

# The Big Bang

By  
**Dave Lindsay**

It was either a Big Bang from nothing or perhaps part of the process a Divine Creator used, but 13.79 billion years ago, the entire universe sprang into existence from a "singularity", the point where all known laws of contemporary physics and understanding simply break down. At that initial moment, virtually everything humanity knows; time, atoms, planets, stars, galaxies and the elements that would eventually combine to create life itself, was compressed into one infinitely tiny particle in space.

Whether you are an atheistic astrophysicist, or a bible-believing Christian is completely irrelevant. Regardless of who you are or how smart you might be, no one knows for a fact what banged, how it banged and/or why, and, until we get to heaven, we never will. For me, the most significant fact to consider is not so much that our universe suddenly and instantaneously burst into existence, but rather that the phenomenal process somehow created the perfect balance of all elements necessary for it to exist. It was, in the beginning, an expanding form of pure energy.

**If** the dominating forces hadn't split when and as precisely as

they had, **if** the singularity produced more or less gravity, **if** there wasn't a 1:1 billion PPM ratio of matter to anti-matter...**if, if, if,** the universe as we know it would not exist. In my view, these quandary-oriented findings of the scientific community would seem to support the possibility (theory) of Intelligent Design. Simply by replacing "Super Force", the term coined by scientists, with "God", it is somewhat easy to reach logical conclusions and rational explanations for its existence.

Clearly, when it comes to biblical principles, religious beliefs and theology, there is a never-ending supply of opinions, and mine is simply one of them. Unfortunately, instead of reading the Bible themselves without the external influence of theologians, too many people become dependent on the 40-minute sermons they hear in churches on a given Sunday. While most church leaders certainly have the best of intentions, they were obviously educated and trained according to the beliefs and practices of a specific religion. So, the only messages we hear are those that these individuals were trained to teach. It's up to us to determine if their "gospel" is in line with the written Word of the Hebrew Bible.

Far too bible believers have chosen to follow the path outlined by their religious organizations. There is however much more at stake than how a region chooses to interpret the Bible. It's up to each Christian to determine which religions and beliefs are genuine and

which aren't consistent with the Bible. When one considers the potential ramifications of an incorrect choice, I would strongly encourage all believers to READ THE BIBLE for themselves and to "test" everything they hear preached about it according to what they have determined and believe the Bible actually says.

Consider the description of the creation process as outlined in the Bible. It is important to maintain proper perspective and to keep in mind; the Bible is made up of 66 books, an incredible number of chapters and a seemingly endless number of pages. There are 39 books in the Old Testament and 27 in the New. It is easy to remember how many there are: **3 x 9 (the number of books in the Old Testament) = 27 (the number of books in the New Testament. Just add 39 to 27 = 66.** Yet, only a few short pages in Genesis were dedicated to explaining "creation". In my opinion, too many Believers tend to overlook that fact, which I contend is important.

There will forever be those who interpret the description literally and believe that the God created our world over the course of six 24-hour days. While the God I believe in could certainly have accomplished such a feat, I am convinced that there is much more to it. Although the Hebrew Bible clearly references the lineage of Adam and Eve and the history of the Israelites, God's chosen people, many have been taught and wholeheartedly believe that the book depicts the history of all mankind.

Based on what I read, I am not sure how anyone could reach that conclusion, but everyone is entitled to their biblical beliefs and I would never impose upon that privilege. I would however encourage everyone to consider re-reading Genesis. It seems to me that the Body of Christ should be focusing on the many beliefs we have in common instead of the petty differences of irrelevant religious interpretations of less significant scriptures.

Matter of opinion, of course, but by intentionally providing a relatively brief and rather vague description of His omnipotent creation process what God seemed to be expressing to us in a somewhat roundabout way (paraphrased) is...

