Flavour gives Colour to Life

Heavy Quark Physics on the Occasion of Thomas Mannel's 60th Birthday

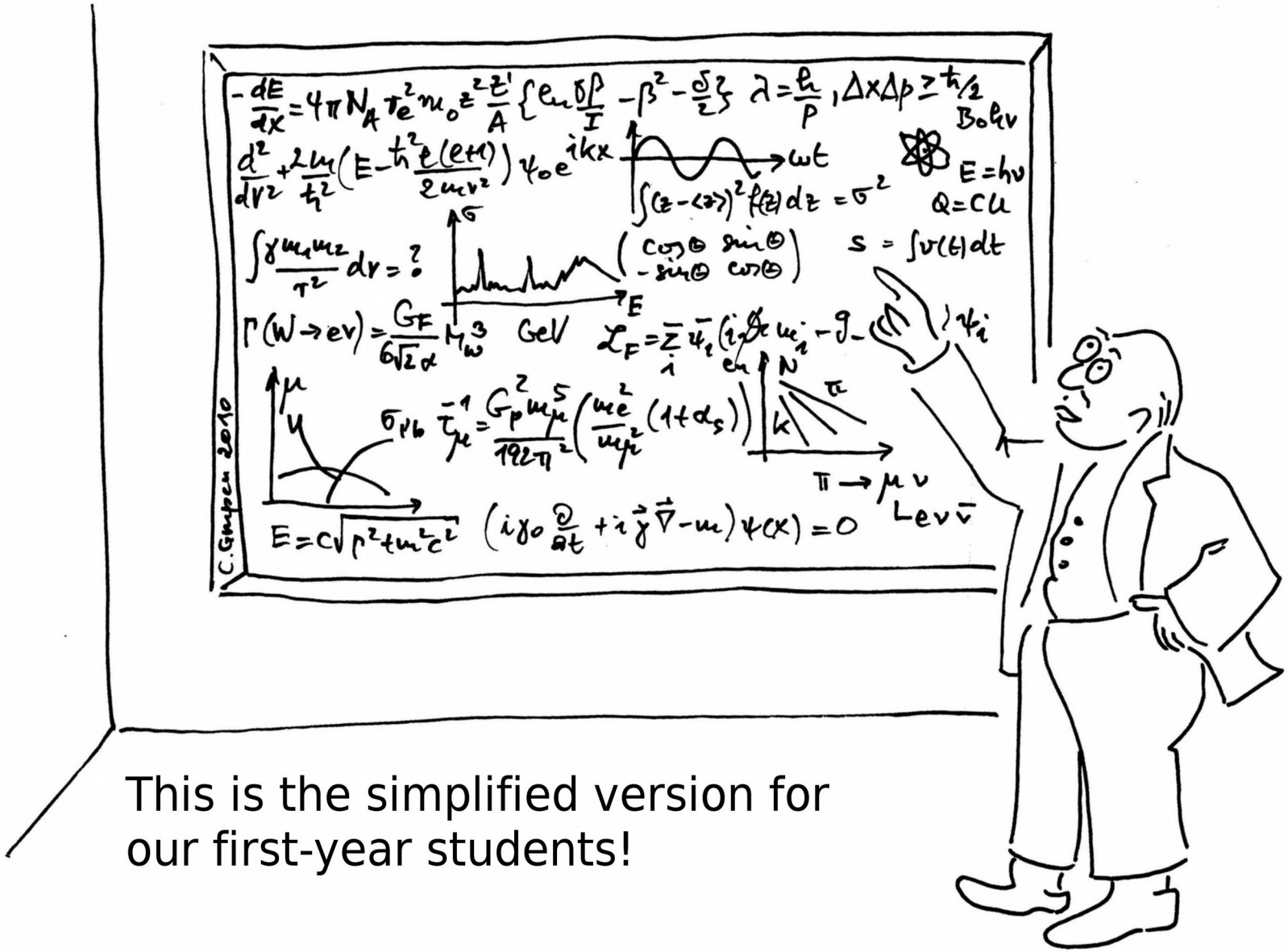
Claus Grupen

October 2018

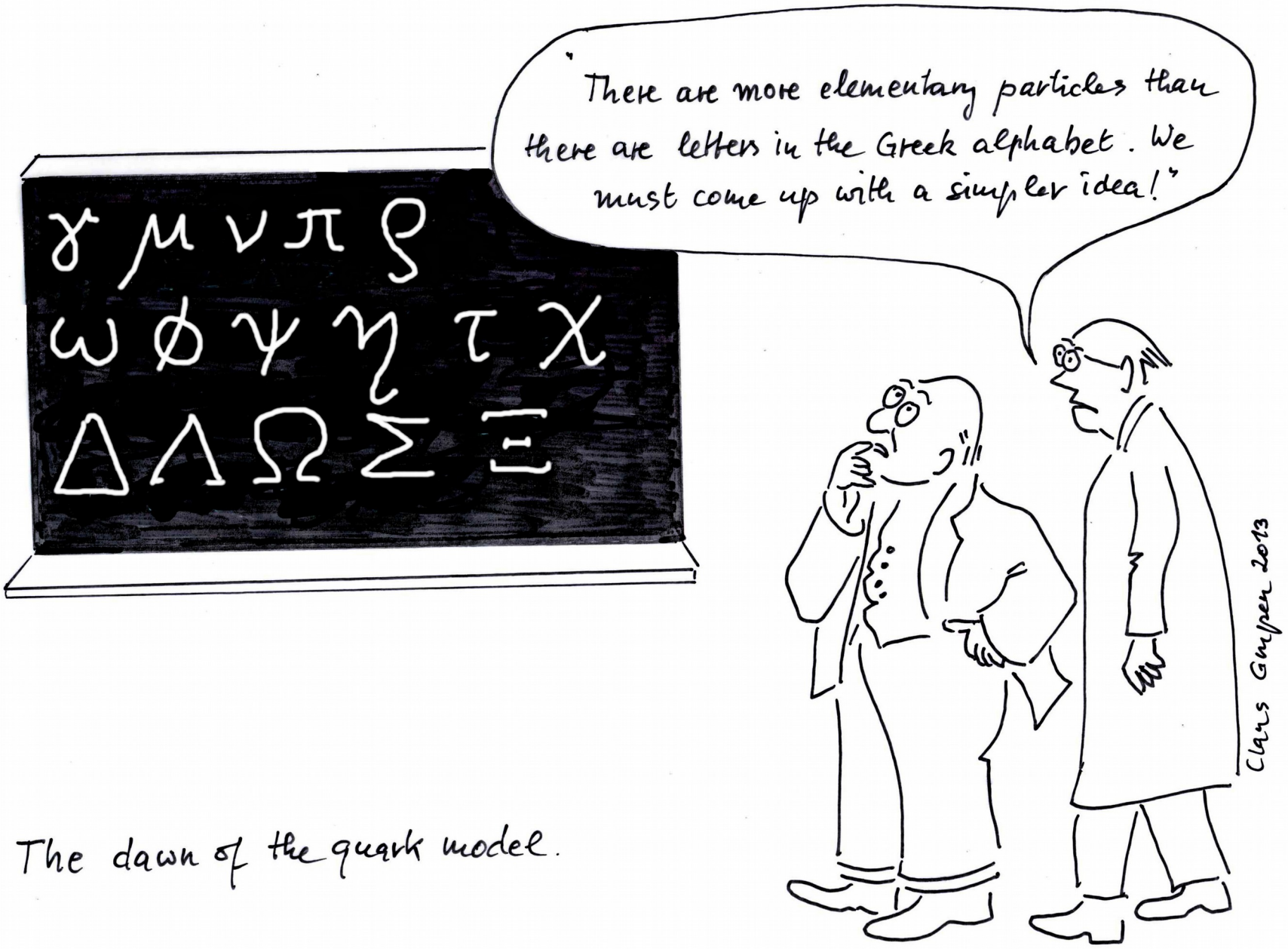
LX

COLOR & FLAVOR

Introduction for the newcomer to this field



This is the simplified version for our first-year students!

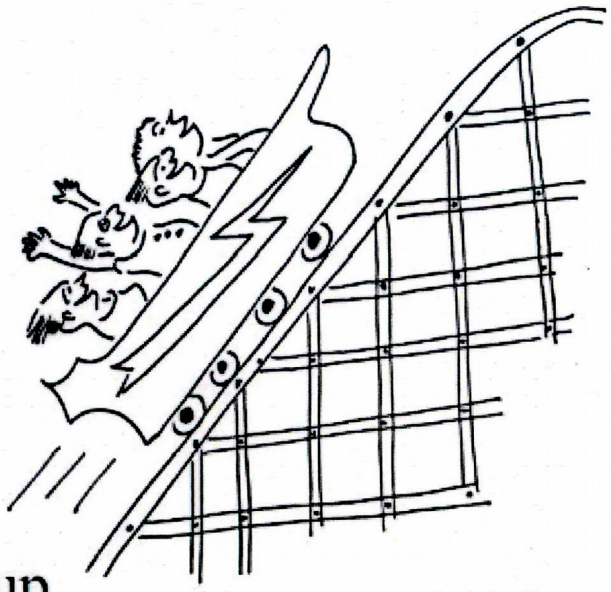


The dawn of the quark model.

Parity Violation


BAR
"A scientific discovery has no merit unless it can be explained to a barmaid!"
Claus Gmpen 2015


