

2014



NATIONAL INSTITUTE OF ADVANCED STUDIES

Indian Institute of Science Campus,

Bangalore - 560 012, India

Wilson - defending Fermi lab construction



Wilson headed 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: "He has only to do with the respect which  
he regard one文明, dignity of men,  
and love of culture. He has to do with: Are he  
good painter, good sculptor, good poets?  
I mean all the things, I revere  
in our country and am patriotic about it.  
IT HAS NOTHING TO DO WITH DEFENDING OUR  
COUNTRY EXCEPT TO MAKE IT WORTH  
DEFENDING"

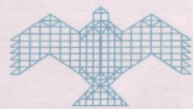
"  
The Physics that work in Nature  
is very subtle" (National)

The case of bacteria eating only half of  
Synthetic sugar like eating half of natural sugar  
- the life now people have invented -  
Controlled life and scientific

Synthetic  
Sugar

(CAUSE AND EFFECT MAY BE TOO FAR OFF)

- Asymmetry - why no magnetic monopoles?
- Many thought Higgs is extremely first
- Interaction of time and space
- Cosmic Expansion
- Cosmic Inflation



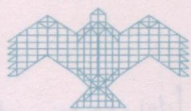
True Higgs Boson may have formed in particle

- 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

Vacuum

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 configurations

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

Are we in a metastable universe?

False vacuum to True vacuum - transition

False vacuum - bubbles like race detectors

Outbreaks at the speed of light ( $\gg$  sound!)

Coleman

Our old universe could be replaced by a

new universe - like new laws - no life

Sydney Coleman: }

\$189 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 impossible

so is history as we know it.

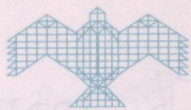
Score 

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, at least some structures capable of knowing joy. This possibility has now been eliminated.

Wileczek and Michael Turner in "Nature" Vol 298 12<sup>th</sup> Apr 1982

"It seems distinctly possible ... that our present vacuum is only metastable and that nevertheless, the universe could have chosen to "hang up" in it. ~~It is~~ 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

1989  
P. Huet and Rees (Nature) - Cosmic Rays  
↓ Vol 309, Apr 1983  
No danger for humans  
Left the film from physics lecture



## Fields

- (1) EM field - Photons
- (2) Gravitational Field - Gravitons
- (3) Force Fields  
String - Gluons (quark quark.)  
Higgs -  $H^+$ ,  $H^0$  (Delay)

### • Field Framework for Matter

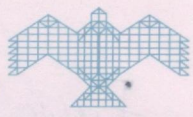
The Probability waves of quantum mechanics may themselves be thought of as

Space Filling Roads 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, or can also be thought of as a wave field that can constitute an interference pattern on a phosphor screen

EM field - photon }  
Matter Field - Electron }  
all particles - all fields

THERE IS ONE MORE - The Higgs Field  
Not discussed yet but  $\rightarrow$  etc



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 is than ever existed.

Temperature at  $10^{-43}$  s =  ~~$10^3$  K~~  $10^{32}$  K  
(ATB)

All fields violently heated to and fro after expansion - most fields 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 average value zero



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

$\therefore$  Formation of Higgs field is a Cosmological phase transition - delimits its symmetry before  $10^{-11}$  ATB  
 $L^{\pm}, 20$  were all massless

Higgs gives mass to the particles and in that different character of force EM and  $Z$  break,

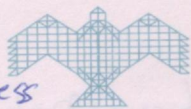
Grand Unification } Georgi, Quinn, Weinberg  
 EM + weak + strong }

Temp  $10^{26}$  K  $\approx 10^{-35}$  s (ART)

Photons, Gluons,  $L^{\pm}, 2$  could all be interchanged with one another - more robust Gauge Theory Symmetry.

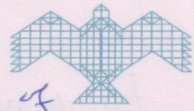
At temp below  $10^{26}$ , Grand Unified Higgs Field entered the story in contact with later  
 EWSB - weak Higgs field. The Grand Higgs field had effect on Gluons - strong force separated.  
 Proton decay predicted. Not seen

# 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 an 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 that 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 correlations between the long distance neurons etc. etc. Late Paul Valente results have helped in the diagnosis of cerebral diseases and in surgicals by



Have not helped in the resolution of

the consciousness problem of which the following are the outstanding ones

- (1) How do the actions of neuronal pulses and neurotransmitter chemicals result in the generation of perception, sensations, emotions, feelings, thoughts etc. Such are the brain functions 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 they generate the motor outputs?
- (4) How and how frequently is stored?

on space, time, geometry via Waldimir Arnold <sup>et al</sup> Mir <sup>papers</sup> (1984) (Moscow)

Gravitational Interactions have been

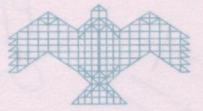
geometrized in General Relativity.

But can be say there the boundary between physics and geometry is very

phy

" 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 defined form of human experience."

Is field theory external to geometry?

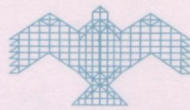
We can say the most elegant solutions lies in the framework of HIGHER DIMENSIONAL GEOMETRY.

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 whose equations can be written in a co-variant form.

sub

Hacking  
Crad Dabgh

P 113



## 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 is no such thing as empty space. Because empty space means that both the values the field and the rate of change are exactly zero.

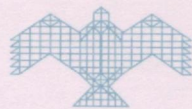
∴ Space is never empty. It can have an impeded state of minimum energy called the vacuum, but that state is subject to quantum jitters or vacuum fluctuations - particles and fields quivering in and out of existence.

# Questions



- What is the Universe
- What are its constituents?
  - How did they arise.
- What is  $\phi$  behind all phenomena?
  - Is there a purpose?
  - Is Science designed to answer these questions?
- What is the dispute 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.

