

“From The Protophobic X Bosons (X17 particle) to Dark Photon, Dark Matter, WIMP’S, Neutralinos, Photinos, Neutrinos, Axions and Axinos.”

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Abstract:

This new paper talks about the elementary subatomic particles on a level hypothetical–theoretical–experimental detection studies in divisions of physics like theoretical, statistical physics, astrophysics, cosmology, particle physics and applied physics. Beginning of the Article is connected with discoveries of X17 (Protophobic X Boson Particle) and the fifth fundamental force of all Universe, called “quintessence” – the energy of Dark Matter or Dark Energy.

The first part of the Paper is dedicated to a Hungarian nuclear physicist Prof. Dr. Attila Krasznahorkay, Dr.Sc. from Research Center Atomki Debrecen. Prof. Dr. Attila Krasznahorkay, Dr. Sc. and his team at Atomki had successfully observed the same anomalies in the decay of stable ${}^4_2\text{He}$ bombarding atoms and unstable transitions of Be^8 , Li^7 , He^4 had been observed in Beryllium–8, strengthening the case for the existence of the X17 particle, the name of this particle means that has energy about 17 MeV (protophobic), because ignoring protons in interactions. Mean lifetime is approximately 10^{-14} s.

Further parts of text describe hypothesis, theories and detection and significance of elementary particles, which are candidates to a building the Dark Matter and Dark Energy like Dark Photons, WIMP’S, Photinos, Neutralinos, Axinos and Axions.

Keywords: Protophobic X–Boson, Dark Matter, Dark Energy, Dark Photon, The Dark Neutrinos, WIMP’S, Neutralinos, Majorana Fermion, Dual Photon, Axinos, Saxion, Axion insulator, Inorganic Crystal Scintillators, Supersymmetry, Hypersymmetry, CDM (cold dark matter).

