GWI – Geometric Wavefunction Interaction Impedances

A maximally natural minimally complete QED model

Clifford algebra is the algebra of quantum mechanics
there exist (at least) two Clifford algebra representations – matrix and geometric
geometric representation of minimally complete vacuum wavefunction is intuitive
eight components - one scalar, three vectors, three bivectors, one trivector
physical manifestation arises via the EM coupling constant

$\alpha = \frac{1}{4\pi\epsilon_0}\frac{e^2}{\hbar c} \approx 0.0073$ → eight topologically appropriate E and B field quanta.

Lagrangian looks at flow of energy between kinetic and potential.
quantum impedance matching governs amplitude and phase of that flow.
Given that fields of QFT are quantized, it is unavoidable that impedances be quantized.

"String theory is 21st century physics that fell accidentally into the 20th century"
Ed Witten

GWI model is 20th century physics that fell accidentally into the 21st century

Geometrically, this 8x8 matrix is the vacuum wavefunction S-matrix,
Generated by geometric products of the two eight-component wavefunctions

	electric charge e *scalar*	elec dipole moment 1 d_{E1} *vector*	elec dipole moment 2 d_{E2} *vector*	mag flux quantum ϕ_B *vector*	elec flux quantum 1 ϕ_{E1} *bivector*	elec flux quantum 2 ϕ_{E2} *bivector*	magnetic moment μ_{Bohr} *bivector*	magnetic charge g *trivector*
e	ee *scalar*	ed_{E1}	ed_{E2} *vector*	$e\phi_B$	$e\phi_{E1}$	$e\phi_{E2}$ *bivector*	$e\mu_B$	eg *trivector*
d_{E1}	$d_{E1}e$	$d_{E1}d_{E1}$	$d_{E1}d_{E2}$	$d_{E1}\phi_B$	$d_{E1}\phi_{E1}$	$d_{E1}\phi_{E2}$	$d_{E1}\mu_B$	$d_{E1}g$
d_{E2}	$d_{E2}e$	$d_{E2}d_{E1}$	$d_{E2}d_{E2}$	$d_{E2}\phi_B$	$d_{E2}\phi_{E1}$	$d_{E2}\phi_{E2}$	$d_{E2}\mu_B$	$d_{E2}g$
ϕ_B	$\phi_B e$ *vector*	$\phi_B d_{E1}$	$\phi_B d_{E2}$ *scalar + bivector*	$\phi_B\phi_B$	$\phi_B\phi_{E1}$ γ	$\phi_B\phi_{E2}$ *vector + trivector*	$\phi_B\mu_B$	$\phi_B g$ *bv + qv*
ϕ_{E1}	$\phi_{E1}e$	$\phi_{E1}d_{E1}$	$\phi_{E1}d_{E2}$	$\phi_{E1}\phi_B$ γ	$\phi_{E1}\phi_{E1}$	$\phi_{E1}\phi_{E2}$	$\phi_{E1}\mu_B$	$\phi_{E1}g$
ϕ_{E2}	$\phi_{E2}e$	$\phi_{E2}d_{E1}$	$\phi_{E2}d_{E2}$	$\phi_{E2}\phi_B$	$\phi_{E2}\phi_{E1}$	$\phi_{E2}\phi_{E2}$	$\phi_{E2}\mu_B$	$\phi_{E2}g$
μ_B	$\mu_B e$ *bivector*	$\mu_B d_{E1}$	$\mu_B d_{E2}$ *vector + trivector*	$\mu_B\phi_B$	$\mu_B\phi_{E1}$	$\mu_B\phi_{E2}$ *scalar + quadvector*	$\mu_B\mu_B$	$\mu_B g$ *vector + pv*
g	ge *trivector*	gd_{E1}	gd_{E2} *bivector + quadvector*	$g\phi_B$	$g\phi_{E1}$	$g\phi_{E2}$ *vector + pentavector*	$g\mu_B$	gg *scalar + sv*

muon – two component Dirac spinor (scalar electric charge plus bivector magnetic dipole) augmented by 'dark' vector electric dipole $\psi_\mu = e\, d_E\, \mu_B$ *(τ completes the 2D algebra)*

unstable wavefunctions contain mix of dark and visible mode components - except γ and ν

for the neutrino wavefunction we follow the muon model, raised in dimensionality, remove scalar electric charge, add (dark) pseudoscalar magnetic charge

