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Wilson - defending Fermi Lab Construction

Wilson hauled up before the,
Congressional Joint Committee on Atomic Energy
to face the question on the project
1969 - Senator John Pastore asked Wilson to
explain how the project would help
the national security

Wilson: "It has only to do with the respect with
which we regard one another, dignity of men,
our love of culture. It has to do with: Are we
good painters, good sculptors, great poets?
I mean all the things, we venerate
in our country and are patriotic about it.
IT HAS NOTHING TO DO WITH DEFENDING OUR
COUNTRY EXCEPT TO MAKE IT WORTH
DEFENDING"

RR "The Physics at work in Nature
is very subtle"
(natural)
{The case of bacteria eating only half of
synthetic sugar while eating all of natural sugar
— the left hand sugar had not evolved —
Connected with Z and electroweak
synthetic sugar
(CAUSE AND EFFECT MAY BE TOO FAR OFF)

- Asymmetry – Why no magnetic monopoles !
- Many things happen in extremely short instant of time and space

  Cosmic Explosion ⎫
  Cosmic Inflation ⎭

  True Higgs field may have powered inflation

* The energy driving inflation came from a field very much like the Higgs field
Some think it is the original Higgs field as described in 1964
The field particle is called INFLATON

<u>Vacuum</u>

To the modern scientist, vacuum is far from empty. It holds an unseen world of thriving fields and associated particles that are popping in and out of existence
Energy is locked up in these fields and gives rise to what scientists reasonably refer to as the universe's Vacuum Energy
The most stable state of the universe can be is when it contains as little energy as possible. The thing is that scientists don't know whether our universe is in its most stable state or not. The universe might contain more energy than is strictly necessary, in which case

given the right incentive, it might suddenly give way and crash it into more stable energy configuration

Can such kicks be given by the collision of particles in the accelerator?

Are we in a meta stable universe?

False vacuum to True vacuum - transition

False vacuum - bubbles like Rice bubbles

Outwards at the speed of light (>> sound!)

Coleman

Our old universe would be replaced by a new universe - with new laws - No life

Sydney Coleman: $ 180 in MASSIVE

"The possibility that we are living in a false vacuum has never been a cheering one to contemplate. Vacuum decay is the ultimate ecological catastrophe and a new vacuum there are new constants of nature. After vacuum decay not only is life as we know it is impossible so is chemistry as we know it.

Stoic

However, one could always draw comfort from the possibility that perhaps in the course of time the new vacuum would sustain if not life as we know it, atleast some structures capable of knowing joy. This possibility has now been eliminated.

"Wilczek and Michael Turner" in "*Nature* vol 298 12th Aug 1982"

"It seems distinctly possible .... that our present vacuum is only metastable and that nevertheless, the universe would have chosen to "hang up" in it. ~~If this~~ ~~If this case then~~ If this is the case, then without warning, a bubble of true vacuum could nucleate somewhere in the universe and move outwards at the speed of light"

"We would all become purple haze" — Wilczek

(1999)

P. Hut and M. Rees (Nature) — Cosmic Rays
vol 302, Apr 1983 assure
No danger from accelerators
upto 100 billion times stronger accelerators

Fields

(1) EM field – photons
(2) Gravitational Field – Gravitons
(3) Force Fields
    Strong – Gluons (quark-quark.)
    Weak – $K^{\pm}$, Σ^{0} (Decay)

- Field Framework for Matter

The Probability waves of quantum mechanics may themselves be thought of as Space Filling Fields that provide probability that some or other particles of matter is at some or other location

An electron for instance can be thought of as a particle – one that leaves a dot on a phosphor screen. It can also be thought of as a wave field that can constitute an interference pattern on a phosphor screen

EM field – photon
Electron Field – Electron
all particles – all fields

THERE is ONE MORE – The HIGGS Field
Not discussed yet $\rightarrow$ 2HC

The entire universe is permeated by an ocean of Higgs Field - a cold relic of the Big Bang - that is responsible for many of the properties of the particles that make up you and me and everything that we have ever encountered.

