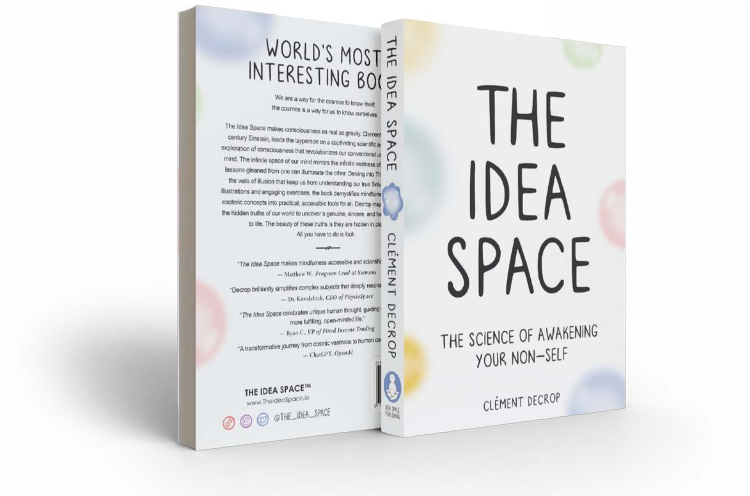
THE IDEA SPACE

SUPPLEMENTAL MATERIAL

CLÉMENT DECROP

THE IDEA SPACE

THE SCIENCE OF AWAKENING YOUR NON-SELF



We are a way for the cosmos to know itself;
the cosmos is a way for us to know ourselves.

The Idea Space makes consciousness as real as gravity. Clement Decrop leads the reader on a captivating scientific exploration of consciousness that revolutionizes our conventional understanding of the mind. The infinite space of our mind mirrors the infinite vastness of the universe, and lessons gleaned from one can illuminate the other. Delving into *The Idea Space* lifts the veils of illusion that keep us from understanding our true Selves. Packed with illustrations and engaging exercises, the book demystifies mindfulness by transforming esoteric concepts into practical, accessible tools for all. Decrop inspires those seeking the hidden truths of our world to uncover a genuine, sincere, and harmonious purpose to life. The beauty of these truths is they are hidden in plain sight. All you have to do is *look*.

"A transformative journey from cosmic vastness to human consciousness."
— ChatGPT, *OpenAI*

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Appendix:

SUPPLEMENTAL MATERIAL

The Supplemental Material covered here serves as a complement to the book, *The Idea Space: The Science of Awakening Your Non-Self*. While the primary text delves into the concept of an "idea space" and its relationship with the universe, this section highlights some technical points that were not included in the main narrative. Additionally available are the Bonus Chapters, which are a continuation of the book. They distill complex physics topics into an accessible format, covering themes like the cosmic calendar, the Big Bang, star formation, black holes, and galaxy formation. Reading the main text is imperative in understanding this appendix.

BREATHING EXERCISES

Breathing is what makes us human. In the gentle rise and fall of our chest, we find the rhythm of life itself. Each breath, a dance of the present moment, inviting us to find stillness within the chaos. These exercises not only anchor us back to the present but also sharpen our awareness, allowing us to navigate life's challenges with grace and clarity. Depending on the situation, each technique offers its unique benefits, guiding us towards a centered state of being.

The first breathing technique, which is often used by Navy Seals, is called box breathing (figure 1). The concept is simple: breath in for four seconds, hold for four seconds, breath out for four seconds, hold for four seconds. Rinse and repeat. Stop and try it a couple times and notice how it makes you feel. Feel free to change up how long you breathe in, breathe out, and hold for (e.g., 7 seconds instead of 4 seconds).

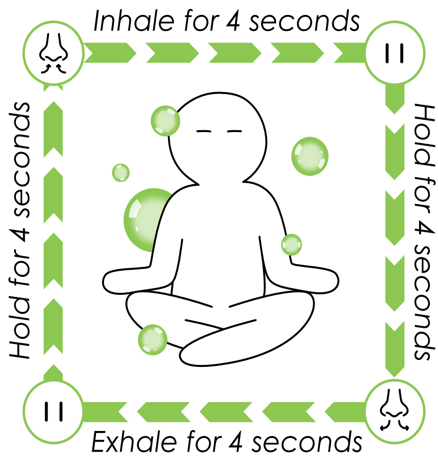


Figure 1. Box breathing.

