My Adventures in Physics

H.B. Nielsen, Copenhagen

Copenhagen, 31st of August , 2012

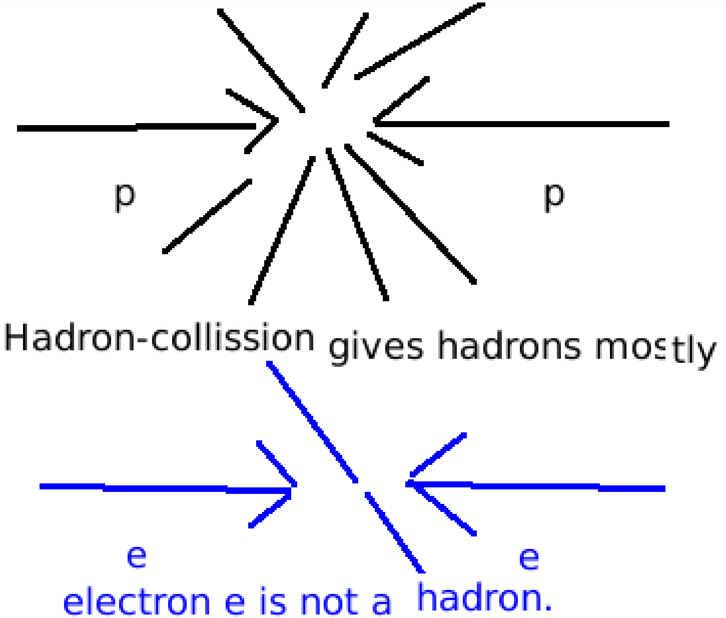
Already Heard about the Old Times by Ninomiya, Froggatt, Olesen, Brink, and (t'Hooft ?)

And now I have myself got one hour to resume 50 years of work: 1 minute and 12 seconds per year; so I am obliged to condensate and reduce the works I shall mention.
After writting my "speciale" on quark model, I worked with my adviser Koba on **generalising** the **Veneziano model** - a model for scattering hadrons as e.g. pi-mesons and omega-mesons - and I was later among those who found out that the **Veneziano model** is a model of **scattering of strings**. Later,the ideas about "Random Dynamics" inspired my work with Masao Ninomiya and Dietrich Foerster about **No-Go theorem** for chiral fermions on a lattice.

Together with Colin Froggatt we considered a random assignment of charges of left and right handed Fermions, leading to masses of quark and leptons (small hierarchy problem) **" Froggatt Nielsen mechnism"** ...
KNO-scaling(Koba-Nielsen-Olesen scaling) is the work about how the distribution of the number of particles produced in a collission of say proton+proton varies with the energy of the collision.
Most cited paper: **Nielsen-Olesen vortex lines** (= ANO-strings).

Plan of Talk:

- 1. Introduction, my dear colleagues have this morning told about our earlier works; I shall talk about later and more recent subjects.
- 2. A bit of Memory.
- 3. Our PREdiction of the Higgs mass from “Multiple Point Principle”.
- 3.1. What If it were Not Accidental?
- 3.2. Standard Model All the Way Up.
- 3.3. Dark Matter and 6t + 6 anti t bound state...kimberlites, Tunguska.
- 4. Newer works on which we work:
- 4.1. String Field Theory (with M. Ninomiya).
- 4.2. Even if LHC works well in spite of bad luck predictions one can still work on complex action.
- 4.3. Coincidences from Complex Action.


p
p
Hadron-collission gives hadrons mostly
e
e
electron e is not a hadron.

My String Theory

At the (end of the) 1960's, when I was a student and I together with my main adviser(s) Ziro Koba generalized the Veneziano model to an arbitrary number of scattering particles, I found out (and spoke about it even at Lund Conference privatly and at NBI,and a t meeting when Heisenberg visited NBI, and Sakita at NBI learned about the strings from me with so great interest that I had told everything when my talk should have started, so I gave it a quarter of an hour too early. There were a little flock of interested participants around me while giving the too early talk. And then Sakita presnted it at the Kiev Conference as a special talk about my string theory (which he had heard learned about from me during his visit in Copenhagen; I suppose that after learning from me he heard about Nambu and Susskind)), see Venezianos contribution in Kiev) independently of Nambu and Susskind that the Veneziano model were a model for strings.

Situation of the Four Forces in the Time of the appearance of String

The situation for the four forces (interactions) were (in my thinking):

Gravity	understood i.a.r. (quantum gravity quite outside experimental reach)	seperate field
Electrodynamics	understood	very fine quantum field theory
Weak inter actions	understood i.a.r.	tiny trouble: nonleptonic decays No Z^0, W speculative.
Strong interactions	not understood	lots of unexplained data

"i.a.r." = "in the accesible region"

Some main Advisers:

My main adviser were Ziro Koba - with whom i later extended the Veneziano model -, in addition I had as physics advisers mainly: Jørgen Kalckar - who formally received my thesis for cand. scient. -, Niels Brene - teaching me about weak interactions, and later many common papers - and Knud Hansen; and I went to a course about quantum electrodynamics by Poul Olesen and Benny Lautrup.
I actually also studied a lot of mathematics, and I may mention some very good mathematics teachers: Hans Thornehave and Werner Fenschel - it were in the course under leadership of Werner Fenchel I had a pentagon problem important for generalizing the Veneziano model -.

A Memory About Standard Model, which is from 1963

Some Roumainian costudent - on a summerschool - told me about a model, that were very much like Standard Model as Glashow had it. It had some extra gauge Boson (presumably Z^0). My thought: **He is a "crackpot"; extra vector particles! we cannot even observe the W; too speculative, not healthy!**
Apart from the Higgs the model of Glashows was the Standard Model, which is now working exceedingly well and for which a couple of nobel prizes were given

Does it not give Hope for Speculative Theoreticians ?

Even if Glashows model from 1963 were believed to be too speculative by me, it turned out in 1973 that the "neutral current" - i.e. the Z^0 - were indeed found!
Could it be that our "Multiple Point Principle"(I may return later to it) PREdicting the Higgs mass would also turn out true in spite of being too speculative?

