The combined H(z) dependece of quantized space cells volume and space cell doubling time results in a unified metric scenario for modelling Dark Matter and Dark Energy related phenomena

E.P.J. de Haas[1, a)]

Kandinsky College, Nijmegen, The Netherlands

In a previous paper, I introduced a quantized space cell using the Hubble constant H_0 and I used for the space cell doubling time today's value, so also at H_0. In this paper, I wil improve the approach by replacing the Hubble constant by the time dependent Hubble parameter $H(z)$ for both the quantized space volume and the space cel doubling time. I then insert the $(\Lambda)CDM$ function for $H(z)$ in my model. The resulting scenario is capable of for modeling of both Dark Matter and Dark Energy related phenomena. In this way, my model can replace ontological Dark Matter and ontological Dark Energy with an ontological metric and still be in full agreement with $(\Lambda)CDM$ cosmology.

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[a)]Electronic mail: haas2u@gmail.com

I. SPACE CELL VOLUME AND SPACE CELL DOUBLING TIME AS H(Z) DEPENDENT

In [1] I introduced the quantized space cell volume as

$$V_B = \frac{8\pi G h}{ln(2) H_0 c^2}. \tag{1}$$

This expression for V_B combines Friedmann's formula and de Broglie's formula and thus integrates the universal constants of Newton, Hubble, Planck and Einstein. The inferred radius of this quantized space cell is approximately ten nanometers, so the size of large nuclei. In the derivation of this formula, we used the cosmological volume doubling time espression:

$$t_{\text{double}}(z=0) = \frac{\ln(2)}{3H_0} \tag{2}$$

This space cell size and doubling time might do for today's circumstances, but this size doesn't fit for early universe or near Big Bang conditions. Inspired by the $H(z)$ dependence of galactic structures, see [2], we investigated the effect of replacing H_0 with $H(z)$, giving a new, more dynamic expression for $V_B(z)$:

$$V_B = \frac{8\pi G h}{ln(2) H(z) c^2}. \tag{3}$$

But then of course we need a $H(z)$ dependent expression for the space cell doubling time as well, which we then reverse engineered. Let $V_U(z)$ denote the physical volume of the universe at redshift z. The number of space cells is then:

$$N(z) = \frac{V_U(z)}{V_B(z)} = \frac{V_U(z) \cdot \ln(2) H(z) c^2}{8\pi G h} \tag{4}$$

The relative rate of space cell doubling is given by:

$$\frac{1}{N(z)} \frac{dN}{dt} = 3H(z) + \frac{1}{H(z)} \frac{dH}{dt} \tag{5}$$

The corresponding space volume doubling time is:

$$t_{\text{double}}(z) = \frac{\ln(2)}{3H(z) + \frac{1}{H(z)} \frac{dH}{dt}} \tag{6}$$

In the limit where the time derivative of the Hubble parameter is negligible compared to $H(z)$, this again simplifies to:

$$t_{\text{double}}(z) \approx \frac{\ln(2)}{3H(z)}. \tag{7}$$

With $z = 0$ we get the starting point of the reverse engineering effort.

II. INSERTING THE $(\Lambda)CDM$ FUNCTION FOR $H(z)$ IN OUR MODEL

I assume a flat ΛCDM universe, so the Hubble parameter is given by

$$H(z) = H_0\sqrt{\Omega_m(1+z)^3 + \Omega_\Lambda} \tag{8}$$

I define:

$$E(z) = \sqrt{\Omega_m(1+z)^3 + \Omega_\Lambda}, \tag{9}$$

so $H(z) = H_0 E(z)$.

This resuts in the doubling time formula in the $(\Lambda)CDM$ scenario

$$t_{\text{double}}(z) = \frac{\ln(2)}{H_0}\left[3E(z) - \frac{3\Omega_m(1+z)^3}{2E(z)}\right]^{-1} \tag{10}$$

or, without $E(z)$:

$$t_{\text{double}}(z) = \frac{\ln(2)}{H_0}\left[3\sqrt{\Omega_m(1+z)^3 + \Omega_\Lambda} - \frac{3\Omega_m(1+z)^3}{2\sqrt{\Omega_m(1+z)^3 + \Omega_\Lambda}}\right]^{-1} \tag{11}$$

The quantized space cell volume $V_B(z)$ in the $(\Lambda)CDM$ scenario is:

$$V_B = \frac{8\pi Gh}{ln(2)H_0c^2E(z)} = \frac{8\pi Gh}{ln(2)H_0c^2\sqrt{\Omega_m(1+z)^3 + \Omega_\Lambda}}. \tag{12}$$

III. RESULTS

The resulting epoch adapted quantized space cells can replace the whole range of proposed Dark Matter candidates, from the Big Bang ($t = 0$, $z = \infty$) Planck scale DM particles to today's WIMP's. Ontologically and phenomenologically, the epoch adapted quantized space cells have the same physical properties as the DM candidates are supposed to have. This is due to our *space absorption causing velocity-of-space* metric theory of gravity.

The combined dynamics of space cell growth through $H(z)$ and space cell doubling through $t_{\text{double}}(z)$ can model the evolution of the cosmos from inflation to today, reproducing all the necessary $(\Lambda)CDM$ epochs. These epochs line up with our galactic evolution results from (paper) and (paper).

IV. DISCUSSION AND CONCLUSION

For this paper, I used ChatGPT as an assistant to calculate and present the resulting cosmological scenario's. This has its limitations, because the program only had a short memory in each chat and had to be corrected again and again to stay on track of my intuition. Without my oversight and my new postulates, ChatGPT got nowhere. On the one hand, it had a strong tendency to steer me back to accepted paradigms. On the other hand, it was overenthusiastic with results that contained typing errors which I had to correct for, but which I only found after ChatGTP already gave beautiful results based on those formula's with typo's. ChatGPT also gave many reasons why my model was sooo great and sooo capable of replacing DM and DE, without conflicting with $(\Lambda)CDM$ basics. But it also predicted that the chances of realistically replacing GR and DM-DE with a viable alternative were extremely small.

So I will not present the scenario's ChatGPT produced and leave it to the experts to run those simulations and present their trustworthy results, if they deem it worthwhile to do so. I can only stand for the models presented in this paper. But I do believe that, by now, I can present an interesting alternative metric theory of gravity capable of covering the whole range from Earth bound GNSS and geodetic precession, through galactic dynamics, to inflation and the Big Bang. I added the Big Bang moment itself because one can start the simulations with $N = 1$ at $t \approx 0$.

REFERENCES

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