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Rethinking the Age of the Universe

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www.turbulence-online.com

http://www.turbulence-online.com/Publications/Purdue_April_2022_Paper.pdf

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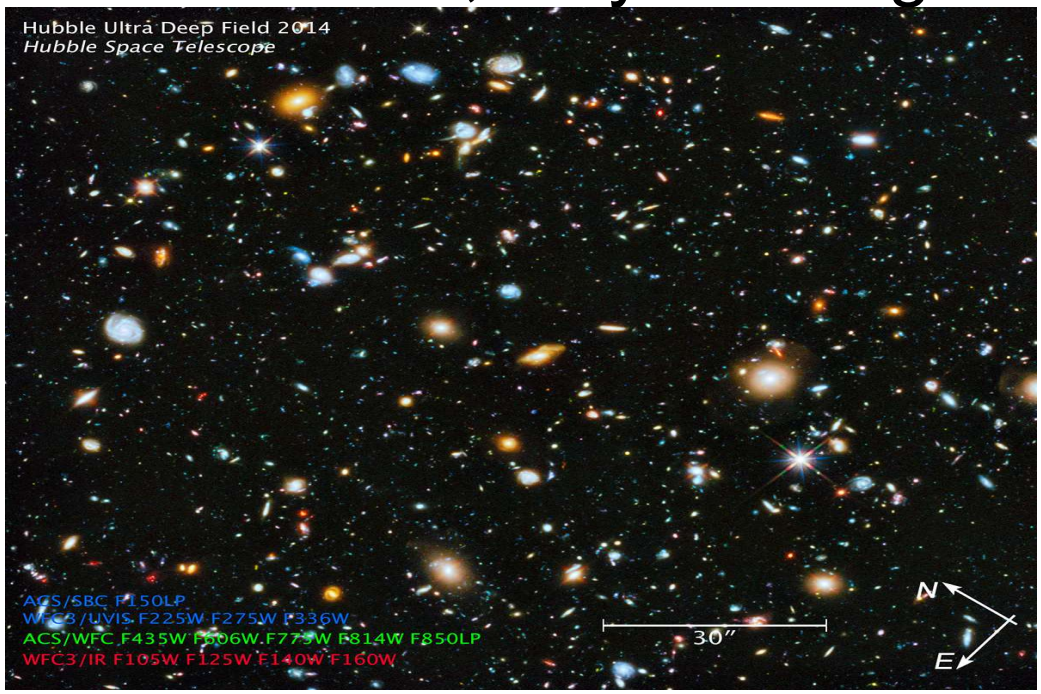
Hubble `Deep Space' Photo

These are not stars, they are all galaxies!!!



Millions of them averaged together are our '***fluid particles'***

--so we treat this like a continuum.'

Velocities approach the speed of light – so we need General Relativity

Universe Composition

(What many physicist say, but not all believe)

- **Only 5% Normal Matter!!!! 27% Dark Matter 68% Dark Energy**
- **These are called `DARK' since if present it does not radiate and is therefore invisible.**
- **All of these `beliefs  of existence of dark matter and energy' are based on the failure the `standard' (*FLRW-based)* cosmological models to explain the data.**
- **But many many are looking for it – so far in vain. After 30 years!**
- **And finally there is the quantum field theory (QFT) estimate of the Big Bang energy which is off by 120 orders of magnitude!!!!**

- **Clearly we need a better idea!**

How do we build a new theory?

What assumptions should we make from the observations?

- **Flat. No curvature**. So basically reference frame should be **Minkowski.**
- **Homogeneous in an infinite space**. **Space not growing, but things are flying apart.**
- **Initial value problem with the Big Bang simultaneously everywhere.**
- **Atomic clocks** should work in at least one frame of reference, ***but maybe not in other.***
- The **BIG** new idea: **Let time and space coordinates evolve together in our "physical" or gravitational frame.**
- And **demand that nothing be moving at all in one of our spaces. This is the real similarity assumption.**

- We use Einstein's Field Equations (μ,ν = 0,1,2 or 3) in the following form:

$$R^{\mu\nu} = \frac{8\pi G}{c^4}\left[T^{\mu\nu} - \frac{1}{2}T\, g^{\mu\nu}\right]$$

- **- $R^{\mu\nu}$** is the **Ricci tensor** and **R** is the **Ricci scalar**, both defined from the **Riemann tensor $R^{\mu}{}_{\nu\alpha\beta}$**

  - $g^{\mu\nu}$ is the **metric tensor** which describes the space we have chose to work in.

