

# “Are Bosons Breakers of Standard Model? A New Confirmation Projects at Fermilab and CERN.”

By Imrich KRIŠTOF, M.Sc.<sup>a</sup>

<sup>a</sup>Faculty of Science, Masaryk University Brno, Kotlářská 2, 611 37 Brno,  
Southern Moravia, The Czech Republic, Central Europe, The Czech Republic.  
Republic.

Author for correspondence:

Imrich KRIŠTOF, M.Sc.

[imrik@atlas.cz](mailto:imrik@atlas.cz)

## **Abstract:**

Since the discoveries of Goldstone Boson, Hungarian Protophobic X Boson,  $W^+$ ,  $W^-$  and  $Z^0$  bosons, sometimes called WIMP'S (WEAK INTERACTING MASSIVE PARTICLES ( $W^+$ ,  $W^-$ )) and namely superknown The “God” Particle – Higgs Boson run more than 10 years. Particle Physics must be have resumed and confirmed and namely new discoveries for example Triple WWW bosons, produced in Particle Collisions.

The ATLAS Collaboration at CERN has detected recently (a few months ago) triple W-boson production – a rare event that could eventually offer signs of new physics, beyond The Standard Model.

The History of discoveries of Bosons elementary particles are far from finished and are interesting and exciting like the extraordinary lives of scientifically celebrities, who this elusive particles detected or predicted.

This realities led to probably rebuilt of The Standard Model and many theoretically and mathematically concepts or basic building stones of The Modern Particle Physics.

**Keywords:** Bosons, Standard Model of particles, WIMP'S, “God” particle, ATLAS Collaboration, WWW boson, CERN, Fermilab, Physics Beyond Standard Model.

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## 1. Introduction

The Standard Model of Elementary Particles, Forces and Fields was a Holy Grail of Theoretical and Particle Physics, it seems, that a last few decades approximately between years 1998 (The First Detection of Neutrino) and 2015 (The First Detection of Oscillation of Neutrinos). Oscillation in 3 flavors /"boom of QFD"/(QUANTUM FLAVORDYNAMICS)/.

Detection of an electron neutrino  $\rightarrow$  muon neutrino and Tau neutrino (Super Heavy neutrino), Oscillations in Japanese Detector in the underground of the former Mine Locality Kamioka in Japan  $\rightarrow$  "Superkamiokande" nowadays "Hyperkamiokande". With help of Neutrino Oscillations (Nobel Prize for Physics 2015) – Takaaki Kajita (Superkamiokande, Japan) and Arthur B. McDonald (Sudbury Neutrino Observatory, Canada), was proved, that neutrinos have non-zero mass, but was detected also, that Neutrino could be A MAJORANA'S PARTICLE – it means be that neutrino and antineutrino are identically particle.

Together particle Neutrino with a negative charge and also antiparticle called Antineutrino with hypothetically positive charge according due to DOUBLE INVERSE  $\beta$  DECAY.

An Experiment GERDA going in the underground laboratory GRAN SASSO (ITALY) in these consequences with till days the most sensitivity of detection verify possibility, that neutrons could be decay due to DOUBLE  $\beta$  DECAY, like  $\beta^-$  radiation (electrons) and like  $\beta^+$  (positrons).

Inverse  $\beta$  Decay, in neutrons are defined like a decomposition and regroup of quarks and Neutron disintegrates due to  $\beta^{+/-}$  decay.

The last problemma of breaking of The Standard Model give to play bosons  $W^\pm$  (WEAKLY INTERACTION) and  $Z^0$  (ZERO CHARGE), and Higgs boson and not in the last place  $\rightarrow$  PROTOPHOBIC X BOSON by The Research At ATOMKI DEBRECEN (HUNGARY) UNDER THE LEADING BY Prof. Dr. Attila KRASZNAHORKAY, Dr.Sc.

Quite complicated, but very relevant and significant will be situation about  $J/\psi$  [PSION] MESON, which is many decades ((from November 1974) known like November Revolution) on the strategic focus of Psychiatry, Psychology, Psychobiology and Psychochemistry – an elusive but probably NON-ZERO MASS PARTICLE  $\Psi$  (PSÍ) OR PSION will offer yet many discoveries on the field of PSYCHOPHYSICAL SCIENCES, for example: Weber-Fechner Psychophysical Law, Quantum Teleportation, Telepathy and Telekinetic sciences, and many senses connected with human physically and psychologically abilities like a memory, a dream, quantum optical events [hallucination, tunnel seeing], emotions, love /  $\beta$  endorphin empathy and emotional intelligence, déjà vu, jamais vu, flashback, ...

