Palermo-Harvard code

Karol Kułaga

1. Steady-state Initial atmosphere

```
cd  STARDY/
```

change permission, if necessary

```
chmod u+x stardy.out
```

compile the program

```
gfortran *.f
```

move compiled program a.exe to „standard name”

```
mv a.exe stardy.out
```

select parameters of a loop – edit the file input _file

run the program

```
./stardy.out < input_file
```

```
cd ..
cd PH/
```

remove object files (*.o)

```
rm *.o
```

compile the program

```
make -f makefile
```

change permission, if necessary

```
chmod +x standard.com
```

edit the file standard.com (parameters of heating function)

make symbolic link to the file with radiative loss function (if necessary)

```
ln –s ../STARDY/radia.dat
```

run the program

```
./standard.com
```

Running PH code

Input_file

input_file | PGRID.DIM | PCODE.DIM | standard.com

```
1 init_atm.bin
  500          Number of output grid points, dimensions
  6.,0.135131E-01,2.e9,.01,1.,.01 Press.,Heat.,L.,frac.conv.fact.,DO_NOT_TOUCH
  0
5 0
  0
```

PGRID.DIM

_file | PGRID.DIM | PCODE.DIM | standard.com

```
      parameter (q=1.11,near=10)
            parameter (ql = 1.11, qr = 1.09)
            parameter (dxm = 3000.)
            parameter (dxgr = 1.E+4)
            parameter (fac = .1)
c
```

PCODE.DIM

ile | PGRID.DIM | PCODE.DIM | standard.com

```
C Maximal grid dimension
      parameter (npt=500)
C Machine dependent (1 for Digital, 4 for SUN's)
      parameter (nf77 = 4)
C Geometric ratios: q to switch between time steps
      parameter (q = 1.11)
C Geometric ratios: ql in chromosphere, qr maximum value in corona
      parameter (ql = 1.11,qr = 1.09)
C Half number of equispaced grid points
      parameter (near = 10)
C Smallest grid spacing
      parameter (dxm = 3000.)
C Largest grid spacing in the equispaced grid region
      parameter (dxgr = 1.E+4)
C Maximum fractional jump of temperature, pressure and density in corona
      parameter (fac = .1)
```

Standard.com

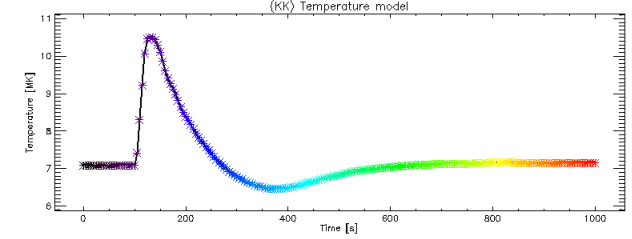
_file | PGRID.DIM | PCODE.DIM | standard.com

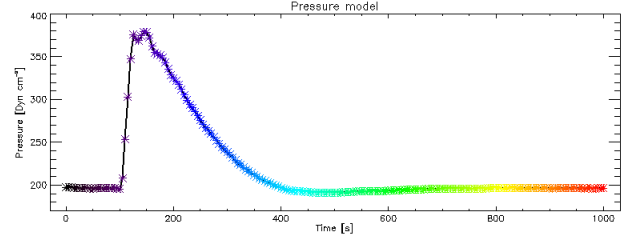
```
./ph.out > standard.log << !
1.,1.,      Stellar Gravity, Radius
1,      1 to include steady heating
0,      1 to continue a previous run
../STARDY/init_atm.bin
0,      choice of the heating space function (0 for Gaussian)
10.,0.,50.,5.,300.01,.5,  H,ton,toff,tout,tend,MAGIC
2.e9,2.000e+08,   Heat center, width
0.,     Heating decay time (tau)
0,      1 for output at every time step
0.001,      initial time step
0,      do not change this
standard.des
L9=2, p=6. , standard run
IEEE
0,      1 to include a steady heating table from an ext. file
standard.bin
0,      1 to force zero velocity at the base
!
```