  -$T^{\mu\nu}$ is the **Einstein's `stress-energy' tensor** which `describes how matter deforms space'.

  - Note that we allow **$T^{\mu\nu}$** to have a ***non-zero divergence*** since we expect a source at t = 0 (the Big Bang).

Our two spaces $(\tau, \vec{\eta})$ and $(t, \vec{x})$

$(\tau, \vec{\eta})$ -space is presumed to be Minkowski and fixed in the expanding matter. So its metric tensor is

$$g_{\mu\nu} = [-1, 1, 1, 1]$$

$(t, \vec{x})$ -space is presumed to be our physical space in which matter is expanding.

We scale BOTH *physical* space AND time with a single length scale, δ, as follc

$$\vec{\eta} = \frac{\vec{x}}{\delta(t)} \qquad \tau = c\int_{t_1}^{t} \frac{dt'}{\delta(t')}$$

This defines the metric tensor: τ (tau) can be shown to be the `proper time'

- Our proposed new model of the universe allows both time and space coordinates to expand together.
- It appears to account for all of the anomalies without any needing additional hypotheses about dark energy or dark matter.
- We appear to be in very good company...

"I believe that the times and distances which are to be used in the Einstein's general relativity are not the same as the times and distances which were to be provided by atomic clocks. There are good theoretical reasons for believing that that is so, and for the reason that the gravitational forces are getting weaker compared to electric forces as the world gets older." (Paul Dirac, Göttingen Interview, 1982 [1])

Paul Dirac interview with F. Hund

https://www.youtube.com/watch?v=H7mOU1Xu-yA

Principal Theoretical Results

- 1. **No critical density.** This a consequence of a zero Ricci tensor and the zero left-hand-side of Einstein's equation.
- 2. The geodesic equation implies that the length scale **$\delta(t) = c\,t$. Note that $\delta(t)$ is both the `similarity length scale' AND what we can see of an *infinite* universe.**
- 3. The Hubble parameter is easily deduced to be **$H(t) = V_r / d = 1/t$** where **t** is the age of the universe in `gravitational time'.
- 4. This implies that **$H(t) / H_o = 1 + z$** where **z** is the Red-shift parameter, **$H_o = H(t_o)$** and **t_o** is the present time (and age of universe)**.**
- 5. The energy density, **e**, is given by **$e(t) = c^4 / G\,\delta(t)^2 = c^2 / G\,t^2$.**
- 6. And the rest mass energy is given by **$\rho(t) = c^2 / G\,\delta(t)^2 = 1/ G\,t^2$.**
-

Compare our single parameter, H_o, fit in the next slide to

this standard model 3-parameter (H_o, Ω_{mo}, and Ω_{ro}) fit to same data .

Redshift parameter

$Z = (\lambda_o - \lambda_s) / \lambda_o$

The Hubble measurements (e.g. from Yu et al 2020) can be made to fit using standard theory **only by fitting parameters for dark energy and matter** to:

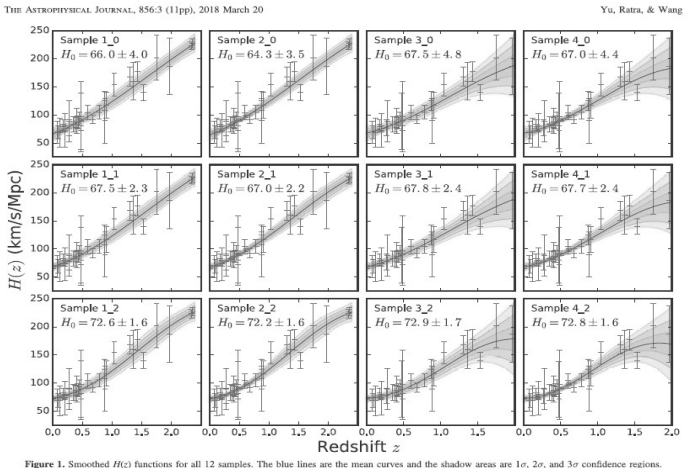


Figure 1. Smoothed $H(z)$ functions for all 12 samples. The blue lines are the mean curves and the shadow areas are 1σ, 2σ, and 3σ confidence regions.