These phenomenons will led to better acception of multidimensional reality [MULTIVERSUM] and better insights to HUMAN BRAIN AND HUMAN BEINGS, THE MOST INTERESTING, POWERFUL AND COMPLEXITY REALITY IN THE EVOLUTION OF UNIVERSE – THE HUMAN BRAIN AND BODY.

## 2. How many bosons are in The Standard Model?

There are 17 named particles in The Standard Model incorporated into the chart shown below, and predicted resp. expected elementary particles (7) like gluino, gravitino, axino and photino like the particles of DARK MATTER AND DARK ENERGY (Visually Fig. 1).

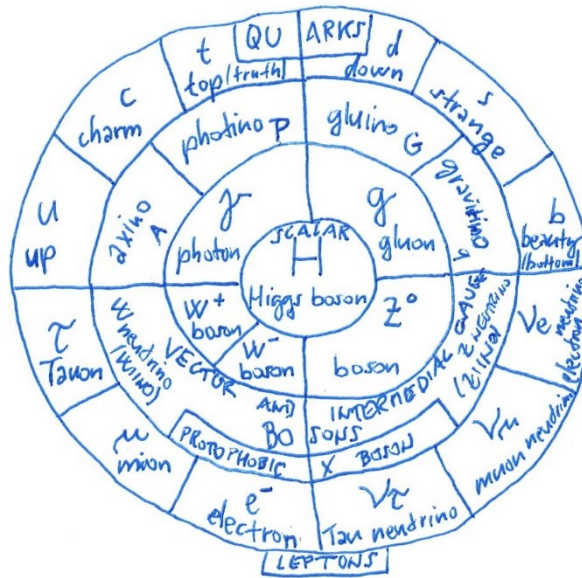


Fig. 1. Hypothetical Actual Diagram of detected and predicted elementary particles of The Standard Model According The Author: Imrich Krištof, M.Sc.

There are 17 named particles in the Standard Model, incorporated into the GROUPS OF PARTICLES: QUARKS, LEPTONS, BOSONS, FERMIONS, NEUTRINOS (PROBABLY MORE THAN FOUR (4 TYPES, RESONANCES, OSCILLATIONS), WIMP'S, GLUONS, PHOTONS, GRAVITINO (FORCES), EXAMPLES OF DARK MATTER AND ENERGY AXINOS AND AXIONS, MAYBE HYPERONS AND MUONS, HADRONS.

The OUTSTANDING POSITION IN THE STANDARD MODEL HAS PROTOPHOBIC X BOSON DISCOVERY FROM HUNGARIAN ATOMKI DEBRECEN (2015). THE EXACTLY X17, (B QUARK) PROTOPHOBIC X17 BOSON (~17 MeV), MYSTERIOUS PARTICLE CONSIST OF DARK MATTER AND D. ENERGY PROBABLY CONNECTED WITH The Fifth Force, is called QUINTESSENCE, WHAT WILL BE INTERESTING WITH THEORY OF EVERYTHING (TOE), SUPERSTRING THEORY, NAMELY HETEROTIC AND SUGRA + STR AND GTR (SUPERGRAVITY THEORY) AND LOOP GRAVITY + SPECIAL THEORY OF RELATIVITY AND GENERAL THEORY OF RELATIVITY).

The last particles discovered were the W and Z bosons in 1983, The TOP (TRUTH) QUARK in 1995, The TAU NEUTRINO in 2000, and like The Higgs boson in 2012. The Protophobic X17 Boson in 2015.

The Higgs Boson is the only known SCALAR BOSON.

### 3. What are Bosons?

... A subatomic particle, whose spin quantum number has an integer value (0,1,2,3, ...)

Bosons are different from second fundamental classes of subatomic particles – so called fermions, which have odd half-integer spin ( $1/2, 3/2, 5/2, \dots$ ). Consequences between Bosons and Fermions are explicit seen in Fermi-Bose Statistics (opposite Fermi-Pauli-Dirac Statistics) – non-interacting identical particles (Majorana's Particles – Neutrinos), these all depend on chosen Mathematic formalism.



Fig. 2. W and Z bosons (1983, SPS CERN).

### 3.1 Bosons Annihilation in an ATLAS Experiment

Boson annihilation are described in Feynman diagrams.

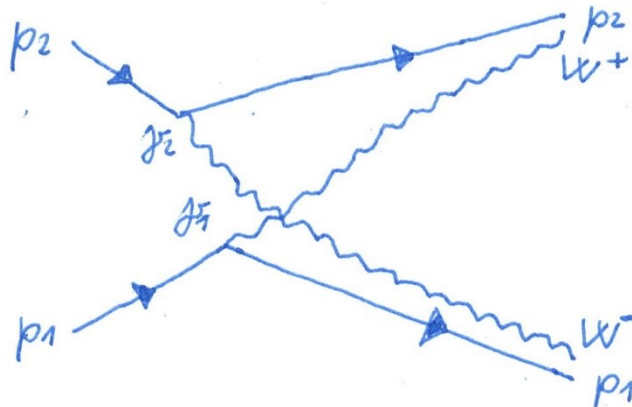


Fig. 3. BOSONS ANNIHILATION IN ATLAS EXPERIMENT EXPLAINED BY FEYNMAN DIAGRAMS.