The second technique is called alternate nostril breathing (figure 2). This one is exactly what it sounds like: close your left nostril, breathe in through your right; close the right nostril, release the left one, and breath out through the left; breathe in through the left nostril, close the left, open the right, and breathe out through the right; etc. The key is to breath in on the same side that you last exhaled on, then switch. What do you notice after doing this breath a couple times?

Figure 2. Alternate nostril breathing.

The third technique are static apnea tables. These are different versions of holding your breath. It's pretty impressive—after trying these exercises, you'll find that you can hold your breath much longer than you thought you previously could. If you want to accustom your body to high levels of CO_2, then try table 1-a; if you want to accustom your body to low O_2 levels, then try table 1-b.

Table 1-a. Building a high CO_2 tolerance.

1	Hold breath for 1:30 min	
2	Rest 2:15 min	Hold 1:30 min
3	Rest 2:00 min	Hold 1:30 min
4	Rest 1:15 min	Hold 1:30 min
5	Rest 1:30 min	Hold 1:30 min
6	Rest 1:15 min	Hold 1:30 min
7	Rest 1:00 min	Hold 1:30 min
8	Rest 1:00 min	Hold 1:30 min

Table 1-b. Building a low O_2 tolerance.

1	Hold breath for 1:00 min	
2	Rest 2:00 min	Hold 1:15 min
3	Rest 2:00 min	Hold 1:30 min
4	Rest 2:00 min	Hold 1:45 min
5	Rest 2:00 min	Hold 2:00 min
6	Rest 2:00 min	Hold 2:15 min
7	Rest 2:00 min	Hold 2:30 min
8	Rest 2:00 min	Hold 2:30 min

A final technique is one that is useful as a base breath (i.e., everyday breath), called *ocean breath*. The breath works like this: Put your hand in front of your face and try to fog it up, like it was a mirror. Give it a try. Now, do that same thing except with your mouth closed—breathing in and out only through the nose. Follow the deep inhalations and exhalations.

For fun, try filling different parts of your body with this breath. For instance, try taking your in breath into your lower back or lower stomach. What does that feel like?

If you want more exercises like these, then check out 100 Daily Meditations Cards at www.TheIdeaSpace.io.

STANDARD UNITS

There are seven fundamental units known as *Système Internationale* (S.I.) units (table 2). We measure everything in our universe using a combination of these units.

Table 2. The SI units that make up our universe.

Unit Name	SI Unit
Mass	Kilogram (kg)
Length	Meters (m)
Time	Seconds (s)
Electric Current	Amperes (A)
Temperature	Kelvin (K)
Amount of Chemical Substance	Mole (moll)
Luminosity Intensity	Candela (cd)

Force (F), is not a fundamental unit, because it can be written as a combination of these seven units. Specifically, as Newton taught us, Force is proportional to mass times acceleration:

$$\text{Force} = \text{mass} \times \text{acceleration.}$$

So, the unit for Force, which is called a *Newton* (N), would be the units of mass times the units of acceleration, or:

$$1 \text{ Newton} = \text{kg} \times \text{m/s}^2.$$

Similarly, Energy (E) is the amount of force times the distance the force travels. So, the units for Energy, or *Joules* (J), is:

$$1 \text{ Joule} = \text{N} \times \text{m} = \text{kg} \times \text{m}^2/\text{s}^2.$$

Lastly, Power (P) is the amount of energy per time. So, the units for Power, or *Watts* (W), is:

$$1 \text{ Watt} = \text{J/s} = \text{kg} \times \text{m}^2/\text{s}^3.$$

NATURAL CONSTANTS AND PLANCK UNITS

For our purposes, there are three natural, or physical, constants in the universe:*

* The fourth is Boltzmann Constant: $k_B = 1.4 \times 10^{-23}\ \text{kg}\cdot\text{m}/(\text{s}^2\cdot\text{K})$. It relates an object's energy to its temperature. Please note, "·" means multiply, or "×".