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1. Introduction

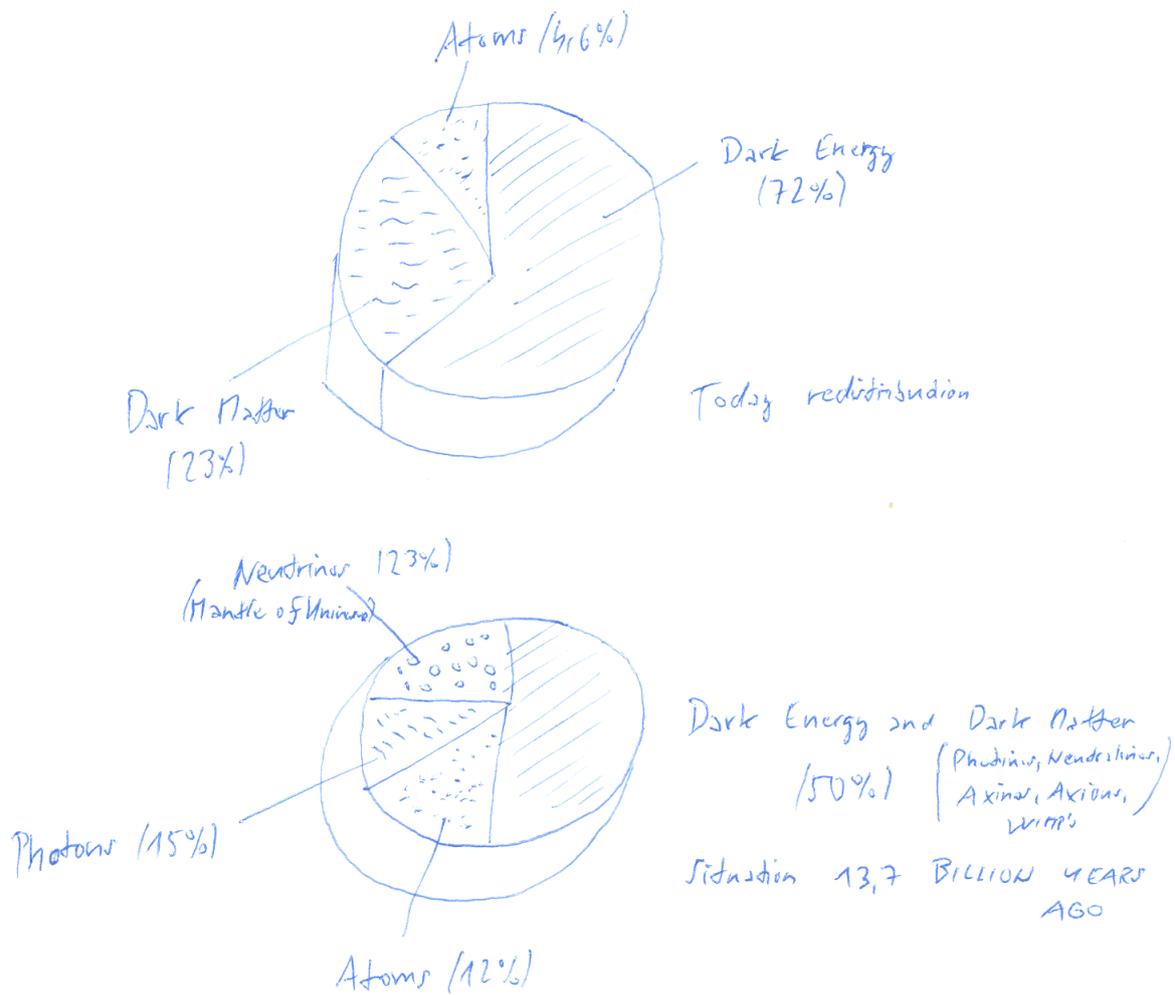
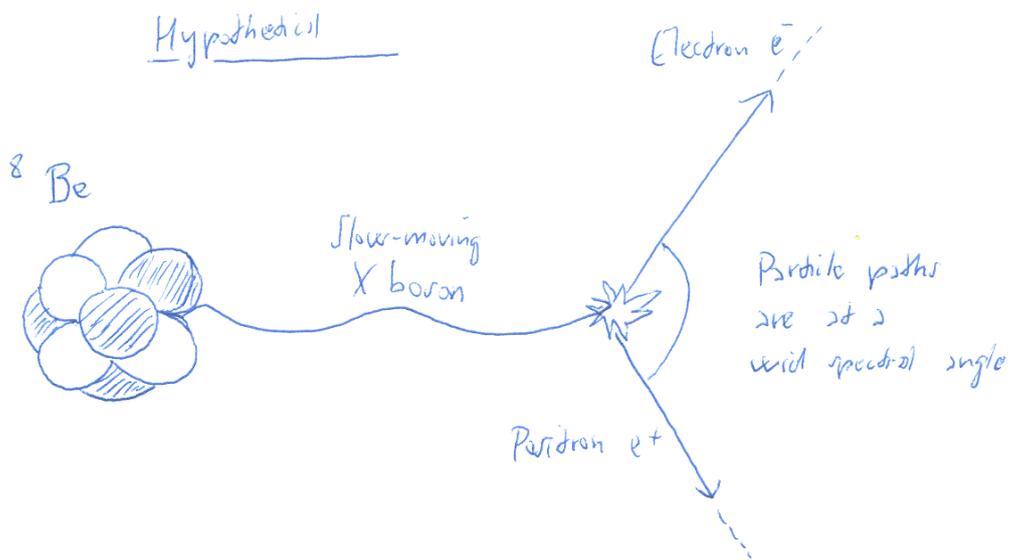
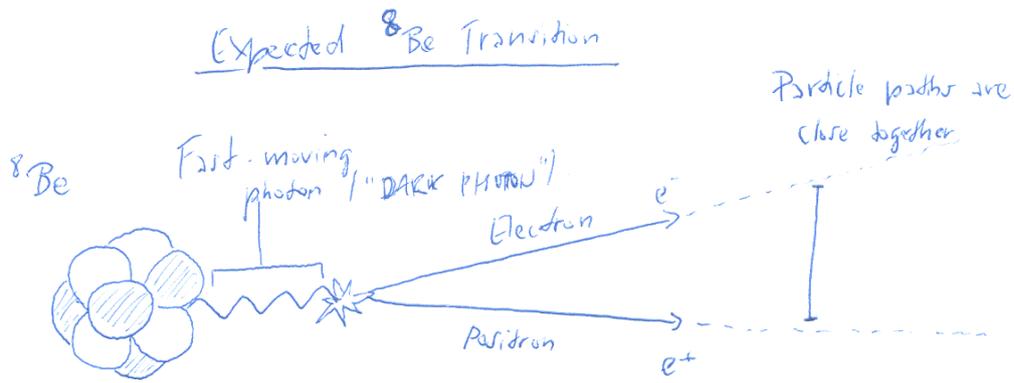


Fig. 1. Redistribution of Dark Matter and Dark Energy in Cosmos (Author prediction sketch).

The heavy neutrinos, dark photons, and dark scalar searches, typically characterized by multi leptons plus missing energy and displaced vertices. A striking signature arises in Kaon factories such as NA 62, where $K^+ \rightarrow l_\alpha^+ \nu l_\beta^+ l_\beta^-$ decays could reveal a heavy neutrino and light dark photon resonance above backgrounds.

X-17 Particle (Protophobic X Boson)



Author Sketch According Quanta Magazine

2. Attila János Krasznahorkay

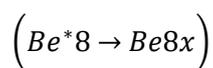


Fig. 2: Attila Krasznahorkay (prabook.com).

*1.1.1954 (66 aged), Bakonszeg, Hungary.

Division of Nuclear Physics Atomki Debrecen.

Superknown for proposed that a protophobic X–boson, with mass of 16,7 MeV suppressed coupling to protons relative to neutrons. The X17 particle is a hypothetical subatomic particle proposed and confirmed by prof. Dr. Attila Krasznahorkay, Dr.Sc. and his colleagues to explain certain anomalous measurement results. The particle has been proposed to explain wide scales of angles observed in the trajectory paths of particles produced during a nuclear transitions of Beryllium–8 atoms and in stable Helium–4 atoms:



and then decays through $X \rightarrow e^+e^-$.

