Update-24.11.18

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The first issue was that in the plot χ_{H2} vs $log\ (n_H)$, when I changed $n_{H,mean}$ the plot was also changing. But this wasn't expected because $n_{H,mean}$ didn't influence the calculations of χ_{H2} in any way. I found out that I was plotting χ_{H2} vs log(x) the whole time, where $x = log\ (\frac{n_H}{n_{H,mean}})$, that was why the plots were affected. I addressed this issue by replacing $log\ (\frac{n_H}{n_{H,mean}})$ by $log\ (n_H)$. The new plot is attached here.

The second issue was the plot between $log\ (\lambda_{Jeans})$ & $log\ (n_H)$, where the values were orders greater than the theoretical values. I addressed this issue too by first replacing $log\ (\frac{n_H}{n_{H,mean}})$ by $log\ (n_H)$, and then plotted in log() (i.e., base-10) instead of ln() (i.e., natural-log). This improved the plot, and now it is matching the analytical values.

$$T_{mean} = 10\ K \tag{1}$$
$$K_b = 1.3806 \cdot 10^{-16} \quad ergs\ K^{-1} \tag{2}$$
$$m_p = 1.6726 \cdot 10^(- 24) \quad g \tag{3}$$
$$G = 6.674 \cdot 10(-8) \quad dyne\ cm^2 g^{-2} \tag{4}$$

So the sound speed now becomes:

$$c_s = \sqrt{\frac{K_b \cdot T_{mean}}{m_p}} \tag{5}$$
$$= 28730.5 \quad cm\ s^{-1} \tag{6}$$

Now, n_H is changing, so it has a range:

$$(n_H)_{min} = 9.9 \cdot 10^{-3} \tag{7}$$
$$(n_H)_{max} = 9.9 \cdot 10^{6} \quad (\ in\ [H]/cc\ ) \tag{8}$$

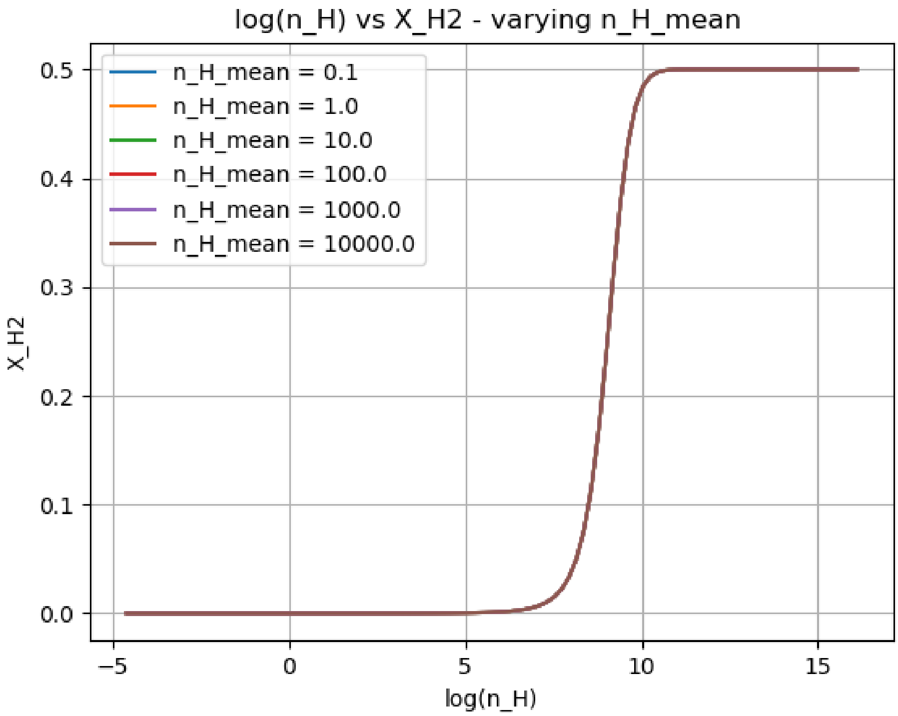

Figure 1: $log\ (n_H)$ vs χ_{H2}

So now λ_{Jeans} will also vary in a range:

$$
\begin{aligned}
(\lambda_{Jeans})_{min} &= \frac{c_s}{(\sqrt{4\pi\ G\ (n_H)_{max}\ m_p})} &(9)\\
&= 7.712 \cdot 10^{15} \quad cm &(10)\\
(\lambda_{Jeans})_{max} &= \frac{c_s}{(\sqrt{4\pi\ G\ (n_H)_{min}\ m_p})} &(11)\\
&= 2.44 \cdot 10^{20} \quad cm &(12)
\end{aligned}
$$

Now I plotted the graph between $log\ (\lambda_{Jeans})$ & $log\ (n_H)$.

$$
\begin{aligned}
\log\ ((n_H)_{min}) &= -2.004 &(13)\\
\log\ ((n_H)_{max}) &= 6.996 &(14)\\
\log\ ((\lambda_{Jeans})_{min}) &= 15.89 &(15)\\
\log\ ((\lambda_{Jeans})_{max}) &= 20.39 &(16)
\end{aligned}
$$

As now can be seen, the plot and the analytical values are in complete sync.

The third point was the problem with the integration. I am still on that issue, and will again update you in that regard.

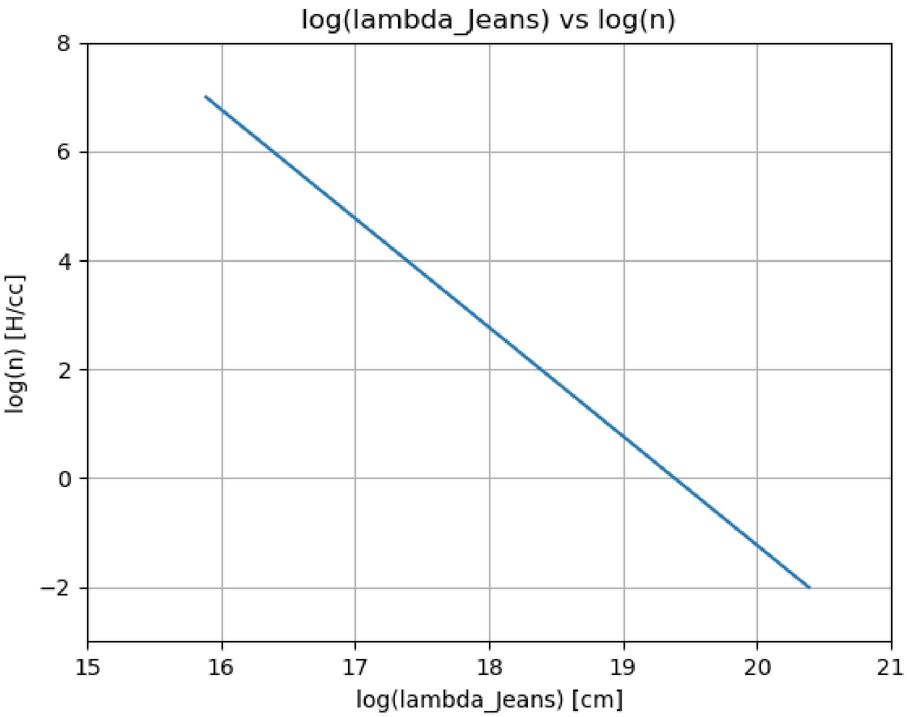

Figure 2: $log\ (\lambda_{Jeans})$ vs $log\ (n_H)$