Experiment at NBI were 19 GeV protons on protons, fixed target

$$p(19\ GeV) + p(\text{at rest}) \rightarrow \text{various hadrons, e.g. pions } (\pi^+,\ \pi,\ \text{and } \pi^0) \quad (1)$$

to be compared to todays Large Hadron Collider (LHC)

$$p(3500\ GeV) + p(3500\ GeV) \rightarrow \text{also various hadrons, more seldom types} \quad (2)$$

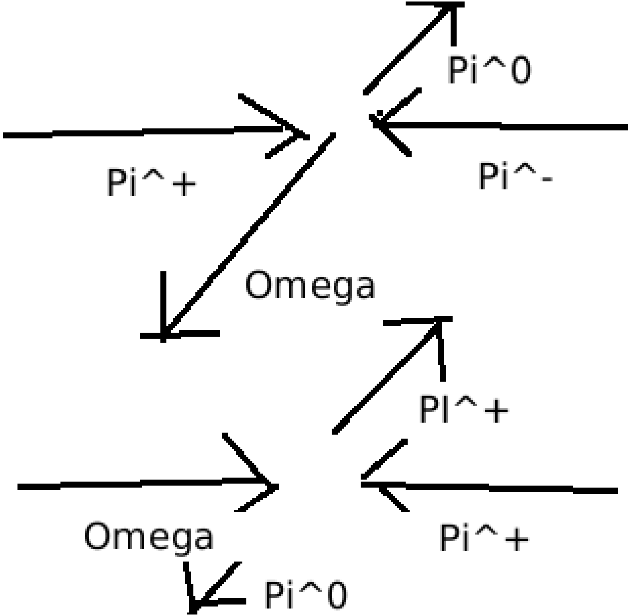
Concepts Relevant in Strong Interaction Physics in 1960's:

General concepts:
Analytic S-matrix (say Mandelstam Representation), crossing symmetry, Regge poles, resonances (= very short lived hadrons (a relatively long lived is π^+), e.g.ω).
Symmetries and Quarks:
Chiral $SU(3) \times SU(3)$ symmetry, current algebra, "the eightfold way", Non-relativistic quark model (with quarks having constituent masses, not equal to current algebra masses)
(Only three quark-flavours were known: up u, down d, and strange s at that time; now all 6 are "found")
Single Quarks alone are though never found, not even today

E.g. Crossing-Symmetry Means:

Several different scattering processes obtained from each other by replacing a particle in the final state by its antiparticle in the initial state - or opposite - are described by analytical continuations of the same amplitude, as function of the external four momenta. [“analytical functions” can be considered a precise way of specifying a very smooth and nice function]
So e.g. the following (scattering)processes are connected by *analytical continuation* (are described by the same (nice) function) :

$$\pi^+ + \pi^- \rightarrow \omega + \pi^0 \quad (3)$$
$$\pi^+ + \pi^- + \pi^0 \rightarrow \omega \quad (4)$$
$$\omega \rightarrow \pi^- + \pi^+ + \pi^0 \quad (5)$$
$$\pi + \pi \rightarrow \pi^+ + \omega \quad (6)$$
(7)


Pi^0
Pi^+
Pi^-
Omega
PI^+
Omega
Pi^+
Pi^0

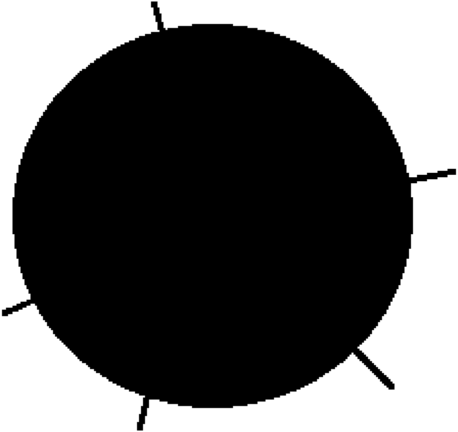
Bit of history of String Theory

In the sixties popular approaches to strong interaction studies were: analytical function scattering amplitudes (S-matrix theory, even bootstrap theory), Regge poles, ...
Then came **Veneziano Model** (= Dual model) ! A very simple function giving a scattering amplitude or S-matrix (actually for the process $\pi + \pi - - > \pi^0 + \omega$, and the crossed form thereof)

I heard about the Veneziano model from a seminar by Hector Rubinstein just when Veneziano had made it.
The scattering amplitude is very simply written in terms of Eulers Gamma or Beta functions.

$$B(-\alpha_s, -\alpha_t) = \int_0^1 x^{-\alpha_s - 1}(1-x)^{-\alpha_t - 1} dx \tag{8}$$

I and my adviser Z. Koba and also others generalized it to more particles participating in the scattering.
Actually my student job were to teach projective geometry, and we had a problem that "accidentally" solved some algebraic equations needed to make the generalization to 5 particles (rather than Venezianos only 4).

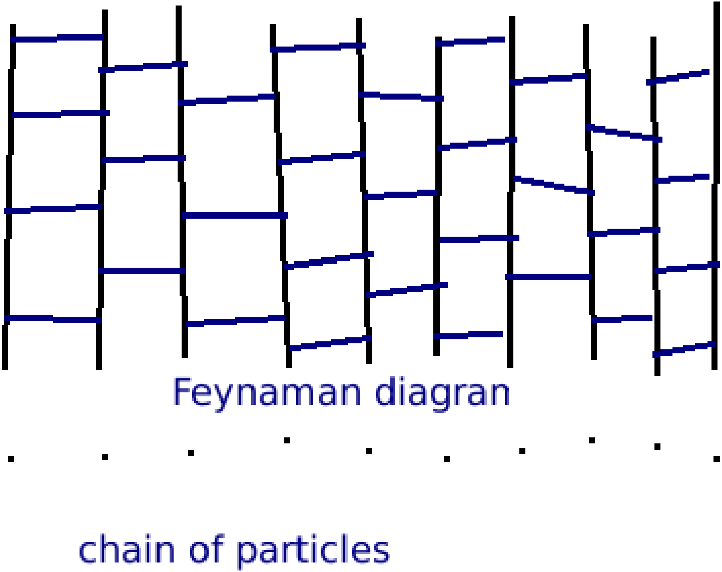


A disk like this were used by Koba and nyself to describe Veneziano models

Nambu, Susskind and I found that the Veneziano model amplitudes are actually the amplitudes for scattering of strings with rather simple properties assuming quantum mechanics and theory of relativity. So **The Veneziano model is really the model for scattering of strings!** If hadron scattering obeys the Veneziano model then it should mean that the hadrons are actually strings.