B
u
b
c
d
t
b
D
K
H



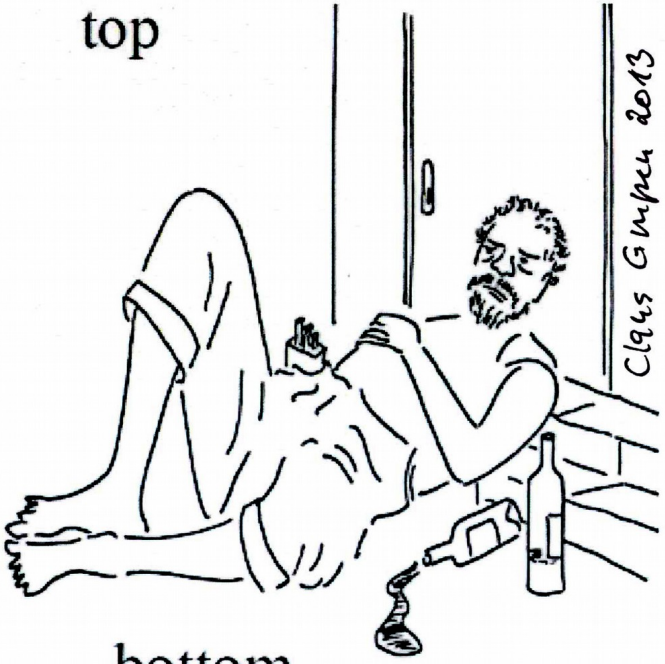
up

charm

top

down

strange

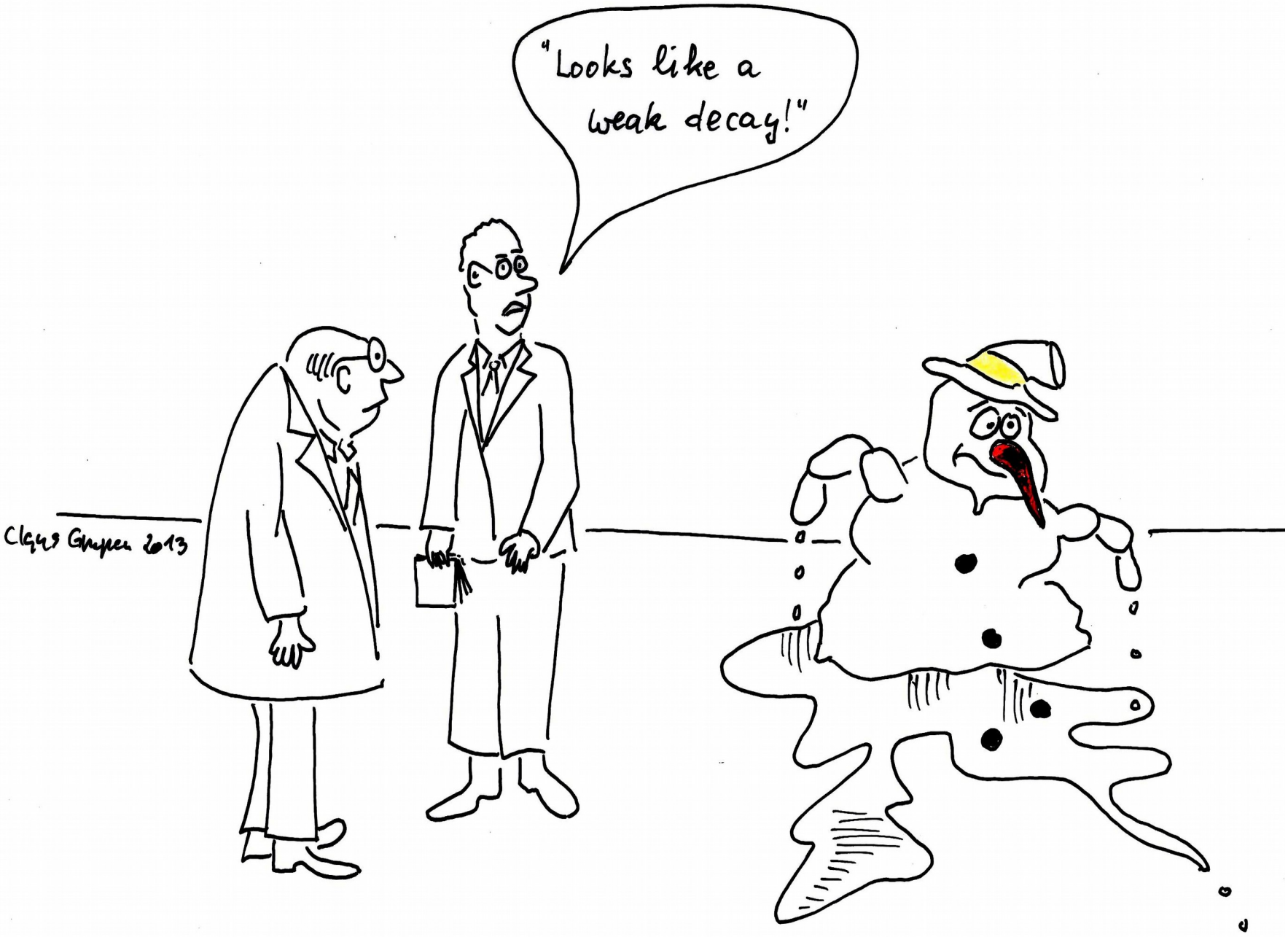


bottom

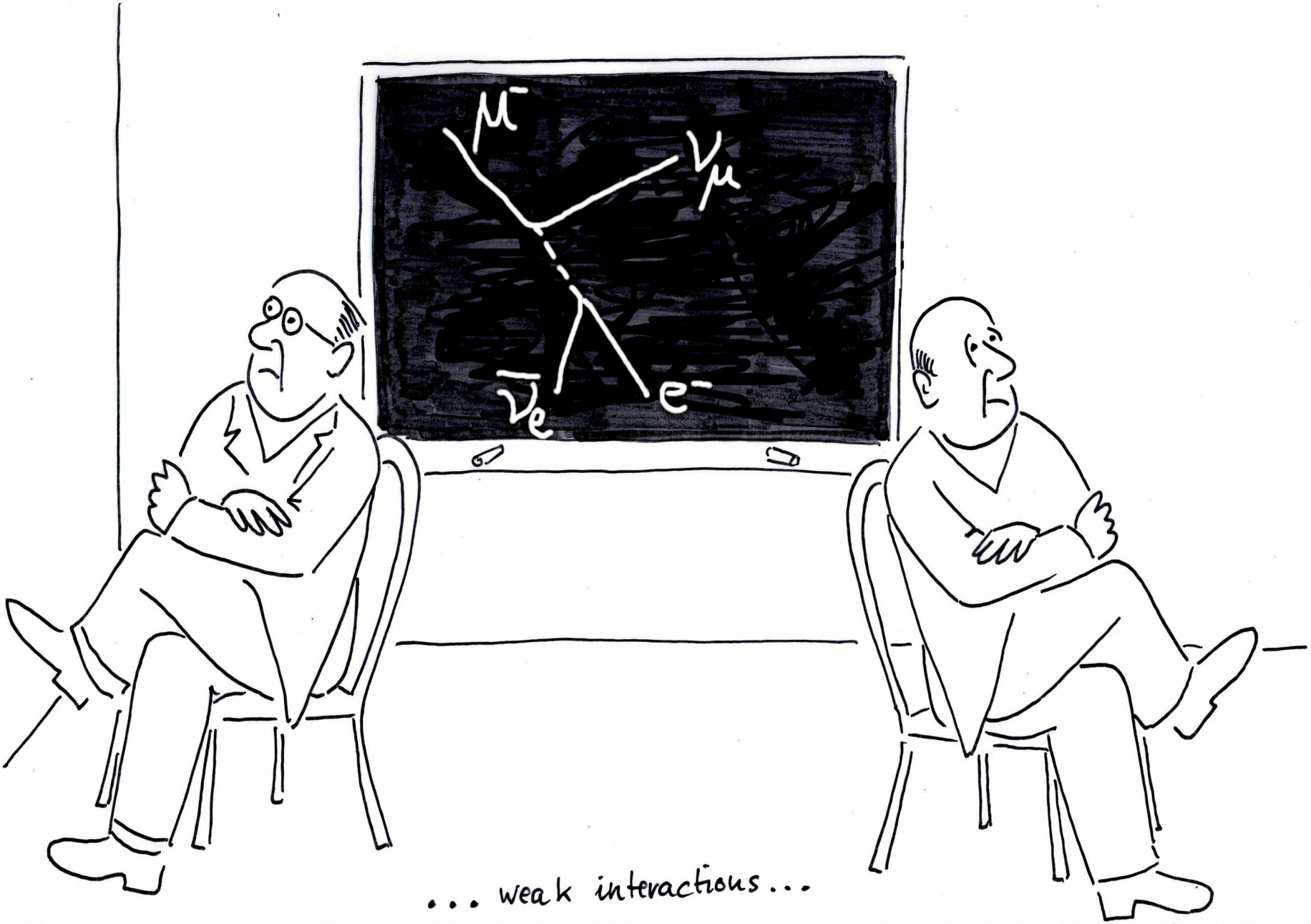

"Quarks are very tiny constituents of nucleons, which you cannot see with the naked eye unless you have been drinking".
Claus Gimpen 2015

B Physics and Weak Decays

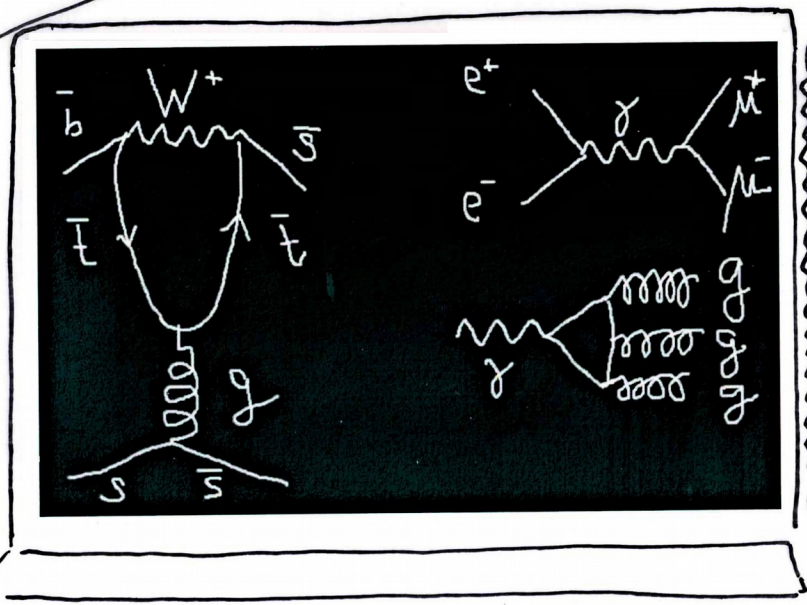
"True, I have put on a lot of weight!
But I have a beauty tag!"

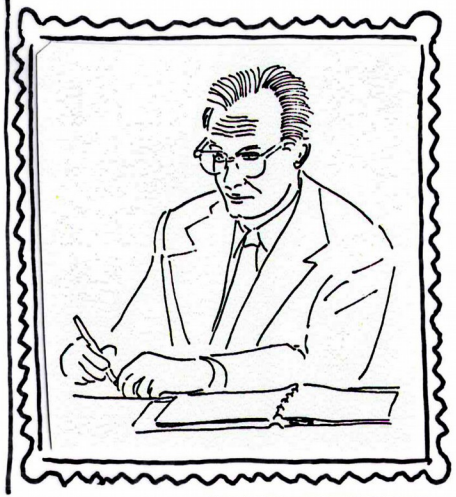

"Looks like a weak decay!"
Claus Grupen 2013

Claus Grupen 2013

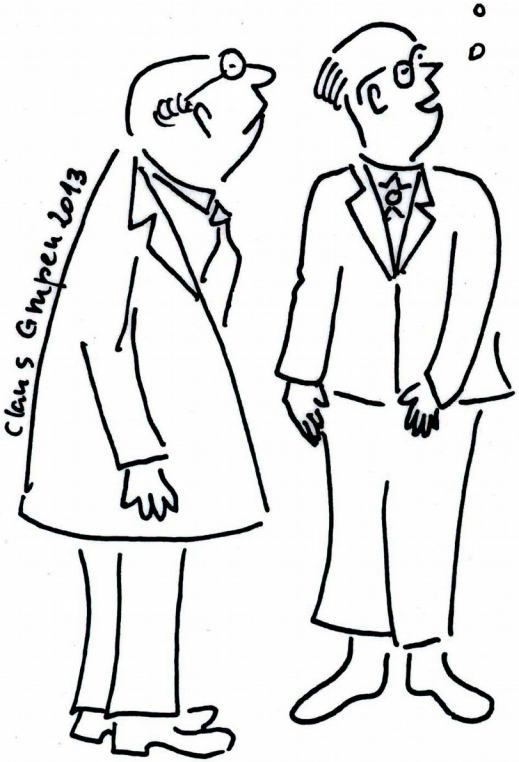

μ^-
ν_μ
$\bar{\nu}_e$
e^-
... weak interactions...