neutrino is topologically protected photon in GWI model

neutrino wavefunction $\psi_\nu = \phi_B \phi_{E1} g.$

	electric charge	elec dipole moment 1	elec dipole moment 2	mag flux quantum	elec flux quantum 1	elec flux quantum 2	magnetic moment	magnetic charge
	e scalar	d_{E1} vector	d_{E2} vector	ϕ_B vector	ϕ_{E1} bivector	ϕ_{E2} bivector	μ_{Bohr} bivector	g trivector
e	ee scalar	ed_{E1}	ed_{E2} vector	$e\phi_B$	$e\phi_{E1}$	$e\phi_{E2}$ bivector	$e\mu_B$	eg trivector
d_{E1}	$d_{E1}e$	$d_{E1}d_{E1}$	$d_{E1}d_{E2}$	$d_{E1}\phi_B$	$d_{E1}\phi_{E1}$	$d_{E1}\phi_{E2}$	$d_{E1}\mu_B$	$d_{E1}g$
d_{E2}	$d_{E2}e$	$d_{E2}d_{E1}$	$d_{E2}d_{E2}$	$d_{E2}\phi_B$	$d_{E2}\phi_{E1}$	$d_{E2}\phi_{E2}$	$d_{E2}\mu_B$	$d_{E2}g$
ϕ_B	$\phi_B e$ vector	$\phi_B d_{E1}$	$\phi_B d_{E2}$ scalar + bivector	$\phi_B\phi_B$	l.h. photon $\phi_B\phi_{E1}$ γ	$\phi_B\phi_{E2}$ vector + trivector	$\phi_B\mu_B$	scalar Lorentz $\phi_B g$ bv + qv
ϕ_{E1}	$\phi_{E1}e$	$\phi_{E1}d_{E1}$	$\phi_{E1}d_{E2}$	$\phi_{E1}\phi_B$ γ	$\phi_{E1}\phi_{E1}$	$\phi_{E1}\phi_{E2}$	$\phi_{E1}\mu_B$	$\phi_{E1}g$ vector Lorentz
ϕ_{E2}	$\phi_{E2}e$	$\phi_{E2}d_{E1}$	$\phi_{E2}d_{E2}$	r.h. photon $\phi_{E2}\phi_B$	$\phi_{E2}\phi_{E1}$	$\phi_{E2}\phi_{E2}$	$\phi_{E2}\mu_B$	$\phi_{E2}g$
μ_B	$\mu_B e$ bivector	$\mu_B d_{E1}$	$\mu_B d_{E2}$ vector + trivector	$\mu_B\phi_B$	$\mu_B\phi_{E1}$	$\mu_B\phi_{E2}$ scalar + quadvector	$\mu_B\mu_B$	$\mu_B g$ vector + pv
g	ge trivector	gd_{E1}	gd_{E2} bivector + quadvector	$g\phi_B$	$g\phi_{E1}$	$g\phi_{E2}$ vector + pentavector	$g\mu_B$	gg scalar + sv

octonion algebra is not associative - absence of RH neutrino

neutrino two-body modes shown in impedance network of next slide

"If you had only one slide
to get your point across…"

Michaele Suisse

The 'One Slide' Introduction to ***Generalized*** Quantum Impedances

Peter Cameron

July 2014

"To understand the electron would be enough"