Fishnet diagrams

A special charcteristic of my own way to at first describe the string theory as I were about to discover that Veneziano model were a string theory were to think of very large Feynman diagrams, that took form of fishnets. One comes to such thinking by imagine the string as being a chain of a lot of particles sitting along in a series. Then one of these particles should only interact with its neighbors in this series. Then one uses a very elegant and intutitive method for making calculations in quantum field theories, which is really the usual type of theories for partices with quantum mechanics, formulated by R. Feynman. In Feynman's approach one draws some diagrams which keep track of the calculations and which have a very nice physical meaning. I used these Feynman diagrams to formulate the string property that only neighbors in the chain interact.


Feynaman diagran
chain of particles

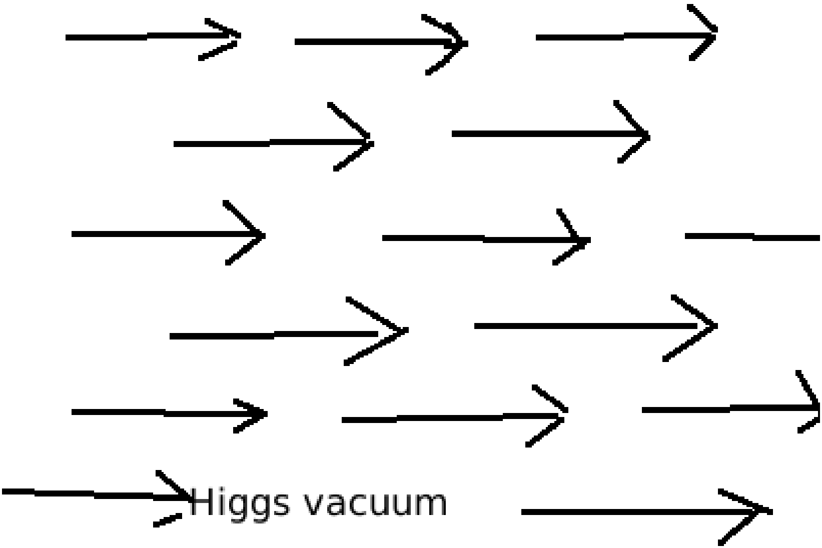
Connection of Fishnet with Eulers Beta-function generalizations

Corresponding to an ideal string not even at the end being a chain of particles, but rather a continuum, one should take the limit of an infinitely dense fishnet diagram, a plate rather than a net.
My technique: Approximate the Feynman propagators occuring in the prescription for evaluating Feynman diagrams by functions easier to compute with Gaussians (i.e. $Kexp(-\alpha p^2)$). Then an analogy with electrical networks (David Fairlie)is achieved: a dense network (fishnet) can be approximated by a conducting surface layer.

Twodimensional conducting layers are especially nice mathematically because they can be deformed - only restricted that it be a conformal deformation (but that still allows a lot of deformations) - so that only very few parameters are needed to describe the for the conductivity properties of the twodimensional surface relevant features. This leads to simplifications of the Feynman diagram result and thus the expression for the amplitude. It become essentially the Euler Beta Function type of intergal.

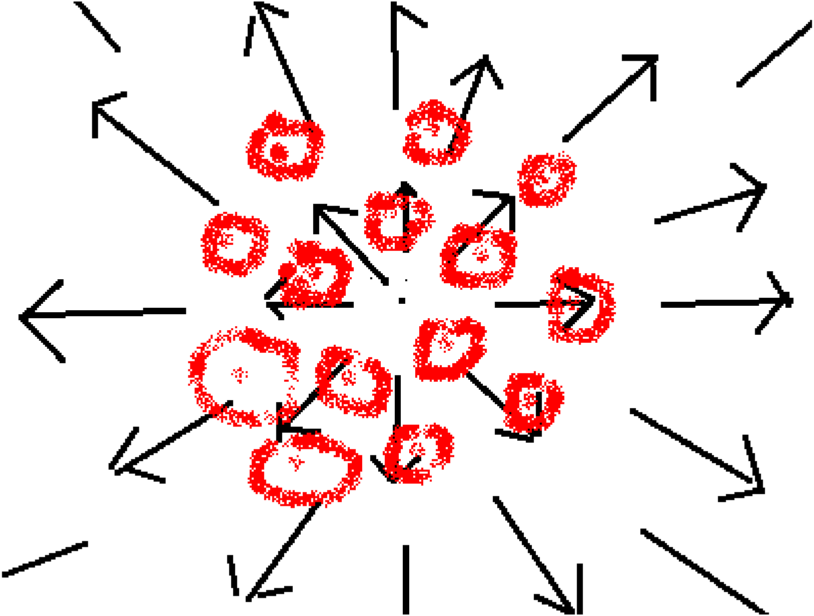
Nielsen-Olesen-vortexline, or ANO-string

In order to make a model for a string Poul and I invented a topological structure - a vortex line - in a (quantum) field theory for a charged scalar(i.e. spinless) that is actually also a tachyon at first, interacting with electromanetic fileds. This happens to be exactly the Higgs model used to illustrate the in our days so successful Higgs mechanism. The important point is :
The vacuum is even classically non-trivial in as far as the scalar field has everywhere a non-zero complex value.
In true vacuum this complex value is the same all over $<\phi(x)>= constant$, but we imagined a more complicated situaion in which there is approximately vacuum all over except for along a line (or curve), the "vortex line"


Higgs vacuum

The notation on the figure for the Higgs-model:

The main field is a *complex* scalar field, which for each point in space and to each time takes a complex value, which can be represented by vector with length and direction, i.e. by an arrow; but it is just accidentally, the scalar field only takes a numerical (but complex) value, but *it has no direction* such as would a real vector field, like for instance the the magnetic potential $\vec{A}$, which I did not draw on the figure, although there is such a field in the Higgsmodel.
However, I drew on the next figure the magnetic field as circles with a dot in the midle to symbolize that the magnetic field is directed perpendicular to the plane we look at.