The Bosons are connected with the fundamental questions:

Could be by  $W^\pm$  or  $Z^0$  bosons (Spin 1) connected with, so called DARK PHOTON AND Particles of DARK MATTER AND THE DARK ENERGY?

Are oscillations and resonances of bosons W, Z, really quantum states of quark, namely t (top, truth) quark?

The top (truth) quark and u (up) quark,  $\bar{u}$  (up) antiquark and d (down) quark and  $\bar{d}$  (down) antiquark, what's a role in QM, QED, QCD and QFD of top (truth) quark?

What's the role in CONFORMAL FIELD THEORY, SUPERSTRING HETEROTIC THEORY, AND QUANTUM LOOP SUPERGRAVITY of b (beauty, bottom) quark and  $\bar{b}$  (beauty, bottom) antiquark?

And what a bottomium resp beautium ( $b + \bar{b}$ ) and multiquarks.

6x6 results of combination of multiquarks (6 quarks + 6 antiquarks)  $\rightarrow$  tetraquarks, pentaquarks, hexaquarks  $\rightarrow$  new material composed matter substentions  $\rightarrow$  metamaterials, composite materials.

### 3.2 The most known Bosons

SCALAR BOSONS (SPIN = 0) (QUANTUM FIELD THEORY)

$\downarrow$  Lorentz Transformation, Lorentz invariant

HIGGS BOSON

(COMPOSITE PARTICLES)

$\alpha$ -particle ( ${}^4_2\text{He}$ ) + scalar mesons

The  $\phi^k$  Theory of QUARTIC INTERACTION IS KNOWN AS “TOY MODEL” OF QFT → PSEUDOSCALAR MESONS → PIONS ( $\pi^-, \pi^+, \pi^0$ ) – the most light mesons in Particle Physics.

Mass:  $\pi^+$ : 139,570 18 MeV/c<sup>2</sup>;  $\pi^0$ : 134, 976 6 MeV/c<sup>2</sup>.

Composition:  $\pi^+$ : u,d;  $\pi^0$ : u,u; or d,d;  $\pi^-$ : d,u.

Lifetime: 26 ns:  $\pi^+ \rightarrow \mu^+ + \nu(\mu)$ . The Neutrino  $\nu$  has negative helicity (angular momentum antiparallel to linear momentum).



Fig. 4. PION.

From Pions are derived Hideki Yukawa particle (1935) on base of Coulomb law.

Pion discovered →  $\pi^+$  Cesare Mansueto Giulio Lattes, Giuseppe Occhialini (1947),  
→  $\pi^0$  Cecil Powell (1950).

### 3.2.1 Protophobic X boson

Discovered by the Hungarian Group of Researchers by Prof. Attila Krasznahorkay in 2015.

This slow moving X boson, which has mass 16,7 million (eV) (MeV) splits into an electron – positron pair.

The Beryllium-8 anomaly is “beautifully” explained by the presence of a previously unknown “vector boson” a typically particle, that would wield a small-felt the fifth force of nature, connected with an extension of the STANDARD MODEL, namely with the DARK MATTER NEUTRINO MASSES, UNIFICATION OF THE FORCES AND OTHER MYSTERIES BEYOND THE STANDARD MODEL NEW PHYSICS.

