

*Measure of
time
Using Time Scales*

1. Galactic and Universal time scale / unit :

Abstract : We use year , day , hour , minute , second and so on as a time scale / units on earth where there is no problem but have you ever thought that we often see that in a space movie or tv series the characters who are far from earth use these units (year , day , hour) to measure time which is totally unrealistic even in real life when we measure a time for a universal body we use year as a unit like : age of sun 4.6 Billion years , time to take sun revolve around milky way 225 million years , age of universe 13.7 billion years etc. Let's suppose in the future humanity becomes an interstellar species and lives on thousands of planets throughout the galaxy . will we be still using year as our one and only time scale or create thousands of time scales for every planet we go , both are equally disturbing . So we need a new time scale which can work on every planet we go to in the galaxy, basically a time scale which can work in the entire milky way galaxy and eventually a time scale for the entire known universe for a really hopeful future.

Let's try to make the new time scales together, trust me it's really simple

a. Galactic time scale 🕒 :

We know that speed of light is constant at vacuum at anywhere in the universe 299,792,458 metres per second or $3 * 10^8$ m/s . Let's try to build the time scale with the help of this information.

[Theory : If we take a certain amount of distance in a straight line, light will always take a certain amount of time to travel that distance in vacuum.]

The average distance between two stars in the Milky way galaxy is $3.784e+16$ metres (according to google and chat gpt) so let's calculate the time light takes to travel this distance .

(we can also take any other distance which is relevant for the entire galaxy, But here let's work with $3.784e+16$ m)

Time taken (t MG) = $(3.78 * 10^{16}) / (3 * 10^8) = 1.26 * 10^8$ seconds = 3.99 earth years
If we take this 3.99 earth years as 1 we will have a new galactic time scale .

Let's call the new scale ,Milky Way Galactic time (t MG)

Hence, 1 t MG = 3 . 99 earth years .

So now we can say age of sun = 1.15 Billion t MG

time to take the sun revolves around the milky way = 56 . 4 Million t MG

Now we need some time scales which are smaller in size .

We use hour , minute , second , millisecond etc as small time scales on earth for galactic small time scales. The process is really simple.

Let's suppose , The average distance between two stars in the Milky way galaxy as(x MG)

Hence , x MG = $3.78 * 10^{16}$ metres .

Let's break x MG into 10 equal pieces each piece is $3.78 * 10^{15}$ m .

We can call this , x 1 MG . so 1 x 1 MG = $3.78 * 10^{15}$ m .

so , 1 t 1 MG = 0.399 earth year = 145 . 635 earth days .

Now let's break , x 1 MG into 10 equal pieces and call one piece of it , x 2 MG

So 1 x 2 MG = $3.78 * 10^{14}$ m , hence 1 t 2 MG = 0.0399 earth year = 14 . 56 earth days

Same way , 1 x 3 MG = $3.78 * 10^{13}$ m , so 1 t 3 MG = 1.456 earth days = 34.944 earth hours

1 t 4 MG = 0.1456 earth days = 3.5 earth hours

1 t 5 MG = 0.0145 ed = 0.35 eh = 21 minutes

1 t 6 MG = 0.00145 ed = 2.099 earth minutes

1 t 7 MG = 12.528 earth seconds

This can be go on still planck time reaches .

Hence , $t MG = 10 * t 1 MG = 10^2 * t 2 MG = 10^3 * t 3 MG = 10^4 * t 4 MG =$
 $10^5 * t 5 MG = \dots\dots\dots$

$$\text{so , } t MG = 10^n * t n MG$$

By using this formula we can calculate numerous numbers of galactic time scales or units which can work anywhere in the milky way galaxy.

The distance between planets in the galaxy can change with time so for a more accurate measure of time we can use Universal time scale . concept of Universal time scale explained below.

b. Universal time scale ⌚ :

One unified time scale for a galaxy is great but we also have trillions of galaxies in the observable universe so let's try to develop another time scale which can work anywhere in the observable and known universe. Maybe it's a little more complicated than the previous one but still no rocket science.

[Theory : same as the previous one light always takes a certain amount of time to cover a certain distance in straight line]

Let's consider observable universe as a giant sphere which has a radius of $4.4 * 10^{26}$ m

Light takes around 46 billion earth years to cover that much distance .