Random Dynamics as Source of Inspiration for Most Works of mine

Turning around the idea of "Random Dynamics": that fundamental laws of nature are exceedingly complicated, but that it does not matter, because almost the same effective laws will result anyway, almost whatever the fundamental ones might be, if they are complicated enough much of the works I have done have been inspired.

How Random Dynamics have Led to Many of my Works

- The first Random Dynamics of getting Lorentz invariance and Weyl Fermions automatically is behind the NO-Go theorem with Masao Ninomiya (and Dietrich Foerster - who were on vacation).
- The Froggatt Nielsen Mechanism was a result of looking for if the quark and lepton spectra could come from random couplings (meaning Random Dynamics)
- The multiple point principle leading to the Higgs Mass can be argued for in Random Dynamics.

Mainly only my string works are not so strongly Random Dynamics inspired.

Must tell about that:
We PREdicted the Higgs Mass

Using what we call **Multiple Point Principle** (with Don Bennett,...), which means, that we assume that the coupling constants - such as top-Yukawa-coupling related to the top-quark mass - and other parameters in the field theory (say the Standard Model) - such as the Higgs mass square - **are tuned in** to have just such values as to ensure:
Several Vacua with the Same Energy Density
or approximately so, we(with C.D.Froggatt) **PREdicted** - long before the Higgs were found - the **mass of the Higgs**.
In one paper (with Froggatt and Takanishi, Meta-MPP) 121.8 GeV $\pm$ 10 GeV; I am painted with Mogens Lykketoft with 135 GeV $\pm$ 10 GeV. Higgs recently confirmed with mass 126 GeV and uncertainty of the order of 2 GeV.

One has in modern high energy physics several "fine tuning problems",

such as:

- 1. Why is the energy density of the vacuum (the so called "dark energy") so enormously small compared to what one would expect from seeking to construct it from the most fundamental physical quantities, G(=Newtons constant) $\hbar$(= Plancks constant) and c(=the speed of light) ?
- 2. Why is the weak energy scale so low compared to the energy scale constructed from the same fundamental constants ?
- 3. "The small hierarchy problem" (Solved ? by Froggatt-Nielsen mechanism?);

because one attempts to **avoid fine tuning of coupling constant or parameters such as Higgs mass.**

Usually physicists worry about Fine Tuning Problems seeking to Avoid Fine Tuning of Couplings and Parameters;

But the "Multiple Point Principle" means that we

make a finetuning theory, and thus finetune, rather than avoiding it!

That is to say: We speculate that there is some untill now indiscovered law according to which the coupling constants and other parameters such as mass of say the Higgs are determined. A proposal for such a law for "fine tuning" would be the "Multiple Point Principle".

The couplings etc. are adjusted to make several vacua (= states of the empty space) have the same or approximately the same energy density. That fixes at least partly these couplings.

Present, June 2012, Higgs Mass

Report number: CERN-PH-EP-2012-167 Cite as: arXiv:1207.0319v1 [hep-ex]
give

$$\mathbf{m_H = 126GeV} \tag{9}$$

and uncertainties in mass are claimed:

$$H -- > \gamma\gamma \quad : \quad \pm 17\% \tag{10}$$
$$H -- > 4\mu \quad : \quad \pm 1.5\% \tag{11}$$
$$H -- > 4e \quad : \quad \pm 2\% \tag{12}$$

At least crudely I can summarize this

$$m_H|_{exp} = 126 \pm 2GeV. \tag{13}$$

Our Updated Prediction:

According to
Report number: CERN-PH-TH/2007-179,
IFT-UAM/CSIC-07-50
Cite as:
arXiv:0710.2484v1 [hep-ph]
the updated value of the Higgs mass that in pure Standard Model gives two dgenerate vacua - i.e. is on the stability border - should be

$$\mathbf{m_H}|_{\textbf{stability border}} = \mathbf{129.4GeV} \pm \mathbf{1.8GeV}. \tag{14}$$

Comparing this to the experimental 126 ± 2 GeV (say) we obtain that the deviation is

$$m_H|_{exp} - m_H|_{stability\ \ border} = 126 \pm 2 GeV - 129.4 \pm 1.7 GeV \quad (15)$$
$$= -3.4 GeV \pm \sqrt{2^2 + 1.7^2} GeV \quad (16)$$
$$= -3.4 GeV \pm 2.6 GeV. \quad (17)$$

This is a deviation of **only** $3.4/2.6\sigma = 1.3\sigma$ in the direction of "our" vacuum being not truly stable but rather only metastable or not stable at all under the assumption that the Standard models works all the way up (to say Planck scale) counted in the Higgs field as an energy scale measure. We want to conclude:
It is remarkable that the Higgs mass has turned out so close to the lowest Higgs mass compatible with the Standard Model having the vacuum we live in be at least stable even if the Standard Model works all the way up!

We PREdicted the Higgs Mass!

You see how proud we are although almost everyone expected a similar mass; for instance supersymmetry puts upper bound(s) that forces the Higgs to be "light" also, and the indirect measurements of the Higgs mass tends to give an even lower value than the lower mass from LEP of 114 GeV.