"It doesn't look like a penguin.....
But then, the other Feynman diagrams
also don't look like Feynman!"

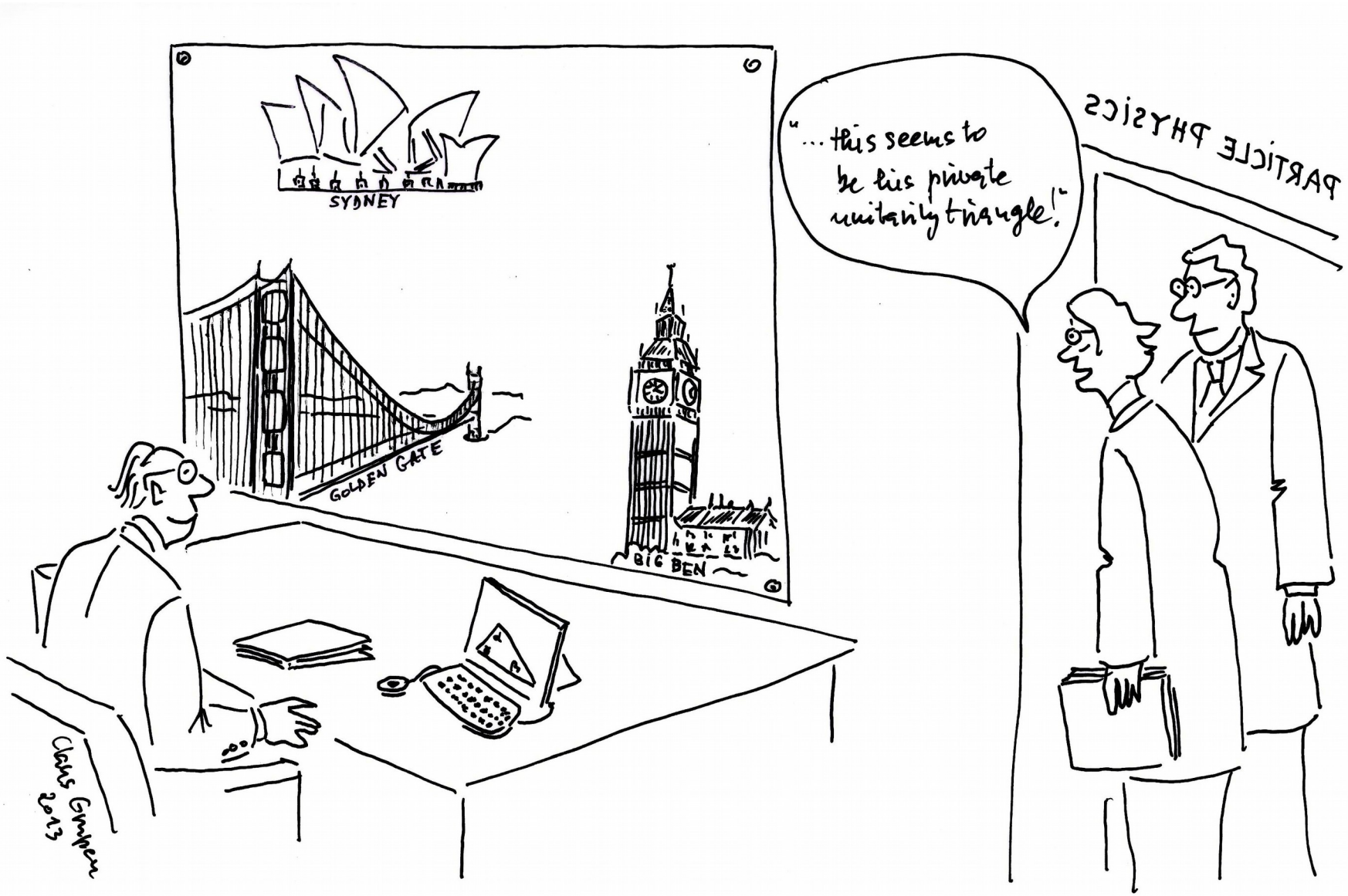




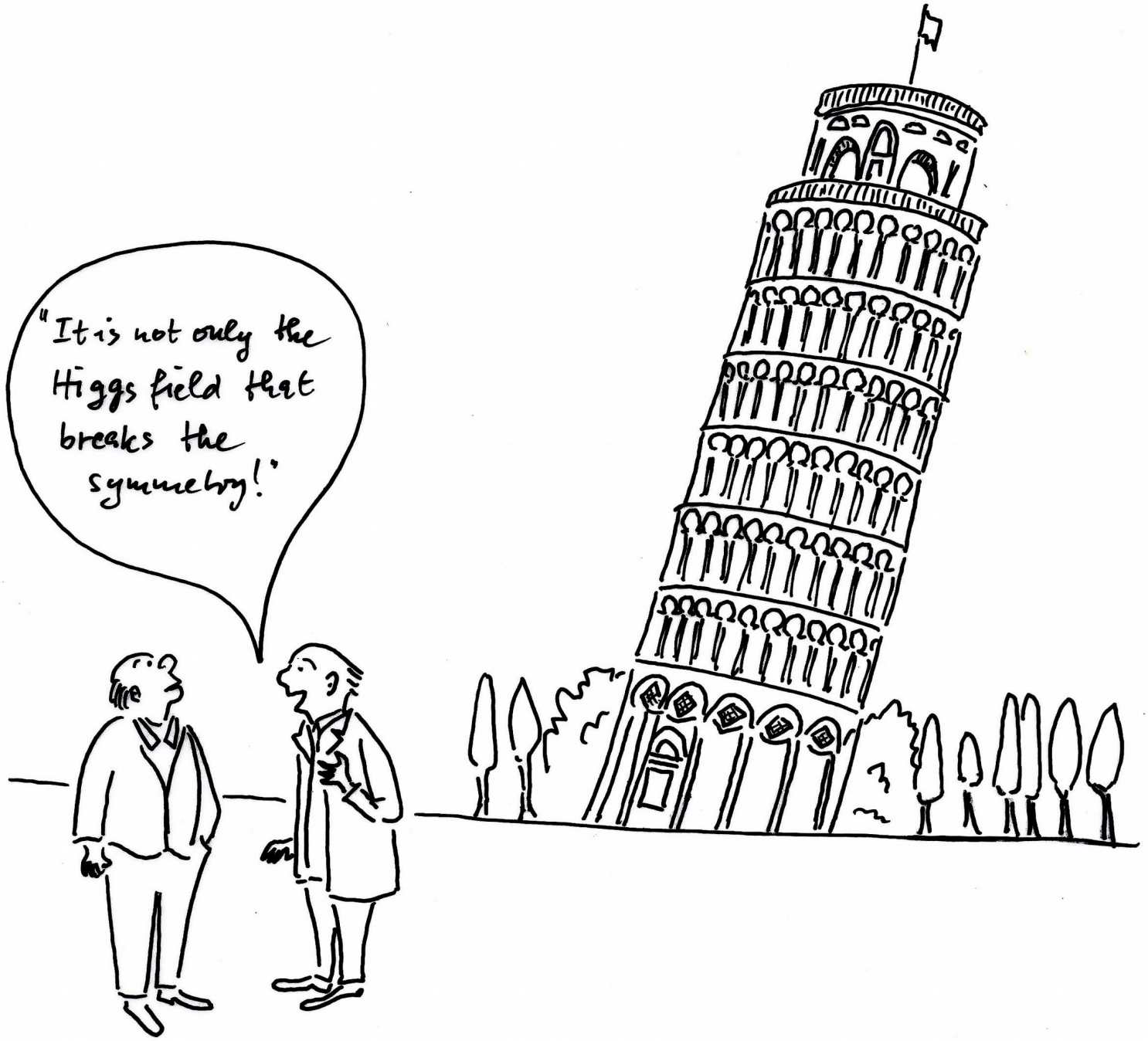
R. Feynman

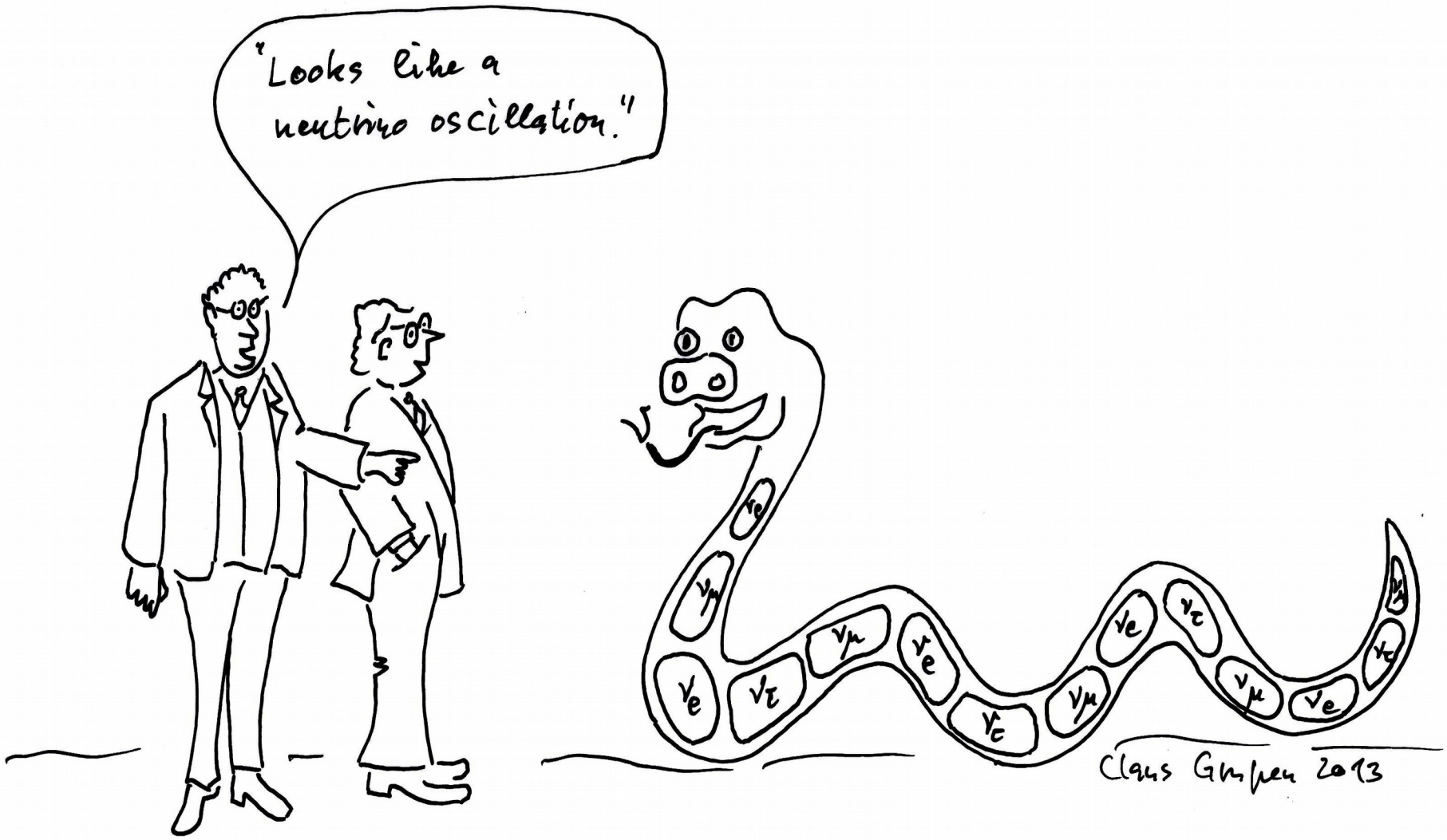


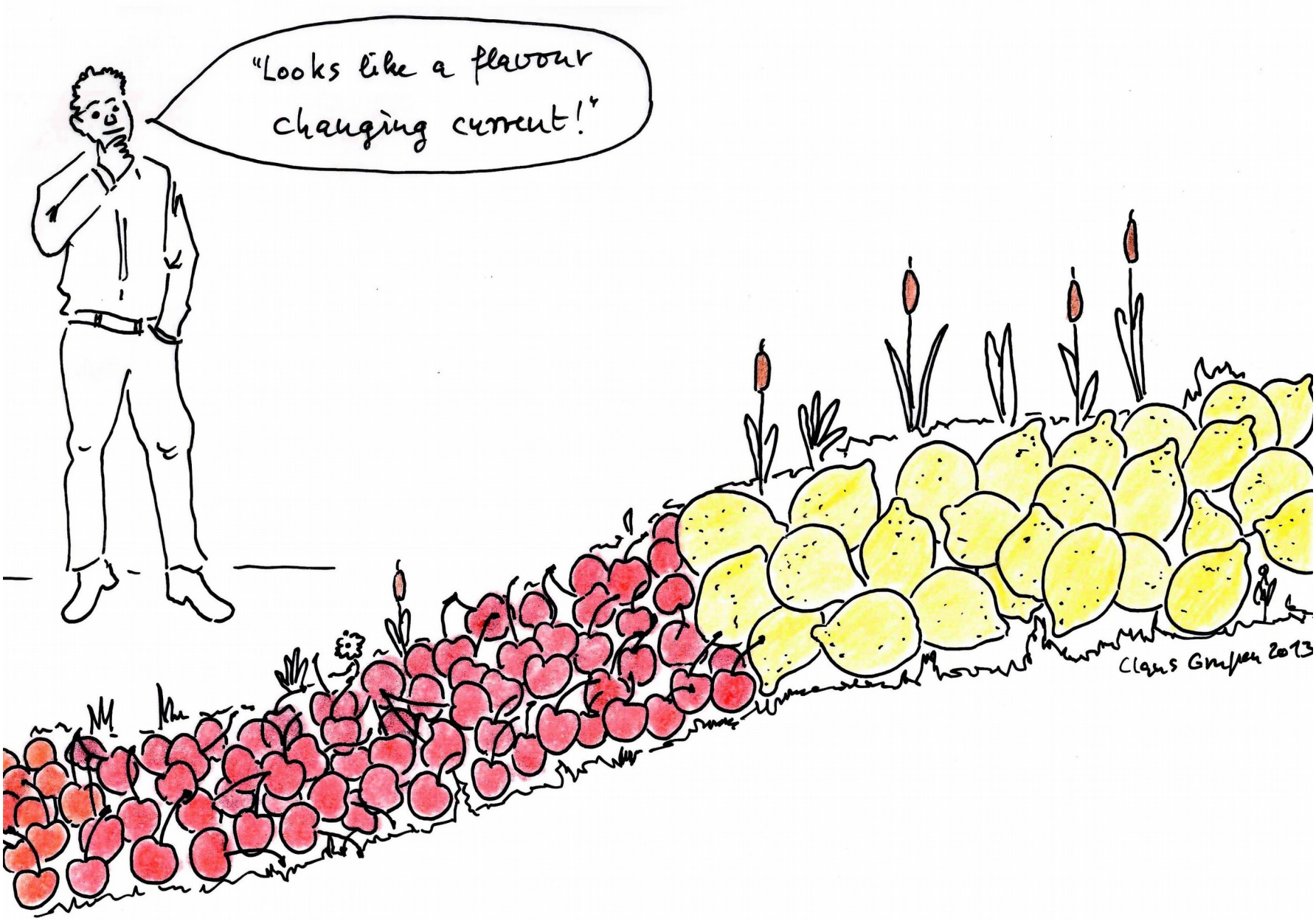
Claus Gmpen 2013


SYDNEY
GOLDEN GATE
BIG BEN
"... this seems to be the private unitarity triangle!"
PARTICLE PHYSICS
Claus Grupen 2013

Symmetry Breaking

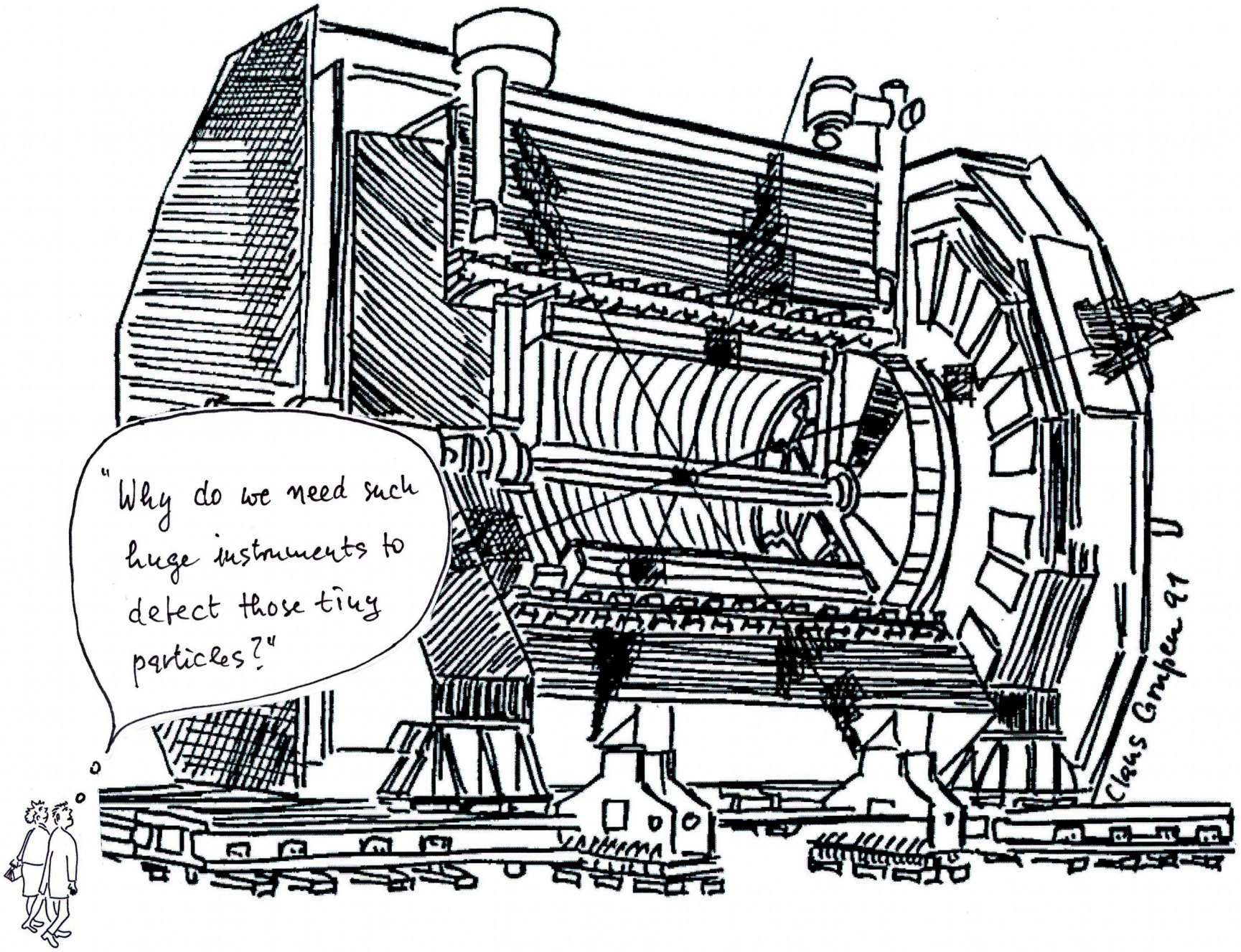

"It is not only the Higgs field that breaks the symmetry!"