The X17 particle is connected with the fifth force and possibly connected with dark matter.

X17 particle

Composition	Elementary particle	Mass $16,84 \pm 0,36 \text{ MeV}$
Interactions	Fifth force “quintessence”	Mean lifetime: 10^{-14} s
Status	Hypothetical, particularly confirmed	Electric charge 0e
Symbol	X17	Based on a $U(1)_X U'(1)$ symmetry
Experimentally theorized	2015	range of 12 fm
		Decays through $X \rightarrow e^+e^-$

The fifth force is proposed by a theoretical hypothesis and calculus to explain various anomalous observations that do not fit existing theories. Another proposal is a new weak force mediated by W' and Z' bosons and W' and Z' neutrinos (WIINOS and ZIINOS). An unknown form of matter called dark matter, the most physicists believe that dark matter (dark photon, dark neutrinos, neutralinos, photinos, Axinos and Axions) consist of a new undiscovered subatomic particles, but some believe that it could be related to an unknown fundamental force, connected with the expansion of the Universe, accelerating, which has been attributed to a form of energies called dark energy. Some physicists speculate that a form of dark energy called quintessence could be the fifth force.

The Universe created enormous numbers of dark neutrinos in the extremely early hot stages of the Big Bang. The Dark Neutrino have the main significance in Astrophysics (Physics of Stars), Solar Systems and Galaxies and namely in Cosmology of whole Universe.

Comment one: The Dark Photon is hypothetical elementary particle, designed like an electromagnetic intermediary particle of dark matter.

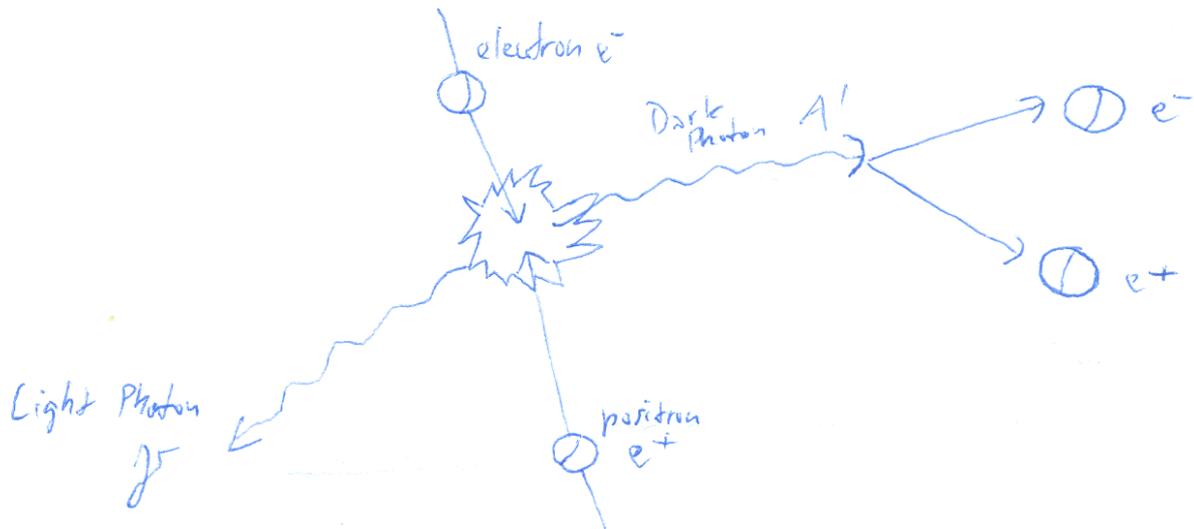


Fig. 3. Born of The Dark Photon.

Comment two: The Dark Neutrinos at the first glance, and heavy neutrinos are the perfect Dark Matter candidate, Solar, Atmospheric and Reactor Neutrinos. Experiment established that the Neutrinos are massive particles.

Dark Neutrinos are connected with cold dark matter, Dark Neutrinos sometimes called sterile neutrino (CDM).

“SUPERSYMMETRY DARK MATTER”