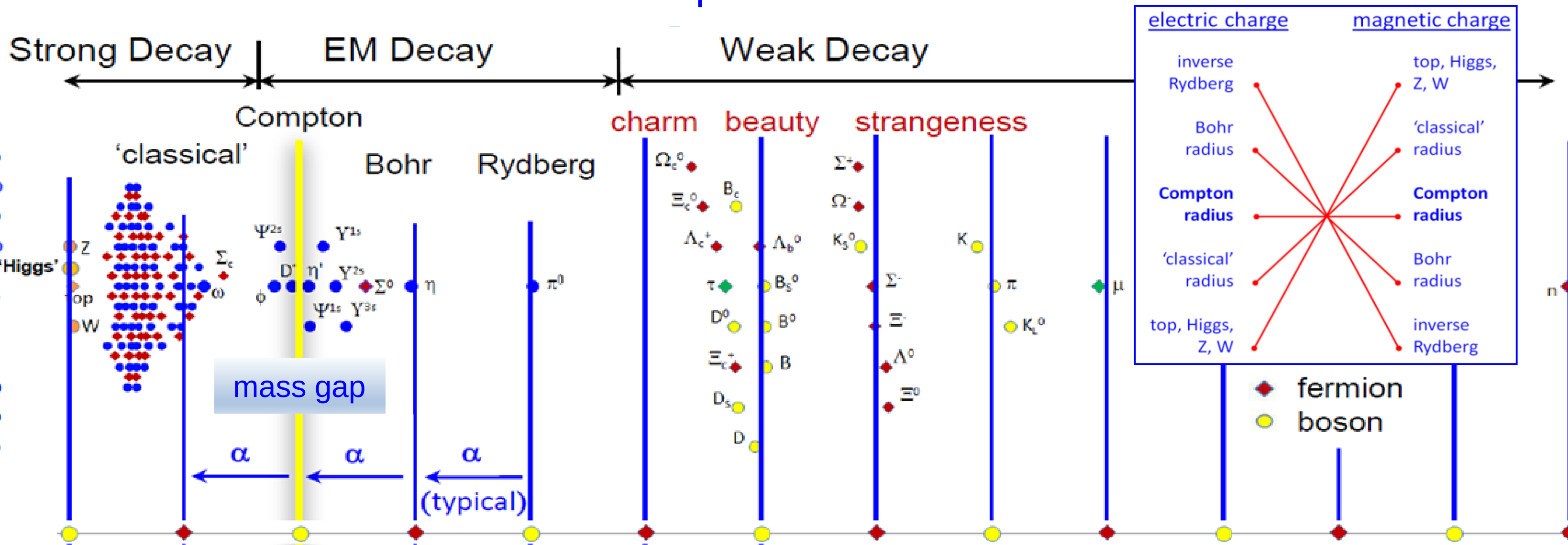
Einstein

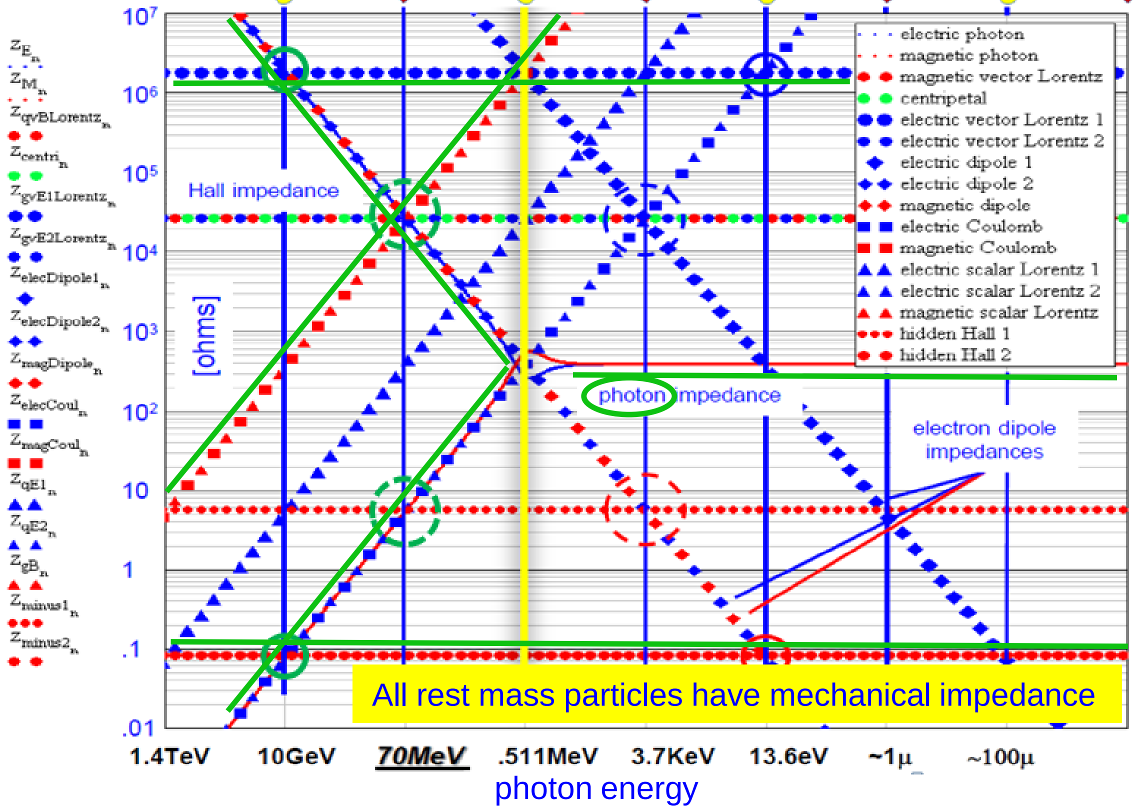
Correlation of unstable lifetimes with nodes of impedance network

$\pi_0 \rightarrow 2\gamma$ 98.8%
$\pi_0 \rightarrow e^+e^-\gamma$ 1.2%

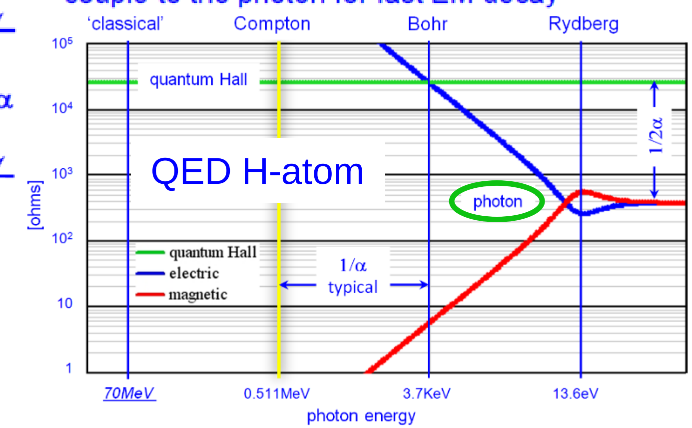
$\eta \rightarrow 2\gamma$ 39.3%
$\eta \rightarrow 3\pi^0$ 32.6%
$\eta \rightarrow \pi^+\pi^-\pi^0$ 22.7%
$\eta \rightarrow \pi^+\pi^-\gamma$ 4.6%

$\eta' \rightarrow \pi^+\pi^-\eta$ 39.3%
$\eta' \rightarrow \rho^0\gamma$ incl. $\pi^+\pi^-\gamma$ 29.3%
$\eta' \rightarrow \pi^0\pi^0\eta$ 21.6%
$\eta' \rightarrow \omega\gamma$ 2.8%
$\eta' \rightarrow \gamma\gamma$ 2.2%





- Horizontal axis in both plots is logarithmic
- Length scales are the same for both plots, and they are properly aligned
- Upper plot shows particle lifetimes multiplied by the speed of light, the coherence lengths (adapted from The Power of Alpha by Malcolm MacGregor)
- Plot at left is electron impedances, details at http://redshift.vif.com/JournalFiles/V18NO2PDF/V18N2CAM.pdf
- Alpha-spaced coherence lengths of η', η, and π_0 are at conjunctions of mode impedances, can couple to the photon for fast EM decay



Naturalness begets Naturalness: An Emergent Definition the paper

Peter Cameron and Michaele Suisse*
P.O. Box 1030, Mattituck, NY 11952
(Dated: August 3, 2019)

We offer a model based upon three 'assumptions'. The first is geometric, that the vacuum wavefunction is comprised of Euclid's fundamental geometric objects of space - point, line, plane, and volume elements - components of the geometric representation of Clifford algebra. The second is electromagnetic, that physical manifestation follows from introducing the dimensionless coupling constant α. The third takes the electron mass to define the scale of space. Such a model is arguably maximally 'natural'. Wavefunction interactions are modeled by the geometric product of Clifford algebra. What emerges is more naturalness. We offer an emergent definition.

0. Introduction

"...naturalness seems to be one of the best-kept secrets of physicists from the general public, a secret weapon for evaluating and motivating theories of the world on its deepest levels"[1].

