Ay190: Computational Astrophysics (Winter Term 2012)
HomeWork - 7

Jan 27, 2012

1 Exercise 1. pp-Chain Nucleosynthesis

Part a :

10^{20} would be a resonable end time for this problem.

Part b :

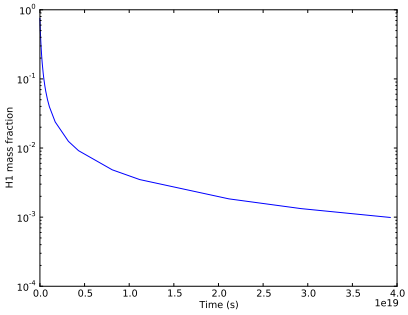

Figure 1: Plot of evolution of ^{1}H.

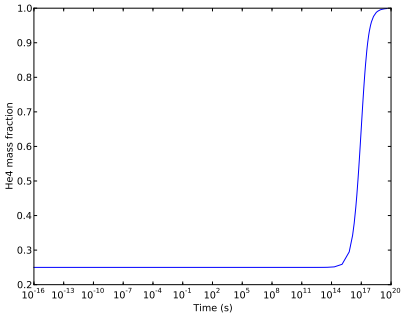

Figure 2: Plot of evolution of ^{4}He.

Figure 1 and 1 shows the evolution of ^{1}H and ^{4}He in semilogy and semilogx scale respectively.

Part c :

When mass fraction of ^{1}H is equal to: 0.000989 then the mass fraction of ^{4}He is equal to: 0.999 at the center of the sun.

Part d :

When mass fraction of ^{1}H is equal to: 0.01 then about 3.5^{18} (S) passed It means that sun burned for about 3.5^{18} (S)

Part e :

The pp I branch

$$^3_2\mathrm{He} + ^3_2\mathrm{He} \longrightarrow ^7_4\mathrm{Be} + \gamma + 12.86\mathrm{MeV}$$

The pp II branch

$$^3_2\mathrm{He} + ^4_2\mathrm{He} \longrightarrow ^7_4\mathrm{Be} + \gamma$$

$$^7_4\mathrm{Be} + \mathrm{e}^- \longrightarrow ^7_3\mathrm{Li} + \nu_e + \ 0.861\mathrm{MeV}/0.383\mathrm{MeV}$$

$$^7_3\mathrm{Be} + ^1_1\mathrm{H} \longrightarrow 2\,^4_2\mathrm{He}$$

The pp III branch

$$^3_2\mathrm{He} + ^4_2\mathrm{He} \longrightarrow ^7_4\mathrm{Be} + \gamma$$

$$^7_3\mathrm{Be} + ^1_1\mathrm{H} \longrightarrow ^8_4\mathrm{B} + \gamma$$

$$^8_4\mathrm{B} \longrightarrow ^8_4\mathrm{Be} + \mathrm{e}^+ + \nu_e + \gamma$$

$$^8_4\mathrm{Be} \longrightarrow 2\,^4_2\mathrm{He}$$

The pp IV (Hep) branch

$$^3_2\mathrm{He} + ^1_1\mathrm{H} \longrightarrow ^4_2\mathrm{Be} + \mathrm{e}^+ + \nu_e + \ 18.8\mathrm{MeV}$$