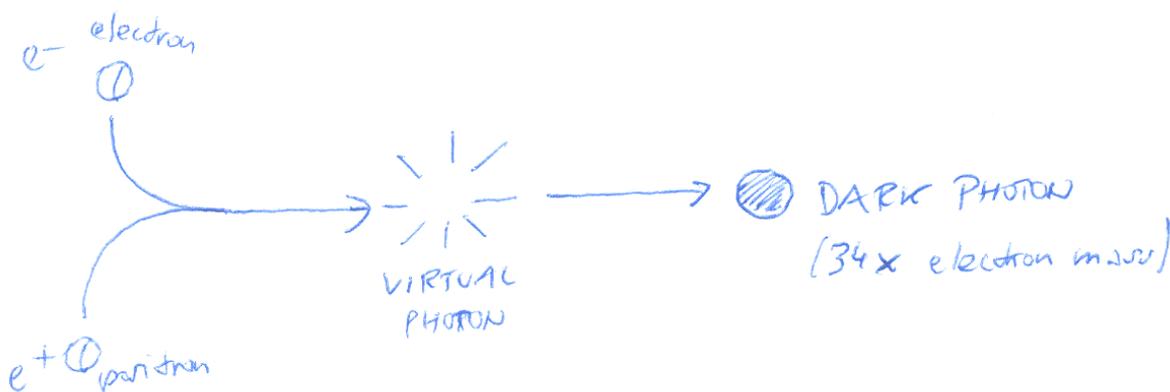


Fig. 4. Dark Photon born (Sketch of the Author).

This hypothetical reaction has probably described born of the dark photon:



(GRB) Gamma Ray Bursts.

Dark Matter is a form of matter, for approximately 85% of the matter in the Universe and about a quarter of it's total mass–energy density or about $2,241 \times 10^{-27} \text{ kg/m}^3$, called ordinary baryonic matter and radiation.

Comment three: Neutralino (WIMP'S) CANDIDATE

Translated from English – in Supersymmetry (SUSY) is Neutralino a hypothetical particle.

Mass	> 300 GeV
Type	4
Spin	$\frac{1}{2}$
Parity	-1
MAJORANA FERMIONS	

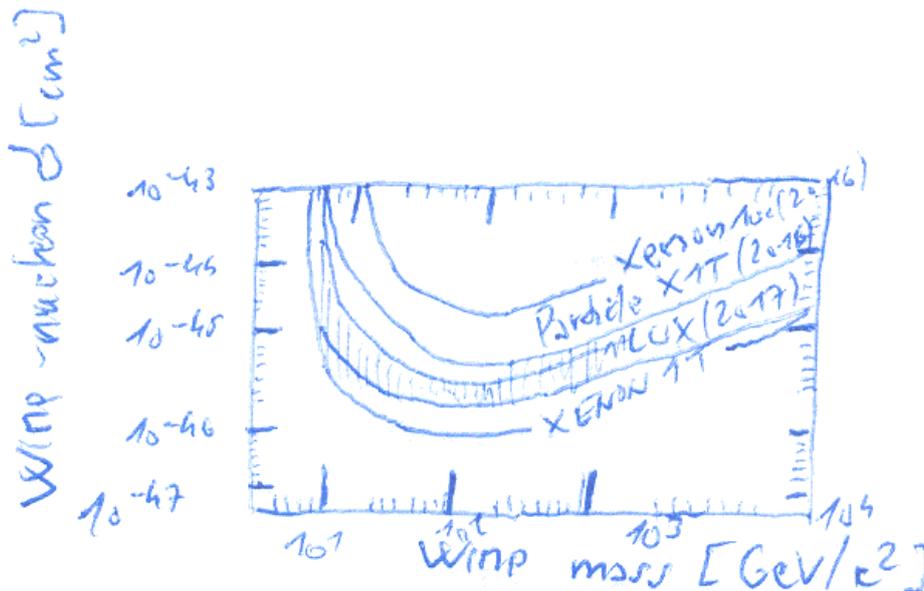
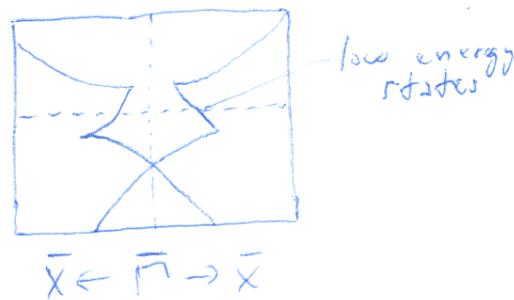
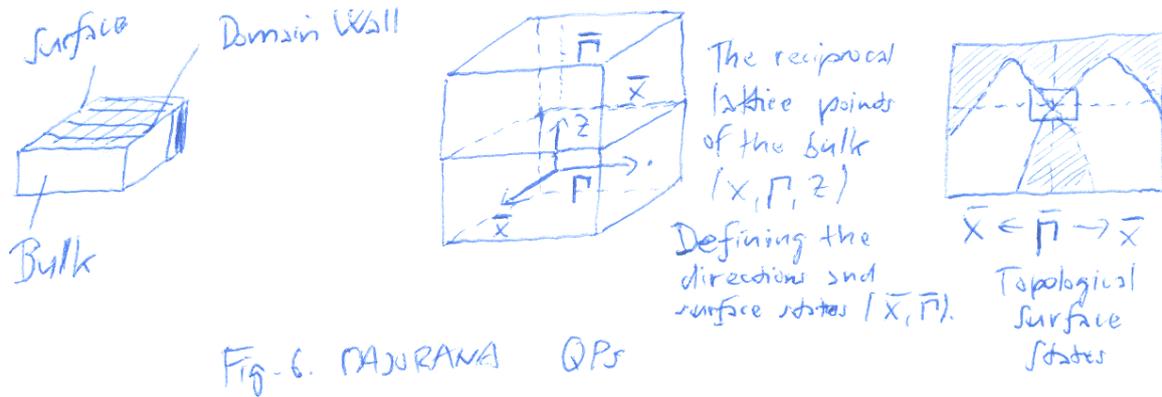


Fig. 5. Detection of DARK MATTER (WIMP'S).