Temperature at 10^{-43} s = 10^{32} K $10^{32°}$ K
(ABT)

All fields violently heaved to and fro
After expansion - most field reached close to Zero - even below Zero
Average closed on Zero - Emptiness

* But Higgs Field has different
Higgs Field Condensed into Non-Zero field
expectation value not Zero
throughout Space - formed the Higgs Ocean

* The Higgs Field does not make it Zero as the Universe Cools

The Higgs Field Condensed into Non-Zero at $10^{15°}$C - ATB = 10^{-11} seconds
Before 10^{-11} ATB Higgs Field fluctuates up and down and hangs over Zero

So prior to 10^{-11} seconds ATB, the particles had no mass

∴ Formation of Higgs Ocean is a Cosmological phase transition - decrease in Symmetry
$W^{\pm}$, Z0 have all masslessness before 10^{-11} ATB

Higgs gives mass to the particles and in later different characters of force EM and E break.

Grand Unification } Georgi, Quinn, Weinberg
EM + Weak + Strong }

Temp 10^{25^0} K $= 10^{-35}$ s (ABT)

photons, Gluons, $W^{\pm}$, Z Could all be interchanged with one another - more robust Gauge Theory Symmetry.

At temp below 10^{28^0}, Grand Unified Higgs Field entered the Story in contrast to later Electro-Weak Higgs Field. The Grand Higgs Field had effect on Gluons - Strong Force Separated. Proton Decay predicted. Not seen

Fundamental Physics and Consciousness

Despite centuries of effort the two fundamental issues on which there is no scientifically satisfactory understanding are 'life' and 'consciousness'. While physical sciences are mostly concerned with the inanimate matter, the issue of consciousness falls in the domain of life sciences; though in recent times the distinction is disappearing especially because of technological developments which are highlighting the advantages of multidisciplinary approaches in the solution of unresolved problems. Over the last several decades the use of tomographic and laser technologies have played a significant role in getting a detailed picture of the structure of the brain and its accessories the trillions of neurons and the flow patterns of the electrical pulses generated in the sensory organs and of the variety of chemicals - the neurotransmitters in the synapses, the connections between the long distance neurons etc. etc. Like other valuable results have helped in the diagnostics of cerebral diseases and in surgeries. They

have not helped in the resolution of the consciousness problem of which the following are the outstanding ones

(i) How do the actions of neuronal pulses and neurotransmitter chemicals result in the generation of perception, sensations, emotions feelings, thoughts etc. which are the main features of consciousness - the hard problem

(2) How do the activities in the different parts of the same cortex and in the different cortices get correlated - the Binding Problem

(3) How do these generate the motor actions?

(4) Where and how memory is stored?

On space, time, geometry Yu Vladimirov et al
Mir publishers (1987) Moscow

Gravitational Interactions have been geometrized in General Relativity.
How can we say where the boundary between physics and geometry lies?

p49
" Universe is whole and unique and its properties can all be learned only from experience
The geometry of the real world →

should be regarded as one of the experimental physical sciences and its assertions and predictions must always be verified through experience or practice. The axioms of geometry, are in fact, are no more than a refined form of human experience."

Is field theory external to geometry?

We can say the most elegant solutions lies in the framework of HIGHER DIMENSIONS GEOMETRY.

It is worth stressing that General Relativity was not even at the moment of its conception by Einstein and Hilbert, solely theory of Gravitation. It is valid for all fields and matter in curved space time where equations can be written in a co-variant form

Stuff

Hawking
Grand Design P113

Heisenberg's Principle of Uncertainty —

It turns out, though not obvious that with regard to this principle, the value of a field and its rate of change play the same role as position and velocity of a particle.

An important consequence of this is that there no such thing as <u>empty space</u>. Because Empty space means that both the values the field and the rate of change are exactly Zero.

∴ Space is never empty. It can have an important state of minimum energy called the vacuum, but that state is subject to quantum jitters or vacuum fluctuations — Particles and fields quivering in and out of existence.

Questions

- What is the Universe
- What are its constituents?
- How did they arise.
- What is / behind all phenomena?
- Is there a purpose?
- Is science designed to answer these questions?
- What is the difference between philosophy and science?
- What is the Reality behind all that we experience?
- What do we mean by Reality?
- What is Life all about?
- What is the Nature of Ultimate Reality?

Upanishads (THAKUR)

The Upanishads are the crystallized essence of the Vedic world view.

"One of the hundred most influential books ever written in the world"
[Martin-Roger Seymour-Smith —

The 100 most Influential Books Ever-Written:
The History of Thought from Ancient-Times to Today (SECAUS - Carol Publishing Group 1998.