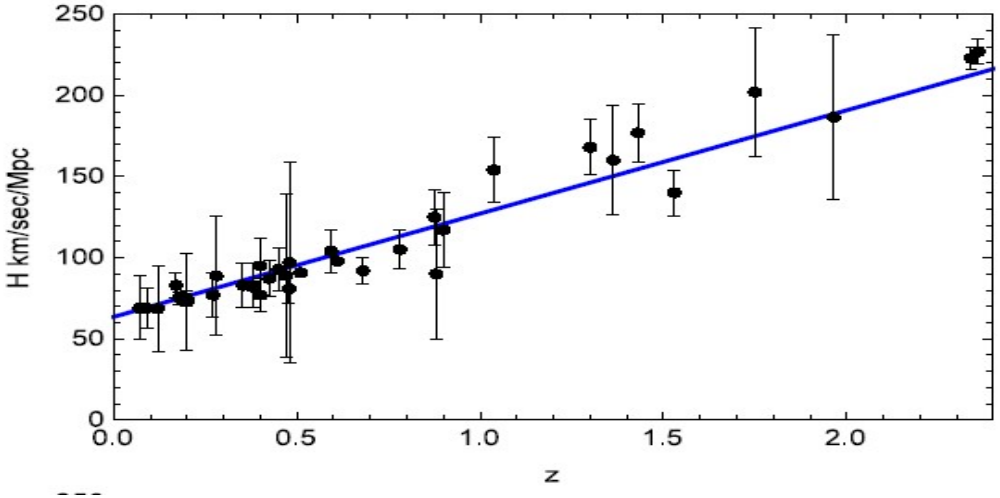
$$H(z) = H_o\sqrt{\Omega_{mo}(1+z)^3 + \Omega_{ro}(1+z)^4 + 1 - \Omega_{mo} - \Omega_{ro}} \qquad (77)$$

where Ω_{mo} and Ω_{ro} are the current values of the non-relativistic and relativistic matter density parameters.

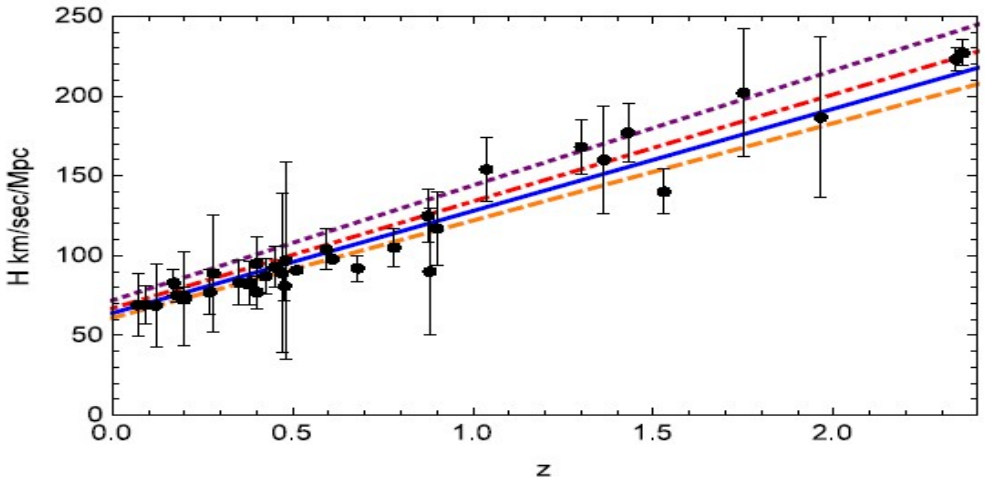
Old best fit is **H_o = 67 km/s/Mpc** which implied **AGE of UNIVERSE = 13.8 billion years**.