MAJORANA FERMIONS

Dr. Enrico Fermi described Ettore Majorana as having the mind of a Genius fundamental particles like electrons or neutrinos but emerging excitations that we term quasiparticles.

STRONG EVIDENCE FOR THE OBSERVATION OF MAJORANA QUASIPARTICLES (MQPs) IN AN IRON–BASED SUPERCONDUCTOR FeSe_xTe_{1-x}. Inferring Majorana modes:



MAJORANA FERMIONS EMERGE AS A QUANTUM SUPERPOSITION OF AN ELECTRON AND A HOLE THAT MOVE FREELY, WITH EACH HAVING THE SAME DIRECTION, OR SPIN.

Majorana QPs: Along the domain wall, a linear set of allowed low-energy states would connect the gapped bands of the topological superconductor.

Majorana Fermions are typically in time-reversal Symmetry from clockwise to counterclockwise and this implies a different equation of motion for Majorana Fermions Backward in Time.

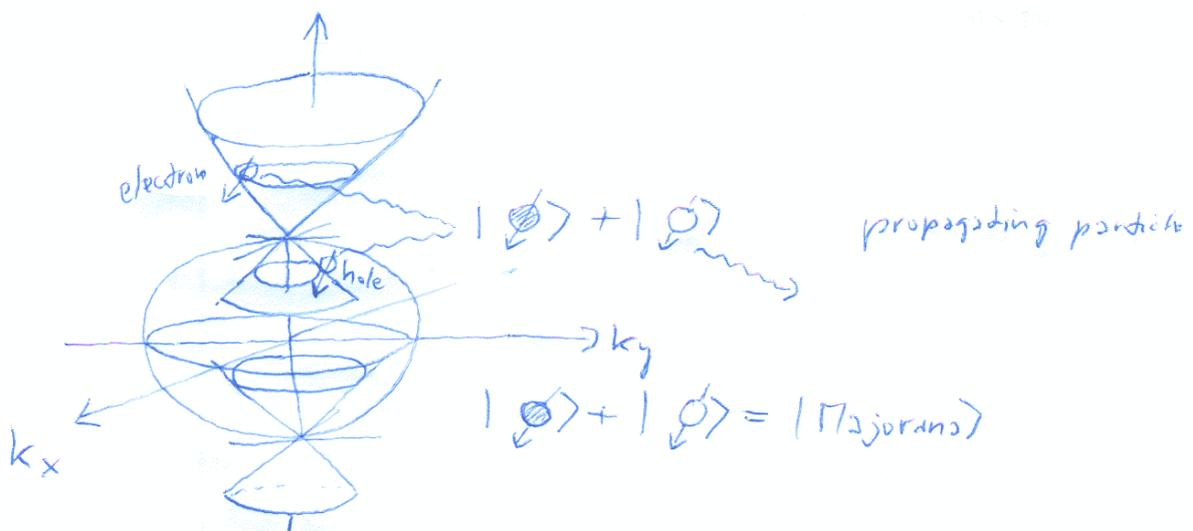


Fig. 7. Majorana Fermions.

Comment fourth: Photinos /fə(ʊ)ˈti:nəʊ/

Symbol $\tilde{\gamma}$, is the hypothetical supersymmetric counterpart of the photon with spin $+\frac{1}{2}$, baryon number 0, lepton number 0, electric charge 0e, with R-parity -1, fermions WIMP, suggest by SUSY (SUPERSYMMETRY THEORY), it's a possible candidate for a dark matter.

Examples of “gauginos”, photino is one of candidates for the lightest supersymmetric particle in a whole Universum, it's proposed that photinos, are produced by sources of ultra-high-energy cosmic rays. It mixes with the superpartner of the Z-boson (ziino) and neutral higgs (higgsino) to form Neutralino.

Comment fifth: DUAL PHOTON

A hypothetical elementary particle that is dual of the photon under electric-magnetic duality.

Comment sixth: Axinos

The Axino is a hypothetical elementary particle predicted by some theories of Particle Physics. Peccei-Quinn theory attempts to explain the observed phenomenon known as the strong CP problem by introducing a hypothetical real scalar particle called the axion, is a fermionic superpartner for the Axion, the axino, and a bosonic superpartner, the Saxion. They are all bundled up in a chiral superfield. The axino has been predicted to be the lightest supersymmetric particle, candidate for the composition of dark matter. Detection of DARK MATTER PARTICLES SEARCH EXPERIMENTS USING NaI(TL), CsI(TL) and CaF₂(Eu) CRYSTALS – “INORGANIC CRYSTAL SCINTILLATORS”. DM. Detection Projects: KIMS Experiment, Light Dark Matter CRESST II, Lowering DAMA (DARK MATTER SEARCH).