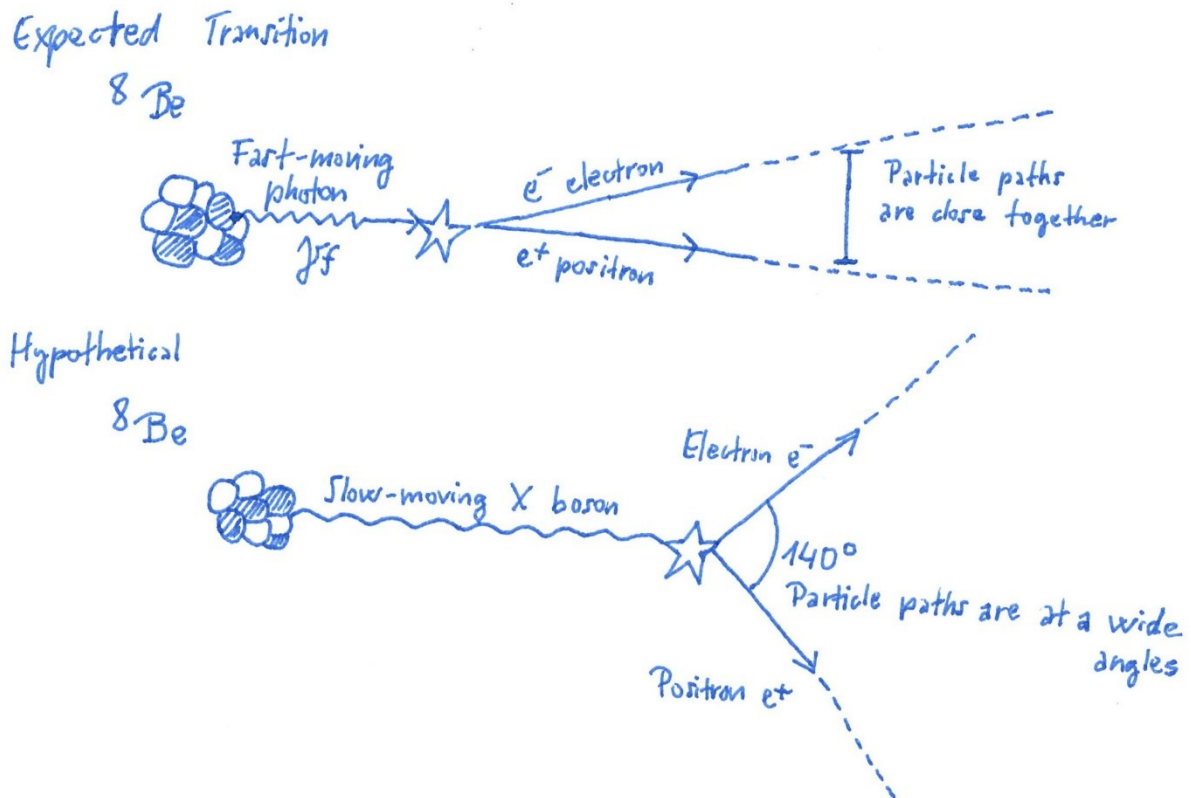


Fig. 5. Theoretical situation of Expected and Hypothetical  $^8\text{Be}$  Transitions and origin of Protophobic X Boson.

### 3.2.2 Goldstone boson (SPINLESS BOSONS)

They were discovered by Yoichiro Nambu and subsequently elucidated by Jeffrey Goldstone. NGBs (NAMBU – GOLDSTONE BOSONS). There are three Goldstones  $\rightarrow$  with charges +1, 0, -1 (4 components created by Higgs field). 3 are absorbed by the  $W^+$ ,  $W^-$  and  $Z^0$  bosons to create their longitudinal components. In particle and condensed matter physics Goldstone bosons have spin 0 (Zero) Higgs boson.

They are interpreted as longitudinal polarization of massive  $W^{+/-}$  and  $Z^0$  boson.

In condensed matter physics goldstone bosons are quasiparticles, known as Anderson-Bogoliubov modes.

Composite bosons have a continuous mass spectrum. Nambu-Goldstone fermions, or goldstinos have spin  $\frac{1}{2}$  instead of 0, broken spontaneously.

NGBs in Relativistic theories was proved by J. Goldstone, A. Salam and S. Weinberg in 1962.



(intermediate particles of electroweak interaction)

Theory of Unification of el. Mag. And weak Interaction.



“Theory of Grand Unification resp. GRAND UNIFICATION (GUT)”

### 3.2.3 Higgs boson (The “God” Particle) [SPIN 0]

The Brout-Englert-Higgs Mechanism or The Higgs-Guralnik-Hagen-Kibble Mechanism provides the means by which gauge vector bosons can acquire nonzero masses in the process of spontaneous symmetry breaking (Fig. 6).

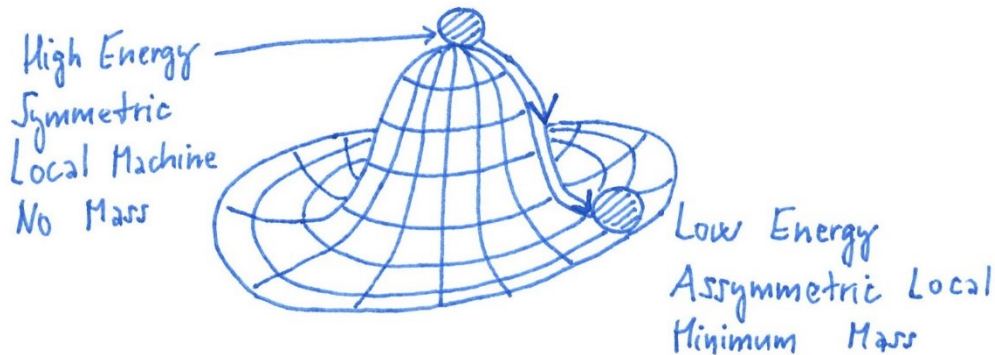


Fig. 6. Briefly Situation of The Higgs Mechanism.  
Sketch by Author: I. Krištof, M.Sc.