Our Hubble prediction compared to Yu et al. data (2018)

$H(z) = H_o\,[1+z]$ where the redshift is **$z = (\lambda_o - \lambda_s) / \lambda_o$**



Best fit is **H_o = 63.6 km/s/Mpc**



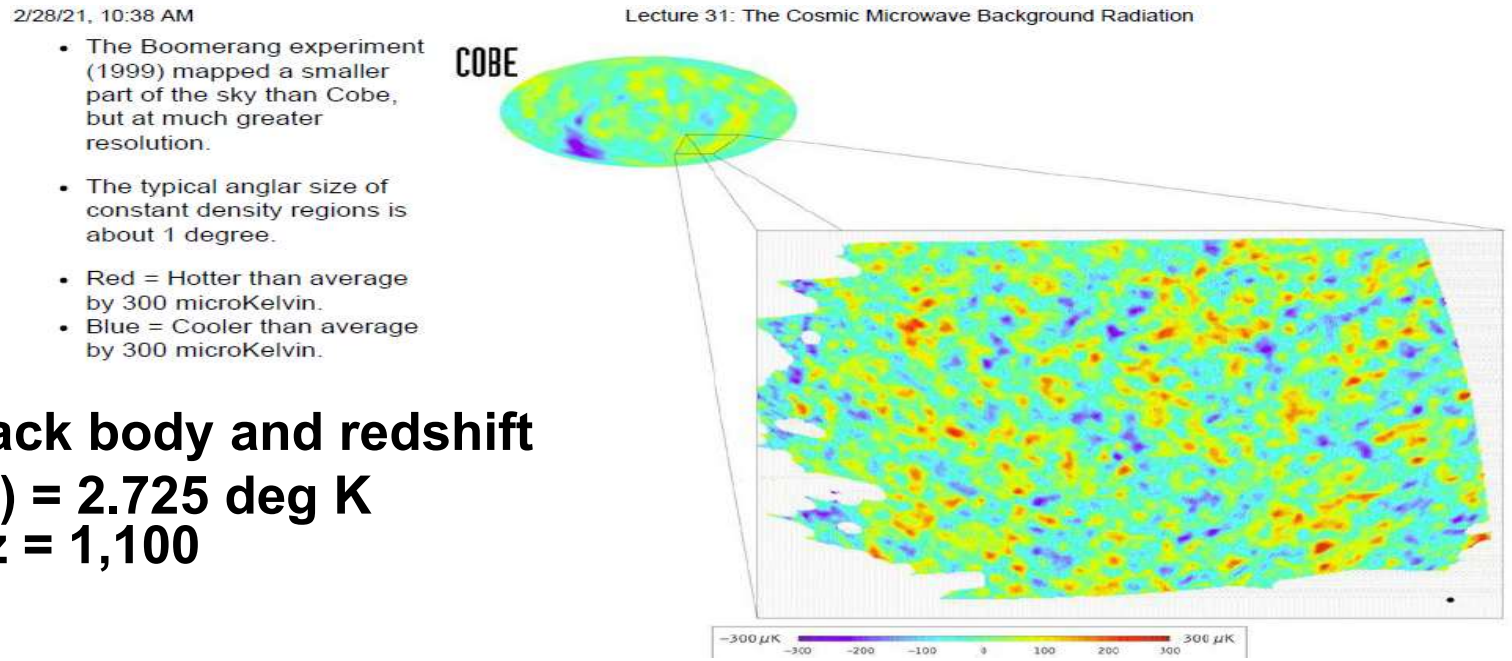
H_o = 61, 63.6, 67 and 71 km/s/Mpc

H_o = 63.6 km/s/Mpc implies **AGE of UNIVERSE = 15.4 billion years**.

Cosmic Microwave Background Radiation

This what decaying turbulence looks like – not acoustic!

No way to have gotten rid of vorticity!



