

# Idiosyncratic Prologue

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Higgs Couplings 2014, Torino, 1–3 October, 2014

On behalf of Chiara and of the organizing committee



to HIGGS COUPLINGS **2014**



**WHERE  
NEXT?**



latecomers arriving ...

I have been asked to be the *curtain raiser*



*Please, be patient*



where do we stand?

*The success of the first few years of LHC operations at CERN, and the expectation of more to come as the LHC performance improves, are already leading to discussions of what should be next for both proton-proton and electron-positron colliders*

In this discussion I see too much theoretical desperation caused by the so far unsuccessful hunt for what is beyond the Standard Model,

*and too little of the necessary interaction of the accelerator, experimenter, and theory communities necessary for a scientific and engineering success*

**B. Richter**

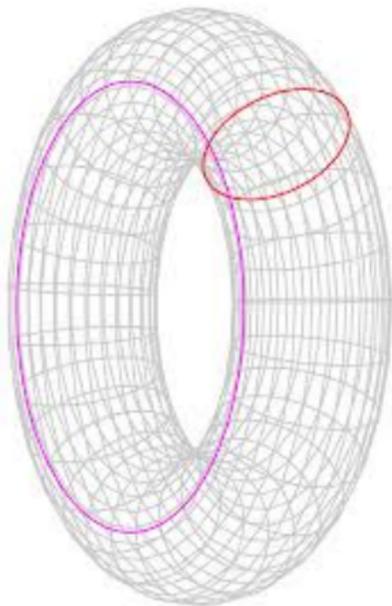


Do we have the resources for preparing upgrades for  
HL–LHC?

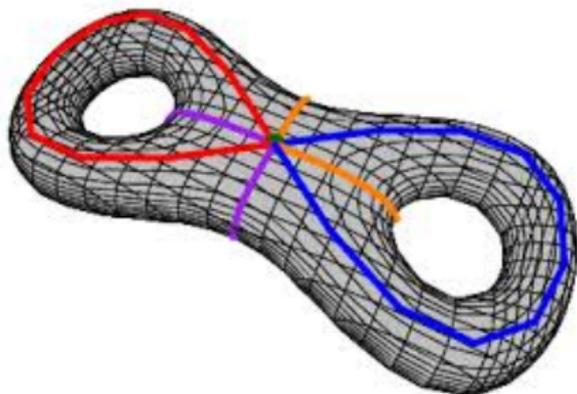
*We should not think that HL–LHC will be done easily and that we can do  
directly thinking for FCC*

**L. Fayard**

We should live on a sphere  
(you can't lasso a basketball)



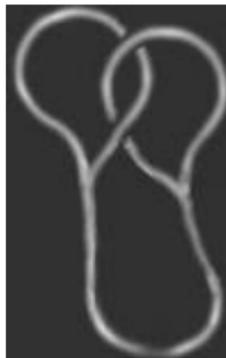
EXP + TH live on a torus



EXP + TH + MACHINE live on a **2**-torus

Imagine our actions as loops on a surface  
congruence of actions in terms of homotopy

Nature as shown by Data



Nature as seen by Theory

**Is There a Way Out?**

without



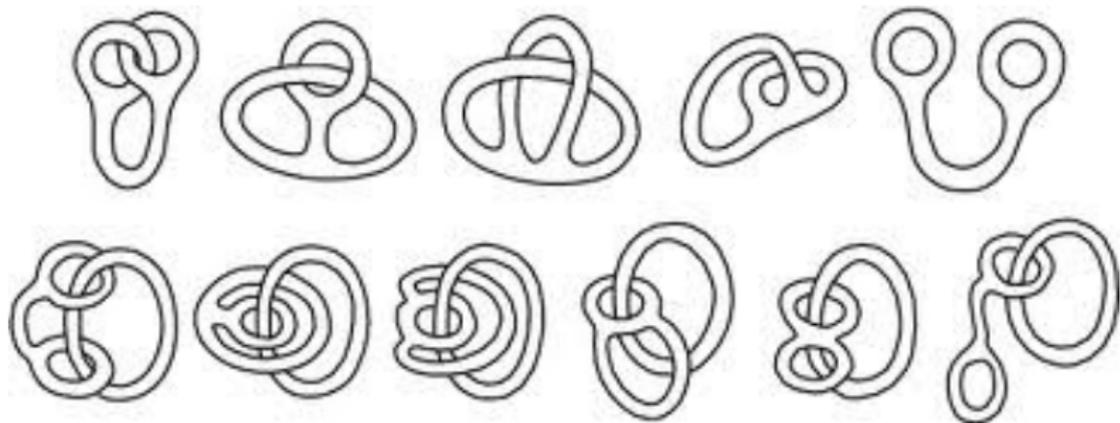
## The Little Monk:

*But don't you think that the truth will get through without us, so long as it's true?*

## Galileo:

*No, no, no. The only truth that gets through will be what we force through: the victory of reason will be the victory of people who are prepared to reason, nothing else*

Here is the solution!



- \* QFT paradigm accepted:



- \* QFT paradigm not accepted: ... we don't have Balmer series to explain, *apparently* we have nothing to explain
- \* (for late night thinking) How sensitive is Big Bang Nucleosynthesis to variations of the SM? Stated differently: how accidental is life on Earth?

## Our job: Physics as a substitute of soma (Amaldi)

*... there is always soma, delicious soma, half a gramme for a half-holiday, a gramme for a week-end, two grammes for a trip to the gorgeous East, three for a dark eternity on the moon ...*

**Soma in Aldous Huxley's Brave New World**



*The measured properties of the Higgs boson are in good agreement with predictions from the SM.*

☞ However, small deviations in the Higgs couplings may manifest themselves once the currently large uncertainties will be improved as part of the LHC program and at a future Higgs factory. There are typical new physics scenarios that lead to observable modifications of the Higgs interactions. They can be divided into two broad categories:

- ① mixing effects as in portal models or extended Higgs sectors,
- ② vertex loop effects from new matter or gauge fields.



In each model it is possible to relate coupling deviations to their effective new physics scale. It turns out that with percent level precision the Higgs couplings will be sensitive to the multi-TeV regime ([arXiv:1403.7191](#)).



## Higgs couplings **measurement** and **interpretation**

*they are consistent  $\iff$  there is at least one possible situation in which they are all true*

- ☞ Despite Wightman Axioms (a separable Hilbert space etc..) QFT is full of assumptions (Yang-Mills existence and mass gap, etc.) but, once you accept them, QFT is a non flexible working environment:  you cannot rescale the theory as you wish and pretend to get meaningful results

## *Measurement without theory?*

- ☞ NO, theory and measurements are *dual* in the sense that a testable theory is associated with a set of data accounts that correspond to that theory.
- ☞ unfortunately the partnership between theory and measurements proved far from equal. Why are the data not better? The facts themselves are not in dispute. However, measurements without theory is a conceptual ingenuity



## Drawing conclusions pre-conclusions

(restricting our attention to the relative merits of realism and instrumentalism)

*Do we have a way of knowing whether “unobservable” theoretical entities really exist, or that their meaning is defined solely through measurable quantities?*

**Leplin** (1984), **Sokal** (2001)

- ✳ Now we must move on to the next step, melting BSM-physics with high-precision SM-technology. The question has been repeated many times but answers are still converging around *Not yet*
- ✳ Meanwhile, it came dangerously close to realizing a nightmare, of Physics done by sub-sets of diagrams instead of cuts. *Well, several years ago we avoided that fate, may be the history will repeat itself?*

*don't mistake activity with achievement*

- ☛ The LHC runs at **7** and **8 TeV** have led to the discovery of the Higgs boson at **125 GeV** which will remain as one of the major physics discoveries of our time.
- ☛ Another very important result was the surprising absence of any signals of new physics that, if confirmed in the continuation of the LHC experiments, is going to drastically change our vision of the field.
- ☛ At present the indication is that Nature does not care too much about our theoretical prejudices, excessive success of the Standard Model?

*Merely to adopt the more powerful assumption is no more than to assume the more powerful conclusion*

