FROM THE FERMI THEORY

TO

THE STANDARD MODEL

In honour of P. Darriulat
LAL, March 23, 2009

An evolution of some theoretical ideas in HEP

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Two Lines

I. Dynamics

Building consistent dynamical models for the fundamental interactions.

II. Symmetries

Discovering their symmetry properties.

Dynamics

The two classical forces

-Electromagnetism

-Gravitation

are both described by the same classical potential:

$$V(r) \sim 1/r$$

which is singular for $r \to 0$.

A classical atom is unstable!

Non-Relativistic Quantum Mechanics solves this problem

$$\Delta(x)\ \Delta(p) \geq \hbar$$

The energy levels in an electromagnetic *or* a gravitational potential are quantised.

but the relativistic corrections bring it back!

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$$\Psi(x) \rightarrow e^{i\theta}\Psi(x)$$

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1932: Isospin. Higher Internal Symmetries

For the physicist, SPACE became an abstract, multidimensional, mathematical object, of which only a part, the four-dimensional space-time, is accessible to our senses.

The Standard Model

All Interactions have a geometric origin

The gauge group is

$$U(1) \times SU(2) \times SU(3)$$

The internal space may be a five-dimensional complex space

$U(1) \times SU(2)$ **vs** $SU(2)$

Georgi-Glashow model

Lee-Prentki-Zumino models

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Weak neutral currents

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Neutral gauge bosons

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Coming soon **The origin of the symmetry breaking**

Beyond the Standard Model

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Physical space *vs* **Internal space**

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Unify physical and internal space.

Gauge transformations are local translations.

Theory of Strings
And other extended objects

Beyond the Standard Model

We need new experimental data

to guide our theoretical speculations

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CONGRATULATIONS, PIERRE

and best wishes