From black body and redshift

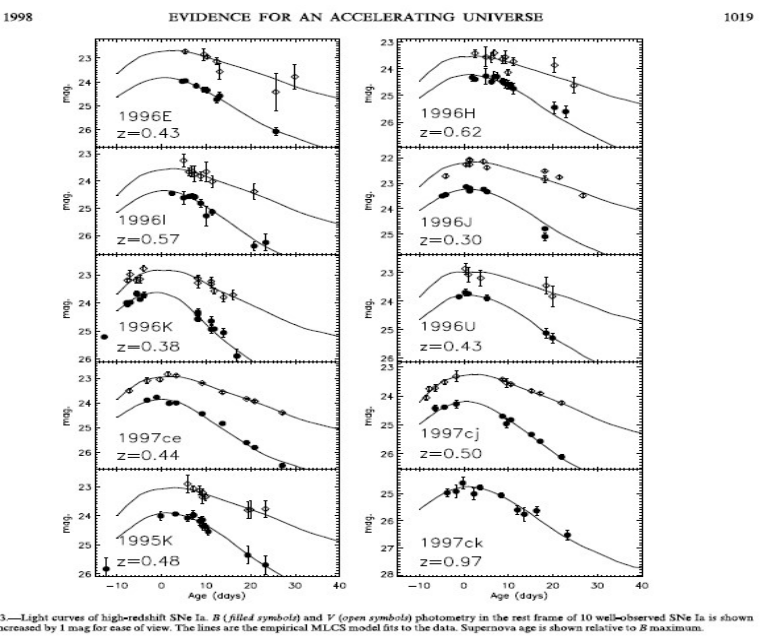
$T_u(t_o) = 2.725$ deg K

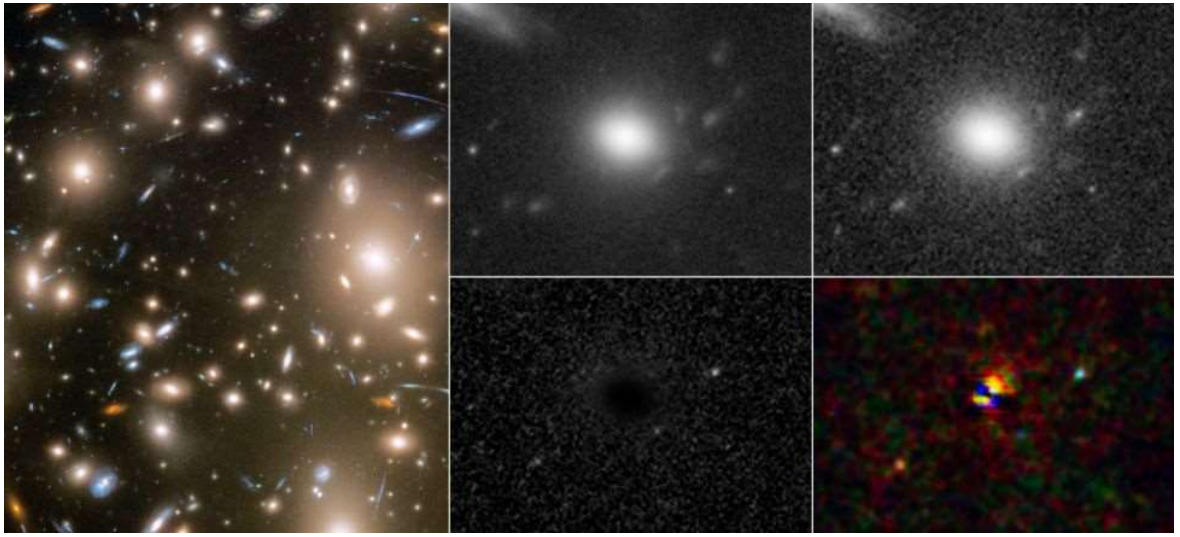
z = 1,100

z = 1,100 corresponds exactly to $T_u(t_o) = 2.725$ deg K and $T_u(t) = 3{,}000$ deg K which is the temperature at which photons can propagate.

