The program starts at temperature $T = 100$ GK, with photons, electrons, neutrinos and their antiparticles, and free protons and neutrons. The neutrons and protons are converted to each other via these three weak nuclear force reactions

$$\begin{aligned} n + \nu_e &\leftrightarrow p + e^- \\ n + e^+ &\leftrightarrow p + \bar{\nu}_e \\ n &\leftrightarrow p + e^- + \bar{\nu}_e \end{aligned}$$

The total forward reaction rate $\lambda(n \rightarrow p)$ and reverse rate $\lambda(p \rightarrow n)$ are much higher than the difference between them. The protons and neutrons therefore are in a state of **equilibrium**. So at these temperatures the ratio of neutron mass fraction X_n vs. proton mass fraction X_p approximates the equation

$$\frac{X_n}{X_p} = \frac{\lambda(p \rightarrow n)}{\lambda(n \rightarrow p)} = \exp\left(-\frac{Q}{kT}\right)$$

which is the dashed line shown in Figure (1) above.

These reaction rates are much higher than the expansion rate of the universe H.

$$H = \sqrt{\frac{8}{3}\pi G(\rho_\gamma + \rho_e + \rho_\nu)}$$

which depends on the energy densities ρ of photons, electrons, and neutrinos. This is how $\lambda(p \rightarrow n)$ can be nearly as high as $\lambda(n \rightarrow p)$ But the λ's decrease over time more rapidly than H. Figure (2) below shows that at around $T = 13$ GK $\lambda = H$. Correspondingly the actual n/p ratio starts to diverge significantly from the equilibrium ratio in Figure (1). For $T < 13$ GK the universe expands too rapidly for the weak rates to occur in significant amounts. So all the reactions stop except for neutron decay $n \rightarrow p + e^- + \bar{\nu}_e$, and the solid graph represents that decay, until nucleosynthesis begins at $T \simeq 1.0$ GK.