'Give the creation process described herein as much consideration as I gave it reference. Even with access to the most comprehensive library of scientific data available, mankind would never be able to truly comprehend the intricate process anyway. Consider when the biblical description was conveyed and to whom. The ancient Hebrew ancestors had virtually no technology at their disposal and an extremely limited ability to comprehend it. If it were my intent for mankind to place a great deal of emphasis on the process, a lengthy dissertation on the topic would have been provided. What was stressed, and is considerably more important to know, is that I created everything. How I did it and how long it took

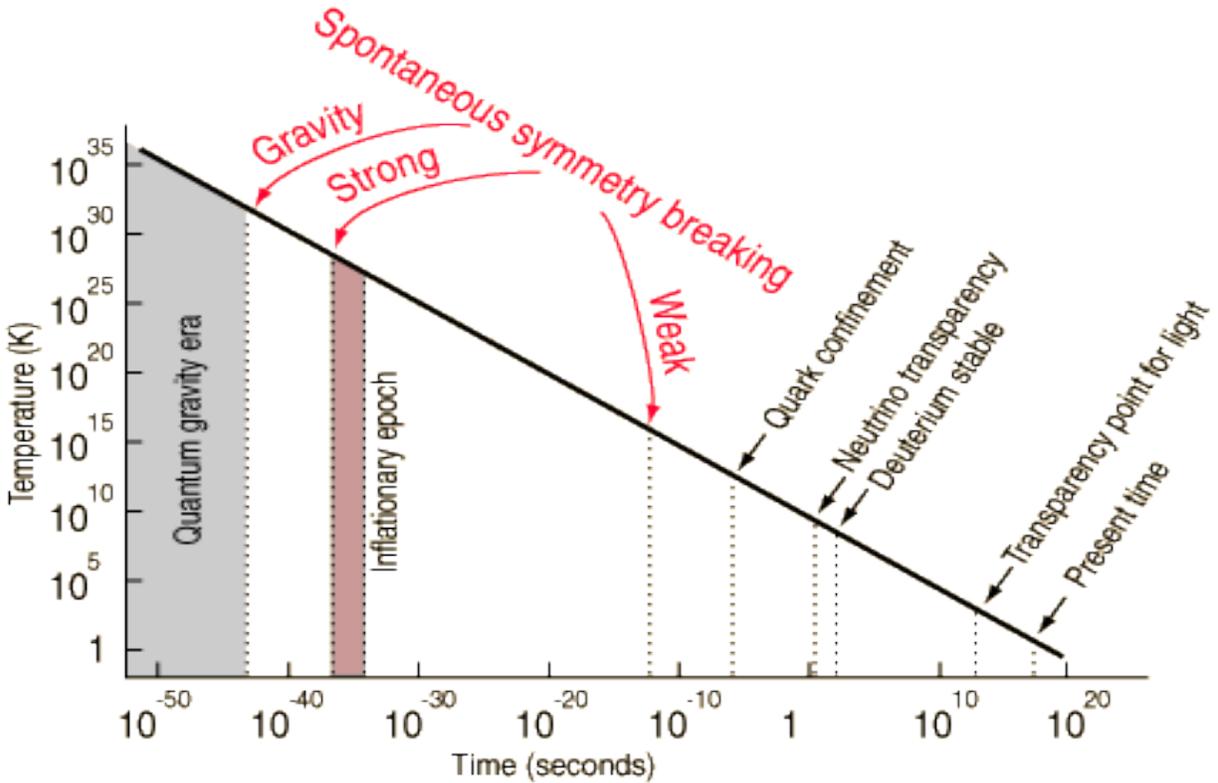
is, for the most part, insignificant and irrelevant. Focus instead on the things that are.'

Scientists have numerous theories about what lies beyond our vast universe. I have my own and such notion tend to spark one's imagination, but it is highly unlikely that genuine mathematical evidence to substantiate any pre-singularity theory will ever exist before the era of humanity ends. So, for the scientific community to dismiss the possibility of a Divine Creator when it is virtually impossible disprove the existence of one, is not only unfair, but utterly irresponsible. Everyone has a right to choose what they believe, but until science can provide the world with a valid explanation for what caused the Big Bang and the many mysteries that populate our universe, they simply must consider and include the prospect of a Creator as the vast majority of people throughout the world contend.

A large community of Astrophysicists, Cosmologists and Astronomers, some of the smartest people in the world, have concluded that; **more of the creation process of our universe took place in the FIRST second of the Big Bang than has taken place during the last 13.8 billion years and will ever take place for the balance of its existence.** Even from a Bible-Believing perspective and a faith-based viewpoint, I see no reason whatsoever to challenge or dispute their findings.

