

HERTZ LECTURE.

DESY Lecture on Physics 2020

Mistakes on the way to a good idea:

Peccei-Quinn Symmetry. A tribute to Roberto Peccei.

Prof. Dr. Helen Quinn
(SLAC National Accelerator Laboratory)

24 September 2020

18:00 h, talk will be live-streamed

<https://webcast.desy.de>

I will talk about the development of the idea now known as Peccei-Quinn symmetry, and its consequences. I will use this work that I did together with Roberto Peccei to illustrate key features of how science progresses. While the problem we were addressing, and the answer we found for it are quite technical, this will not be a highly technical lecture. Rather it will be a story about our confusions and the circuitous path to their resolution. It is also an illustration of how the mathematical descriptions of physics, as Heinrich Hertz pointed out in reference to Maxwell's equations, not only provide solutions to the question or problem that led to their development, but can also suggest things that their developers did not even dream about.

This talk will also be a tribute to Roberto, emphasizing his attributes as a scientist, and as a person, that not only were key to this work but that made him a such a successful scientist and leader of scientific institutions throughout his career.



Heinrich Hertz

1857 Hamburg-Karlsruhe-Bonn 1894

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PHYSICAL REVIEW LETTERS

CP Conservation in the Presence of Pseudoparticles*

20 JUNE 1977

R. D. Peccei and Helen R. Quinn†
Institute of Theoretical Physics, Department of Physics, Stanford University, Stanford, California 94305
(Received 31 March 1977)

We give an explanation of the CP conservation of strong interactions which includes the effects of pseudoparticles. We find it is a natural result for any theory where at least one flavor of fermion acquires its mass through a Yukawa coupling to a scalar field which has nonvanishing vacuum expectation value.

PHYSICAL REVIEW D

VOLUME 16, NUMBER 6

Constraints imposed by CP conservation in the presence of pseudoparticles*

15 SEPTEMBER 1977

R. D. Peccei and Helen R. Quinn†
Institute of Theoretical Physics, Department of Physics, Stanford University, Stanford, California 94305
(Received 31 May 1977)

We elaborate on an earlier discussion of CP conservation of strong interactions which includes the effect of pseudoparticles. We discuss what happens in theories of the quantum-chromodynamics type when we include weak and electromagnetic interactions. We find that strong CP conservation remains a natural symmetry if the full Lagrangian possesses a chiral U(1) invariance. We illustrate our results by considering in detail a recent model of (weak) CP nonconservation.

PHYSICAL REVIEW LETTERS

Hierarchy of Interactions in Unified Gauge Theories

H. Georgi,† H. R. Quinn, and S. Weinberg
Lyman Laboratory of Physics, Harvard University, Cambridge, Massachusetts 02138
(Received 15 May 1974)

We present a general formalism for calculating the renormalization effects which make strong interactions strong in simple gauge theories of strong, electromagnetic, and weak interactions. In an SU(5) model the superheavy gauge bosons arising in the spontaneous breakdown to observed interactions have mass perhaps as large as 10^{17} GeV, almost the Planck mass. Mixing-angle predictions are substantially modified.

