Formation-by-Information

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Abstract: Have you ever wondered if the postulates and principles of Relativity, Quantum Mechanics and Classical physics could be thrown away? Is it possible to start with a single axiomatic notion that effortlessly brings together all of the currently disjoined branches of physics?

What is Formation-by-Information? The world of physics (as it stands right now) has two separate realities: one of the "material" reality (i.e. protons, electrons etc.) and the other of information that those entities apparently possess. This is unnecessary for a simple reason: the "material" world (in a sense espoused by modern day physics) isn't anything but the information we can collect about it. To employ Occam's razor, we should first recognize such state of affairs as hopelessly redundant (and ultimately messy), and then, simplify it. Only the information is foundational, and its existence and use represents the very final aspect of any possible reality.

To explain this in a bit more colorful way, it's not "turtles all the way down", i.e. there is no other fundamental layer beneath information. There is no "stuff" that makes the information existence possible; there are no particles that comprise its "storage"; there is no "processing unit" that can be decomposed into smaller pieces, which can be then decomposed into even small pieces, etc. Why? What would this "stuff" be, other than information? How would it know what to do, other than by using information? Can anything happen without using information (through whatever reason or logic), aside from utterly random acts? The unqualified answer is: no. Not even electrons and protons can display any specific behavior without the use of information. Information is foundational, and that is the paradigm shift.

A practical application of Formation-by-Information: A short proof of Special Relativity time dilation is given *without* any concepts or postulates of Einstein's. *Only* the formation-by-information approach is indicated. Why focus on this particular piece? It is to show that mysterious premises, such as relativity and the constancy of speed of light, can be forgotten in favor of axiomatic notions. Forget that Relativity exists. Forget about Quantum Mechanics, Gravity, Mass and Light. Let's start from the beginning, before the first principles. A single example that shows how this New Physics can produce immediate results may just be the proverbial picture that's worth more than a thousand words.

Premise of Formation-by-Information: Any physical effect occurs only due to possession and use of fundamental information, the kind of information used on the level of basic physical constituents. We will call such constituents that possess and use information 'computers' and the usage itself 'processing' (please do not confuse these terms with the garden variety of everyday devices). Information is inseparable from the space in which it exists and is available instantly to any computer. If there is more information than storage, then information is processed to fit (i.e. 'compressed'). A computer has a fixed processing throughput and memory storage. It has the simplest memory in the form of previous and current information, which are combined to produce future information. This isn't a transposition of computer science back into the realm of physics. This is truly an axiomatic setup that goes before the first principles of physics. We don't expand on this here, please see my book (referenced at the end of this essay) for more.

Deductions: After current information is processed, it becomes previous information. The previous information is to be computed with current information, thus creating physical action and future information. We can express this with (i is the information storage of a computer that must have two distinct subsets, one for the previous and one for the current information):

$$i_{previous}(t) = i_{current}(t - \Delta t) = i$$

(1)

The current and previous information is what's used for computation and it fills the entire storage, which is limited in capacity:

$$i_{previous} + i_{current} = constant$$

(2)

If available-information increases (i.e. there is more information to process than the storage available), the storage for previous information will decrease because the storage (again) is limited in capacity:

$$\left(i_{previous} - \Delta i\right) + (i_{current} + \Delta i) = constant$$

(3)

which means some information must be lost to allow increased available-information to fit the same storage.

Let us analyze a limiting case of two isolated computers: C moves with speed v relative to M, and C is small enough for virtually all of its available-information to originate from M. Computer C would see more information from M compared to when at rest. This is because, if C's speed doubles, it would visit twice as many locations and see twice as much information. So the change of available-information at C is proportional to speed v :

$$\frac{\Delta i}{i} = s \times v$$

(4)

where s is a constant of proportion, i is the storage of C and Δi is the additional information originating in M at the location of C, due to their relative movement. The additional information cannot be greater than the limited storage C has:

$$\Delta i < i$$

(5)

The cost to compute when there is no additional available-information (i.e. $\Delta i = 0$, there is no information loss) is proportional to

$$H_0 = i \times i = i^2$$

(6)

i.e. each fact from the previous content pairs with each fact from the current content. When there is additional available-information (i.e. $\Delta i \neq 0$, there is information loss) the cost to compute is (again, current and previous facts pair with each other, see Eq. 3):

$$H_0 = (i - \Delta i) \times (i + \Delta i) = i^2 - \Delta i^2$$

(7)

In this case, the existing information has to be compressed to free up storage for additional information Δi, in order to minimize the loss. The cost to 'compress' (i.e. compute the 'surplus' information with itself) is

$$H_Q = \Delta i \times \Delta i = \Delta i^2$$

(8)

This doesn't compute any new useful information. The total cost of computation is the cost to compress information plus the actual cost of computation:

$$H_1 = H_1 + H_Q = (i - \Delta i) \times (i + \Delta i) + \Delta i \times \Delta i = i^2$$

(9).

So it is

$H_1 = H_0$ (10)

i.e. the cost to compute information is the same whether there is information loss or not. However, there is more useful information processed when there is no loss.