Our - Takanishi Froggatt and me - prediction in the 2001 article:

m_{Higgs} **= 121.8 ± 11 GeV**

With insertion of the present top quark mass

m_t =172.9 GeV ± 1.5 GeV,

we rather would now get from same principles:

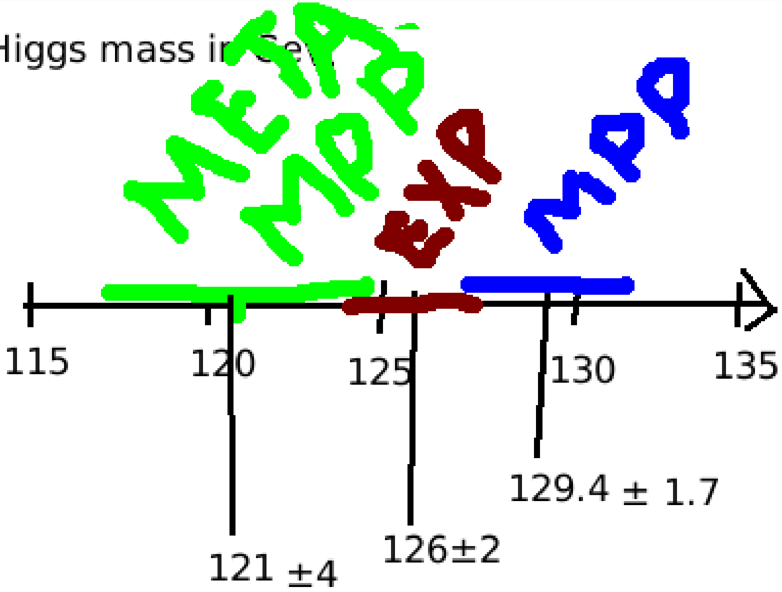
m_{Higgs} **=121 ± 5 GeV,**

while the experimental measurement were in the range:

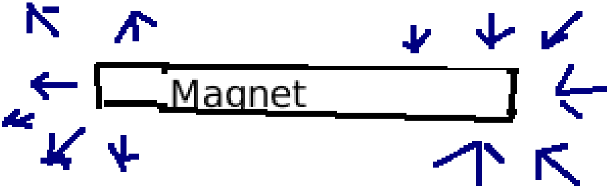
$m_{Higgs}|_{exp}$ **= 124 to 126 GeV.**

Phantasticly good agreement! But even our exact degeneracy prediction in modern form fits equally well!

Higgs mass in GeV



Have in mind that quantum mechanics very quickly stated says:
In stead of it being a question whether light is **particles** as Newton suggested **or waves** as Huigens suggested, then in **quantum mechanics Both are right:**
Particles and Waves are the same thing!
Light e.g. is both particles and waves.
So to every type of particle there corresponds a corresponding (effective) field which oscillates as the waves.
Especially there corresponds to the Higgs particle a (strictly speaking four) Higgs fields.



In every point of space at any time there is a magnetic field vector with strength and direction: .

Higgs-field only numbers.

246

246

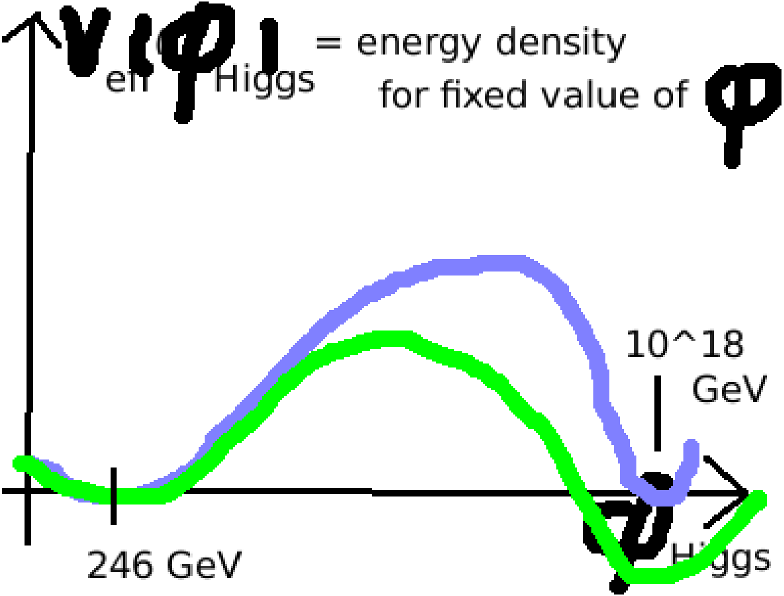
246

246

245

246

246


$V_{eff}(\phi_{Higgs})$ = energy density
for fixed value of ϕ
10^18
GeV
246 GeV
ϕ_{Higgs}

If our Higgs Mass Agreement were Not an Accident,

If our PREdiction of Higgs mass were *not* an accident, then a Higgs field of the order of the 10^{18} GeV, which is close to the Planck energy scale (which is determined from the most fundamental physical constants $\hbar$, c, and G), where the second minimum is would have to **make sense and the Standard Model would have to be essentially correct even at such large Higgs fields** or energies.
Standard Model would have to be essentially functioning far beyond in energy scale what most colleagues of mine believe it will.
No very severely "new physics" up to the 10^{18} GeV scale for the second minmimum.

Sad ? Dull? But:

If our PREdiction of Higgs mass Not an Accident, then MPP valid

As consolation for the sadness, that Standard Model should be valid "all the way up", we would in the case of our prediction not being accidental have got the principle **"multiple point principle"**, that several vacua (= minima in the scalar field effective potential like the Higgs field one) have the same energy density. That would mean **more theoretical information**, and we would correspondingly have an easier time seeing by indirect methods more details of the laws of physics than, if we had not had such a principle as MPP.

So it might not be so sad after all, if our ideas of "multiple point principle" were right!

If our PREdiction were not accidental we might use our theory of Couplings MPP

With such a principle MPP we might be able to extract usefull information - about details at much higher energy scales - from very accurate measurements of the coupling and parameters like the Higgs mass. ILC might be extremely usefull for that.

so not so sad after all; ILC usefull for new physics even further away in energy scale

Could the Standard Model Work All the Way Up to Planck Scale?