# Planck Time Timeline

All that happened during the Planck Time Period,  
the First Second of the Big Bang



Modeling of the "[Big Bang](#)": Humans tend to measure time in terms of **hours, minutes and seconds**, but in order to describe and more accurately measure the initial sequence of the earliest events, the initial moment by moment sequence of creation, scientists needed a new concept of time. So, physicists divided the "one-second timeframe" into a unit of measure called **Planck Time**,  $t_P$  "[Planck time](#)", which is  **$5.39 \times 10^{-44}$  seconds**...an unimaginable tiny fragment of time...a proposed interval during which all the known [fundamental forces](#) were unified into one single force.

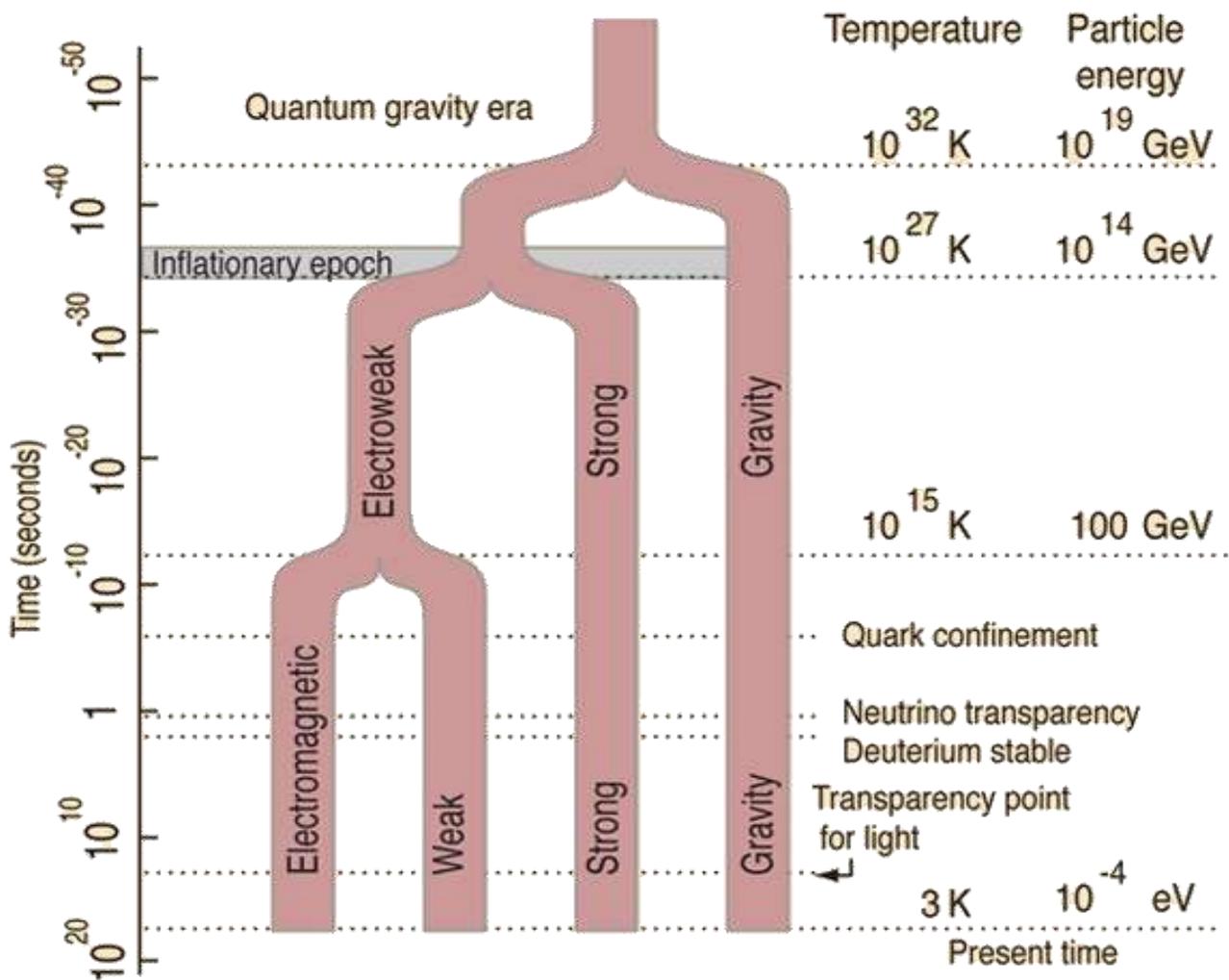
To calculate Planck Time, divide the minuscule Planck length by the speed of light:  $t_P = (\hbar G / 2\pi c^3)^{1/2}$ , which is the time it would take a photon travelling at the speed of light to cross a distance equal to the Planck length. This is the '**quantum of time**', the smallest measurement of time that has any meaning;  $10^{-43}$  seconds.