Intermediate Vector Bosons  $\rightarrow$  W and Z Bosons, exactly  $W^- Z^0 W^+$ ,  $Z^0$  BOSON IS ELECTRICALLY NEUTRAL AND IS ITS OWN ANTIPARTICLE. Does exist a neutral vector boson or neutrino  $\nu_0 \rightarrow$  like predicted in 30-ies years of 20-th Century Italian Brilliant physicist Ettore MAJORANA ( $Z^0$  and  $\nu_0$ ).

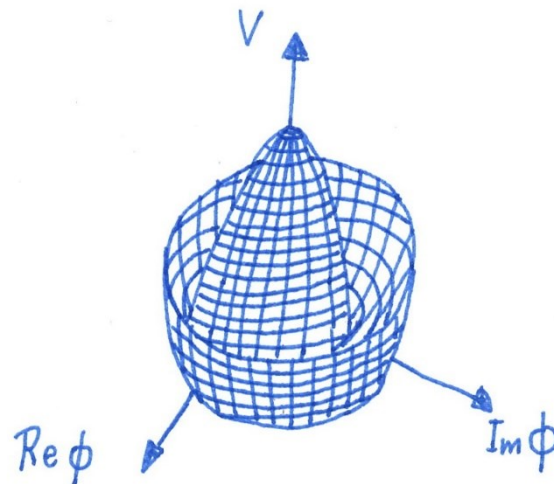


Fig. 7. Englert-Brout-Higgs-Guralnik-Hagen-Kibble Sombrero effect.

## 4. Satendranáth Bose & Enrico Fermi

### 4.1 Satedranáth Bose

\*1.1.1894 Kalkata, British India – 4.2.1974 Kalkata, India

Physicist, mathematician. He’s known for his work on quantum mechanics (QM) starting in 20-ies years of 20-th Century.

He creates bases for Bose-Einstein Statistics and Theory of Bose-Einstein Condensate.

Exactly after him was named one of type of fundamental elementary particles – BOSONS (also BOSE’s particles).





Fig. 8. Dr. Satyendranath Bose according cs.m.wikipedia.org  
Author of the Paper.

#### 4.2 Enrico Fermi

\*29.9.1901 Roma, Italy – 28.11.1954 Chicago, Illinois, U.S.A.

Italian-American physicist, researcher of nuclear reactions, quantum theory, particle physics and statistical mechanics, theoretical and experimental physicist, worked on  $\beta$  and  $\gamma$  radiation and The Lead physicist on MANHATTAN PROJECT with Robert Oppenheimer, Edward Teller, Leo Szilard, Eugene Wigner, Emilio Segré, Richard Feynman.

1938 Nobel Prize Winner for Physics, One of The So Called Fathers of The Atomic Bomb, also the author of theories known like Fermi Paradox, which are focused on question of numbers of intelligent Extraterrestrial Civilizations in The Universe.



Fig. 9. Enrico Fermi.  
Author according wikipedia.org

### 5. Bose-Einstein Condensate

Is matter, consist of BOSONS by temperature reached ABSOLUTLY ZERO 0 KELVINS (-273,15 °C), DURING THIS PHYSICAL CONDITIONS HAVE THE BIG PART OF SET OF ATOMS AND BOSONS, MINIMAL QUANTUM ENERGY. THIS QUANTUM EFFECT IS OBSERVABLE IN MACROMOLECULAR GRADE, RESPECTIVELY SCALE.