Gravitational Constant: G = 6.7×10^{-11} $m^3/(kg \cdot s^2)$, dictates the gravitational effects between two bodies (figure 3-a).

Speed of Light: c = 3×10^8 m/s, or 186,000 miles per second, is the speed light travels in a vacuum (figure 3-b).

Planck Constant: $h = 6.6 \times 10^8$ $J \cdot s$, is the quantum measure of angular momentum in particles, pointing either up or down (figure 3-c).

(a) Gravitational Constant **(b)** Speed of light **(c)** Planck Constant

Figure 3. Natural Units.

Max Planck (1858 – 1947) creatively thought to combine these three units to obtain our aforementioned SI units. Through dimensional analysis, we see that Planck's units for length and time are:[*]

$$Planck\ Time, t_p = \sqrt{\frac{\hbar \cdot G}{c^5}} = 5.4 \times 10^{-44}\, seconds$$

$$Planck\ Length, \ell_p = \sqrt{\frac{\hbar \cdot G}{c^3}} = 1.6 \times 10^{-35}\, meters$$

Essentially, Planck Length and Planck Time are hypothesized as the smallest, meaningful units of measurement.

SELF-SIMILARITY DIMENSION

The *self-similarity dimension*, D, of a fractal curve is given by:

$$D = \log N/\log(1/r),$$

where N is the number of measuring sticks in a certain iteration, and r is the factor by which the size of the *original* measuring stick is reduced.

[*] $\hbar$ is the reduced Pllanck Constant, which is simply $\hbar = h/(2 \cdot \pi)$.

Let's use the Koch Curve as an example (figure 4). Starting with E_0, what is the dimension of this line? Well, a line simply has dimension of one: D = 1. How about E_1? Here, the number of measuring sticks is four, N = 4. Furthermore, the measure of each measuring stick is reduced by a factor of r = 1/3. Plugging those numbers into our equation, you obtain a dimension of D = 1.262. . . Now, what about E_2? This time, we have 16 measuring sticks, so N = 16. The measure of the original measuring stick is reduced by r = 1/9. Thus, the dimension comes out to D = 1.262. . .! Keep this going and you'll find that the self-similarity dimension stays the same throughout.

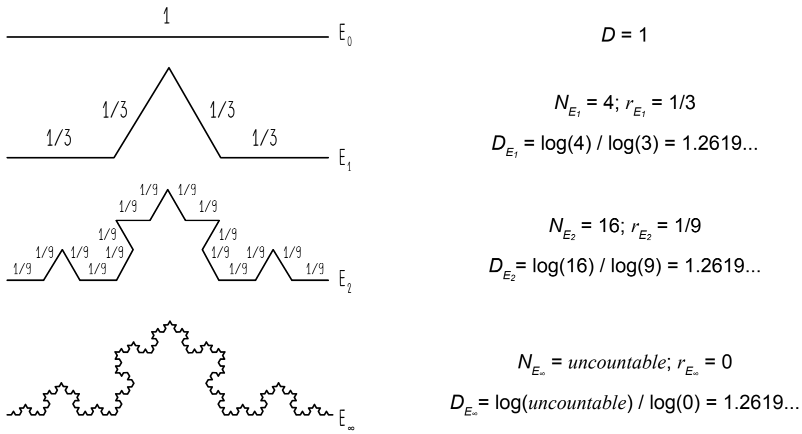


Figure 4. The self-similarity dimension of the Koch Curve is D = 1.262.

We can do the same process for the Standard Middle Thirds Cantor Set, which has a self-similarity dimension of D = 0.63109. . . (figure 5). For example, at C_1, the number of measuring sticks is N = 2, and the size of the original measuring stick is reduced by a factor of r = 1/3. Plugging these values into our equation gives us D = 0.63109. . .