Axions

3. Roberto Peccei and Helen Rhoda Arnold Quinn

Roberto Peccei

Italian-American physicist, *6.1.1942, Torino, Italy, + 1.6.2020, was an Italian physicist, vicerector for Physical Research in U.C.L.A. (2000 – 2010), elementary particle physicist, his interest in physical field were focused in reign of electroweak interaction and in boundaries elementary particle physics and Cosmology.

Helen Rhoda Arnold Quinn

*19.5.1943 Melbourne (77 year), is an American physicist natured by Australia (born in Melbourne, Australia), known for her achievements in physics of elementary particles. Attribute to searching of Unitary Theories of 3 Fundamental Force Interactions, Strong Nuclear Power, Electro-mag. Power and Weak Nuclear Power. She is honored by many OUTSTANDING Appreciations Including The Dirac Medal.

Roberto Peccei and Helen Quinn in 1977, were proposed an existence of hypothetical elementary particles called Axions. These particles may have resolved problemma of CP symmetry and they are a particles which may have composed and constitute the observed the cold dark matter budget.

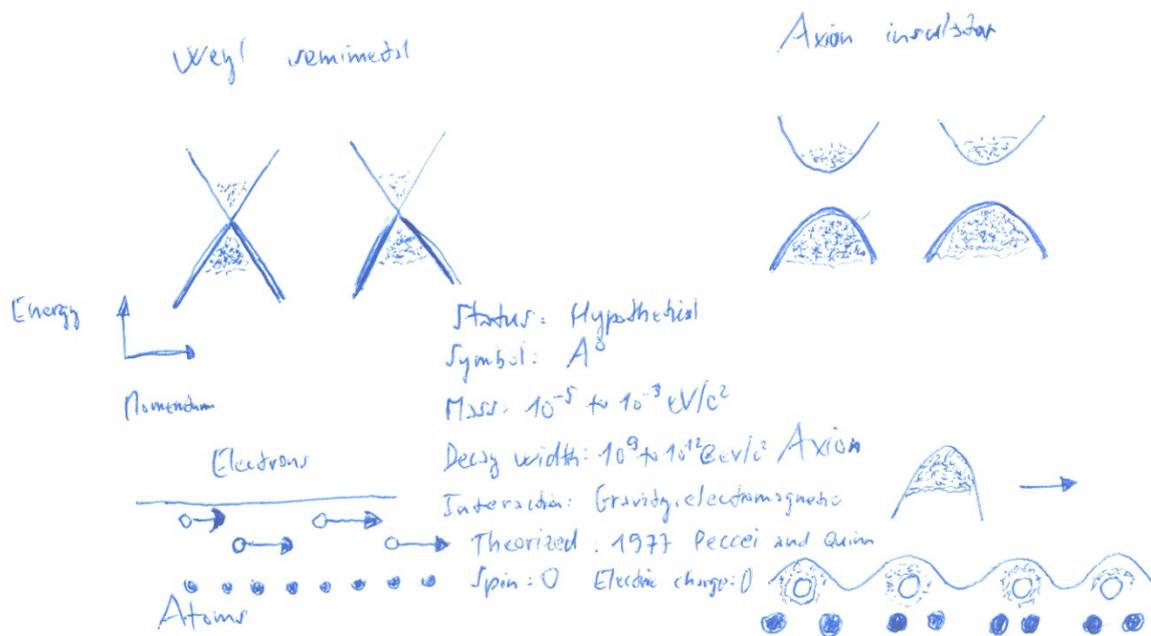


Fig. 8. Axions.

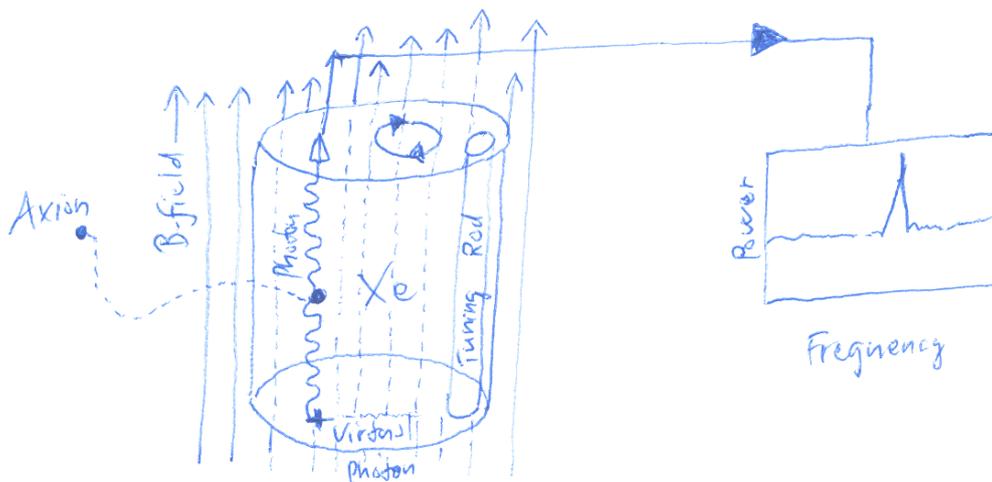


Fig. 9. Detector of Axions (Dark Matter).