### 5.1 The Six States of Matter

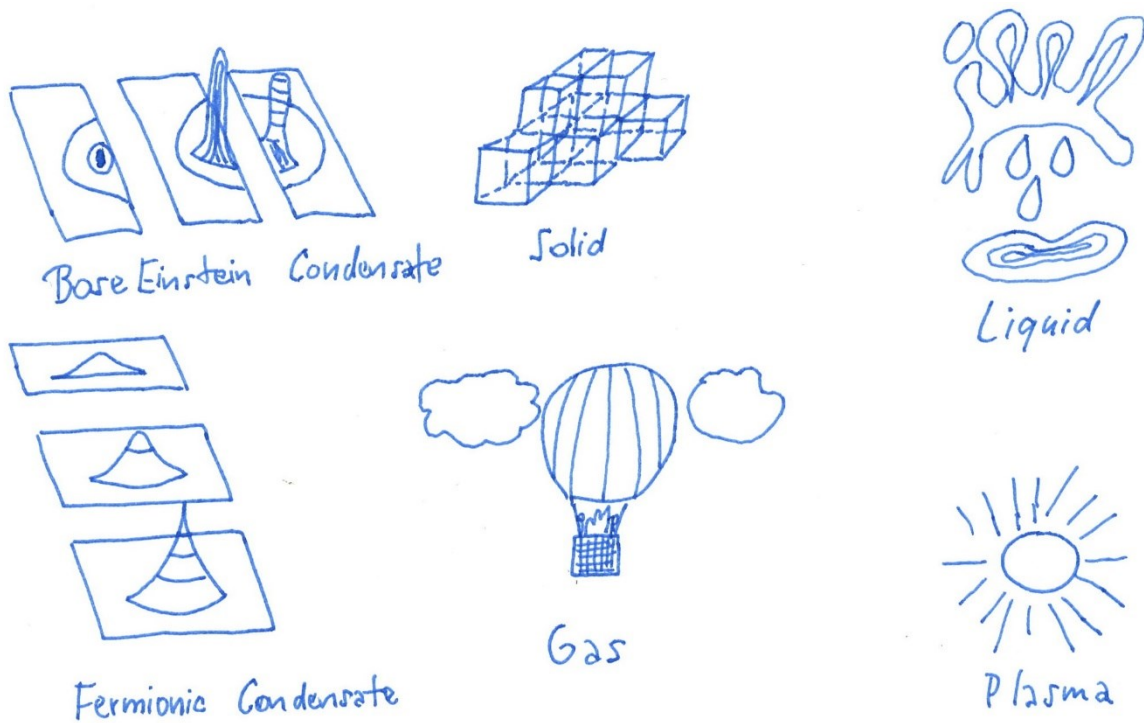


Fig. 10. Symbolic Scheme of The Six States of Matter.  
Sketch According The Author.

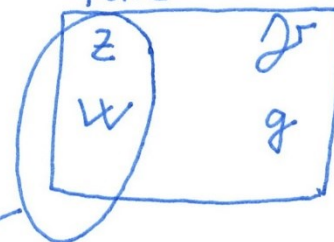
### 6. Bosons in The Standard Model (WIMP'S !!)

Quarks

Leptons

SCALAR  
(H)

Forces



Z and W Bosons  
(Intermediate Bosons)  
participated on exchanging  
interaction in Atomic Nuclei  
and in reactions of elementary  
particles, discovered in CERN in 1983

Prediction (1968) by  
Abdus SALAM  
Sheldon LEE GLASHOW  
Steven WEINBERG

Fig. 11. Prediction (1968) by A. SALAM, S. LEE GLASHOW, S. WEINBERG.

ZERO MASS:  $W^\pm: 80,387 \pm 0,017 \text{ GeV}/c^2$   
 $Z^0: 91,1876 \pm 0,0021 \text{ GeV}/c^2$

MEAN LIFETIME:  $\sim 3 \times 10^{-25}$  s

SPIN: 1

$\Gamma_Z = 2,4952 \pm 0,0023$  GeV

$\Gamma_W = 2,085 \pm 0,042$  GeV

INTERACTION: W = WEAK (WIMP'S !!)

Z = ZERO ELECTRIC CHARGE

$\phi$  THE LAST PARTICLE NECESSARY TO DISCOVERY

Electric Charge:  $W^\pm : \pm 1e$

$Z^0 : 0e$

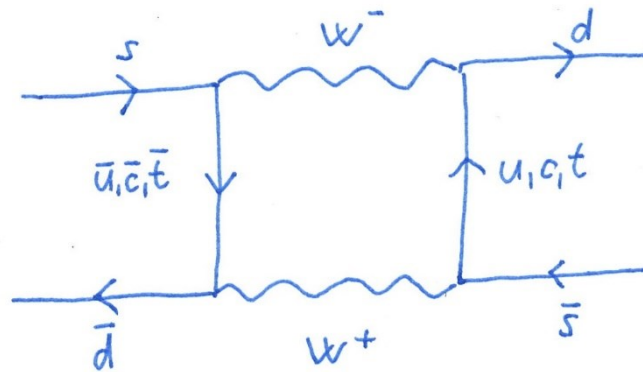


Fig. 12. A Feynman diagram showing KAON OSCILLATION MEDIATED BY  $W^\pm$  BOSONS, SKETCH OF AUTHOR OF THE PAPER.