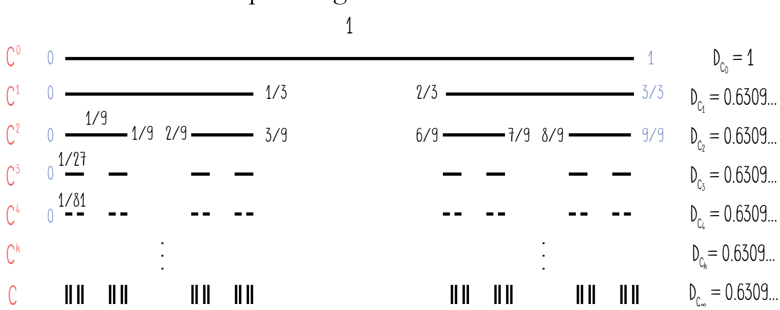


Figure 5. The self-similarity dimension of the Cantor Set is D = 0.631.

As a fun homework problem, what would dimension of the Cantor Set if I took out the middle quarter instead of the middle third?*

HOW LONG IS GREAT BRITAIN?

According to Lewis Fry Richardson's experimental data, the self-similarity dimension of the west coast of Great Britain is close to D = 1.25. To achieve a Koch Curve with the same self-similarity dimension, we have to reduce the size of our initial measuring stick by a factor of approximately 0.33 in the first iteration. Thus, the first iteration would have four measuring sticks, N = 4, each with a length of 0.33, or r = 0.33. Then, the second iteration of The Koch Curve would have 16 measuring sticks, N = 16, each with a length of 0.11, or r = 0.11.

You can repeat this process until the size of your measuring stick is approximately Planck Length, or 1.6×10^{-35} meters. At the 72nd iteration, there are $N = 2.2 \times 10^{43}$ measuring sticks. Plus, each measuring stick measures $r = 2.3 \times 10^{-35}$ meters, which is close to Planck Length. Thus, the total length is $N \times r$, which comes out to approximately 500,000 km.

SPECIAL RELATIVITY EQUATIONS

Let's bring back Joe and Misty. They want to perform an interesting experiment with their new toy. After a string of failed attempts, the company behind Deep Rule and Deep Time sent the best friends a pair of their new, catch-all toy, callled *Deep Measure.*

Deep Measure is a machine that changes the laws of physics. It has two settings: classical and relativity. To test out their new toy, they decide to make various measurements to see if there's any difference between what Joe and Misty measure.

As part of the toy's package, Joe gets a magic ruler that can measure the position (x, y, z) of a point, *P*, and how long it took to make the measurement (t). In the experiment, the instruction indicate Joe must stay at rest, while Misty must move to the right with cerain velocity, v_{Misty}. Then, as Misty moves in the x direction, she uses the other magic ruler to measure the position (x', y', z') of the same point, *P*, and her own time (t').

* For a Cantor Set with the middle 1/4 taken out, the first iteration, C_1, has two measuring sticks, N = 2, and the original measuring stick is reduced by r = 3/8. Thus, the dimension is D = 0.7067. . .

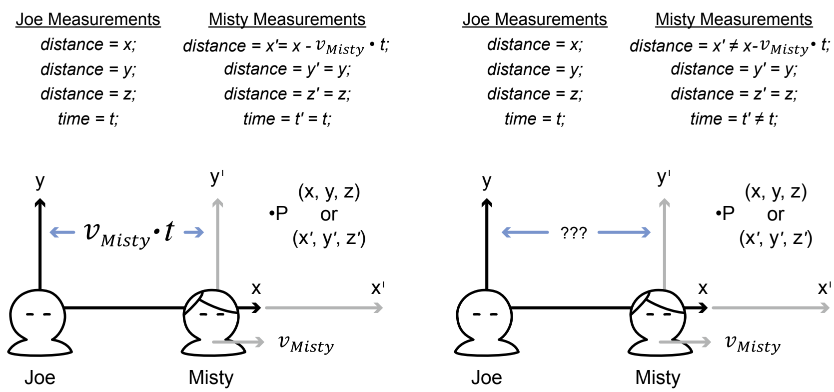
For clarity, all of Misty's measurements are noted with a prime. Joe and Misty decide to run the experiment twice: once on the classical setting and once on the relativity setting. As the experiment runs, both Joe and Misty write down their respective measurements. We see the results from their experiment below (figure 6). On the left, Joe and Misty used the classical setting. On the right, Joe and Misty used the relativity setting.