[6] G. Guidice, "Naturally Speaking: The Naturalness Criterion and Physics at the LHC" (2008) https://arxiv.org/abs/0801.2562

betwixt and between lay the desert

[7] G. Guidice, "The Dawn of the Post-Naturalness Era" (2017) https://arxiv.org/abs/1710.07663

[8] S. Hossenfelder, "Screams for Explanation: Finetuning and Naturalness in the Foundations of Physics" (2018)

Summary

two fundamental concepts are absent from SM, both 'historical accidents'

geometric representation of Clifford algebra – vacuum wavefunction

generalized quantum impedances – governs amplitude and phase

their restoration yields a model that is **naturally**

gauge invariant, finite, confined, asymptotically free,

and contains the four forces, dark matter and energy,…

a model that provides a complementary perspective to SM

this year's Nobel

The model gives us a handle on how to augment translation gauge field

RF accelerating cavities of baseline muon collider design

with rotation gauge fields of carefully chose topological impedances.

Focus is not on wavefunction energy/frequency, but rather relative phases of components.

Terrell/**Penrose** rotation – finite light speed, appearance of rapidly moving objects,…

baez animation

Such an approach would be most effective at low energies, where most needed

Conclusion

The tf08-tf11 Loi requests that the community become pro-active

"Validating a Maximally Natural Electromagnetic Model of the Four Forces"

If the model is what it appears to be, then reasonable and prudent behavior suggests including it where relevant in our recommendations to P5.

backup

muon lifetime enhancement - geometric and topological potentials

- decay = decoherence due to **relative phase shifts** of wavefunction coupled modes
  - breaks Maxwell/QED flow of energy between E and B
  - seek to counteract shifts induced by self-excitation of vacuum wavefunction **impedances**
- two possibilities – translation (local) or rotation (local and nonlocal) gauge fields
  - translation – longitudinal electric field (RF cavities), 1/r geometric Coulomb potential

    Lorentz transform - time dilation
  - rotation – longitudinal magnetic field (solenoids?), $1/r^2$ topological vector Lorentz potential

    Terrell/Penrose rotation – finite light speed, appearance of rapidly moving objects,…
- two more possibilities – muon or neutrino wavefunction
  - muon – two component Dirac spinor (scalar electric charge plus bivector magnetic dipole)

    augmented by 'dark' vector electric dipole $\psi_\mu = \mathbf{e}\ \mathbf{d}_E\ \boldsymbol{\mu}_B$ *(τ completes the 2D algebra)*
  - neutrino – two component photon (vector magnetic plus bivector electric flux quanta)

    augmented by 'dark' trivector magnetic charge $\psi_\nu = \phi_B\ \mathbf{g}\ \phi_E$
  - topological symmetry breaking - in SI units dark trivector magnetic charge and visible vector magnetic flux quantum and are numerically identical yet topologically distinct.
  - in this model neutrino can be thought of as **topologically protected photon**
  - we seek to apply a 'bias' – a topological phase shift sufficient to measurably delay excitation of a manifested neutrino from the vacuum wavefunction
  - effective at low energy – complements RF cavities where most needed
  - first step – exhaustive literature search for effect of B fields on lifetimes

existing

new

mini-abstract: Muon collider lifetime enhancement requires understanding vacuum and neutrino wavefunctions

NEUTRINO 2020

Massless Neutrino Oscillation via Maximally Natural Vacuum Wavefunctions*

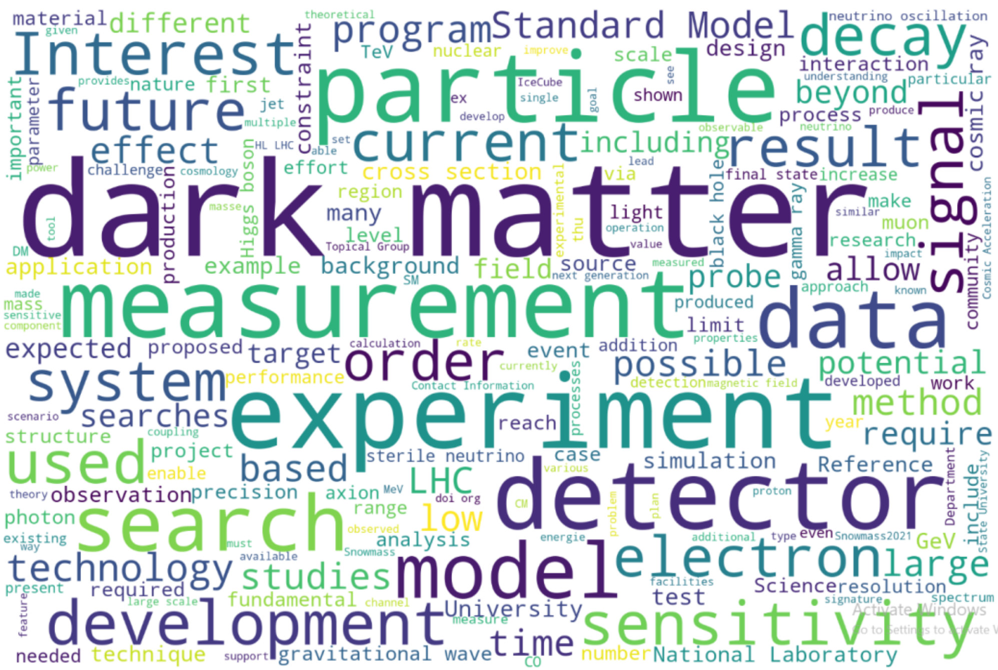
Peter Cameron – Brookhaven National Laboratory (retired) electronGaugeGroup@gmail.com