**Planck Limit** is equal to  $1.616255(18) \times 10^{-35}$  m. It is a base line in the system of Planck units, developed by physicist Max Planck. The Planck length can be defined from three fundamental physical constants: the speed of light in a vacuum, the Planck Constant and the **Gravitational Constant**:  $G = 6.673(10) \times 10^{-11} \text{ m}^3 \text{ kg}^{-1} \text{ s}^{-2}$ .

There are a **billion, billion, billion, billion Planck Time** in **ONE second**. But there are only a **billion, billion** seconds in the entire history of the universe. So, there are more Planck Time in one second than there are seconds since the Big Bang took place 13.79 billion years ago and more seconds than will ever be in the balance of the universe's eternal existence.

# Big Bang Expansion and the Fundamental Forces

Below is an attempt to illustrate the "[spontaneous symmetry breaking](#)" which is presumed to have separated the original force into the four forces which we see operating in the present, low temperature universe. Proposed energies and temperatures associated with each of the symmetry breaks are shown along with a modeling of the time elapsed in the big bang model.



# Before 1 Planck Time

Before a time classified as a Planck time,  $10^{-43}$  seconds, all four [fundamental forces](#) were presumed by physicists to have been unified into one force. Hmmm, even science states that the entire universe came from one force. All the matter, energy, space and time in our universe exploded outward from the so-called singularity, but virtually nothing prior to that period is known. ANY hypothesis or theoretical notion about the pre-singularity time is, and can only be, speculative. I tend to believe that what science has labeled as this so-called **ONE force** could more conceivably have been the "force" we know as God, which was sparked by the pre-existing eternal Spirit of God Himself.

Because science has no real coherent model of what might happen under such conditions, we do not know a great deal about later periods either. The [electroweak unification](#) has been supported by the discovery of the [W and Z particles](#), and can be used as a platform for discussion of the next step, the [Grand Unification Theory \(GUT\)](#). The final unification has been called a "super-grand unification theory" and becoming more popular is the designation "theory of everything" (TOE). But "theories of everything" are separated by two great leaps beyond the experiments we could ever hope to do on the Earth.

# Era of 1 Planck Time

In the era around one Planck time,  $10^{-43}$  **seconds**, it is projected by present modeling of the [fundamental forces](#) that the [gravity](#) force begins to differentiate from the other three forces. This is the first of the [spontaneous symmetry breaks](#) which lead to the four observed types of interactions in the present universe.

Looking backward, the general idea is that back beyond 1 Planck time we can make no meaningful observations within the framework of classical gravitation. One way to approach the formulation of the Planck time is presented by Hsu. One of the characteristics of a [black hole](#) is that there is an [event horizon](#) beyond which we can obtain no information - scales smaller than that are hidden from the outside world. For a given enclosed mass, this limit is on the order

of  $L = \frac{Gm}{c^2}$  where G is the [gravitational constant](#) and c is the [speed of light](#). But from the [uncertainty principle](#) and the [DeBroglie wavelength](#), we can infer that the smallest scale at which we could locate the event horizon would be the [Compton wavelength](#).

$$\lambda = \frac{h}{mc}$$

Equating L and  $\lambda$ , we obtain a characteristic mass called the

$$m_{\text{planck}} = \sqrt{\frac{hc}{G}} = 5.46 \times 10^{-8} \text{ kg}$$

Planck mass:

Substituting this mass back into one

$$\lambda_{\text{Planck}} = \sqrt{\frac{Gh}{c^3}} = 4.05 \times 10^{-35} \text{ m}$$

of the length expressions gives the Planck length

and the light travel time across this length is called the Planck

$$t_{\text{Planck}} = \sqrt{\frac{Gh}{c^5}} = 1.35 \times 10^{-43} \text{ sec}$$

time:

Keep in mind that this is a characteristic time, so its order of magnitude is what should be noted. Sometimes it is defined with the wavelength above divided by  $2\pi$ , so don't worry about the number of significant digits.

## Separation of the Strong Force

At a time around  $10^{-36}$  seconds, present models project a separation of the [strong force](#), one of the four [fundamental forces](#). Before this time the forces other than [gravity](#) would be unified in what is called the [grand unification](#). The [spontaneous symmetry breaking](#) which occurs in this era would distinguish as a separate interaction the force which would hold nuclei together in later eras.