On the classical setting (figure 6-a), the two get the same measurements for everything, except distance. However, the two are smart. They know since Misty is moving, her measurements for distance must be different; and, they deduce that Misty's measurements can relate to Joe's measurement based on Misty's speed. Since distance is equal to velocity multiplied by time (i.e., $x = v \cdot t$),* Misty's measured distance in relation to Joe's is simply:

$$x' = x - v_{Misty} \cdot t.$$

With this relation, both Joe and Misty agree that they've measured the same thing in all four dimensions.

However. . . Something interesting happens on the relativity setting. Here, the two best friends don't get the same expected measurement for the x distance, nor the same time (figure 6-b)! Joe and Mo are baffled. "What gives?", Joe and Misty ask one another, completely bewildered.



(a) Joe and Misty's measurements are the same based on the classical setting

(b) Joe and Misty's measurements are different based on the relativity setting

Figure 6. Joe and Misty's magical experiment.

* To understand this equation, think of the following: How much distance would you travel if you travelled at 60 miles per hour for one hour? 60 miles.

Thankfully, the toy came with an explanation inside the box that shows the discrepancy between the classical and relativity settings. A representation of what's in the box is illustrated below (figure 7). This equations represent Misty's measurements in relation to Joe's measurements. As always, "c" is the speed of light which is 186,000 miles per second; and, all prime values are Misty's measurements, while unprimed values are Joe's measurements.

$$x' = \frac{x - v_{Misty} \cdot t}{\sqrt{1 - \frac{{v_{Misty}}^2}{c^2}}}$$

$$y' = y$$

$$z' = z$$

$$t' = \frac{t - (v_{Misty} \cdot x/c^2)}{\sqrt{1 - \frac{{v_{Misty}}^2}{c^2}}}$$

Figure 7. The relation between distance and time for Joe and Misty based on the relativity setting.

The transformation of equations from the classical setting to the relativity settings are known as Lorentz Transformations after Hendrik Lorentz (1853 – 1928). Of course, if Misty were moving in the other directions as well, then a similar Lorentz transformation would occur in those spatial dimensions based on the speed Misty was moving in those directions.

In short, these equations tell us: when you move in a direction relative to a stationary observer, you spatially contract in that direction for the stationary observer. And, to make up for that spatial contraction, your time slows down relative to the stationary observer. In other words, space and time are one; hence, spacetime.

FAILURE OF SIMULTANEITY AT A DISTANCE

Another interesting property of time is the concept known as "failure of simultaneity at a distance". Let's bring back Lois and Clark and their synchronized clocks. Clark will stay still, while Lois moves rightward at the some velocity, v_{Lois}. Now, if Lois takes a look at two events that happened at two different places, but at the same time, then those events do not happen at the same time when viewed by Clark!

For instance, in Lois's reference frame she measured the clocks to be in synch: one event occurs at point x_1 at time t_0, and another event occurs at a different point x_1 at the same time, t_0. The catch is Lois does not know she is moving, but Clark does. For him, he'd find the two corresponding times differed by an amount of:

$$t_2' - t_1' = \frac{v_{Lois} \cdot (x_1 - x_2)/c^2}{\sqrt{1 - \frac{{v_{Lois}}^2}{c^2}}}$$

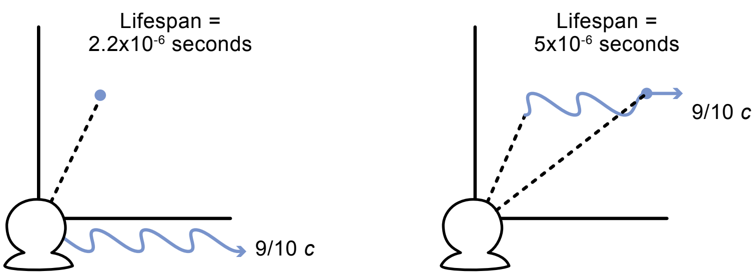
So, the clocks are not synchronized from Clark's perspective.