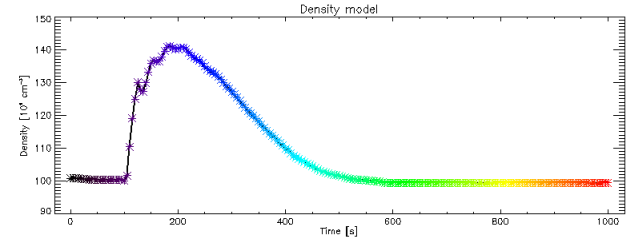
Script

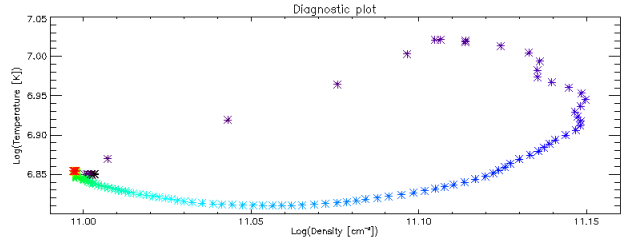
```
laptop@Karol ~
$ sh ./scriptPH.sh -h

   points      = value   Number of output grid points; optional value = 500
   press       = value   Pressure [Dyn/cm^2]; optional value = 6.
   heat        = value   Heat at the beginning [Erg/s/cm^2]; optional value = 0.135131E-01
   lenght      = value   Half lenght of loop [cm]; optional value = 2.e9
   conv        = value   frac.conv.fact; optional value = .01
   q           = value   Change in grid [1.11 EQ 11%]; optional value = 1.11
   near        = value   Points number in transition region; optional value = 10
   ql          = value   Change in grid in Chromosphere; optional value = 1.11
   qr          = value   Change in grid in Corona; optional value = 1.09
   dxm         = value   Lowest size of cell (Step betweeen points [cm]); optional value = 3000.
   dxgr        = value   Biggest size of cell (Step betweeen points [cm]); optional value = 1.E+4
   fact        = value   Threshold which decided about changing the grid; optional value = .1
   funct       = value   Choice of the heating space function (0 for Gaussian); optional value = 0
   heating     = value   Flare heating; optional value = 10.
   ton         = value   Time after heat is turning on; optional value = 0.
   toff        = value   Time after heat is turning off; optional value = 50.
   tout        = value   Time bin for saving data; optional value = 5.
   tend        = value   Time range in seconds; optional value = 300.01
   heatcen     = value   Position where occure heat; optional value = lenght of loop
   width       = value   Width of heat area; optional value = 1/10 of lenght of loop
   decay       = value   Heating decay time (tau); optional value = 0.
   timesav     = value   Saving all points (1) or only with bin tout (0); optional value = 0
   timeini     = value   Initial time step; optional value = 0.001

   precursor   = value   Possibility of adding precursor in flare (1-include, 0-skip); optional value = 0
   functprec   = value   Precursor choice of the heating space function (0 for Gaussian); optional value = 0
   heatingprec = value   Precursor flare heating; optional value = 10.
   tonprec     = value   Precursor time after heat is turning on; optional value = 0.
   toffprec    = value   Precursor time after heat is turning off; optional value = 50.
   toutprec    = value   Precursor time bin for saving data; optional value = 5.
   tendprec    = value   Precursor time range in seconds; optional value = 300.01
   heatcenprec = value   Precursor position where occure heat; optional value = lenght of loop
   widthprec   = value   Precursor width of heat area; optional value = 1/10 of lenght of loop
   decayprec   = value   Precursor heating decay time (tau); optional value = 0.
   timeiniprec = value   Precursor initial time step; optional value = 0.001


laptop@Karol ~
$ sh ./scriptPH.sh press=200. heat=2.2100e0 lenght=0.727e9 conv=0.02 heating=20.0e0 ton=100. toff=120. tend=1000.01 heatcen=0.3e9 width=0.145e9 decay=10.
```

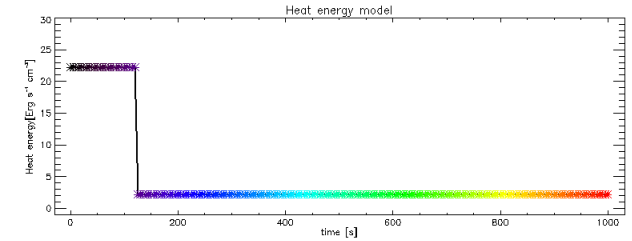
Short flare

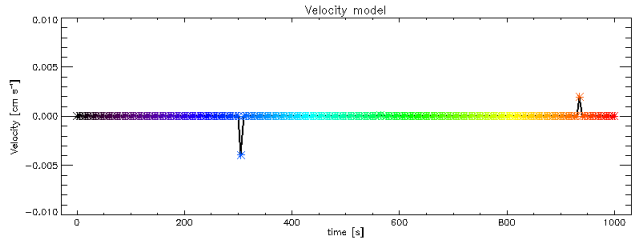

(KK) Temperature model
Temperature [MK]
Time [s]

