

Readme

This Code computes the analytical solution given by Topygin(1980), for a shock acceleration model in a Cartesian geometry (Topygin (1980), equations 5.9 and 5.10). In this file we want to give a brief overview over the Code's functions and features.

In line 7-14 an equidistant grid is defined, on which the solution will be computed. The limits and the number of grid points can be changed and adjusted by the user.

In line 17-36 the grids were given a value in regards to the Cartesian spatial coordinate r and the momentum variable $s = \ln\left(\frac{p}{p_0}\right)$. The Code offers the opportunity to implement the grids in a non-equidistant way, by using the lines 24 or 34, which represent a grid with a higher resolution around the shock $r = 0$, or $s = 0$. Other reparametrizations can be defined by the user.

In Line 39-52 the solution by Topygin(1980) is calculated, assuming a source δ -function at x_0 the shock at $t = 0$ and $s = 0$, at a given time t defined in line 40. The user has the opportunity to derive the time integration instead, representing the case, in which the source gets injected not for a single point in time, but for all times.

In lines 56-66 the computations are written into a file.

In lines 70-87 there is a simple integration scheme implemented, should the reader wish to calculate the integrated solution mentioned above.

In lines 90-151 the Topygin solution is calculated and its parameters are defined. The meaning of the variables is given in the code-file itself.

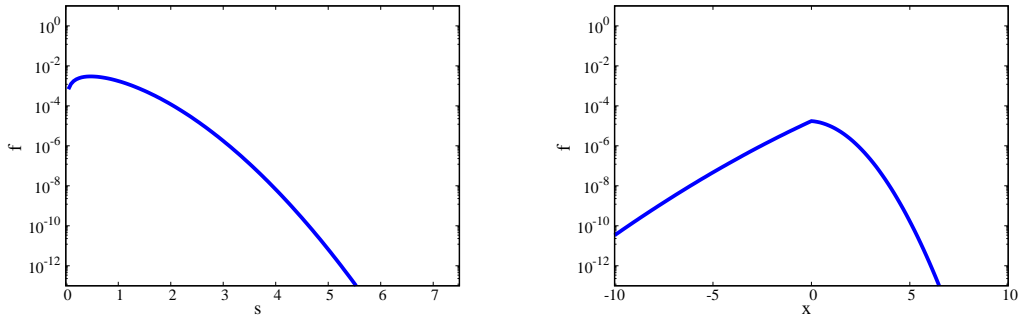


Figure 1: Two reference plots produced by the code, for $V_1 = 1$, $\kappa_1 = 1$ and $q = 4$ at $x = 0$ (left panel) and $s = 2.5$ (right panel).

The Paper we are referencing here is:
Topyghin, I. N., “Acceleration of particles by shocks in a cosmic plasma.” Space Sci. Rev. 26, 157–213 (1980).