RELATIVITY OF A MUON

Let's say that we have a muon, which is traveling at 9/10th the speed of light. How long will the muon last before disintegrating? Well, it depends. On one hand, from the muon's perspective, it's average lifetime is around 2.2×10^{-6} seconds. So, if we placed an observer to move along the same path as the particle, then they would see it live for that long (figure 8-a). On the other hand, if we have a stationary observer (figure 8-b), then the muon lives for:

$$2.2 \times 10^{-6}/\sqrt{1-(9/10)^2}$$

The muon from the standpoint of a stationary observer would live for 5×10^{-6} seconds—twice as long! The muon appears to last longer for the stationary observer compared to the moving observer.



(a) Moving observer **(b)** Stationary observer

Figure 8. The stationary observer **(a)** sees a particle live for seconds, while **(b)** a moving observer sees a particle live for seconds.

QUARKS

There are six different "flavors" of quarks, including: up, down, strange, charmed, bottom, and top. From there, each flavor comes in three different "colors": red, green, and blue. Please note this is not the same thing as the red, green, and blue we see—it's just a grouping physicists use. The reason we use colors is because when quarks combine, they tend to produce a neutral white color. The quark family is represented in the below figure—and, yes, all these quarks have anti-quarks (anti-up, anti-down, etc.) and anti-colors (anti-red, anti-green, and anti-blue)!

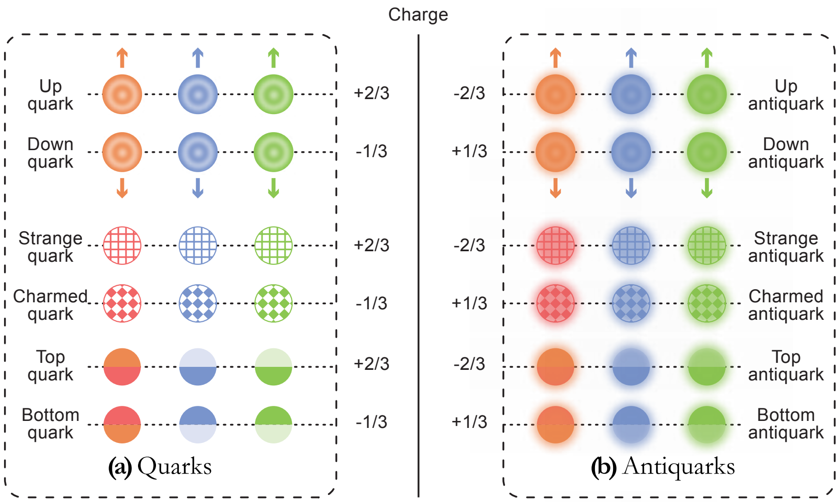


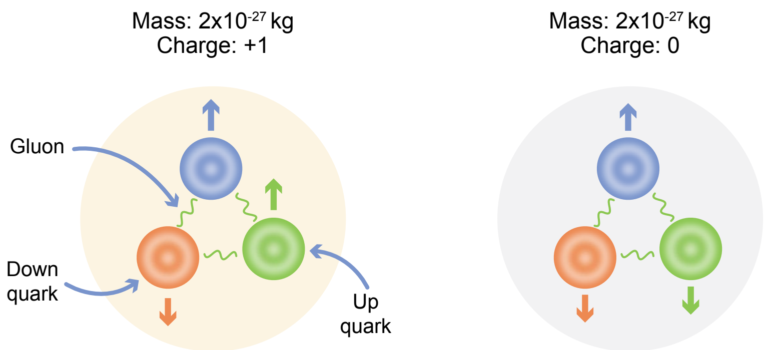
Figure 9. Each of the quarks with their respective antiquarks.

For a concrete example, a proton has two up quarks and one down quark. One quark has to be red, one quark has to be blue, and one quark has to be green (figure 10-a). Similarly, the neutron is made up of two down quarks and one up quark, each a separate color (figure 10-b). The green squiggly lines in the figure are the gluons, or the strong force carrying particles.

The astute reader will note that the proton and neutron mass isn't simply the mass of the quarks themselves. In fact, hadrons only get a portion of their mass (about 1%) from the quarks themselves. The rest of the mass comes in the form of the binding energy between quarks. This is possible through the mass-equivalence proposed by Einstein, $E = mc^2$.