Let the radius of the observable universe , r_U .

if we cut r_U into numerous small fragments we will have many small lengths . Since r_U is a very large number we have to break it into many small pieces just 10 will not work.

According to google there could be 2 trillion galaxies in the observable universe (though the number varies very much with time , other numbers can also be taken)

But here we will consider 2 trillion

Let's divide, r_U by 2 trillion or by $2 * 10^{12} = (4.4 * 10^{26}) / (2 * 10^{12}) = 2.2 * 10^{14}$ m.

Let's call it , x_U . hence, $1 x_U = 2.2 * 10^{14}$ m

Time take to light to cover this distance is 733333.333 earth seconds. Let's call it, t_U
So , $1 t_U = 7.3 * 10^5$ earth seconds = 0.023 earth years = 8.49 earth days

But -

We know universe is expanding

The rate of the expansion of the universe is 67500 m/s/Mpc (hubble constant)

also, $r_U = 14257.93$ Mpc

So, rate of expansion of the total observable universe is = $67500 * 14257.93$ m/s
= $9.62 * 10^8$ m/s

Now , $x_U = 2.2e+14$ m = $7.13e-9$ mpc

So , rate of expansion of universe for xU = hubble constant * distance = $67500 * 7.13e-9$
 $= 0.000481 \text{ m/s}$
 More accurately, 0.0004981 m/s

So we can say every second xU increases by $4.981e-4 \text{ m}$
 So , now we can say in $7.3e+5 \text{ s}$ the xU increases by $= (7.3e+5) * (4.981e-4) = 363.613 \text{ m}$

Time take to cover that distance by light $= 363.613 / (3 * 10^8) = 1.212 * 10^{-6} \text{ s}$
 $= 1.403e-11 \text{ earth days}$

So , t U increases by $1.403e-11 \text{ earth days}$ with every t U (8.49 ed)

So,now
 new,

$$\begin{aligned} 1 \text{ t U} &= 8.49 + (1.403e-11) \text{ earth days} \\ 2 \text{ t U} &= (2 * 8.49) + [2 * (1.403e-11)] \text{ ed} & [n \text{ t U is not time taken to cover } n \times \text{U}] \\ 3 \text{ t U} &= (3 * 8.49) + [3 * (1.403e-11)] \text{ ed} \end{aligned}$$

Let , $1.403e-11 = Q$ (and call it universal time expansion constant)

$$\text{So , } n \text{ t U} = n * 8.49 + n * Q \quad \text{ed}$$

$$\text{or } n \text{ t U} = n (Q + 8.49) \quad \text{ed}$$

By using this formula we can create a time scale which can work anywhere in the observable and known universe.

According to this the age of the observable universe is around 590 billion t U.
 (not exact value)

We can create more smaller and bigger universal time scales just like the previous one either by dividing 1 x U into 10 pieces or attaching 10 x U to create a bigger scale. But for this one the process will be a lot of challenging since we have to consider the expansion of the universe.

Finally if we try to make a analog clock using this time scale suppose 1 t U = 360 degrees 2 t U will never be 720 degrees it will be (720+something) degrees. Maybe for a small time span the extension will be negligible but for a long time span it will add up .So we can say it is really hard and approximately impossible to make a 2D analog clock using this scale.

We have to keep in mind it is not a circular time scale like year,day etc it is more like a linear time scale because it is not based on a circular motion of an astronomical body it is based on linear motion of light.

C. Machines to measure “t MG” and “t U” :

To measure any time we need a machine irrespective of it's scale / unit. Like we use analog and digital clocks to measure year , day , hour , minute , second etc on earth. We need a different type of machine to measure t MG and t U.

Let's try to make a machine to measure t MG (let's make it till “t 7 MG”) :

t MG . t 1 MG . t 2 MG . t 3 MG . t 4 mg . t 5 MG . t 6 MG . t 7 Mg

Since , $t MG = 10^n * t n MG$. So for each 10t 7 MG there will 1 t 6 MG for each 10 t 6 MG there will be 1 t 5 MG for each 10 t 5 MG , 1 t 4 MG and it goes like that and finally for each 10 t 1 MG , 1 t MG .