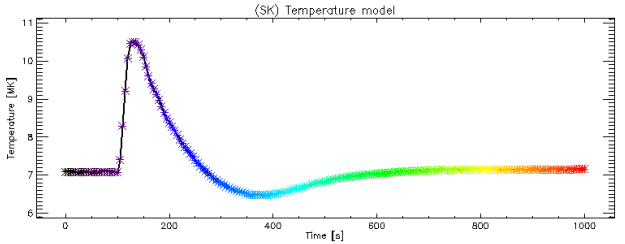

Pressure model
Pressure [Dyn cm⁻²]
Time [s]

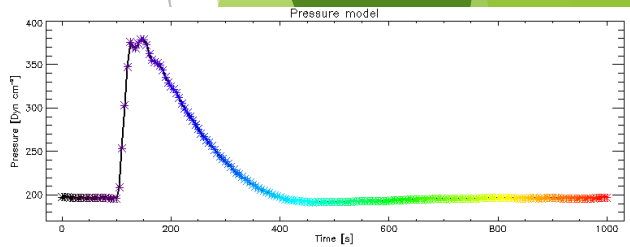

Density model
Density [10⁹ cm⁻³]
Time [s]

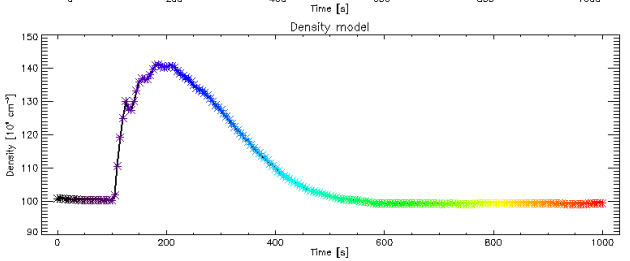

Diagnostic plot
Log(Temperature [K])
Log(Density [cm⁻³])

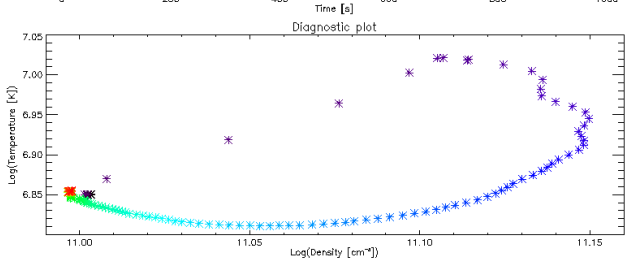

Heat energy model
Heat energy[Erg s⁻¹ cm⁻³]
time [s]

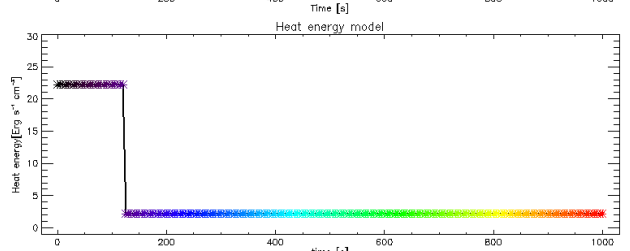

Velocity model
Velocity [cm s⁻¹]
time [s]

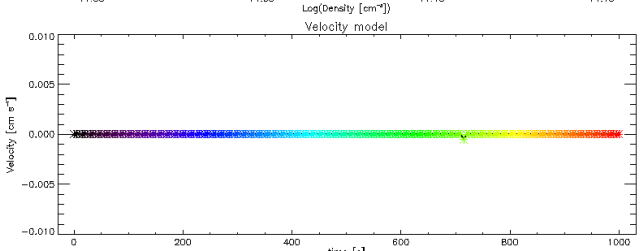

(SK) Temperature model
Temperature [MK]
Time [s]


Pressure model
Pressure [Dyn cm⁻²]
Time [s]

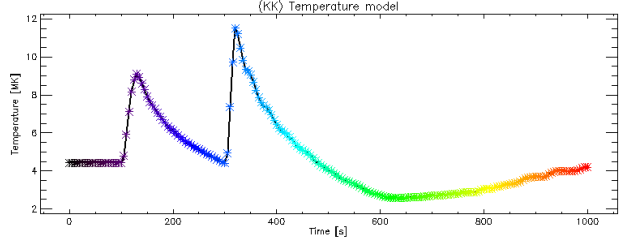

Density model
Density [10⁹ cm⁻³]
Time [s]