For instance, a proton weighs around 2×10^{-7} kg. An up quark and down quark weigh around 4×10^{-10} kg and 8×10^{-10} kg, respectively. The sum of two up quarks and one down quark is only ~1.6×10^{-29} kg, which is about 1% of the total mass of a proton. As stated, the majority of the rest of the weight comes from the binding energy of the quarks. Quarks are a weird and whacky world.

Protons and neutrons aren't the only creations of quarks. In general, particles made up of three quarks are called *baryons*, while particles made of a quark/antiquark pair are called *mesons*. You may say, *I thought you said quarks can only combine to produce a neutral white? How can that be with only two quarks?* The answer lies in the fact a quark/antiquark pair can be colorless if it meets with its anti-color counterpart, like a red quark meeting with an anti-red quark. Overall, baryons tend to be stable, while mesons tend to be unstable. This is because mesons annihilate when a particle meets with its antiparticle colleague. So, mesons live for a very, very short period of time.



(a) Proton **(b)** Neutron

Figure 10. (a) Proton (charge +1) with two up quarks and one down quark. **(b)** Neutron (charge 0) with two down quarks and one up quark. The green squiggly in both is the gluon.

UNCERTAINTY PRINCIPLE

In Chapter 8, we discussed particle-wave duality as being analogous to a clopen phenomenon. Quantum mechanics describes this phenomena more precisely through the Heisenberg Uncertainty Principle. There are multiple ways to summarize what it is, but I think it's best said by physicists. So, I'll let Richard Feynman's and Kip Thorne's words fill the ether:

> One cannot design equipment in any way to determine which of two alternatives is taken [i.e. wave path or particle

> path], without, at the same time, destroying the pattern of interference. . . If we try to "pin down" a particle by forcing it to be at a particular place, it ends up having a high speed. Or if we try to force it to go very slowly, or at a precise velocity, it “spreads out” so that we do not know very well just where it is. (Richard Feynman)

> The uncertainty principle is a fundamental feature of the laws of quantum mechanics. It says that, if you make a highly accurate measurement of the position of an object, then in the process of your measurement you will necessarily kick the object, thereby perturbing the object’s velocity in a random, unpredictable way. (Kip Thorne)

All in all, it is impossible to measure the precise location of an object, like an electron. If you make a precise enough measurement about its location, then there will be a high uncertainty about that object’s velocity.

There is a way to put a more quantitative scope to the Heisenberg Uncertainty Principle. The basics of it are the following formula:

$$\Delta p \Delta x \geq \hbar/2,$$

where, Δp signifies “the change in” momentum (i.e., momentum is mass times velocity), Δx is “the change in” the particular location of a particle in question, and $\hbar$ is the reduced Planck constant.

What this equation says is exactly what the two above physicists said: if you try to measure the precise location of a particle, then the less precisely you’ll be able to measure its momentum. Conversely, if you try to measure the precise momentum of a particle, then it’s location will more difficult to pin down. There’s an inherent trade off in between location and momentum.

The uncertainty principle is one of the driving principles in understanding why we don’t fall through cold, solid objects, like the ground below you. It also happens to be the same reason small stars don’t collapse on themselves. The phenomena that prevents you from falling through your chair and a white dwarf from collapsing on itself is called *electron degeneracy pressure*. In neutron stars, a similar principle applies, but the name changes to *neutron degeneracy pressure*.

As stated in the text, an atom consists of a nucleus with an electron cloud. The electron cloud is simply a probability distribution of finding an electron at a particular location around the nucleus.

With that framing, let's picture an atom in two states: State 1 and State 2 (figure 11). The main difference between both states is that gravitational pressure in State 2 is larger the the one in State 1. As it is clear, the increase in gravitational pressure decreases the volume (i.e., $-\Delta x \Delta y \Delta z$) of the electron cloud. In other words, the electron is confined to a smaller space.

Since the cloud is smaller, you can more accurately pin down the location of an electron. And, if we can more accurately measure the location of an electron, then, by Heisenberg's Uncertainty Principle, the momentum, or speed, of the electron must go up (i.e., $+\Delta p$)!