If really the Standard Model should work so long as to the Planck scale energies (or Higgs field size), then an **explanation** for the phenomena usually calling for new physics would be **needed**.
I would say: **Some right handed or see-saw neutrinoes are needed,** but right handed neutrinoes($\approx$ see saw neutrinoes) is formally almost the Standard Model, , **however, otherwise we have speculations to solve:**

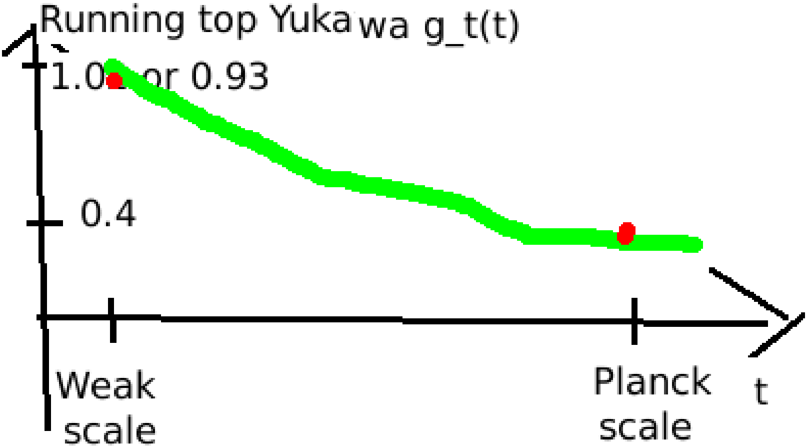
- **Dark matter,**
- **Scale Problem (or almost hierarchy problem)**

How to get Dark Matter and Weak Scale Low Just with Standard Model and MPP?

If we want to take seriously that the agreement of our Higgs mass means that Standard Model works essentially up to almost Planck scale - except for some "right handed " or see-saw-neutrinoes - without "new physics" we have to explain **inside the Standard Model** the **dark matter** and why the weak scale is so low compared to the from dimensional argumenst expected much bigger energy scale (the scale problem).
With the help of our finetuning theory - most likely "multiple point principle" - we **can at least come with some slightly complicated speculations that could solve this problems** and thus make it possible to have **only the Standard Model - though with some see-saw neutrinoes - "all the way up"** to energy scales slightly below the Planck scale!

The Scale Problem of Why the Weak Scale so Low Compared to the Planck Scale

The problem is that the ratio of the weak scale - experimentally $\approx$ 100 GeV - relative to the Planck $\approx 10^{19}$ GeV is so small 10^{-17} that it has come out somehow as an exponential of a relativ large number of the order of 40. Such an exponential can easily come out of the **renormalization group** with coupling constants of the order the couplings in the Standard Model typically have, if one somehow mannage to get a requirement of the type that a coupling due to the renormalization group running shall go from one value at one scale to another one at another scale.



Scale ratio of the Planck scale to weak scale must be so as to allow g_t to go from 1.0 to 0.4 !

How the Strong or QCD-scale "Naturally" gets Much Smaller than say Planck Scale

By means of the renormalization group running idea it becomes at least somewhat natural, that the scale of strong interactions Λ_{QCD} - being the scale at which the running QCD-finestructure constant $\alpha_S(t)$ goes to infinity, or at least is not small - can be many orders of magnitude smaller than some fundamental scale - say Planck scale (= the one determined by $\hbar$, c, and G)- at which we think of the value of this running coupling constant (fine structure constant in case)$\alpha_S(t)$ as having gotten specified a value of the order of magnitude typical such couplings $\approx 1/100$.

Analogously to the Strong scale Λ_{QCD} we get from MPP Conditions making the Weak Scale "exponentially" Small

If we can get the specification of there being several vacua with the same energy density - the "multiple point principle"- to enforce that some running coupling (in fact we can with the top-quark yukawa-coupling $g_t(t)$) should take specified values at two different scales, in fact the weak scale and the "fundamental scale" taken as Planck scale, then this requirement could enforce that the ratio of these two scales could be an "exponentially" large (or small) ratio.

Our model with MPP suggests that we shall ONLY use the Standard Model almost to Planck Scale,

if namely really the Higgs has its mass for the reason of being on the meta-stability-border in the Standard Model, it must be because this Standard Model is relevant at the energy scale at which the instability becomes realized.
Also we shall with a fine tuning principle have gotten rid of one of the complaints of the pure Standard Model picture(the hierarchy problem).
Further we - Colin Froggatt and myself - have a perhaps a bit complicated and specuative model for **dark matter** only based on Standard Model and our type of finetuning proposal (Balls of small white dwarfs with an internal vacuum with a condensate of bound states of 6t + 6 anti t)

vacuum without condensate

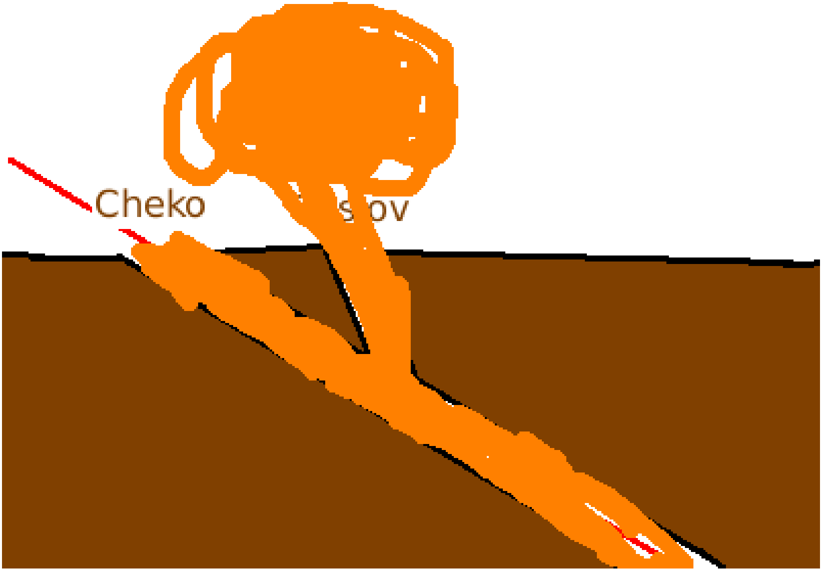
Our dark matter ball

Tunguska Event

Hundred years ago there occurred presumably a comet impact at Tunguska in Sibiria. Trees fell in a pattern as from an explosion in the air. There were a presumed new lake *Lake Cheko*. In the newspapers were written about sounds of the explosion and one man were killed.