In 2020, the XENON1T experiment at the Gran Sasso Laboratory in Italy reported a result suggesting the discovery of Solar axions. The Results are not yet significant at the 5δ -sigma level required for confirmation, and other data are possible though less likely. Further observations are planned after the Observatory upgrade to XENONnT is completed.

The Axion is the massless "Goldstone boson" of this broken symmetry (Peccei–Quinn Symmetry), presents θ as a funkcional component – a global U(1) symmetry under which a complex scalar field charge. This symmetry is spontaneously broken by the vacuum expectation value obtained by this scalar field.

Robert Peccei and Helen Quinn in 1977, they proposed that, according their theory the QCD Lagrangian be extended with a CP^- violating term known as “the θ term”. QCD instantons, massless Goldstone boson on QCD scale influenced by QCD nonperturbative effects.

This branches of Theoretical Physic’s known like SUPERMULTIPLY PHYSICS, ia a representation of a supersymmetry algebra, particles called superpartners, operators in a quantum field theory, which is superspace are represented by superfields.

Superfields were introduced by Abdus Salam and J.A. Strathdee in their 1974 article: “supergauge Transformations”.

Operations on superfields and partial classification were presented a few months later by Sergio Ferrara, Julius Wess, and Bruno Zumino in SUPERGAUGE MULTIPLY AND SUPERFIELDS.

MAJORANA-WEYL SPINOR (VECTOR BUNDLES) – D-DIMENSIONAL TORUS IS A VECTOR MULTIPLY CONTAINING D-REAL SCALARS.

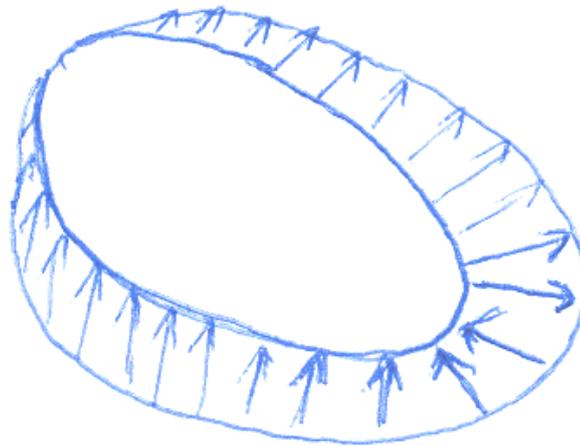


Fig. 10. Vector Bundles (D-DIMENSIONAL TORUS)

DIRAC SPINOR Ψ further auxiliary complex scalars F_i , the name “hypermultiplet” comes from old term “hypersymmetry” for $N = 2$ SUPERSYMMETRY used by Fayet (1976). SPINORS WERE INTRODUCED IN GEOMETRY by Élie Cartan in 1913, like “intrinsic angular momentum” or “spin”.

Pauli Spin Matrices is also known in his exclusion principle of the particles with the same spin in one orbital of atom (1931).

Comment the seventh: Sergio Ferrara

* May 2, 1945, Italian physicist, working on theoretical physics of elementary particles and supergravity, spreading of Einstein Relativity, based on principle "local supersymmetry", together with Daniel Z. Freedman "Super Yang–Mills theories" together with Bruno Zumino "Black Hole Attractors", is professor at the U.C.L.A, LOS ANGELES, an emeritus staff member at CERN, Geneva, Fr./It.

Bruno Zumino

*28.4.1923, Roma, Italy, + 21.6.2014, Berkeley, U.S.A., an Italian theoretical physicist at Berkeley, U.S.A., Alma mater: Universita La Sapienza, Roma.

Julius Wess

*5.12.1934 Oberwölz Stadt, Austria – 8.8.2007 Hamburg, Germany.
An Austrian theoretical physicist, known as co-creator Wess–Zumino Model and Wess–Zumino–Witten Model in "SUPERSYMMETRY" in 1987 holder of Medal of Max Planck.

In 2013, Christian Beck suggested that axions might be detectable in Josephson Junctions, and in 2014, he argued that a signature, consists with a mass $\approx 110 \mu\text{eV}$, had in fact been observed in several preexisting experiments.

Ultralight Axion (ULA) with $m \sim 10^{-22} \text{ eV}$ is kind of scalar field dark matter which seems to solve the small scale problems of CDM (COLD DARK MATTER). Theories predict that the Universe would be filled with a very cold Bose–Einstein Condensate of primordial Axions. In Supersymmetric theories the Axion has both a scalar and fermionic Superpartner. The fermionic superpartner of the Axion is called Axino, the scalar superpartner is called Saxion or Dilaton. They are all bundled up in chiral superfield.

