda}$
which is produced without a chromospheric temperature rise.
Paschoff has obtained high resolution spectra of the solar K line of CaII
which have similar, though usually more pronounced, asymmetric peaks. A velocity
gradient in the chromosphere may itself be a mechanism
for core brightening.

\begin{equation}
\frac{\partial I}{\partial x}(x, \mu) = -\kappa(x) I(x, \mu)
+ \frac{\lambda(x)}{2} \int_{-1}^{1} f(\cos \Theta) I(x, \mu') d\mu' + S(x),
\end{equation}

where $f(\cos \Theta)$ is the phase function and $\Theta = \theta - \theta'$. To proceed further, we expand $f$ in terms of Legendre
polynomials, i.e.

\begin{equation}
f(\cos \Theta) = \sum_{n=0}^{\infty} a_n P_n(\cos \Theta) = \sum_{n=0}^{\infty} a_n P_n(\mu) P_n(\mu').
\end{equation}

We then define

\begin{equation}
I^+ = I(x, \mu) \quad \text{for all } \mu > 0
\end{equation}

\begin{equation}
I^- = I(x, \mu) \quad \text{for all } \mu < 0
\end{equation}

together with

\begin{equation}
\Phi = (I^+ + I^-)/2
\end{equation}

\begin{equation}
\Psi = (I^+ - I^-)/2.
\end{equation}

The above equations give

\begin{equation}
\mu \frac{\partial \Phi}{\partial x} = -\kappa \Phi + \frac{\lambda}{2} \sum_{n=0}^{\infty} a_{2n+1} P_{2n+1}(\mu)
\times \int_{-1}^{1} P_{2n+1}(\mu') \Psi d\mu' \tag{1a}
\end{equation}

\begin{equation}
\mu \frac{\partial \Psi}{\partial x} = -\kappa \Psi + \frac{\lambda}{2} \sum_{n=0}^{\infty} a_{2n} P_{2n}(\mu) \int_{0}^{1} P_{2n}(\mu') \Phi d\mu' + S, \tag{1b}
\end{equation}

where we have used the well-known relationship

\begin{equation}
P_n(-\mu) = (-1)^n P_n(\mu)
\end{equation}

and the integral forms

\begin{equation}
\frac{1}{2} \int_{-1}^{1} P_{2n}(\mu') I d\mu' = \int_{0}^{1} P_{2n}(\mu') \Phi d\mu'
\end{equation}

\begin{equation}
\frac{1}{2} \int_{-1}^{1} P_{2n+1}(\mu') I d\mu' = \int_{0}^{1} P_{2n+1}(\mu') \Psi d\mu'.
\end{equation}

If we now consider the situation where $\lambda$ has the same
dependence as $\kappa$, i.e. $\lambda(x) = \lambda_0 \kappa(x)$, and multiply
equation (1a) by $1/\kappa$, operate with $\partial/\partial x$ and substitute from\equation (1b), we obtain

\begin{equation}
\mu \frac{\partial}{\partial x} \left( \frac{1}{\kappa} \frac{\partial \Phi}{\partial x} \right) = \Phi - \lambda_0 \sum_{n=0}^{\infty} a_n P_n(\mu)
\times \int_{0}^{1} P_n(\mu') \Phi d\mu' + S
\end{equation}

where we have used the orthogonality conditions for Legendre polynomials. Clearly, this equation is of the same form as the original Feautrier second-order differential equation for isotropic scattering in one-dimension. The solution is obtained by using the usual difference tech-