Our Picture of Tunguska

Contrary to say the comet picture:
In which the "comet" came in and made an explosion in the air first then hitting earth at lake cheko.
we have:
The ball came first with very little effect in the air and hit the earth at Lake Cheko. Then it dug itself very deep into the earth - our calculations suggest that it on the borderline went out again in some other place on the earth -. The very heated earth material were the pressed back partly through the just dug "hole" and partly made a short way to the earth surface. It was hot material comming out of the earth the short way via Suslov Crater and some trues seen by Kulik who were there as firts researcher.


Cheko
s ov

If there is one fall of earth of our dark matter balls every 100 years to 200 years, there should be a lot of the extremely deep holes left by the passage of such balls into the earth. Have geologists seen them?

They observe *kimberlite pipes*, which are pipes through which material from deeper earth comes up often containing diamonds.

We suggest that these kimberlite pipes are due to earlier infalls of our type of dark matter.

Time Interval of impacts	r_B^{-1}	200 years
Rate of impacts	r_B	$1.5 * 10^{-8}\ s^{-1}$
Dark matter density in halo	ρ_{halo}	0.3 GeV$/cm^3$
dark matter near solar system	$\approx 2\rho_{halo}$	0.6 GeV $/cm^3$
Mass of the ball	m_B	$1.4 * 10^8$ kg
Estimated typical speed of ball	v	160 km/s
Kinetic energy of ball	T_v	$1.8 * 10^{18}$ J
Energy observed in Tunguska	$E_{Tunguska}$	$(4to13) * 10^{16}$ J
Potential shift between vacua	ΔV	10 MeV
Cube root of tension(from m_B)	$s^{1/3}$	110 GeV
Cube root of tension(weak scale)	$s^{1/3}$	≈100 GeV
Ball density	ρ_B	$7 * 10^{15}$ kg$/m^3$
Radius of ball	R	.16 cm

Remarkable Coincidence:

The value for the (third root of) the surface tension s of he skin($=$ phase border between the two vacuum phases) becomes the same number almost whether we estimate it as

- tension needed to make the typical balls just able to barely resist the pressure so that they collaps, when we have imposed the size by imposing the mass for needed for one fall on earth every 200 years.

  or

- we just take the (third root of) tension to just be given from dimensional arguments using it is a weak scale physics caused surface and thus $s^{1/3} \approx 100 GeV$.

I think we shall not have time for the following subjects which presumably Colin and Poul will have talked about:

- **Random Quantum Numbers and the Froggatt-Nielsen Mechanism**
- **Multiplicity Scaling, KNO-scaling**

(Random) Quantum Numbers Protecting Masses for Quarks and Leptons, Froggatt-Nielsen Mechnism

Inspired by the idea of Random Dynamics - meaning random laws of nature - C.D. Froggatt and I estimated, how the spectra of quarks and leptons might look, if there existed a system of **approximately conserved charges assigned differently to the "right" and the "left" components for quarks and leptons**, and they were taken to be essentially randomly assigned.
The idea, that it is the existence of some approximately conserved types of charges that approximately prevents some quarks and leptons from obtaining non-zero masses, and thereby solves the "little hierarchy problem", is what is called Froggatt-Nielsen-mechnism.
"The little hierarchy problem": Why are the mass ratios between quarks as well as between (charged) leptons so big ?

Example of Small Hierarchy Problem:

E.g.$m_{top}/m_u \approx 173 GeV 3 MeV \approx 50000$
Such a huge ratio needs an a explanation, and the Froggatt-Nielsen mechanism explanation is, that there exists some approximately conserved - presumably yet unknown - type of charge, or likely several, for which the "right" and the "left" components for the u-quark have *different* charge numbers. Thereby it becomes approximately forbidden even under use of the Higgs field to achieve a mass different from zero for the u-quark (unless the Higgs just has the number of charges being the difference between that for right and that for left).
This is what some kind poeple call Froggatt Nielsen Mechanism.

On the Distribution of the Number of (charged) Particles Produced in a Hadron Collissions

From some scaling ideas proposed by Feynman Poul Olesen, Ziro Koba and I derived a scaling law for the multiplicity distribution. It became rule for how the probability for obtaining in a hadron collission a given number of particles (hadrons) produced varies as the energy of the colliding particles are increased.

The KNO-scaling Formula for Multiplicity

Let σ_n denote the cross section for in some - p+p collission - to obtain just n (offen one counts only the charged particles comming out because it is easiest), and $\sigma_{tot\ or\ inel}$ say just that the **probability for getting just n (charged) particles comming out of the collision is denoted $\frac{\sigma_n}{\sigma_{tot\ or\ inel}} = P_n$, then KNO-scaling says:**

$$P_n = \frac{1}{< n >}\Phi(\frac{n}{< n >}) \tag{18}$$

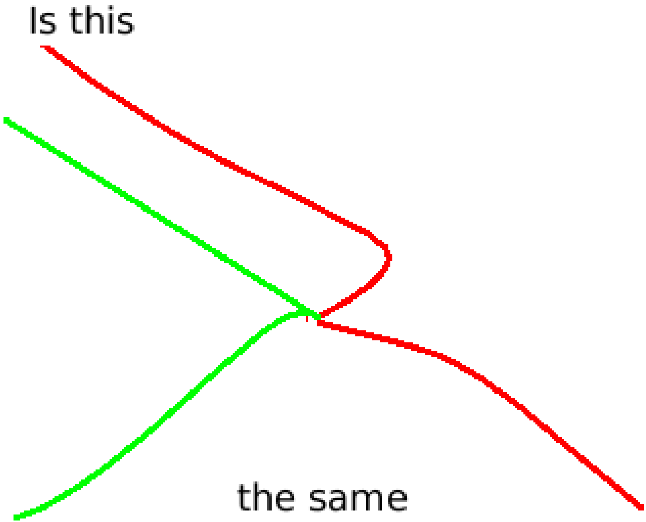
where Φ should be the same function for different energies of colliding particles, starting from some high enough energy.

i do not think there shall be time for talking about our String Field Theory:

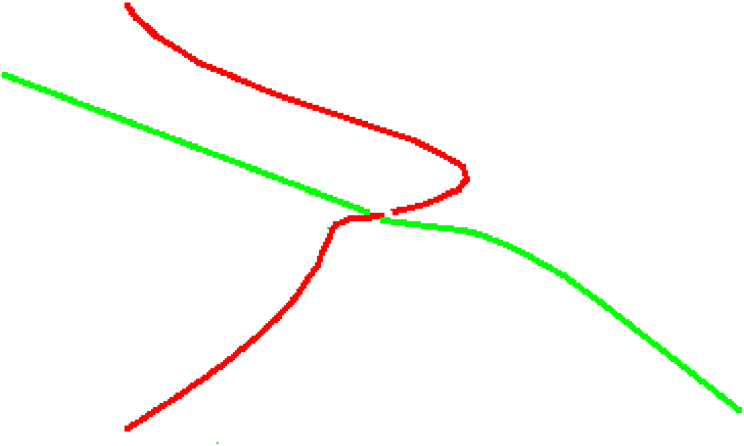
Ninomiya and me: A new string field theory in which the string theory is revealed as being solvable, and in which the right and left mover waves running on the string get essentially liberated from the string.

Ninomiyas and mine later work on strings

New type of String Field Thoery Ours deviate from ealier "string field theories" (= second quantized string theory) by Kaku-Kikkawa or Witten etc.
A string field theory means a quantum mechanical description in which you can describe an arbitrary number of strings. A quantum theory describing an arbitrary number of particles is called " second quantized". The field theory is made from the single string theory in a similar way as the second quantized (i.e. quantum field theory) is made from the single particle quantum mechanics.


Is this
the same

as this ?



Our string field theory deviates from those of Kaku-Kikkawa Witten etc, in the answer to whether the foregoing two string configurations are the same state or not. We take them the same, while Kaku etc. take them different!

We get the string field theory to be "trivial"

in the sense that there is no development: scattering of strings is a fake. It looks that strings can scatter, but really you set up a set of strings and looks at it and it can look like a different set of strings so that one would say that it looks as if there were a scattering. we are on the way to calculate that when you look for the probability amplitude for finding that this looking like there were a scattering give you a scattering of a certain angle and a certain energy etc. you get for this probability amplitude just what Venezianos scattering amplitude model would have given you for the "seemingly haven taken place"scattering.

If our (mine and Ninomiyas) string field theory is correct, then string(field theory) is a “trivial” or solvable theory

:

There are so many conservation laws that the whole development is calculable from the conservation laws. It may be so calculable in principle that one might begin to worry: Could a so calculable theory really be behind the real world in which there are lots of things not calculable so easily?

Here we start again after the presumably left out material on Small Hierachy, multiplicity scaling, and String field theory:

I must mention:

The Somewhat Not so Successfull Prediction in New York Times of Bad Luck for LHC Higgs Production is Supported by Some Other Coincidenses

In fact there is a prediction of this Complex Action Theory giving a massrelation involving the electron mass and the light quark masses and the amount of energy carried by the quark in say the neutron. It works pretty well.
Also the "knee" in cosmic ray spectrum looks like being there to deminish Higgs production in the cosmic radiation hitting the atmosphere.
And one may consider it that the Higgs field expectation value were adjusted to make the imaginary part of the action in the vacuum minimal.

Ashamed ?

It looks that this bad luck prediction for LHC were rather unsusccessful; but I am not ashame, otherwise most scientists making predictions should be also ashame. Most of science is wrong predictions, so if this were shamefull the majority of scientists should be ashamed.
Just remind that our prediction of Higgs mass is rather exact.
At least according to one way of arguing for MPP the complex action theory with its unlucky prediction could also be considered giving our Higgs mass.

The main topics were:

- Memory from old time 1960's
- My history with string and Veneziano model.
- Including shortly the Nielsen Olesen vortex line.
- Arguing for Multiple Point Principle from our success with PREdicting the Higgs mass,
- and thus suggesting that Standard Model should work almost to the Planck scale, and that we have speculations allowing there to be no new physics before except for see-saw-neutrinoes.

Several Projects on which I am Working Just Now:

- String Field Theory (with M. Ninomiya).
- Dark Matter having fallen in Tunguska, and making Kimberlites, when the dark matter balls fall? (with C. Froggatt).
- Formal investigation of e.g. Harmonic Oscillator (and inverse harmonic oscillator) with **complex action** or non-Hermitean Hamiltonian, Slow Roll Problem ? (with K. Nagao)
- Gravity in Plebansky formulation(L. Laperashvili, D. Bennett, ...)

Contnued Present Projects

- A new Phase of High Density Neutron Matter, Magnetars. (with V. Soni)
- Weyl Anomaly using Dirac Sea (Y. Habara and M. Ninomiya...)
- A Relation between Quark and Electron Masses ... from Complex Action.
- Evaluation of Feynman-diagrams by Sadle Point Approximation. (with Leo Wallin)
- MPP and Cosmological Constant ... (with Roman Nevzorov ...Froggatt)
- Bosonization Requires Families (w. N. Mankoc Borstnic...)
- Guendelmann Variables and Gravity (with Don Bennett, L. Laperashvili) [The tragedy happened to our colleague Donald Bennett, who got invalid following as a consequence of a stroke and triple operation on the brain.]

Yet continued present works:

- Mirror Worlds (L.Laparashvili, Anca...)
- Homolumo Gap Investigation of Dynamical Matrices(with Ivan Andric, Daniel Jurman, and Larisa Jonke)
- Is the Vacuum Possibly Really Empty ? (I think it is not truly empty)(with S.E. Rugh)
- Can we Derive Locality from General Relativity type Diffeomorphism Symmetry (with Astri Kleppe, Don Bennett)
- Homepage on "Random Dynamics" (with Astri Kleppe).
- Restoration of Lorentz Invariance in Some Non-relativistically inspired model.(Avinash Dar, Spenta Wadia)
- What is the property of the Standard Model Group that has made it be selected to be the realized gauge group (with Don Bennett)

Many Many Thanks to the Organizers:
Charlotte Christiansen,Henrik Damgård, and Niels Obers, and Anna Maria Rey
and to **the Other Speakers**
and to
the Listeners