This increased speed acts as a resistive force against the gravitational pressure, which prevents the collapse of cold, solid objects (e.g. chairs, floors, etc.). Surprisingly, it just so happens it is the same reason why white dwarfs don't collapse onto themselves! Nature works in mysterious ways, no?

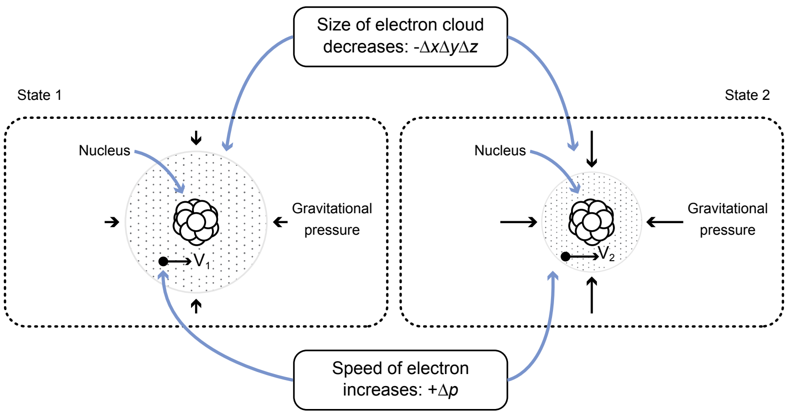


Figure 11. The Heisenberg Uncertainty Principle helps explain electron degeneracy pressure, which is the phenomena that prevents us from falling through the ground.

Reiterating the phenomena: in atoms, electrons flow around the nucleus in an electron cloud. However, the more gravity pushes in, the less space there is for those electrons to flow around freely. In other words, the density of electrons increases as the volume of the electron cloud decreases. In turn, the electrons start to speed up. This speed up causes the electrons to create a sort of pressure that resists the contracting gravity. Kip Thorne states the results well: "a 1 percent increase in density produced 1.667 percent increase in pressure." However, that is for non-relativistic electrons. In other words, electrons that move well below the speed of light. For electrons moving closer to the speed of light, a 1 percent increase in density produced a 1.333 percent increase in pressure.*

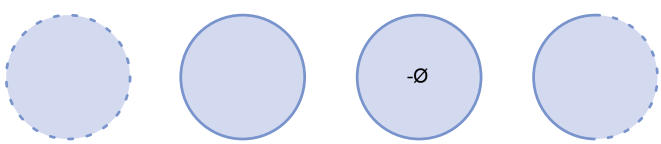
In larger stars, the gravitational pressure is so strong that the electrons move almost at the speed of light. When this happens, the electrons and protons combine to form neutrons and electron neutrinos. During this phenomena, all the atoms in the iron core of the star contracts from a size of 10^{-18} cm to 10^{-13} cm in a fragment of a second. This contraction drags the outer layers of the star towards the core and bounce off the iron dome to create a *supernova*. What remains is an extremely dense object known as a neutron star.

As the name implies, a neutron star is made up mostly of neutrons. Here, neutron degeneracy pressure keeps the star afloat. In other words, the quarks making up the neutron are confined to less and less space. Thus, the quarks move faster and faster. The increased speed acts as a form of internal resistance to the force of gravity and prevents the star from collapsing into a black hole.

All in all, the Heisenberg Uncertainty Principle states: if Δx goes down, then Δp must go up; and, vice versa. If you know the location of a particle, then the speed of the particle must increase. If you know the speed of a particle, then you are uncertain about its location.

NEITHER GROUPINGS

In the main text, we saw a grouping can either be open, closed, or clopen (simultaneously open and closed). In reality, a grouping can also neither open nor closed, like figure 12-d. This means all groupings are either open, closed, clopen, or neither (figure 12).



(a) Open **(b)** Closed **(c)** Clopen **(d)** Neither

Figure 12. The different topological types of groupings.

* As a caveat, using the uncertainty principle to explain the broader concept of degeneracy pressure only works for fermions (electrons, quarks, and hadrons). This is because, no two fermions can occupy the same quantum state in a particular region due to the *Pauli Exclusion Principle*.

THANK YOU

FOR READING!