But our theory places this at 14 billion years ago, and 1.4 billion years after Big Bang.

What about supernovae (Type 1a) data that some have claimed prove that expansion rate is increasing?





Abell 370 -gravitational lensing (left). Evolution (right).

Reiss et al 1998 Supernovae

See animation at https://www.space.com/early-phase-supernovae-photographed-by-hubble

Relation of distance to star, D, and time at star, t_s, to redshift parameter $z = (\lambda_o - \lambda_s)/\lambda_o$

$$\frac{t_s}{t_o} = \frac{1}{1+z} \qquad D = c\, t_o \left[\frac{z}{1+z}\right] = R_o \left[\frac{z}{1+z}\right]$$

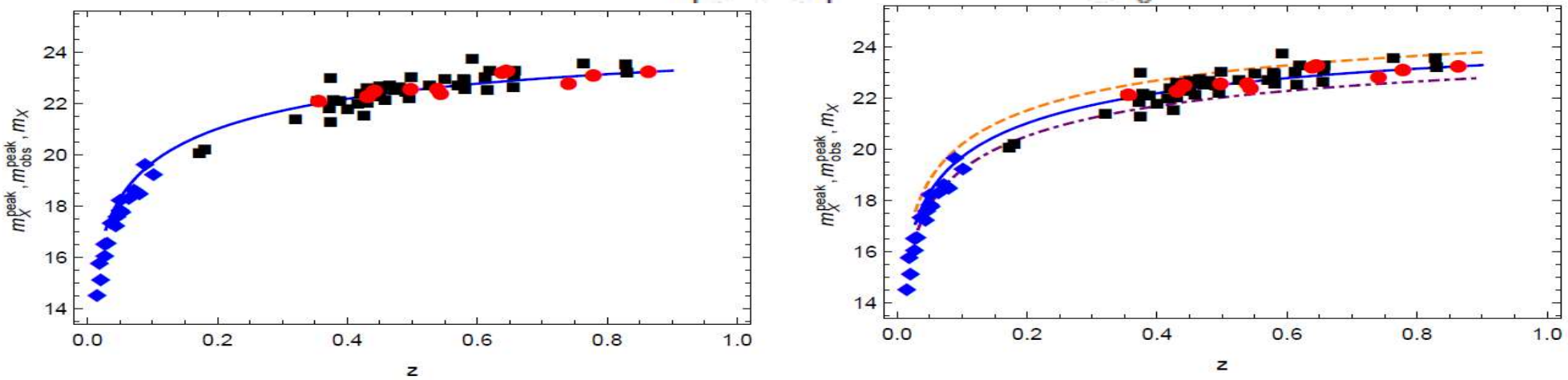
Our result that $D/R_o = z/(1+z)$ can be contrasted with the prevailing model given by [24] as:

$$\frac{D\ H_o}{c} = (1+z)\ |\Omega_k|^{-1/2}\ sinn\left\{|\Omega_k|^{1/2} \int_0^z [(1+z)^2(1+\Omega_M z) - z(2+z)\Omega_\Lambda]^{-1/2}\right\}$$

where $\Omega_k = 1 - \Omega_M - \Omega_\Lambda$, and $sinn$ is sinh for $\Omega_k \geq 0$ and sin for $\Omega_k \leq 0$. The differences between the theories will prove to be crucial when we consider the supernovae data in Section 7.3 below.

Our solution compared to "*uncorrected*" Supernovae data

$$\mu = m - M = -5\ log_{10}\left[\frac{z}{1+z}\right] - 5\ log_{10}\left[\frac{c}{H_o}\right] + 25 \qquad (90)$$



- **For plot on left, the only parameters are H_o= 63.6 km/s/Mpc (chosen from Hubble fit) and absolule magnitude M_v = 18.5 (close to Chandrasekar limit). Curve on right shows M_v = 18.0, 18.5, 19.0). All three are within the stated error bars.**
- **Our infinite universe is not expanding, but things are flying apart with an increasing length scale.**
- **And it needs no Dark Energy nor Dark Matter! No `1+z' `correction' to data**

How about “The worst prediction in the history of physics”?