SnowMass2021

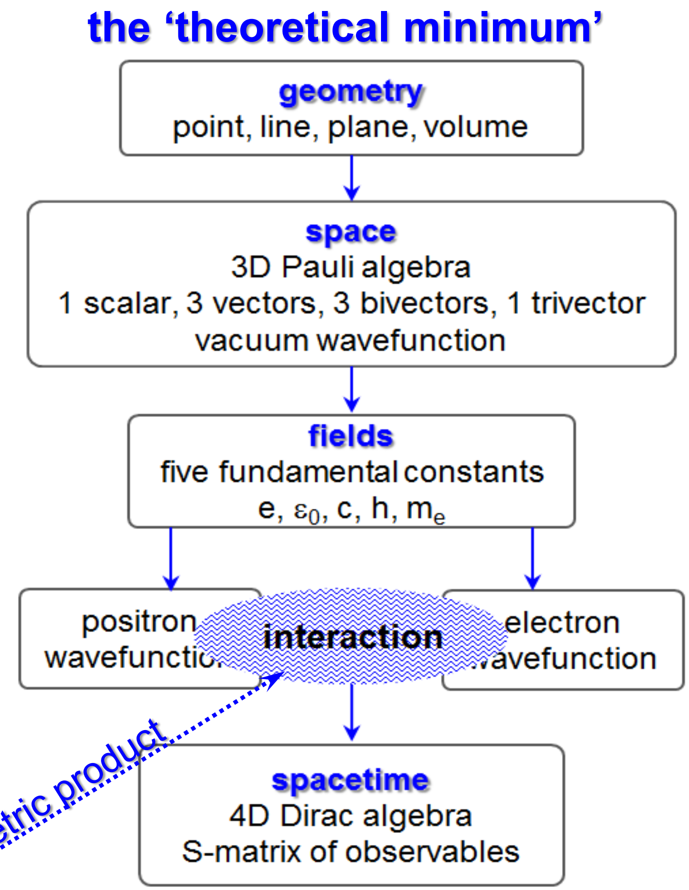
https://indico.fnal.gov/event/19348/contributions/186426/

tf8-tf11 Loi Validating a Maximally Natural Electromagnetic Model of the Four Forces

(1) quantized electromagnetic impedance matching of
(2) geometric wavefunction interactions
Two fundamental conceptual structures absent from the Standard Model
All data is consistent with massless oscillation.



thank you Gordon Watts



Given two vectors W and Z, the geometric product WZ changes grades. In the product

$$WZ = W \cdot Z + W \wedge Z,$$

two grade 1 vector bosons transform into a grade 0 scalar boson and grade 2 bivector fermion,

$$WZ = Higgs + top.$$

In the geometric representation, Pauli matrices are basis vectors of 3D space, Dirac matrices of 4D spacetime

impedance matching governs amplitude and phase of energy/information transmission
scale invariant and dependent impedances correspond to rotation and translation gauge fields

all rest mass particles have
mechanical impedances!
SI units [kg/s]

Electron Impedances

Apeiron, Vol. 18, No. 2, April 2011

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July 24, 1975

THE TWO BODY PROBLEM AND MACH'S PRINCIPLE

Peter Cameron

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The classical analysis of the two-body problem is frequently complicated by the introduction of a system of co-ordinates which is independent of either of the bodies.

submitted to AJP 1975
published as an appendix to
the electron impedances paper

It is only recently, and particularly with the quantum Hall effect and the development of nanoelectronics, that impedances on the scale of molecules, atoms and single electrons have gained attention. In what follows the possibility that characteristic impedances might be defined for the photon and the single free electron is explored is some detail, the premise being that the concepts of electrical and mechanical impedances are relevant to the elementary particle. The scale invariant quantum Hall impedance is pivotal in this exploration, as is the two body problem and Mach's principle.

To understand the electron would be enough - Einstein

vibratory piledriver
two synchronized counter-rotating eccentrics
transforms 2D rotation to 1D translation.

mechanical analogy of electron and positron spinors
rotating in opposite directions in phase space

The 1975 paper drove the inquiry – contained
classical and quantum mechanics and gravitation.

Topological inversion of SI units - more impedance
[kg/s] means less flow, not more!
This thwarted Bjorken, Feynman, many others.

