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Multi Billion Dollar Projects to find answers to some fundamental questions in Physics and Astronomy (19th April 2017)

① As of April 2017, what are the fundamental questions?

- (i) What is "space"?
- (ii) What is "time"?
- (iii) What is matter?
- (iv) What is Radiation?
- (v) What is ~~causality~~ Force?
- (vi) What is Entropy (vii) What is Causality (viii) Point Particles - Composites -

② Space - Internal and External.

Planck Time 10^{-43} s / Small and Big \sim in 100 billion light years
 (EGH) Connections
 Dimensional Analysis
 How and when was space first created?
 Is the space expanding? What is the cause cause
 Is space continuous or discrete?
 Dimensionality of space -

(3) Time - time flows - What flows? What is directionality? Past \rightarrow future

Personal thermodynamic Cosmology
 Is rate of flow of time same everywhere?
 What is the rate of flow?
 Are all three in the same direction?
 Reversibility - Emergence of time
 Gravitational Field - Curvature of Space

④ Space-time Continuum -

All physical action in 4-dimensions spacetime continuum
 We humans experience and act in 3-d of space and
 What is the reason for the 1-d of forward moving time?
 Evolution (P)

(1) Quotations

(2) General Relativity Equations

Higgs Boson

(3) The Big Bang Scenario

Gravitational Lens

(4) Details of Big Bang

(5) Matter vs Anti-matter Protons, Antiproton properties

(6) Standard Model of Particle Physics

Proton Decay (?) Super-symmetry? Matter-Anti Matter?

(7) Dark Matter - Expts. - Searches

Slide 95% Duration

(8) Dark Energy

2 Credits

(9)

① Detection of Gravitational waves
on 14th September 2015 at 09:50 UTC
at Louisiana and Washington (Livingston)

Hansford

Separation of mirrors in each $1/10^{13}$

colliding ~~binary~~ binaries 2.4 billion light years away
observation time differs at the two points = 7 milliseconds

L shaped of lens event

② Second Event 26th December 2015

Normally 180° 180° are of phase at the detector

Lengths and shapes are given by laser

one arm longer and the other shorter in one half cycle

and the opposite in the other cycle

Black hole formed 36 and 29 solar mass

4-6% of the energy of the binary - in the form of
1-3

disks 13 billion ly. - 400 Megaparsecs

{ Defects: No Correlation with EM disturbances - optical, x-ray, gamma-ray, radio
Disturbance for hundreds of hours after but not the same

future: Aerial locations - near Shubin

Advanced Virgo, LIGO in Japan

India - Indigo

LISA Space Based Interferometer - Deep Space