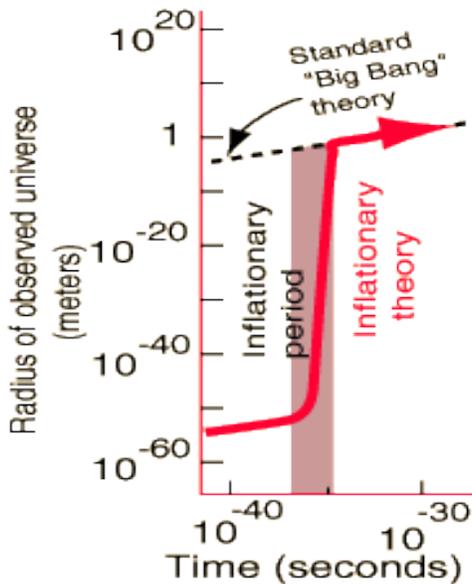
In the 1970's. Sheldon Glashow and Howard Georgi proposed the grand unification of the strong, weak, and electromagnetic forces at energies above  $10^{14}$  GeV. If the ordinary concept of [thermal energy](#) applied at such times, it would require a temperature of  $10^{27}$  K for the average particle energy to be  $10^{14}$  GeV.

Though the strong force is distinct from gravity and the electroweak force in this era, the energy level is still too high for the strong force to hold protons and neutrons together, so that the universe is still a "sizzling sea of [quarks](#)".

## The Inflationary Period

Lemonick and Nash in a popular article for Time describe inflation as an "amendment to the original Big Bang" as follows: "when the universe was less than a billionth of a billionth of a billionth of a second old, it briefly went through a period of supercharged expansion, ballooning from the size of a proton to the size of a grapefruit (and thus expanding at many, many times the speed of light). Then the expansion slowed to a much more-stately pace.

Improbable as the theory sounds, it has held up in every observation that astronomers have managed to make."



The inflationary epoch may have expanded the universe by  $10^{20}$  or  $10^{30}$  in this incredibly brief time. The inflationary hypothesis offers a way to deal with the [horizon problem](#) and the [flatness problem](#) of cosmological models.

Triggered by the [symmetry breaking](#) that separates off the [strong force](#), models suggest an extraordinary inflationary phase in the era  $10^{-36}$  seconds to  $10^{-32}$  seconds. More expansion is presumed to have occurred in this instant than in the entire period (14 billion years?) since.

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## Uncertainty Principle

Important steps on the way to understanding the uncertainty principle are [wave-particle duality](#) and the [DeBroglie hypothesis](#). As you proceed downward in size to atomic dimensions, it is no longer valid to consider a particle like a hard sphere, because the smaller the dimension, the more wave-like it becomes.

It no longer makes sense to say that you have precisely determined both the position and momentum of such a particle. When you say that the electron acts as a wave, then the wave is the quantum mechanical [wavefunction](#) and it is therefore related to the probability of finding the electron at any point in space. A perfect sinewave for the electron wave spreads that probability throughout all of space, and the "position" of the electron is completely uncertain.

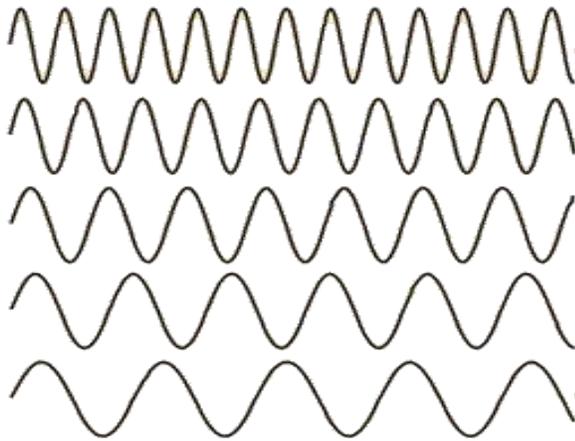
Precisely determined momentum



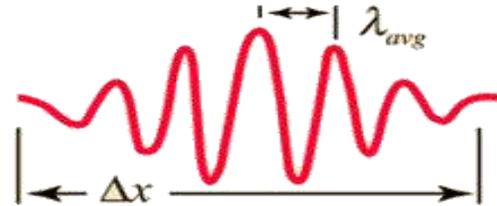
A sine wave of wavelength  $\lambda$  implies that the momentum is precisely known. But the wavefunction and the probability of finding the particle  $\Psi^*\Psi$  is spread over all of space!

$$p = \frac{h}{\lambda}$$

p precise  
x unknown



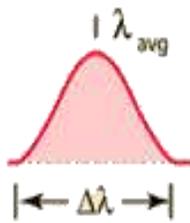
Adding several waves of different wavelength together will produce an interference pattern which begins to localize the wave.