Generalized Quantum Impedances: A Model for the Unstable Particles

background independent

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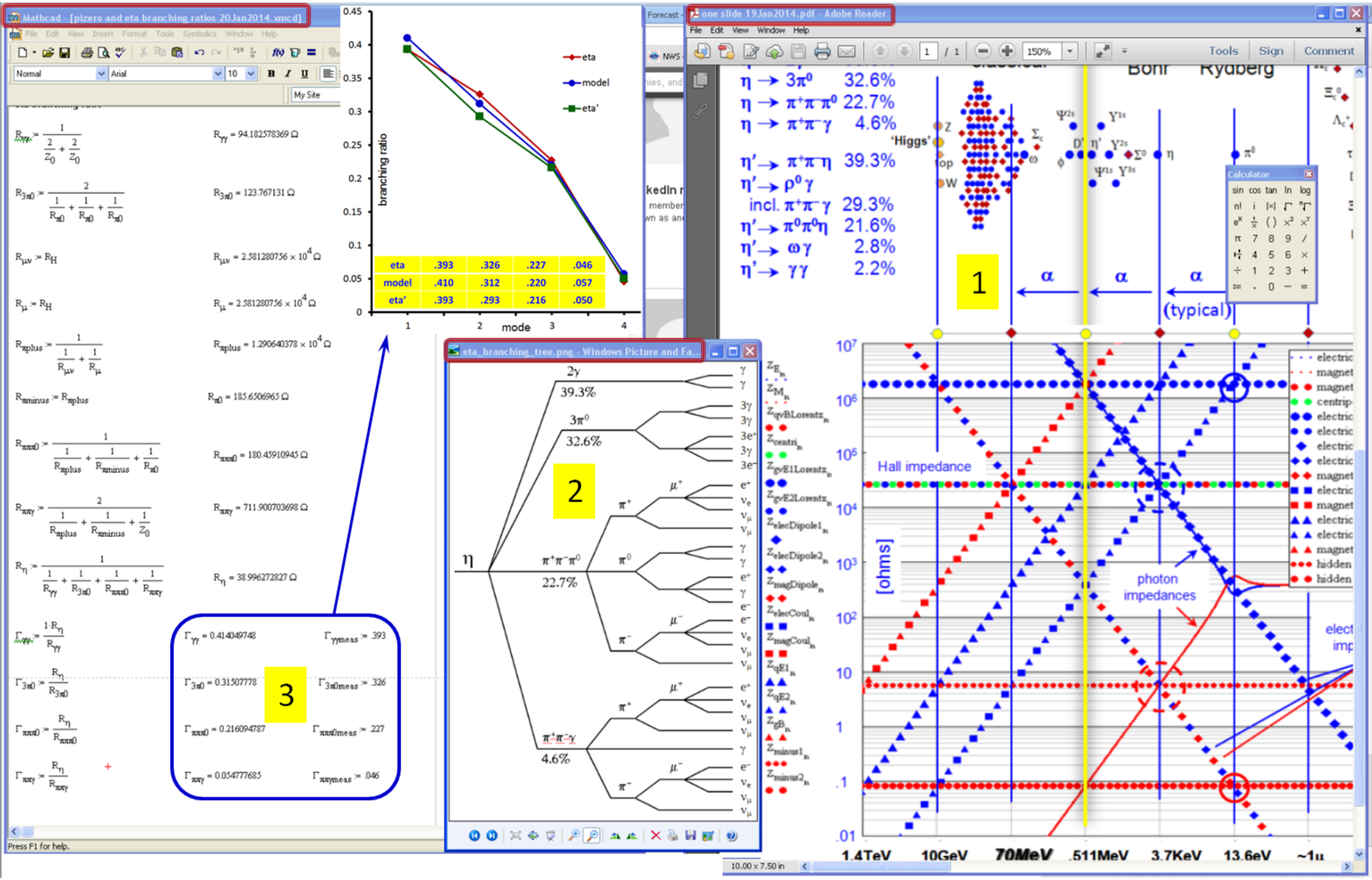
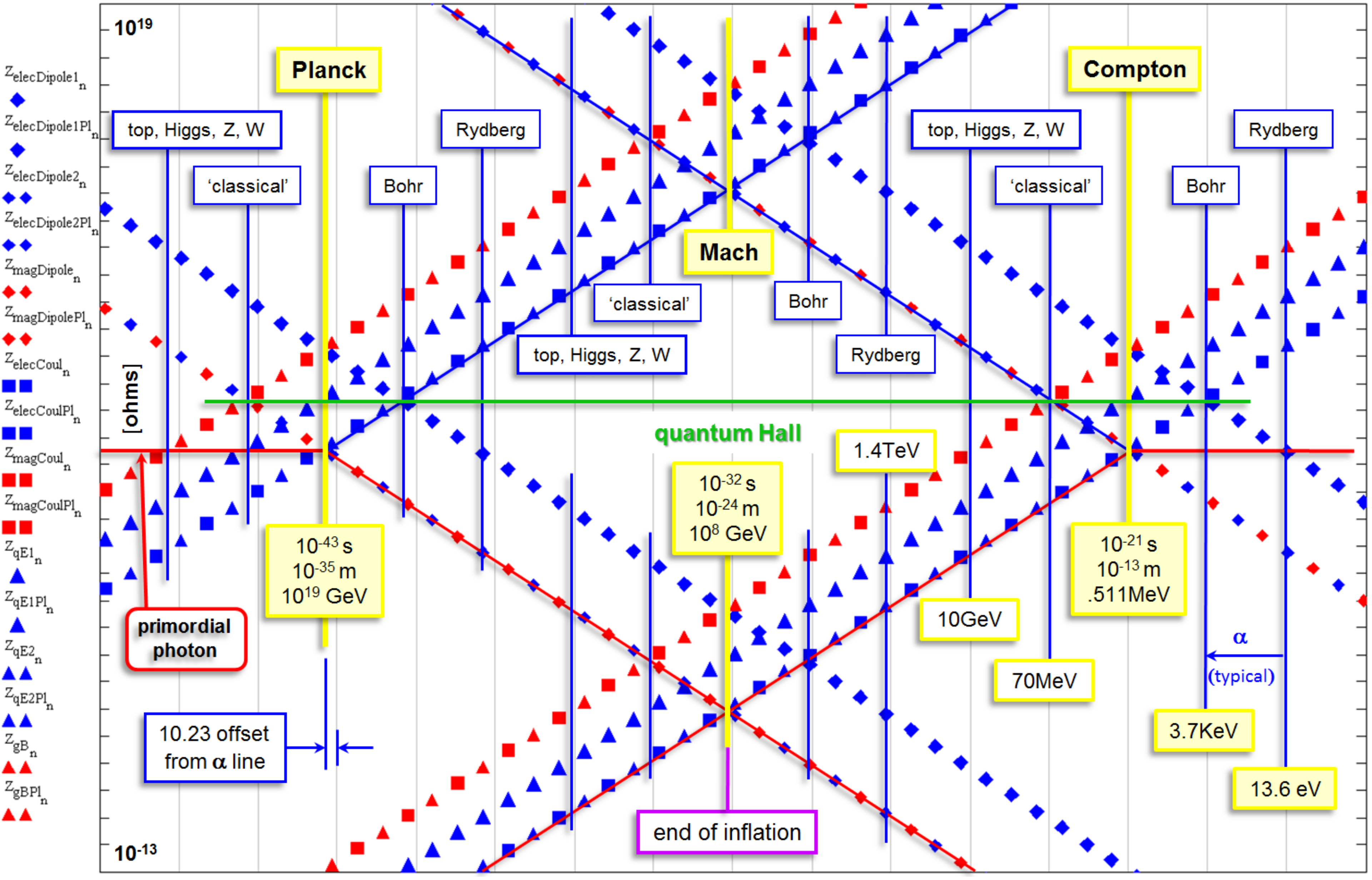
(Dated: June 20, 2012)