## 7. The Atomki Group at Debrecen (Hungary)

The Atomki Group has produced three previous papers on their  $^8\text{Be}$  experiment – Conference Proceedings in 2008, 2012 and 2015. The first paper claimed evidence of a new boson of mass 12 MeV. The second described anomaly approximately 13,45 MeV boson. The New claim now is boson with a mass of 16,7 MeV. In these years at Atomki, de Boer detected multiple anomalies in Beryllium, Carbon and Oxygen nuclear transitions evidence, he claimed of a “pandemonium” of more than 10 candidate bosons.

## 8. Herman Klaus Hugo Weyl

9.11.1885 Elmshorn, Germany – 8.12.1955 Zurich, Schweiz (Switzerland)

Was German Mathematician and Theoretical Physicist and Philosoph. He worked in wide reign of Maths, namely Theory of Numbers, Lie Algebra, Differential geometry. Known for: Weyl's group, Weyl Tensor and Spinor, Weyl Algebra.

Lived and worked with A. Einstein in Princeton (U.S.A.) till 1952. Very often, the “spin quantum number”, is simply called “spin”. Spinors and Bispinors behave similarly to vectors. A Bispinor is more or less “the same phenomenon” as a Dirac Spinor, a bispinor is a mathematical construction that is used to describe some of fundamental elementary particles, including quark and electron. Embodiment of a spinor is consistent with the requirements of Special Relativity.

Bispinor transform in a “spinorial” mode under the actions of the Lorentz group, which describes the symmetries of MINKOWSKI SPACETIME. Bispinors are so called by this terminus, because they are consisted out of two simpler component Spinors, The Weyl Spinors.

## 8.1 “CHIRAL” OR WEYL REPRESENTATION

The (+ - -) signature is sometimes called – the west coast metric, while the (- + +) is the east coast metric.

The 4x4 Gamma matrices used in the Weyl Representation are:

$$\gamma_0 = \begin{bmatrix} 0 & 1 \\ 1 & 0 \end{bmatrix}$$
$$\gamma^k = \begin{bmatrix} 0 & \delta^k \\ -\delta^k & 0 \end{bmatrix}$$



Fig. 13. Herman Klaus Hugo Weyl  
According TFP (The Famous People)  
Author of the Article.

## 9. Hedy Lamarr

- Projectile fusion offers new path to clean energy, quantum communications for alien civilization.
- Neutrino detectors could monitor treaty compliance by nuclear submarines, interesting in this field of research is the “superbeautiful” or the most beautiful actress and young superintelligent woman and scientist Hedy Lamarr in 1942.

Her discovery was patented and is known like FHSS (FREQUENCY – HOPPING – SPREAD – SPECTRUM), so that exceptional species of frequency modulation, to use to manage to missile submarines torpedos, at the first used in Cuban crisis in 1962. Today are systems of FHSS wide-spread using and create indivisible part of IT (Wi-Fi nets and Bluetooth Systems).

This transmissions we find by GPS Satellites, satellite television and nets of mobile telephones.

Hedy Lamarr, was born like Hedwig Eva Maria Kiesler,

\*9.11.1914 Vienna, Austria – 19.1.2000 Casselberry, Florida, U.S.A.

was Moravian-Austrian-American Actress and Inventor, considered one of the most beautiful actress of The Silver Screen.



Fig. 14. Hedy Lamarr  
[upload.wikimedia.org/  
wikipedia/commons/6/61/Hedy](https://upload.wikimedia.org/wikipedia/commons/6/61/Hedy)

## 10. CERN in 2022 (MARKING 10 YEARS OF DISCOVERY)

Ten years of precision measurement at the LARGE HADRON COLLIDER (LHC) have shown the Higgs boson to be significant remarkably consistent with the minimal version required by the Standard Model. As “a fragment of vacuum” resp. “hidden energy of vacuum” with the barest of quantum numbers, the Higgs boson is potentially connected to many fundamental open questions in particle physics.

Gerard 't Hooft reflects on how renormalization elevated the Brout-Englert-Higgs mechanism to a consistent theory capable of making testable predictions.