So if we try to write time codes at t Mg scale it will be .

t MG . t 1 MG . t 2 MG . t 3 MG . t 4 mg . t 5 MG . t 6 MG . t 7 Mg
 00 . 00 . 00 . 00 . 00 . 00 . 00 . 01 (at 1 t 7 MG)
 00 . 00 . 00 . 00 . 00 . 00 . 00 . 09 (9 t 7 MG)
 00 . 00 . 00 . 00 . 00 . 00 . 01 . 04 (1 t6 . 4 t7 MG)
 00 . 07 . 08 . 02 . 09 . 02 . 03 . 06
 (7 t1. 8 t2. 2 t3. 9 t4 . 2 t5 . 3 t6 . 6 t7 MG)

Since , $t n MG = 10 t (n+1) Mg$

So , from t 1 MG to t n MG maximum numerical value can be 09 and minimum can be 00.

But , for t MG maximum value can be ∞ , since t MG is the highest scale for galactic time . and galactic time is a linear time scale and not a circular one.

So, time codes for $4.5 * 10^5 t$. 4 t1 . t2 . 8 t3 . 6 t4 . 7 t5 . 9 t6 . 6 t7 MG will be :

t MG . t 1 MG . t 2 MG . t 3 MG . t 4 mg . t 5 MG . t 6 MG . t 7 Mg

4.5e+5 . 4 . 00 . 8 . 6 . 7 . 9 . 6

Suppose , t MG was 00 at the time of Big Bang.

So time codes at this moment will be approximately :

t MG . t 1 MG . t 2 MG . t 3 MG . t 4 mg . t 5 MG . t 6 MG . t 7 Mg

3.455e+9 . 0-9 . 0-9 . 0-9 . 0-9 . 0-9 . 0-9 . 0-9

Values of “t 1 MG” to “t n MG” will become more accurate , as we will put the time of Blg Bang more accurately. It has to be really really accurate since “9 t 1 MG” = 3.59 earth years only.

The “t U” machine:

Now let's try to make a machine which works on the universal time scale. First let's break down “t U” into 10 equal pieces [note : we're not breaking x U] . so value of each piece will be $[(8.49 * 10^{-1}) + (Q/10)]$ let's call it “t 1 U”. If we break “t 1 U” to 10 equal pieces value of each piece will be $[(8.49 * 10^{-2}) + (Q/10^2)]$ it will be “t 2 U” .

So,

t U . t 1 U . t 2 U . t 3 U . t 4 U . t 5 U . t 6 U ...

$(Q + 8.49) . 10^{-1}(Q + 8.49) . 10^{-2}(Q + 8.49) . 10^{-3}(Q + 8.49) . 10^{-4}(Q + 8.49) . 10^{-5}(Q + 8.49) . 10^{-6}(Q + 8.49)$ ed
.....

Just like the galactic machine we can think now at 10 t 6 U there is 1 t 5 U at 10 t 5 U
There is 1 t 4 U and so on.

But, the expansion of the universe is an irreversible process. After 9 t 6 U there will not be 1 t 5 U . 00 t 6 U it will be 1 t 5 U . 10 t 6 U and then it will go till 19 t 6 U and after that it will be 2 t 5 U . 20 t 6 U .

(though we can write 1 t n U . 00 t (n+1) U , but it will not show the relation between time and the expansion of the universe for each small scales independently)

so , 1 t 4 U will be .

1 t 4 U . 10 t 5 U . 10^2 t 6 U....

1 t 2 U . 10 t 3 U . 10^2 t 4 U . 10^3 t 5 U . 10^4 t 6 U....(1 t 2 U)

So , 1 t U will be :

1 t U . 10 t 1 U . 10^2 t 2 U . 10^3 t 3 U . 10^4 t 4 U . 10^5 t 5 U . 10^6 t 6 U....

So , 27 t U will be :

27 t U . 27*10 t 1 U . 27 * 10^2 t 2 U . 27* 10^3 t 3 U . 27* 10^4 t 4 U . 27* 10^5 t 5 U . 27* 10^6 t 6 U....

But since , if the value of “t U” is 1 so the value of t 1 U can be anything between “10 t 1 U” to “19 t 1 U” and for “ t 2 U” “100 t 2 U” to “199 t 2 U” and so on.