Our theory intersects with the QFT estimate at **t = 4.5 Planck times** using currently observed values of density (e.g. Abullah et al 2020) and Hubble parameter (Yu et al 2018)

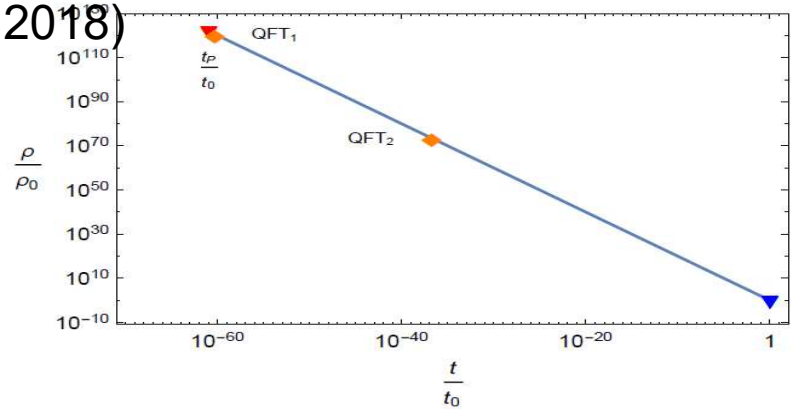


Figure 3: Plot of equation 98 showing 122 decades of mass density normalized by the present value versus time normalized by the age of the universe. The blue triangle is the present value. Also shown are the QFT1 value and the QFT2 value (orange diamonds), both normalized by the present day density of Abdullah et al. [2].

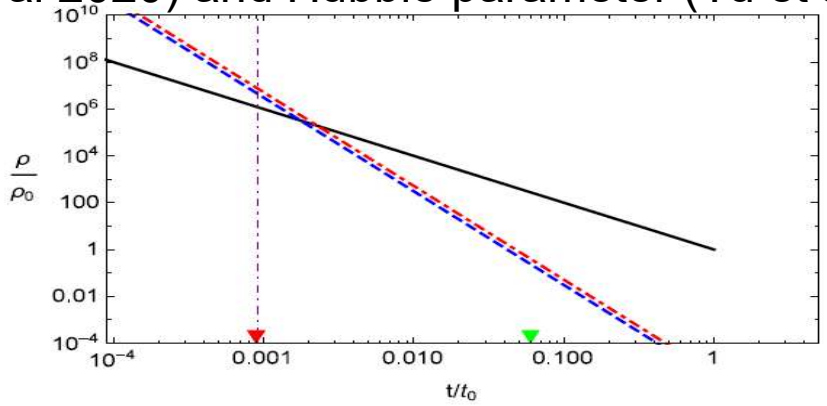


Figure 4: Blow-up of Figure 3 showing only times after $t/t_o = 10^{-4}$. The black line is equation 100, and the dashed lines are the radiation estimates of equation 109 and 110. For reference purposes, we have also shown on the plot the time associated with the Cosmic Background Radiation (red triangle) when the temperature was 3000 degrees K corresponding to $z = 1100$. The green triangle indicates the age of the Methuselah star (14.5 billion years).

So Quantum Field Theory prediction might actually be the ‘***best prediction***’! Our theory consistent with both QFT and current measurements ***without dark matter or dark energy***. Only parameter is $\mathbf{H_o}$ from fit to Yu et al data

Some interesting facts from universe theory

- ***The baryonic matter astronomers say is out there now is all that is dynamically important***. We need neither Dark Matter nor Dark Energy.
- The stars do NOT vanish over the horizon, the visible horizon moves with them. But they may all burn out.
- The invariant of the stress-energy tensor, T is just proportional to:
- $T = \text{constant} \quad u(t)^3 / \delta(t)$
- Every turbulence expert immediately recognizes this from Kolmogorov theory for turbulence in the limit of infinite Reynolds number.
- ***It is, ϵ_K, the spectral flux of energy to smaller scales.***
- Does this correlate with the generation of dust? Or maybe galaxies – dust?