Abstract. Self-similar MHD shock waves have been studied under the action of monochromatic radiation into a non-uniform stellar atmosphere with a constant intensity on unit area. It has been assumed that the radiation flux moves through the gas. Variation of flow variables have been shown in tables for two different cases.

1. Introduction

Study of the propagation of shock waves under the action of monochromatic radiation can be important, because this phenomena is distinctive in the distributed nature of the absorption of energy. Using dimensional analysis Sedov (1959) analysed certain classes of self-similar solution with distributed energy release. The self-similar solutions can reflect the principal effects of the real process of interaction of radiation with gas. Deb Ray and Bhowmick (1976) have obtained the self-similar solutions for the central explosion in stars with radiation flux when the shock is isothermal and transparent. Khudyakov (1983) studied the self-similar problem of motion of a gas under the action of monochromatic radiation. Ojha and Nath (1987) discussed the similarity solution for point explosions in stars in a non-uniform self-gravitating medium including the effects of a magnetic field and radiation flux, on neglecting the radiation pressure and its energy. Nath (1989) discussed the self-similar cylindrical magnetohydrodynamic shock waves under the action of monochromatic radiation. Nath and Takhar (1990) further studied the same problem in the absence of a magnetic field.

In the present study we have considered the problem of a radiating gas in a sphere with model absorption coefficient, which is reducible to a self-similar form. The problem has been discussed with and without effects of a magnetic field. Finally comparison have been made with the cylindrical problem in the presence and the absence of a magnetic field.

2. Formulation

The equations of motion of an ideal gas under the action of monochromatic radiation neglecting heat conduction and viscosity in the spherical symmetry case, are given...
by

\[ \frac{\partial \rho}{\partial t} + \nu \frac{\partial \rho}{\partial r} + \rho \frac{\partial \nu}{\partial r} + \frac{2 \rho \nu}{r} = 0, \] (1)

\[ \rho \left( \frac{\partial \nu}{\partial t} + \nu \frac{\partial \nu}{\partial r} \right) + \frac{\partial p}{\partial r} + h \frac{\partial h}{\partial r} = 0, \] (2)

\[ \frac{\partial h}{\partial t} + \nu \frac{\partial h}{\partial r} + h \frac{\partial \nu}{\partial r} + \frac{h \nu}{r} = 0, \] (3)

\[ \frac{\partial p}{\partial t} + \nu \frac{\partial p}{\partial r} - \frac{\gamma p}{\rho} \left( \frac{\partial \rho}{\partial t} + \nu \frac{\partial \rho}{\partial r} \right) = (\gamma - 1) \frac{1}{r^2} \frac{\partial (j r^2 / \rho_0)}{\partial r}; \] (4)

where \[ \frac{\partial j}{\partial r} = kj \] (5)

where \( \nu, \rho, p, h, r, t \) and \( \gamma \) are velocity, density, pressure, magnetic field, radial distance, time and ratio of specific heats. Also, \( k \) represents the coefficient of absorption.

The specific internal energy is given by

\[ e = p / \rho (\gamma - 1) \) (with \( \gamma = \) constant). \] (6)

The boundary conditions for the problem are given by

\[ \nu_1 = \frac{2D}{\gamma + 1}, \] (7)

\[ \rho_1 = \frac{\gamma + 1}{\gamma - 1} \rho_0, \] (8)

\[ p_1 = \frac{2D^2 \rho_0}{\gamma + 1}, \] (9)

\[ h_1 = \frac{\gamma + 1}{\gamma - 1} h_0; \] (10)