Suppose : “10 t 1 U” to “19 t 1 U “ can be written as (10_19) t 1 U or [10+(0_9)] t 1 U.

So corrected, 27 t U will be :

$$27 \text{ t U} \rightarrow 27 \cdot 10 + (0_9) \text{ t 1 U} \rightarrow 27 \cdot 10^2 + (0_99) \text{ t 2 U} \rightarrow 27 \cdot 10^3 + (0_999) \text{ t 3 U} \\ \rightarrow 27 \cdot 10^4 + (0_9999) \text{ t 4 U} \rightarrow 27 \cdot 10^5 + (0_99999) \text{ t 5 U} \rightarrow 27 \cdot 10^6 + (0_999999) \text{ t 6 U}$$

So , we can also say , 27 t U in terms of earth days :

$$27(Q+8.49) \rightarrow [27 \cdot 10 + (0_9)] [(Q+8.49)10^{-1}] \rightarrow [27 \cdot 10^2 + (0_99)] [(Q+8.49)10^{-2}] \\ \rightarrow [27 \cdot 10^3 + (0_999)] [(Q+8.49)10^{-3}] \rightarrow [27 \cdot 10^4 + (0_9999)] [(Q+8.49)10^{-4}] \rightarrow \\ [27 \cdot 10^5 + (0_99999)] [(Q+8.49)10^{-5}] \rightarrow [27 \cdot 10^6 + (0_999999)] [(Q+8.49)10^{-6}] \text{ ed}$$

Suppose : 999999 = 9.9..e+5 , 99999999999 = 9.9..e+10

[note : we consider 990000 = 9.9e+5 but 999999 = 9.9..e+5]

So , general formula of “a t U” at t n U will be :

$$a \text{ t U} = [a \cdot 10^n + [0_9.9..e + (n - 1)]] [(Q + 8.49)10^{-n}] \text{ ed}$$

$$a \text{ t U} = [a \cdot 10^n + [0_9.9.. \cdot 10^{(n-1)}]] [(Q + 8.49)10^{-n}] \text{ ed}$$

[only if, a>0]

Suppose an cosmic phenomenon takes around 10 earth days so time code for that in galactic scale will be :

t MG . t 1 MG . t 2 MG . t 3 MG . t 4 mg . t 5 MG . t 6 MG . t 7 Mg....

00 . 00 . 00 . 06 . 08 . 09 . 09 . 09....

Universal scale will be :

$$\begin{array}{ccccccc}
 t_U & . & t_{1U} & . & t_{2U} & . & t_{3U} & . & t_{4U} & . & t_{5U} & \\
 1 & . & 11 & . & 117 & . & 1177 & . & 11778 & . & 117785 \\
 = 1 & . & 10+1 & . & 10^2+17 & . & 10^3+117 & . & 10^4+11778 & . & 10^5+10^4+7785
 \end{array}$$

Time code for three earth days will be in Universal scale :

$$\begin{array}{ccccccc}
 t_U & . & t_{1U} & . & t_{2U} & . & t_{3U} & . & t_{4U} & . & t_{5U} & . & t_{6U} & . & t_{7U} \\
 & & & & & & & & & & & & & & \\
 0 & . & 3 & . & 35 & . & 353 & . & 3533 & . & 35335 & . & 353356 & . & 3533568 \\
 & & & & & & & & & & & & & & \\
 0 & . & 3 & . & 3*10+5 & . & 3*10^2+53 & . & 3*10^3+553 & . & 3*10^4+5335 & . & 3*10^5+5*10^4+3356 & . & 3*10^6+5*10^5 \\
 & & & & & & & & & & & & & & +3*10^4+3568
 \end{array}$$

By using these two theories we can create a perfectly working system for galactic time and universal time scales machine.

For creating the system of the machines we can use computer programming or other technologies By doing this we can create a system which works both on computers and machines specially designed for these scales.

Because we have to consider expansion of the universe using t_U scale is much more complex than t_{MG} scale in real life.

Since , relativity is a basic feature of time and universe it will also work for galactic and universal time scales and any other scales . Because relativity is a fundamental property of our universe and it doesn't matter in which scale or unit we are measuring the time. More about the topic of relativity later.