The discovery of exact impedance quantization in the quantum Hall effect was greatly facilitated by scale invariance. Both follow from the application of the Lorentz force to a two dimensional ballistic current carrier. This letter speculates upon the possibility that quantum impedances may be generalized, defined not just for the Lorentz force, but rather for all forces, resulting in a precisely structured network of scale dependent and scale invariant impedances. If the concept of generalized quantum impedances correctly describes the physical world, then in quantum physics such impedances govern how energy is transmitted and reflected, how the hydrogen atom is ionized by a 13.6eV photon, or why the π_0 branching ratio is what it is. An impedance model of the electron is presented, and explored as a model for the unstable particles as well.

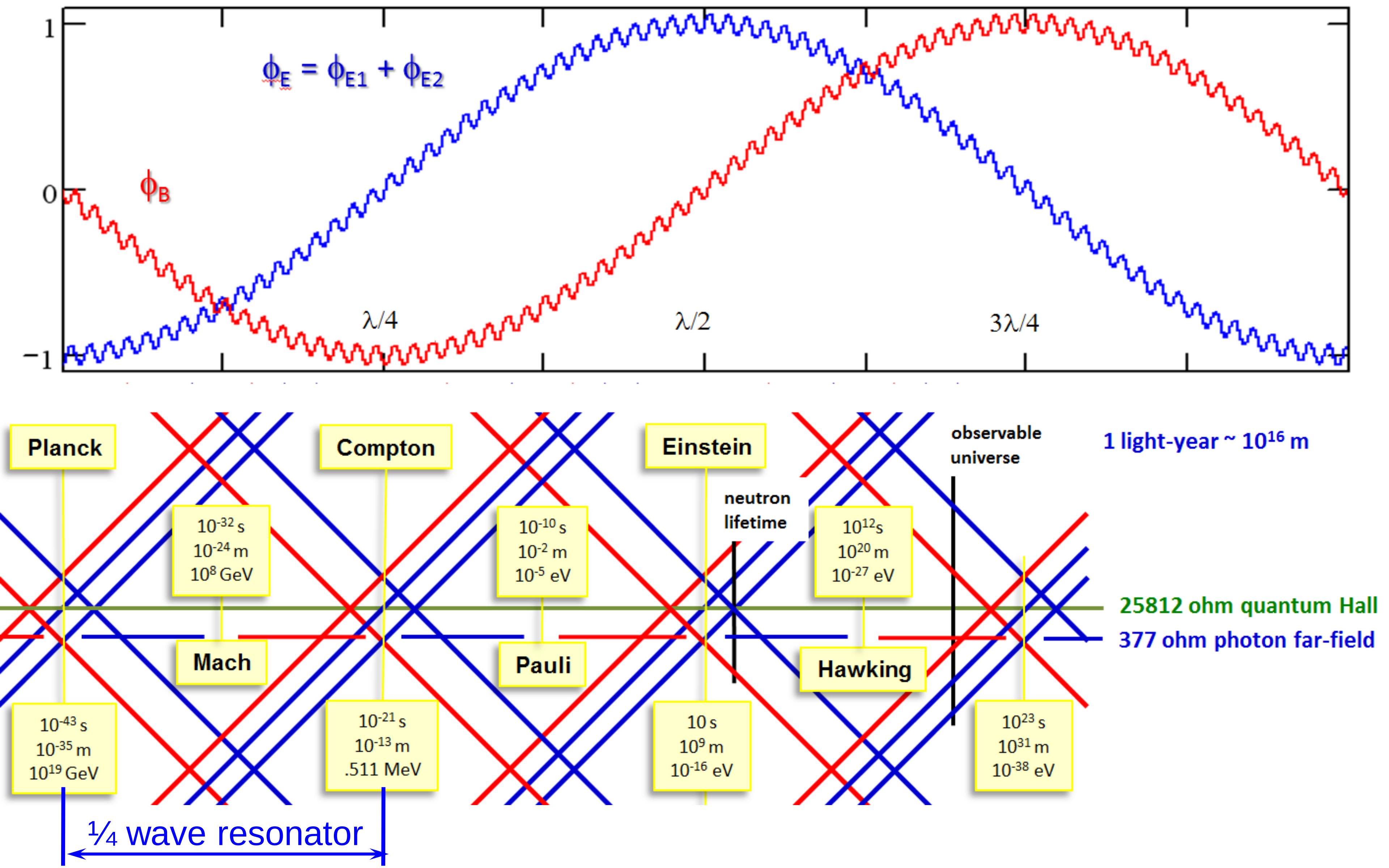
BSM example 2 – chiral anomaly – precise pizero, eta, and eta' branching ratios in powers of α