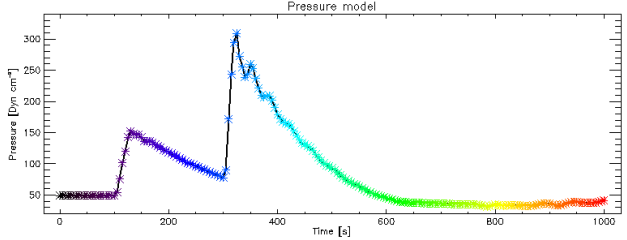

Diagnostic plot
Log(Temperature [K])
Log(Density [cm⁻³])

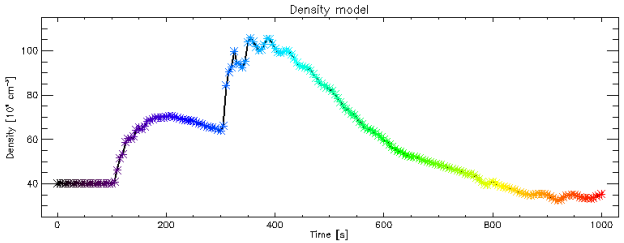

Heat energy model
Heat energy[Erg s⁻¹ cm⁻³]
time [s]

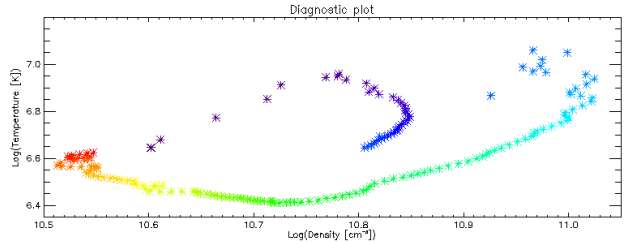

Velocity model
Velocity [cm s⁻¹]
time [s]