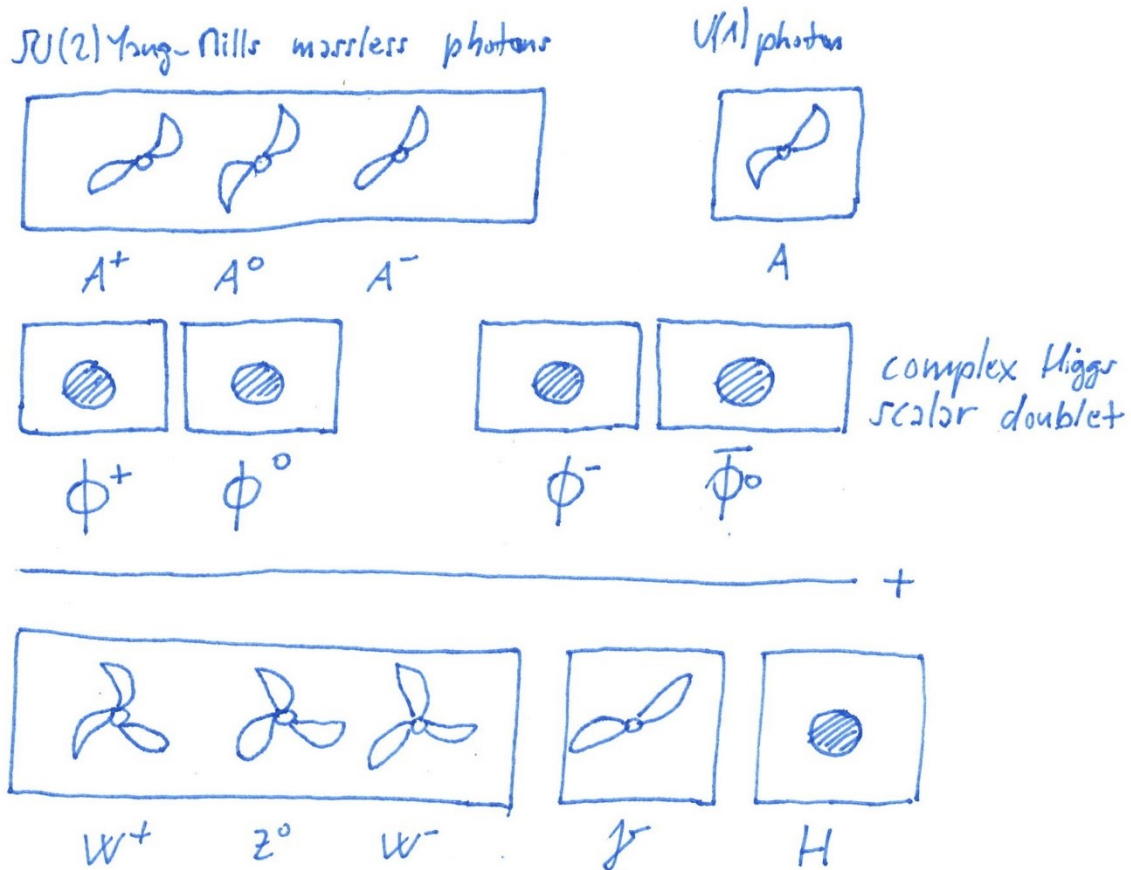


Fig. 15. Dynamical Massless spin-1-particles (top) have 2 degrees of freedom (white shapes), whereas spin-1 particles with mass (middle) have three. Below the solid line the effect of the masses of the particles are included. Note that the electric charges match perfectly.

Author of the Paper according the CERN Courier.

## 11. Predictions from Fermilab (Batavia – Illinois)

Newly Measured Particle Seems Heavy Enough to Break Known Physics. A new analysis of W bosons suggests these particles are significantly heavier than predicted by the Standard Model of particles.

The curious heaviness of the W boson, one of 17 fundamental known elementary particles, may point to unknown particles or forces. Physicists have found, that an elementary particle, called W boson (WEAK BOSON) appears to be 0,1% too heavy – a tiny discrepancy, that could foreshadow a huge shift in fundamental and particle physics.

At the FNAL (Fermi National Accelerator Laboratory) in Batavia, Illinois, that smashed its final protons a decade ago. The roughly 400 members of the Collider Detector at Fermilab (CDF) collaboration have continued to analyze W bosons produced by the collider, called the Tevatron, chasing down myriad source of error to reach an unparalleled level of precision.

## 12. Conclusion

The Standard Model is known to be incomplete, leaving various grand mysteries unsolved, for example, such as the nature of dark matter, dark energy, dark forces.

It's very probably, that number of particles in the Standard Model must be much more than 17, the most probably is, that the whole final number of elementary particles in SM must be even count of finally all known relevant elementary particles.

These realities could resolve the principles of unknown mechanisms and effects of Physics Beyond the Standard Model and at extremely places in the Multiversum, for example like in singularities in the center of supermassive blackholes and wormholes, in the center of the Galaxies.

### 13. Acknowledgements

Author of this Paper Thanks to His loved superintelligent and lovefull Parents, to Prof. RNDr. Joseph Havel, Dr.Sc., Dr.hc. for helpful advices to publicate in English Language, namely for information about The MALDI-TOF MASS SPECTROMETRY.

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The biggest thanks belong to Ing. Josef Pokorný.

This work was also supported by MUDr. Suzanne Hejtmánková and Prim. MUDr. Phillip Vrtek, from Brno City's Hospital in Húskova St. no. 2, for creation conditions to writing this Paper.

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