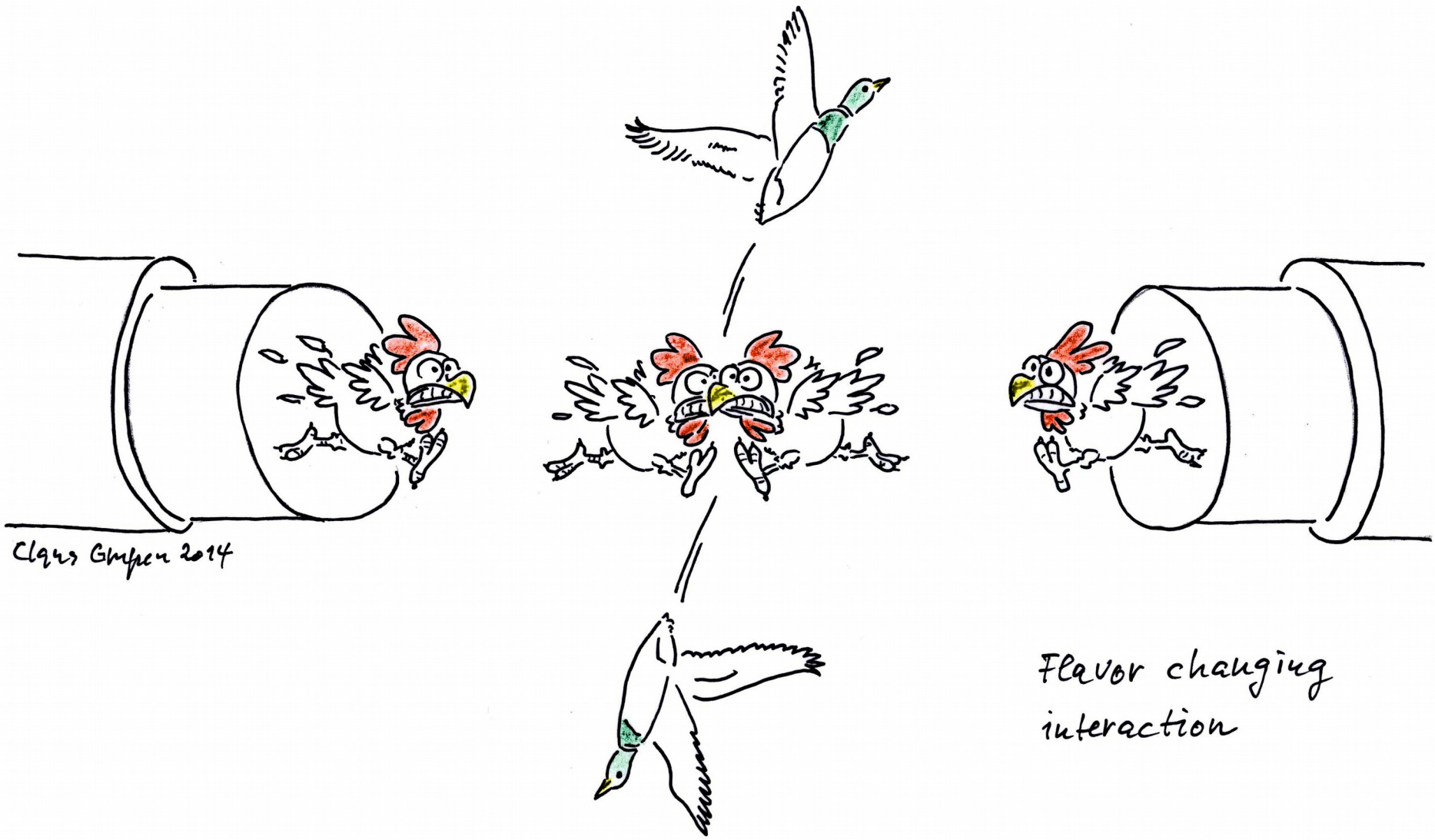

"Looks like a neutrino oscillation."
Claus Grupen 2013


"Looks like a flavour changing current!"
Claus Gmeiner 2013

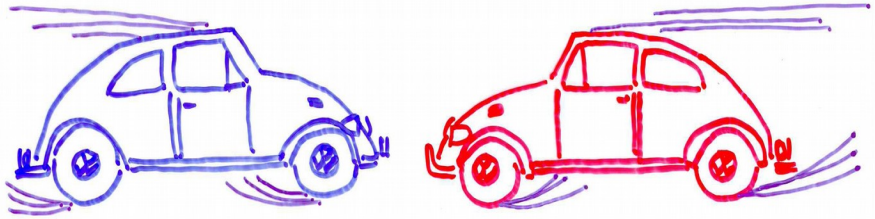
Experiments

An ugly experimental fact can ruin a beautiful theory.


"Why do we need such huge instruments to detect those tiny particles?"
Claus Grupen 91