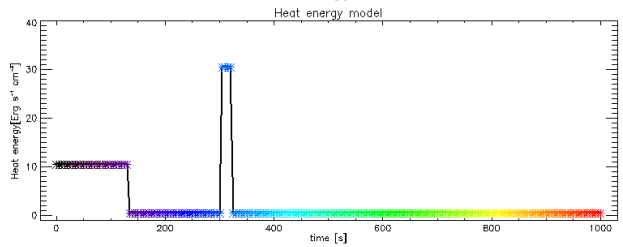
Flare with precursor

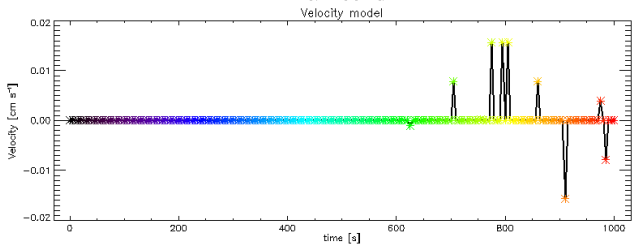


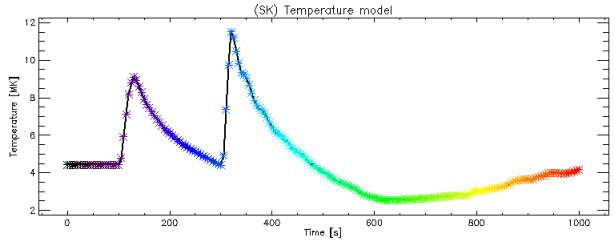


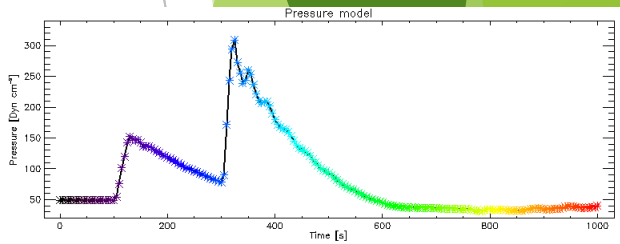


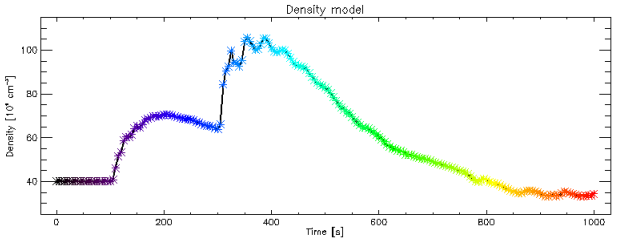


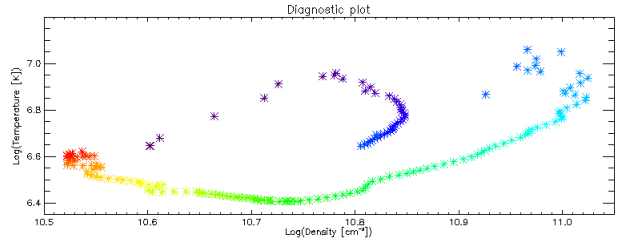


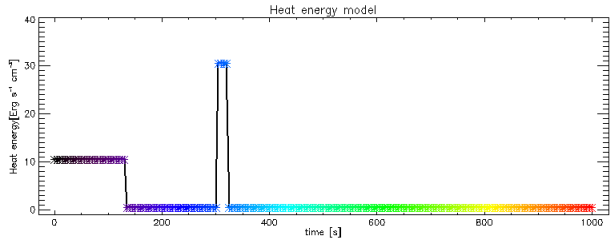


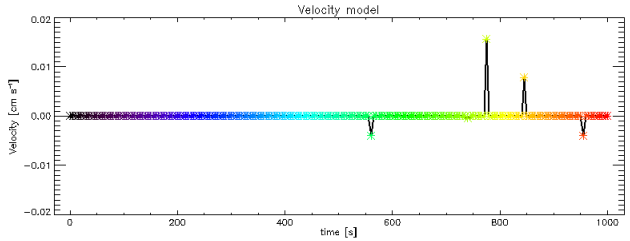




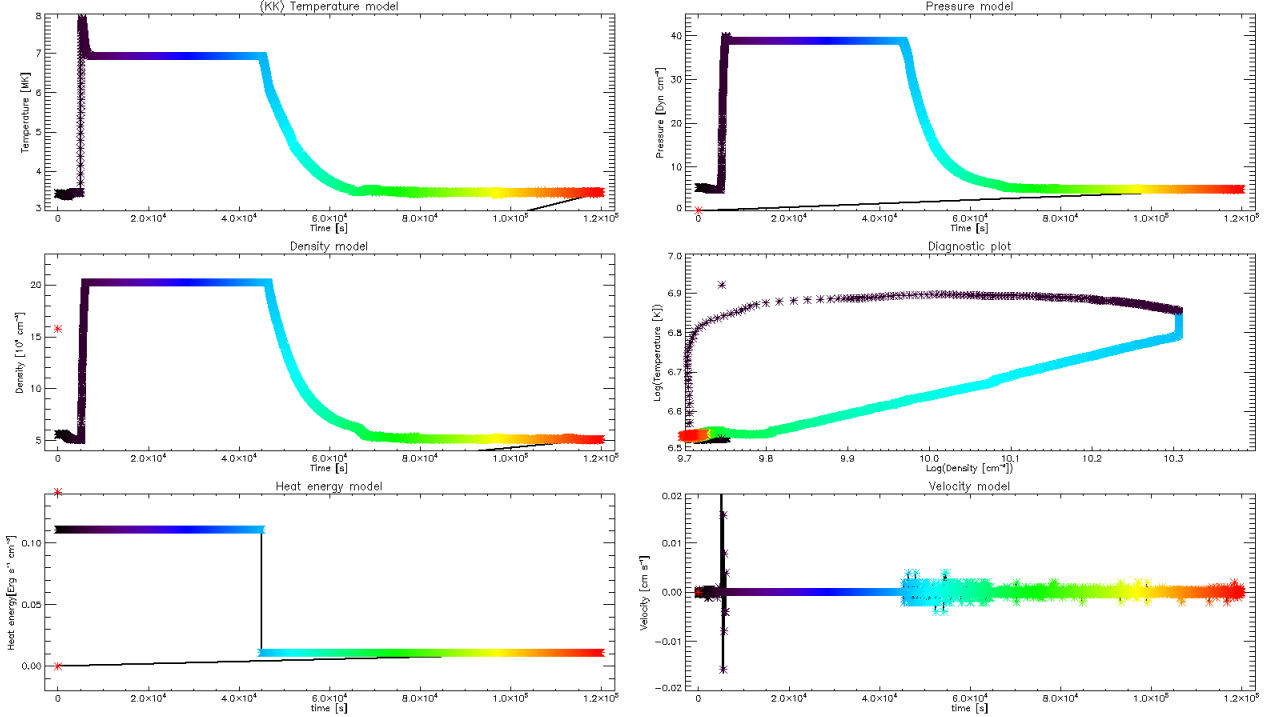


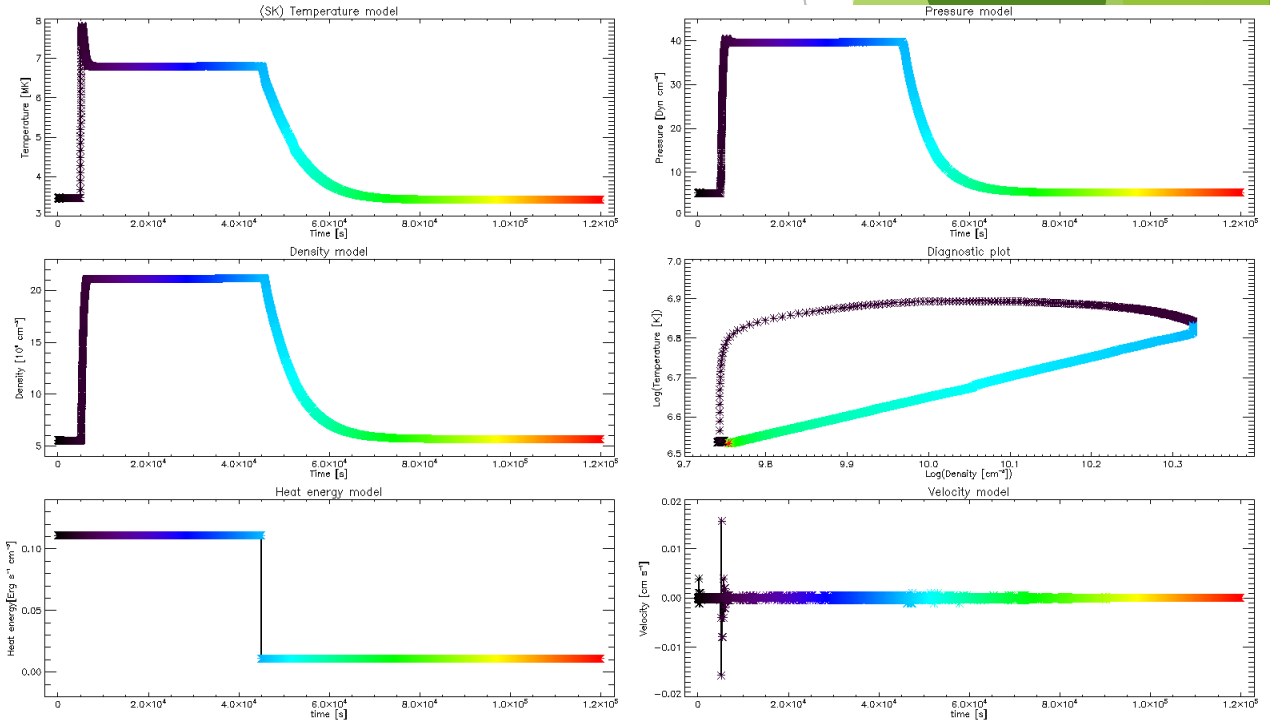






Long flare


(KK) Temperature model
Temperature [MK]
Time [s]
Pressure model
Pressure [Dyn cm⁻²]
Time [s]
Density model
Density [10⁹ cm⁻³]
Time [s]
Diagnostic plot
Log(Temperature [K])
Log(Density [cm⁻³])
Heat energy model
Heat energy[Erg s⁻¹ cm⁻³]
time [s]
Velocity model
Velocity [cm s⁻¹]
time [s]


(SK) Temperature model
Temperature [MK]
Time [s]
Pressure model
Pressure [Dyn cm⁻²]
Time [s]
Density model
Density [10⁹ cm⁻³]
Time [s]
Diagnostic plot
Log(Temperature [K])
Log(Density [cm⁻³])
Heat energy model
Heat energy[Erg s⁻¹ cm⁻³]
time [s]
Velocity model
Velocity [cm s⁻¹]
time [s]

Different computer