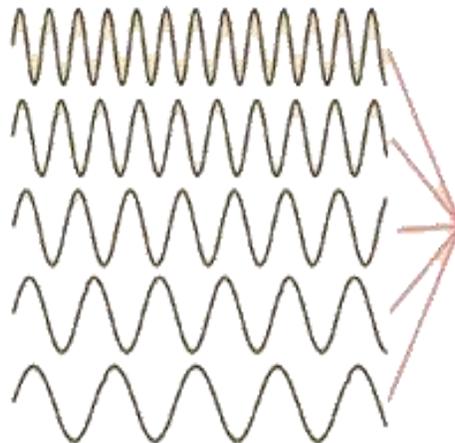
But that process spreads the momentum values and makes it more uncertain. This is an inherent and inescapable increase in the uncertainty  $\Delta p$  when  $\Delta x$  is decreased.

$$\Delta x \Delta p > \frac{\hbar}{2}$$

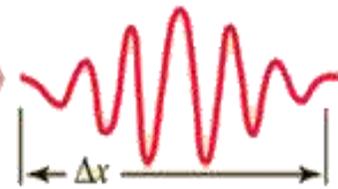
A continuous distribution of wavelengths can produce a localized "wave packet".



$$p = \frac{h}{\lambda}$$



Each different wavelength represents a different value of momentum according to the DeBroglie relationship.



Superposition of different wavelengths is necessary to localize the position. A wider spread of wavelengths contributes to a smaller  $\Delta x$ .

# Quark-Antiquark Period

As the [inflationary period](#) ends, the universe consists mostly of energy in the form of [photon](#), and those particles which exist cannot bind into larger stable particles because of the enormous energy density. They would exist as a collection of [quarks](#) and antiquarks along with their [exchange particles](#), a state which has been described as a "sizzling sea of quarks". This time period is estimated at  $10^{-32}$  seconds to  $10^{-5}$  seconds. During this period the [electromagnetic](#) and [weak](#) forces undergo the final [symmetry break](#), ending the [electroweak unification](#) at about  $10^{-12}$  seconds.

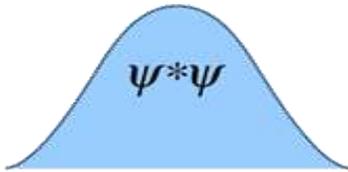
## Quark Confinement

When the expansion of the "primordial fireball" had cooled it to  $10^{13}$  Kelvin, a time modeled to be about  $10^{-6}$  seconds, the collision energies had dropped to about 1 GeV and quarks could finally hang onto each other to form individual [protons](#) and [neutrons](#) (and presumably other [baryons](#).) At this time, all the kinds of particles which are a part of the present universe were in existence, even though the temperature was still much too high for the formation of nuclei. At this point we can join the standard "[big bang](#)" model as outlined by Steven Weinberg in *The First Three Minutes*.

## Particle Confinement

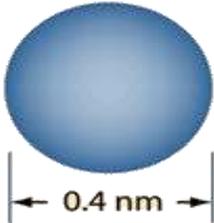
The [uncertainty principle](#) contains implications about the energy that would be required to contain a particle within a given volume. The energy required to contain particles comes from the [fundamental forces](#), and in particular the [electromagnetic force](#) provides the attraction necessary to contain electrons within the atom, and the [strong nuclear force](#) provides the attraction necessary to contain particles within the nucleus. But [Planck's constant](#), appearing in the uncertainty principle, determines the size of the confinement that can be produced by these forces. Another way of saying it is that the strengths of the nuclear and electromagnetic forces along with the constraint embodied in the value of Planck's constant determine the scales of the atom and the nucleus.

The following very approximate calculation serves to give an order of magnitude for the energies required to contain particles.



$\psi^*\psi$  is the probability of finding the particle.