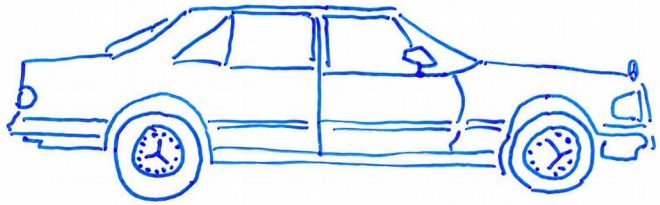


Flavor changing interaction

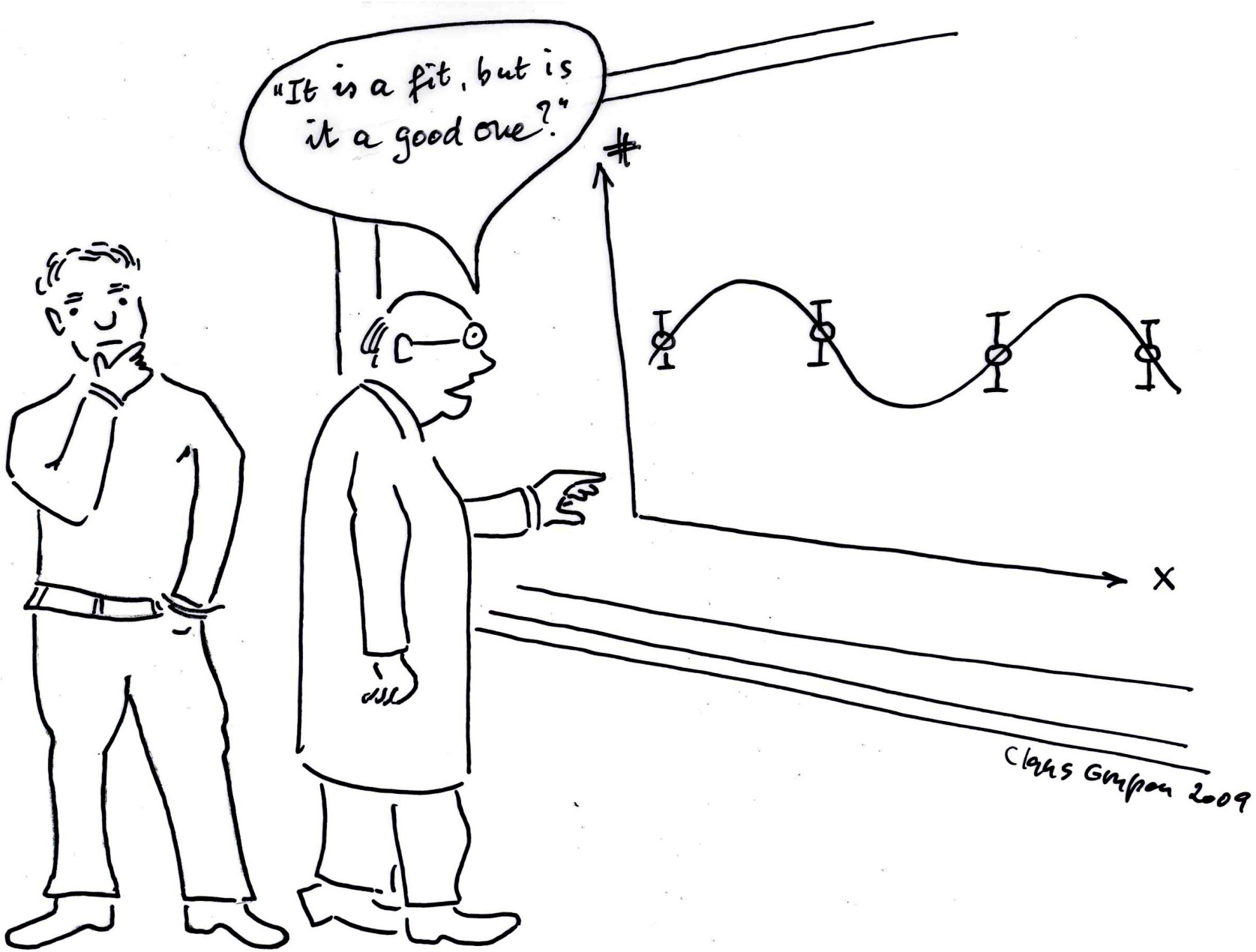


... acceleration

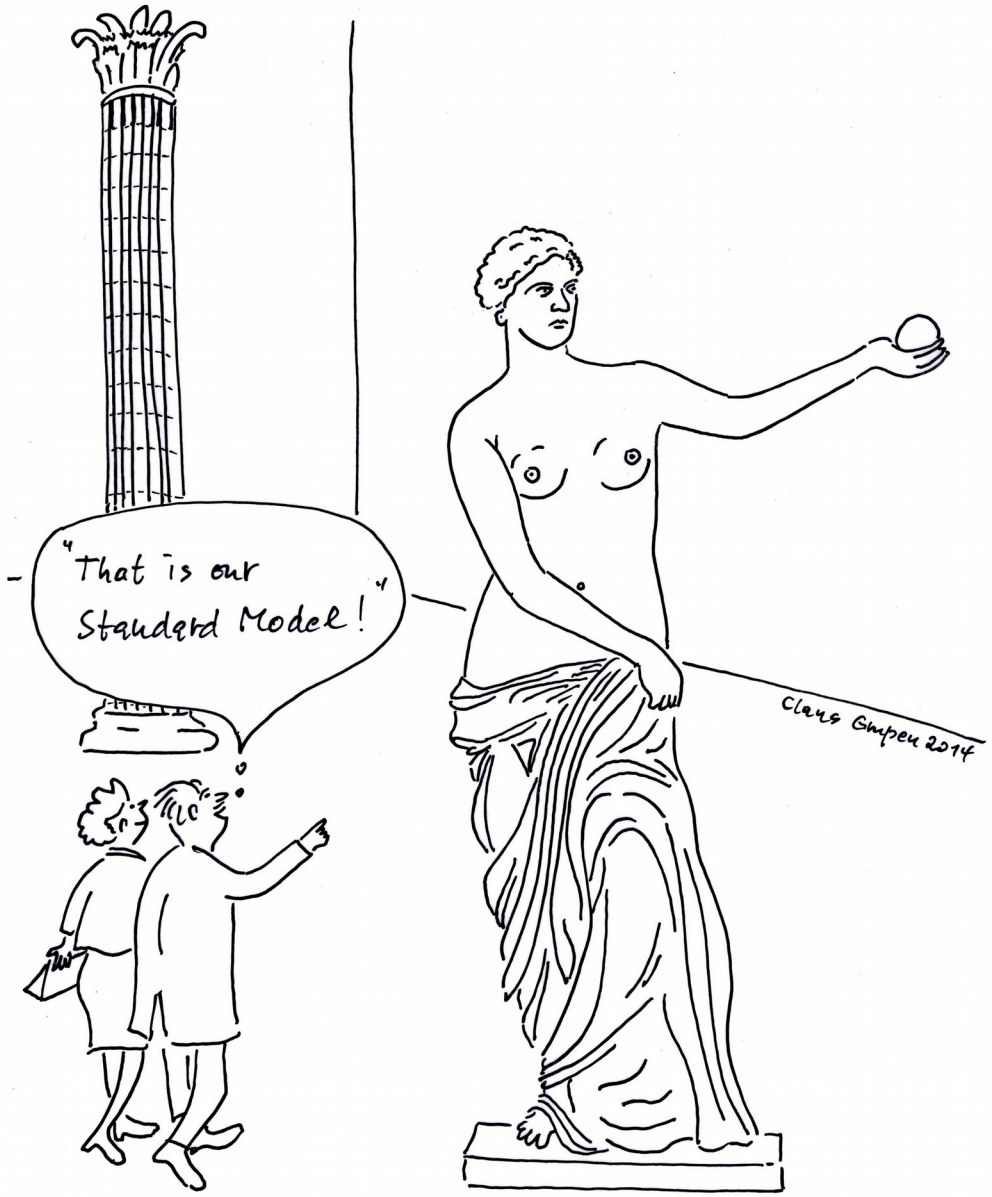
... collision

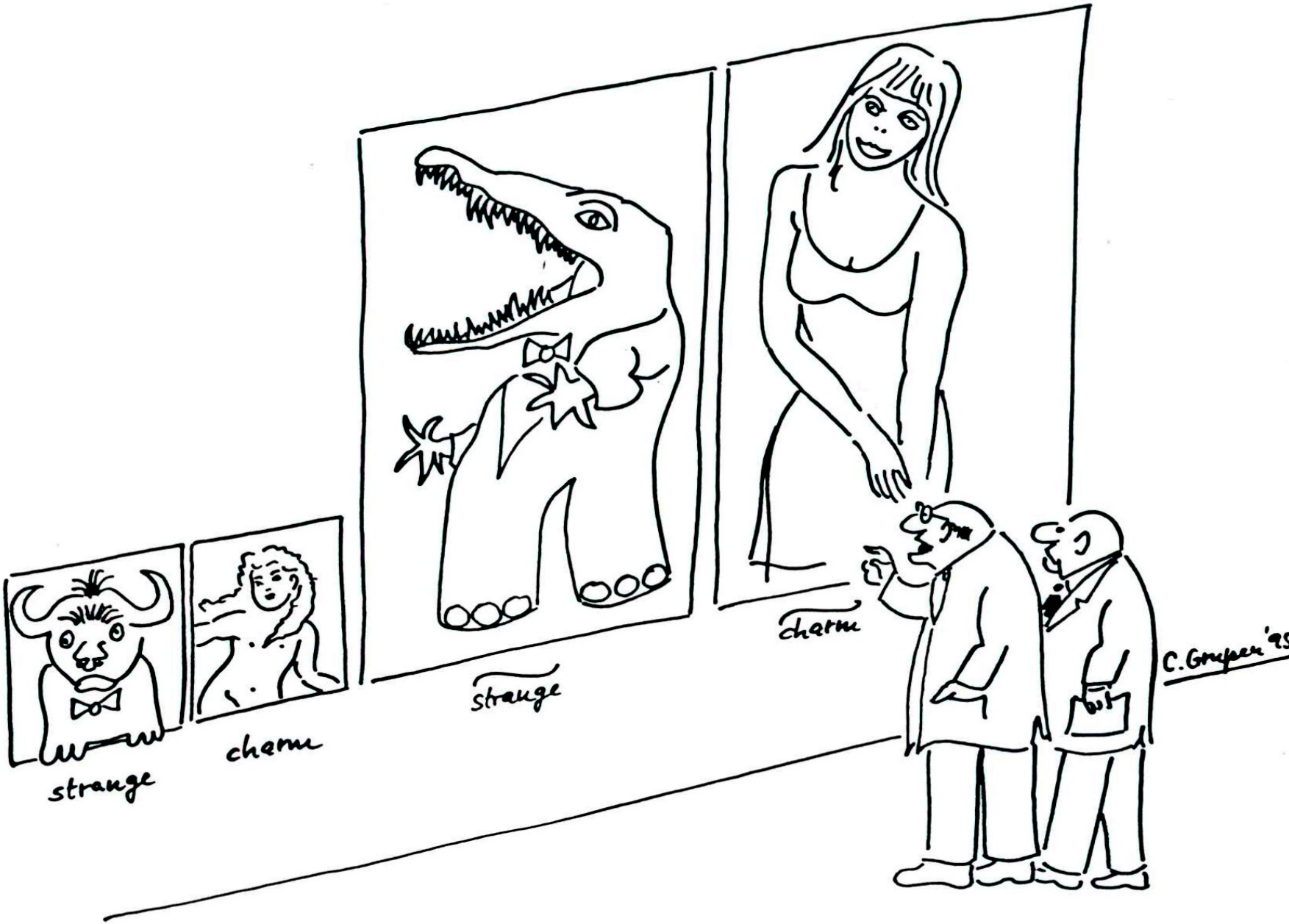


... result with a rare cross-section