What happens when C's speed is so high that additional data fills all the storage (i.e. $\Delta i = i$)? In this case, the throughput of information processing converges to zero because virtually all resources are spent on compression. If this speed is c, then $v = c$ when $\Delta i = i$) it follows from Eq. 4:

$s = 1/c$ (11)

At this speed, the computation comes to an effective halt, and so does any change due to it. Thus, this has to be the maximum speed possible.

The Eq. 11 deduces that there has to be a speed limit. This is the reason for light to exist.

The throughput without information loss is apparently i/t_0 where t_0 is the time it takes a processing cycle to complete. When there is information loss, the effective throughput (of useful information) can be derived by modeling it with the equivalent, when there is no information loss:

$$i_{lossy} \times i_{lossy} = (i - \Delta i) \times (i + \Delta i)$$

(12)

The throughput with information loss is:

$$T_{lossy} = \frac{i_{lossy}}{t_0} = \frac{\sqrt{i^2 - \Delta i^2}}{t_0} = \frac{i}{t_0} \times \sqrt{1 - \Delta i^2/i^2}$$

$$= T_{lossless} \times \sqrt{1 - \Delta i^2/i^2}$$

(13)

The throughput of (useful) computation varies with information loss:

$$T_1 = \frac{\sqrt{i^2 - \Delta {i_1}^2}}{t_0}$$

$$T_2 = \frac{\sqrt{i^2 - \Delta {i_2}^2}}{t_0}$$

$$T_1 \neq T_2$$

. (14)

If we introduce t_1 and t_2 as times measured by a computer via this throughput (we call it 'application-time' t_1 and t_2, versus 'real-time' t), it must be:

$$T_1(t_1) = T_2(t_2)$$

(15)

and it follows:

$$t_1 = t_2 \times \frac{\sqrt{i^2 - \Delta {i_1}^2}}{\sqrt{i^2 - \Delta {i_2}^2}} = t_2 \times \frac{\sqrt{1 - \Delta {i_1}^2/i^2}}{\sqrt{1 - \Delta {i_2}^2/i^2}}$$

(16)

Application-times t_1 and t_2 effectively measure how much slower or faster (useful) computing works. By using the equations above, we have:

$$t_1 = t_2 \times \frac{\sqrt{1 - s^2 \times {v_1}^2}}{\sqrt{1 - s^2 \times {v_2}^2}}$$

(17)

By using the aforementioned $s=1/c$ (Eq. 11), if we compare a case at rest versus a case of relative motion ($v_1=0$, $v_2=v\neq 0$), it becomes:

$$t_1 = \frac{t_2}{\sqrt{1 - v^2/c^2}}$$

(18)

This is the "time dilation" in Special Relativity, deduced without any postulates. We call it a "performance hit" because of its origins in information science. The conclusion is that time does not slow down, only the rate of physical processes vary. This rate is relative to a computer that does not have any additional information to process, i.e. a small computer infinitely far away.

Conclusions: We have derived one of the crucial results of Special Relativity without any notions of relativity or light. In a similar fashion, it can be shown that the gravitational "time dilation" can be derived without any notion of gravity. We can also derive, out of thin air, Heisenberg's Principle of Uncertainty and Newton's Law of Gravitation. The concepts such as light, mass or force emerge naturally without presupposing either one of them. I have derived all these results in my book "Faster Than Light: The New Physics" through simple and elegant mathematics. The sheer number of fundamental results derived and the apparent unification of Quantum and Relativistic effects eliminates the one-off effect and points to an information reality as a new paradigm, a *New Physics* if you will.

This essay was meant to give a succinct demonstration of the formation-by-information paradigm, and not the paradigm itself (for that, please refer to the aforementioned book). Thus, this is neither a thorough nor complete presentation of it, but an illustration only as appropriate for an essay. It should, however, allow you to grasp why the informational approach is likely to be the deeper truth when it comes to some of the fundamentally unexplained phenomena of the 20th century.

Einstein's Relativity, Heisenberg's Uncertainty and Newton's Gravity may collectively count as an "explanation" of said phenomena in the minds of many. They are not, however. They are good mathematical workouts that start from postulates and principles that are as mysterious today as they ever were. No one really knows why we should accept those postulates and principles. They are "smart guesses" inferred from the facts of life, a kind of street-smarts packaged into a formidable mathematical clamshell. They jump-start the story of modern physics somewhere in the middle, without having a clue as to why any of them should be true. As a result, it is very likely that physics as we know it is a subset of a greater science, one with the concept of information at its heart. That state of affairs limits not only our understanding of the Universe, but the technological promise it can offer.

It is clear that a new kind of physics is needed. We need physics of information because the concept of information is the only axiomatic one that doesn't need to be given "form" or "substance", and doesn't have to "feel right" to be accepted. By now it should be clear that chasing the "material" is immaterial and is conceptually akin to “turtles all the way down”, as it cannot be explained by an underlying concept other than inventing it, and so on, ad infinitum. For the full formal theory that turns this short essay into a scientific theory, see my book “Faster Than Light: The New Physics”.