$\psi$  = wavefunction



Assume  $\Delta p = p$   
 $E = \frac{p^2}{2m}$

Assume atomic size =  $0.4nm$

$$\text{Nuclear size} = \frac{1}{20,000} \times 0.4nm$$

Using the atomic size as the uncertainty in position:

This shows that Planck's constant determines the relationship between  $\Delta x$  and  $\Delta p$  and therefore the energy of confinement.

$$\Delta p = \frac{h}{\Delta x} = 1.66 \times 10^{-24} \text{ kg} \cdot \text{m} / \text{s}$$

These are in the range of observed atomic and nuclear processes.

Energy to:

Confine electron in atom:  $9.4eV$

Confine proton in nucleus:  $2.05MeV$

Confine electron in nucleus:  $3.77GeV$

This is about a factor of a **thousand** above the observed energies of nuclear processes, indicating that the electron **cannot be confined** in the nucleus!

## Confinement Calculation

### Confinement in atom

Assume atomic size =  $0.4nm = \Delta x$

$$\Delta p = \frac{h}{\Delta x} = 1.66 \times 10^{-24} \text{ kg} \cdot \text{m} / \text{s}$$

$$\Delta p = p ; E = \frac{p^2}{2m}$$

For electron:

$$E = \frac{(1.66 \times 10^{-24} \text{ kg} \cdot \text{m} / \text{s})^2}{2(9.11 \times 10^{-31} \text{ kg})(1.6 \times 10^{-19} \text{ J} / \text{eV})}$$

$$E = 9.4eV$$

### Confinement in nucleus

Nuclear size =  $\frac{1}{20,000} \times 0.4nm = \Delta x$

$$\Delta p = \frac{h}{\Delta x} = 3.31 \times 10^{-20} \text{ kg} \cdot \text{m} / \text{s}$$

For electron:

$$E = \frac{(3.31 \times 10^{-20} \text{ kg} \cdot \text{m} / \text{s})^2}{2(9.11 \times 10^{-31} \text{ kg})(1.6 \times 10^{-19} \text{ J} / \text{eV})}$$

$$E = 3.77 \times 10^9 eV = 3.77GeV$$

For proton, divide by  $m_p / m_e = 1836$

$$E = 2.05 \times 10^6 eV = 2.05MeV$$

If you examine this calculation in detail, you will note that a gross approximation was made in the relationship  $\Delta p = h/\Delta x$ . This was done to get a qualitative relationship that shows the role of Planck's constant in the relationship between  $\Delta x$  and  $\Delta p$  and thus the role of  $h$  in determining the energy of confinement. The other reason for doing it was to get an electron confinement energy close to what is observed in nature for comparison with the energy for confining an electron in the nucleus.

If you actually use the limiting case allowed by the uncertainty principle,  $\Delta p = \hbar/2\Delta x$ , the confinement energy you get for the electron in the atom is only 0.06 eV. This is because this approach only confines the electron in one dimension, leaving it unconfined in the other directions. For a more realistic atom you would need to confine it in the other directions as well. A better approximation can be obtained from the [three-dimensional particle-in-a-box](#) approach, but to precisely calculate the confinement energy requires the Shrodinger equation (see [hydrogen atom calculation](#)).

$$E = m c^2$$

**E = energy      m = mass      c<sup>2</sup> = speed of light squared**

Albert Einstein said, "We know nothing about (God and the world) at all. All our knowledge is but the knowledge of schoolchildren. Possible we shall know a little more than we do now, but the real nature of things...that we shall never know, never."

**Physics:** The study of matter and energy and the interactions between them.

Newton's equation: **F = ma** < Force is equal to mass x acceleration

Inertial Frame of Reference: if there are no objects around to exert forces on a 'test' object, to test out the forcefields that might be acting on it. That object will move with uniform motion without acceleration.

Regarding 3 & 4 Vector equations. It has direction, it has a magnitude and it has components.

F is a vector & a is a vector / mass is NOT a vector

If the mass of an object is not influentially changed, it retains its mass. The X1, X2, X3 coordinates of an object are components.

The formulas provided serve only as an example of the physics mankind has managed to achieve in its very brief existence. So, the astronomical and cosmological capabilities of God, who we believe created the universe, are so much more advanced that mankind cannot even fathom. The brightest minds the world has ever known, geniuses like Albert Einstein and Stephen Hawkings, could not begin to perceive or even imagine the technology God has attained.

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