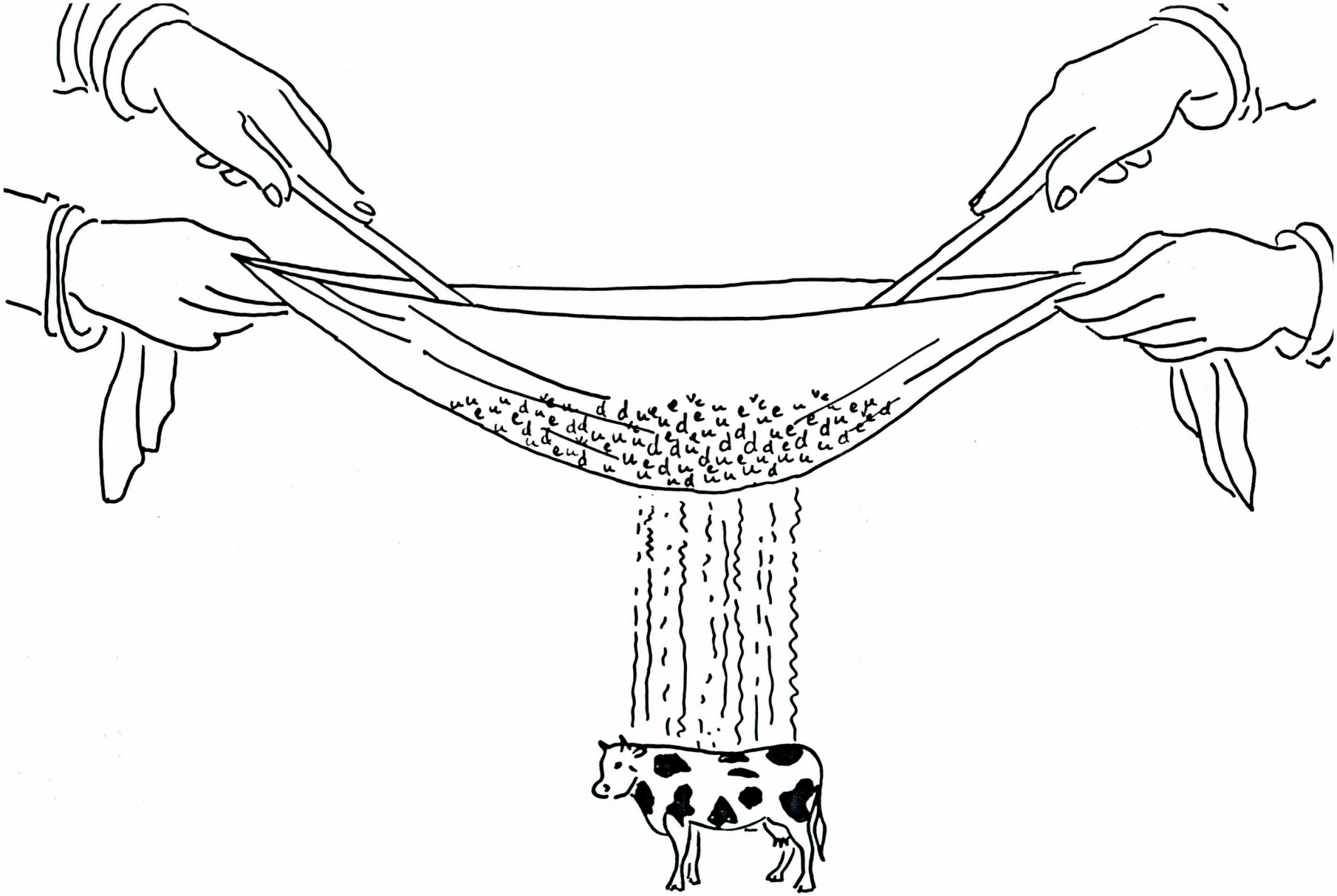

"It is a fit, but is it a good one?"
#
X
Claus Gwiser 2009

Beyond the Standard Model


"That is our Standard Model!"
Claus Gimpel 2014



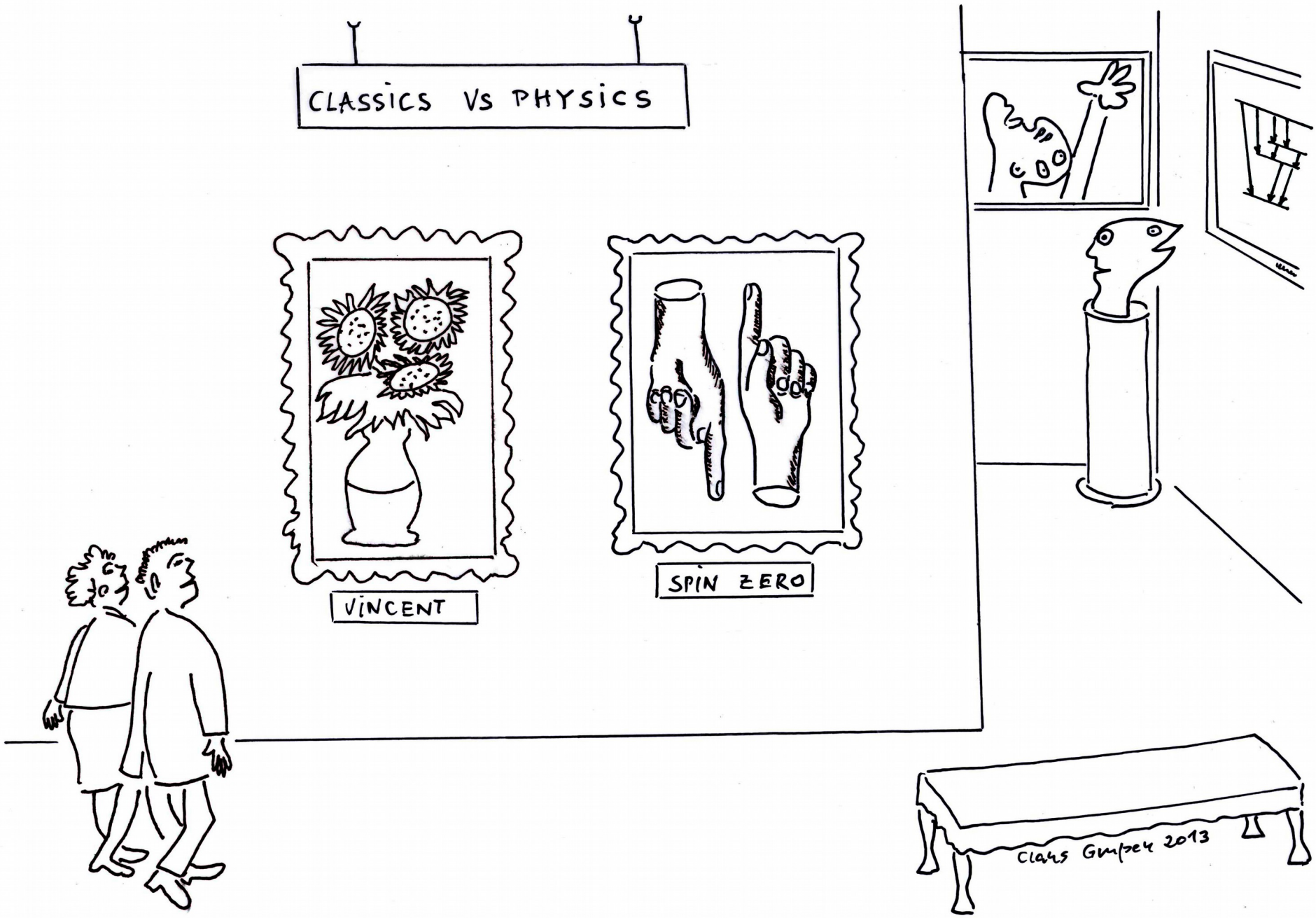
"These are the supersymmetric partners of strange and charm!"