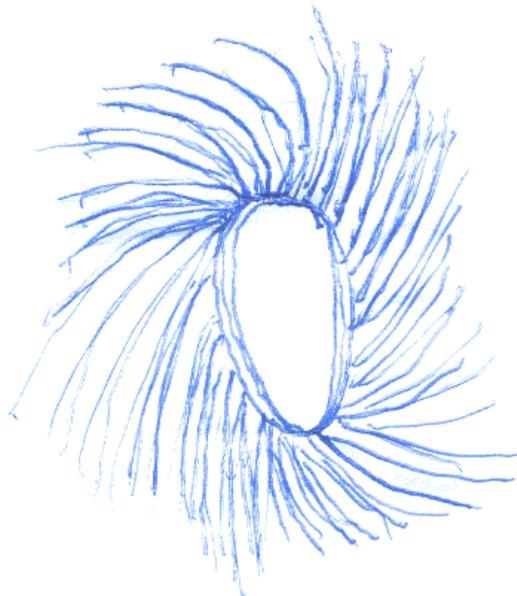


Fig. 11. Fantastic Picture (Illustration of Axion).

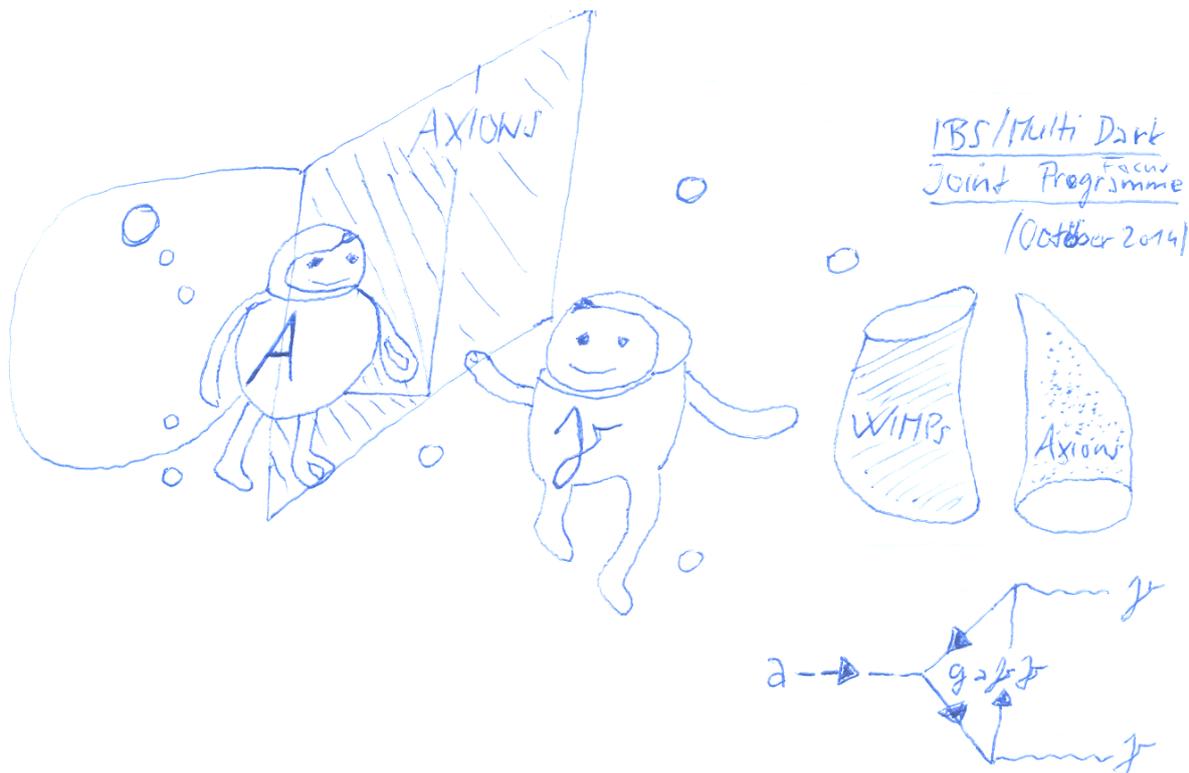


Fig. 12. Axions / Symmetry.

4. Conclusions

The Understanding to forces fields, which bounded the whole Universe and also our and Animals bodies and brains (souls), (the lepton fields, quark fields, gauge bosonic fields, hadron fields, meson fields – psionic fields), the powers of the brain, gravitational power fields, nuclear strong and weak powers, electro–magnetic powers, submillimeter powers (gluons, hadrons). The knowledge of Universe (The Cosmos, Multiversum, Paraversum) is so significant, because through the “our life surroundings” in physical language – physical (power) fields, we can recognized foreign extraterrestrial entities of life and also our own minds and bodies and souls.

Maybe thanks to physics of elementary particles, could be resolved a question – if the souls of Human / Animals MINDS ARE IMMORTAL OR IMMATERIAL OR MATERIAL.

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