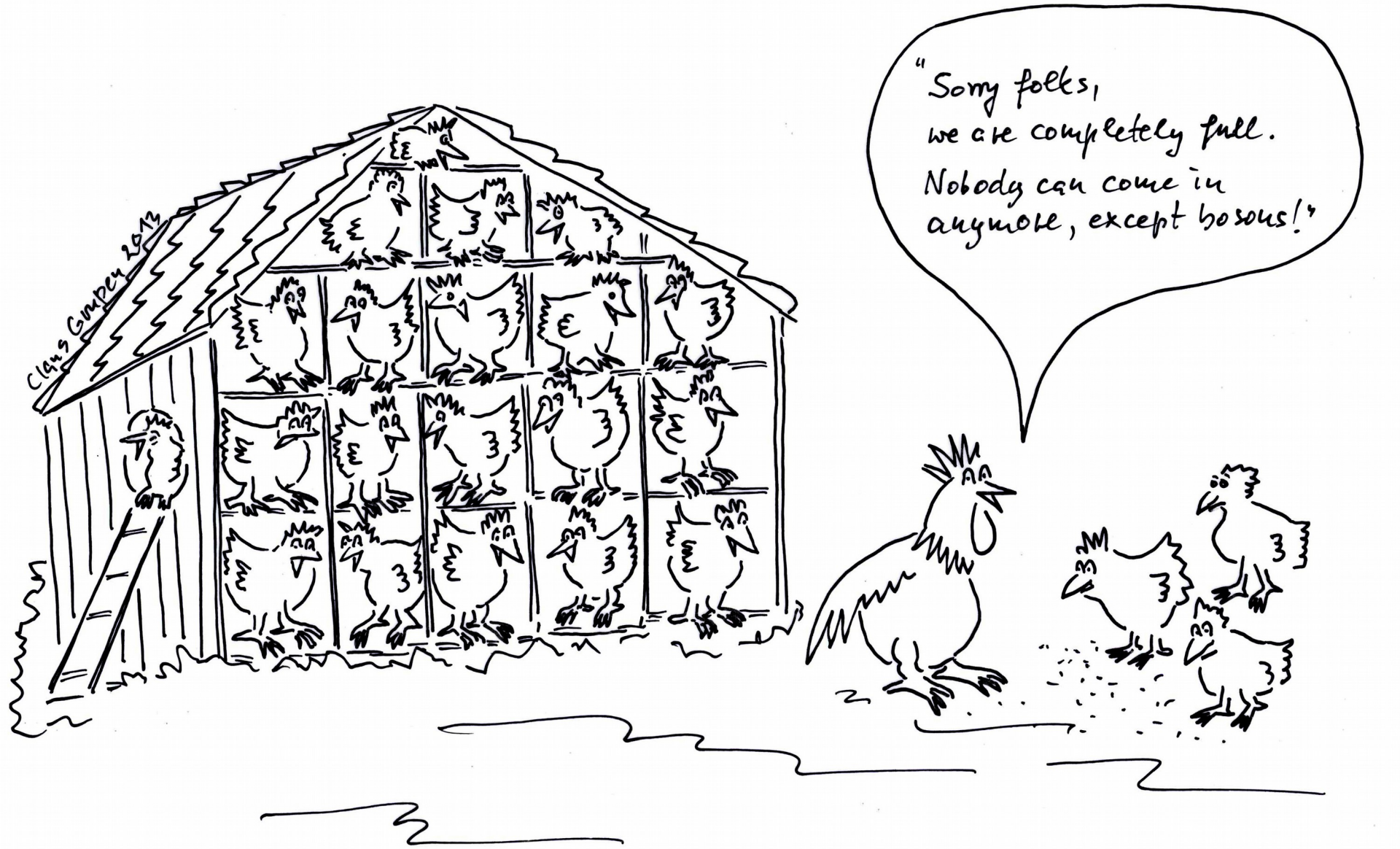


Creation of Life

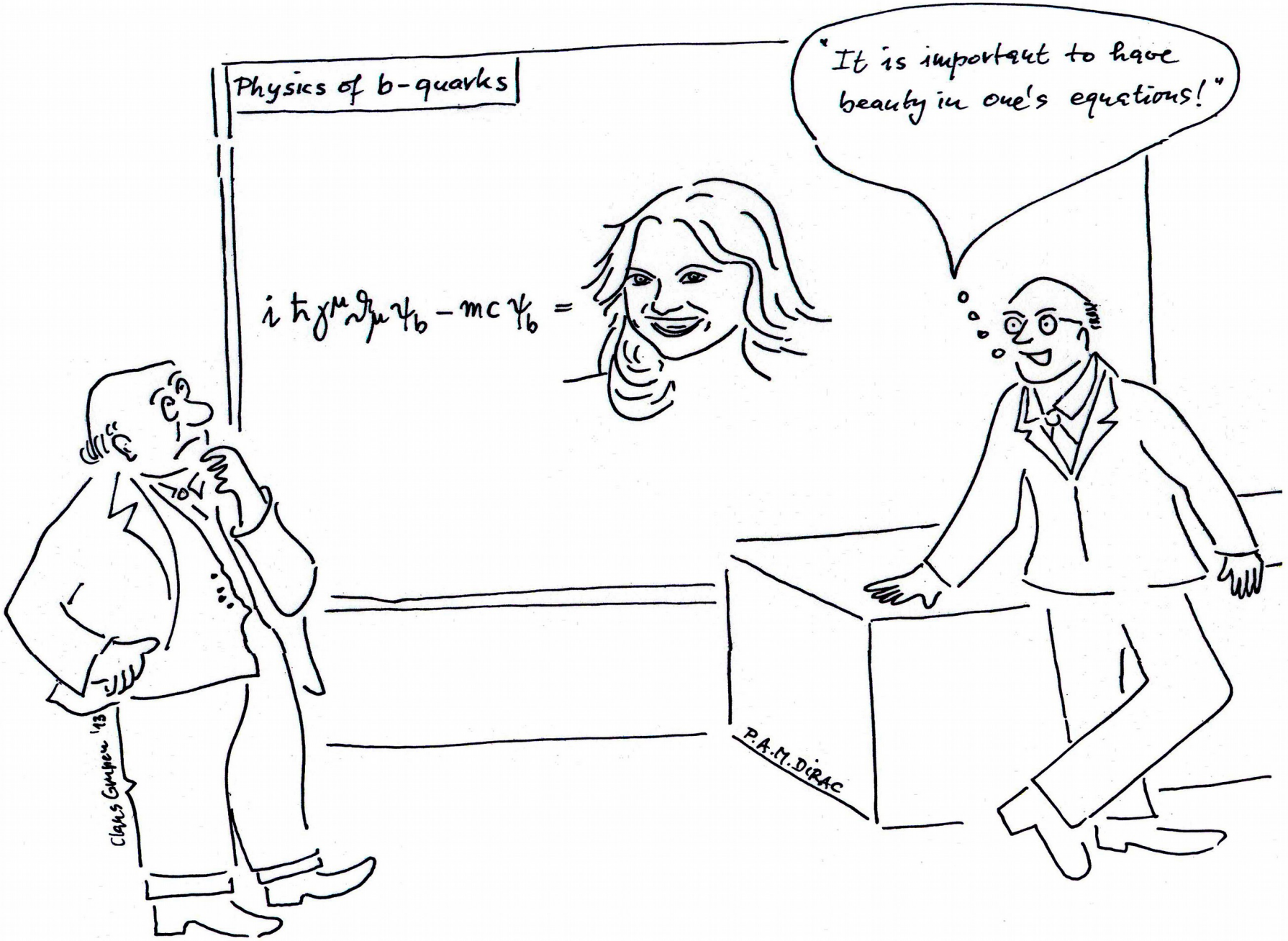
Claus Grupen 1993

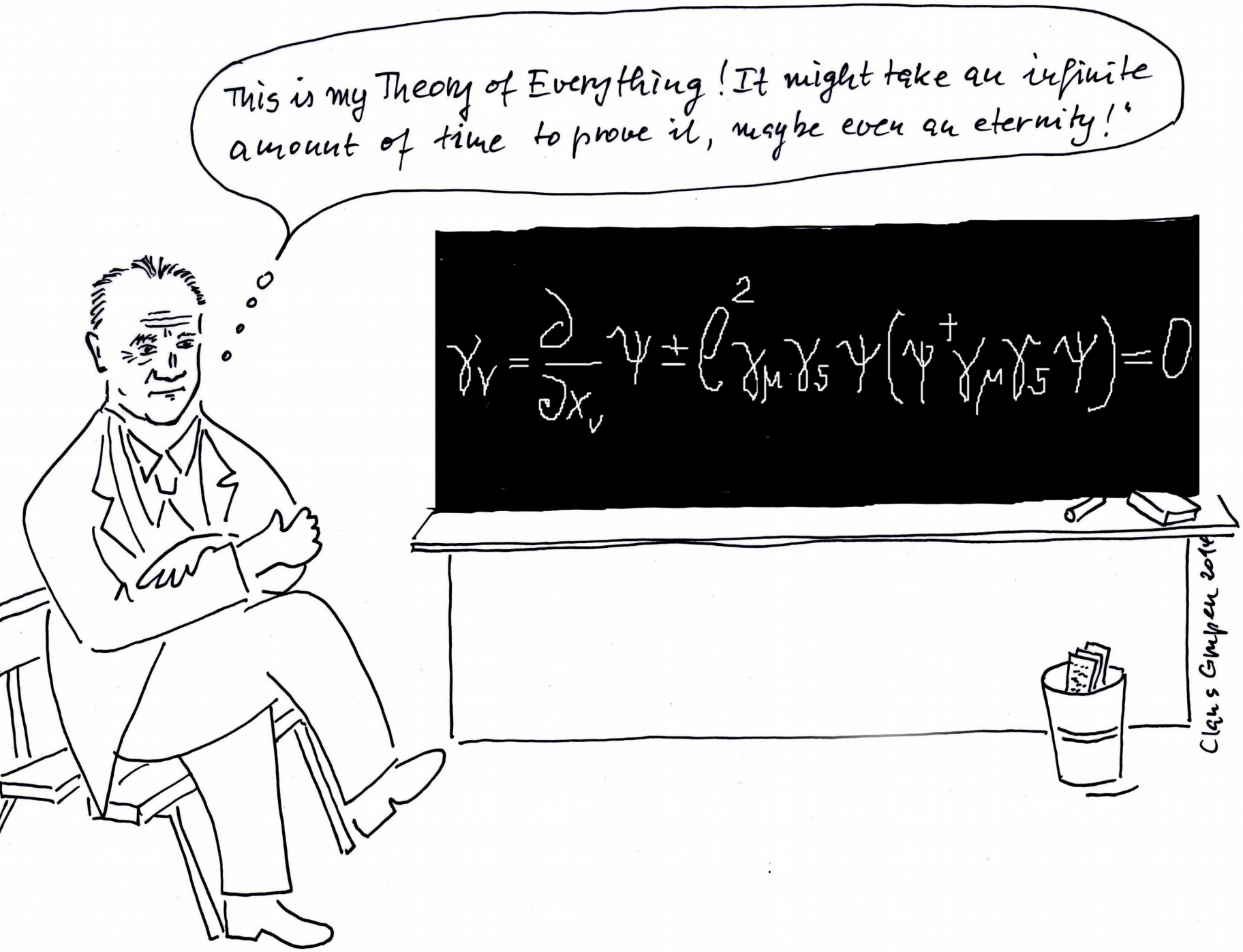
Spin Physics

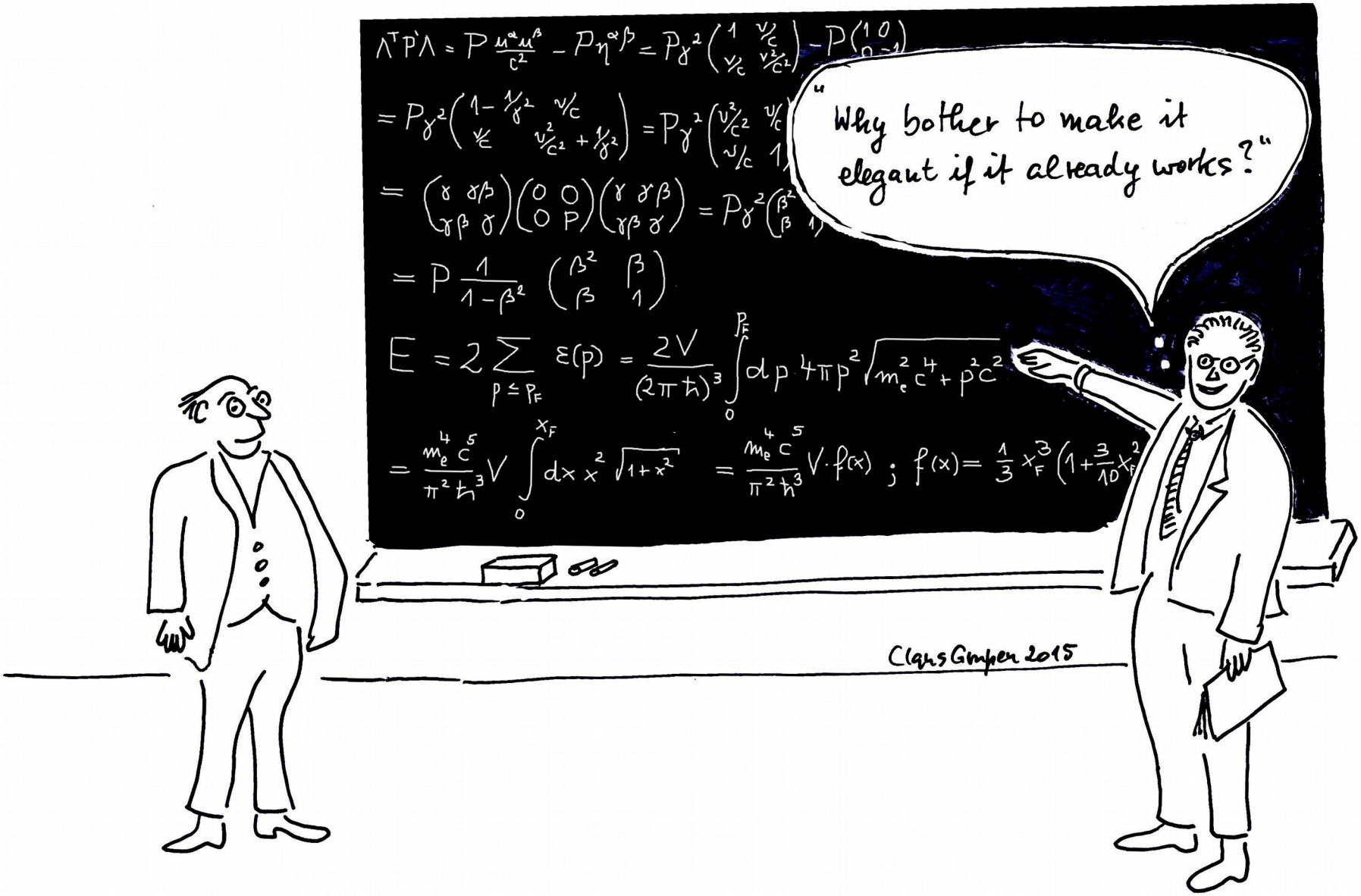

CLASSICS Vs PHYSICS
VINCENT
SPIN ZERO
Claus Gimpel 2013


Claus Gimpel 2013
"Sorry folks,
we are completely full.
Nobody can come in
anymore, except bosons!"

Theory of Everything

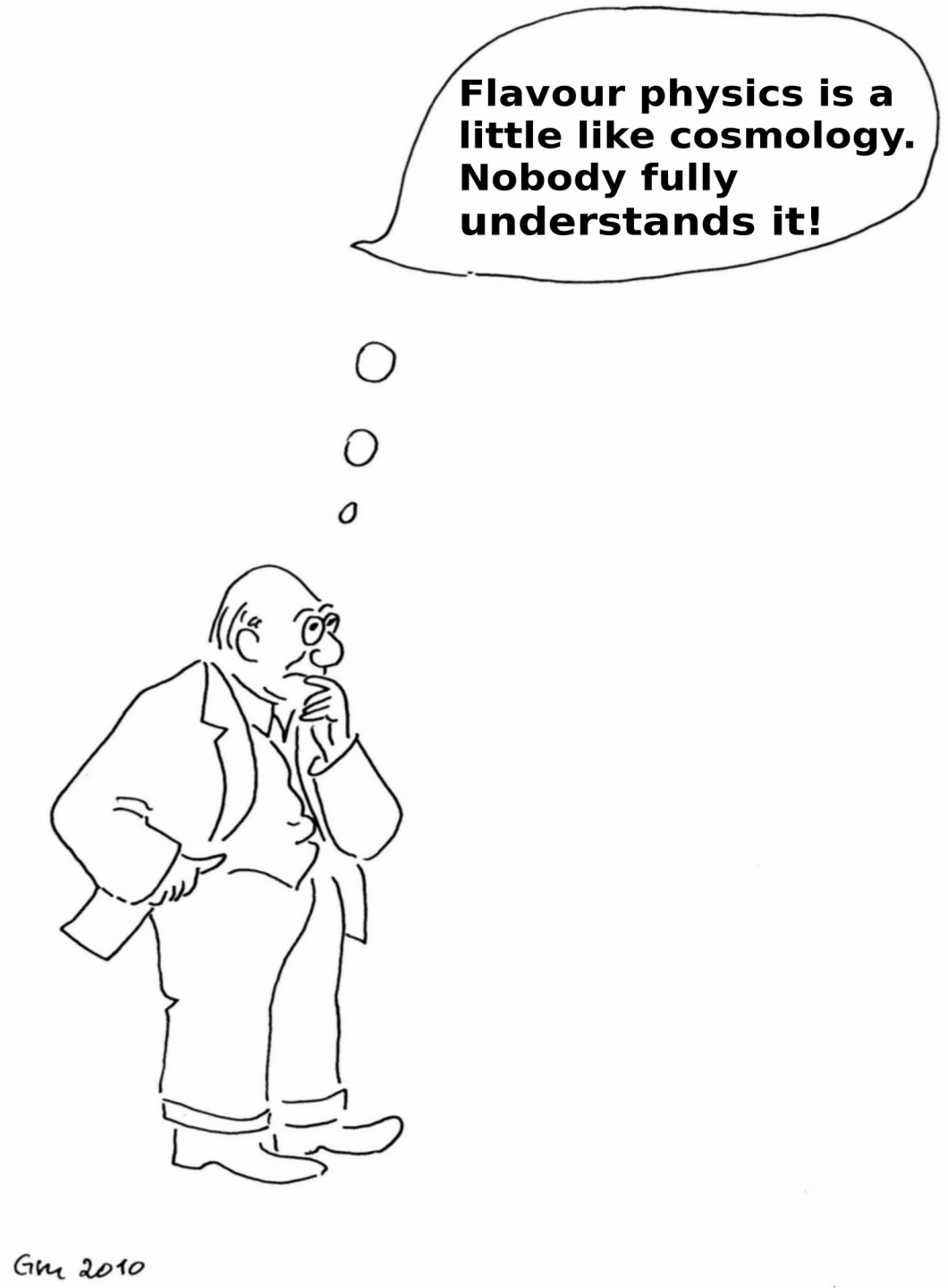

Physics of b-quarks
$i\hbar\gamma^\mu\partial_\mu\psi_b - mc\psi_b =$
"It is important to have beauty in one's equations!"
P.A.M. DIRAC
Claus Gumpen '13


This is my Theory of Everything! It might take an infinite amount of time to prove it, maybe even an eternity!"
$\gamma_\nu = \frac{\partial}{\partial x_\nu}\psi \pm \ell^2 \gamma_\mu \gamma_5 \psi (\psi^\dagger \gamma_\mu \gamma_5 \psi) = 0$
Claus Gmyrek 2019


"Why bother to make it elegant if it already works?"
Claus Gimper 2015

Conclusions


PSYCHOTHERAPIST
Dr. G. MELBORP
"I SOLVE ALL
YOUR PROBLEMS"
CLAUS GINDEN 2002


Flavour physics is a little like cosmology. Nobody fully understands it!
GM 2010