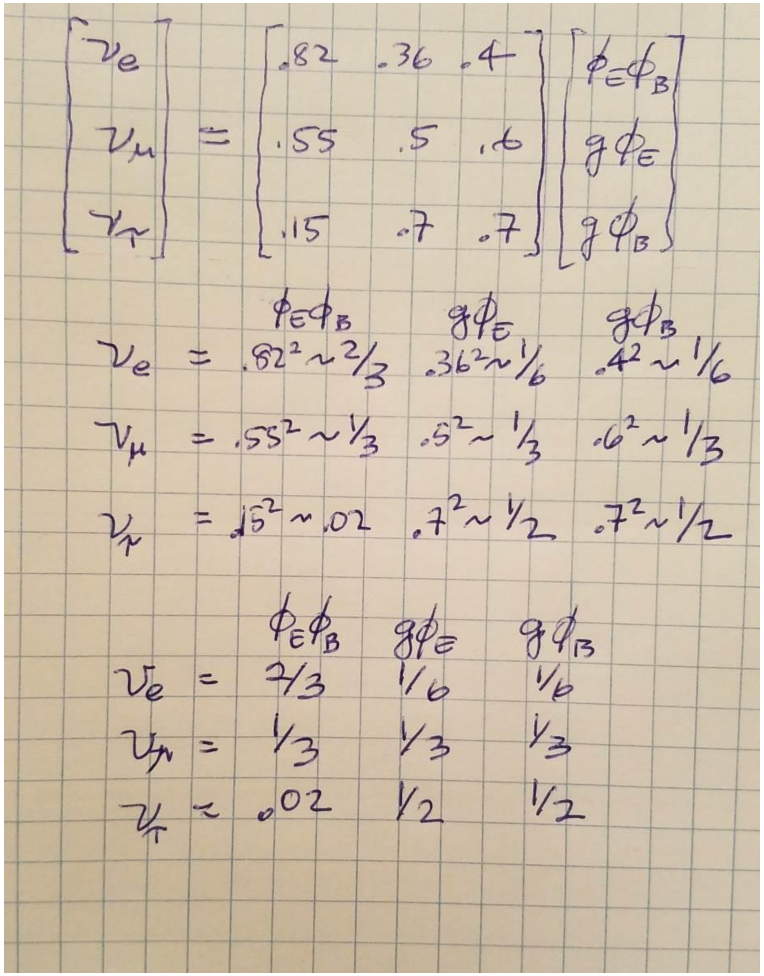
BSM example 3 – origin of mass, gravitation, inflation, chirality, baryon asymmetry,…



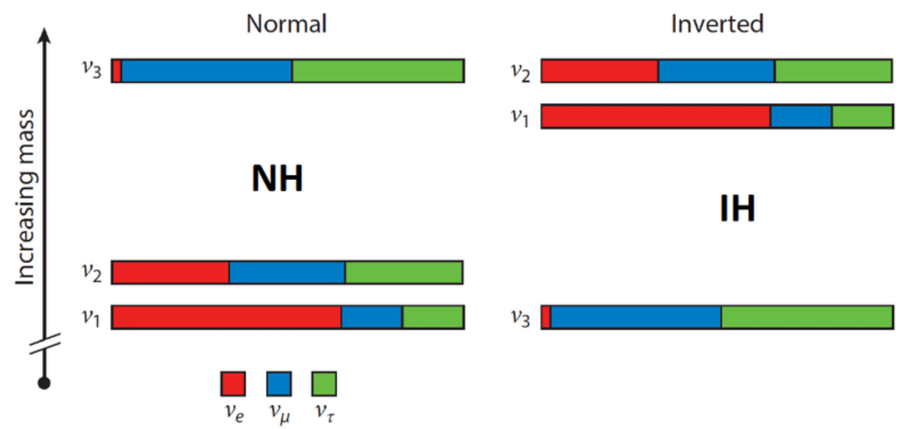
BSM example 4 – mismatched attenuated Planck photon – dark energy?



Neutrino modes as PMNS 'mass states'

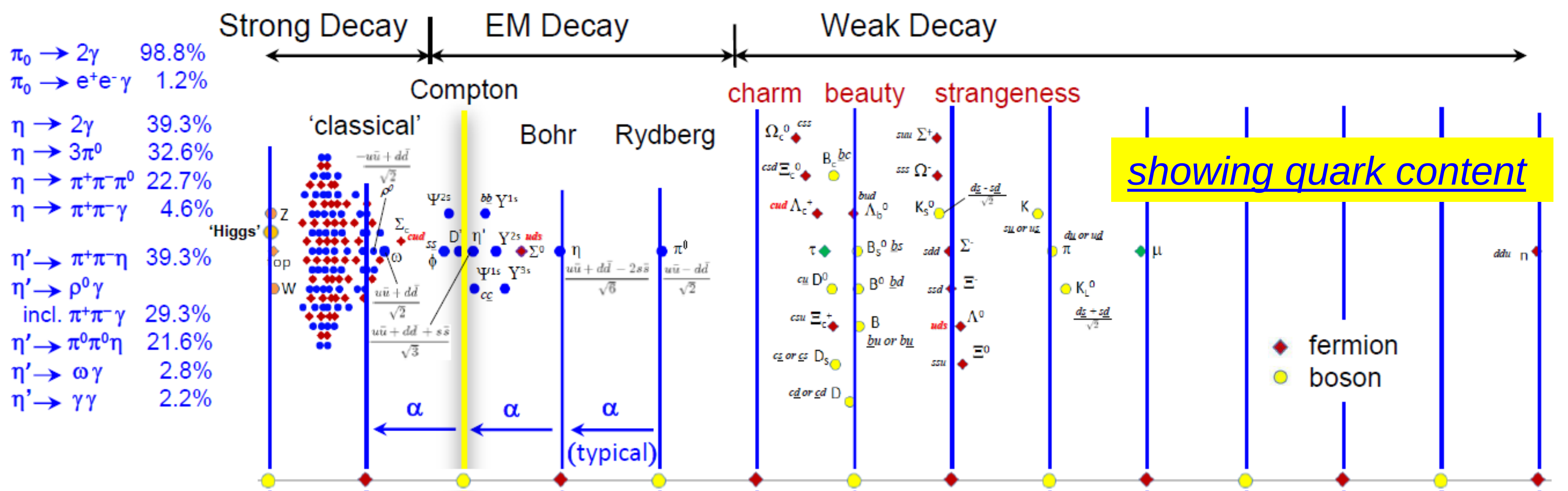


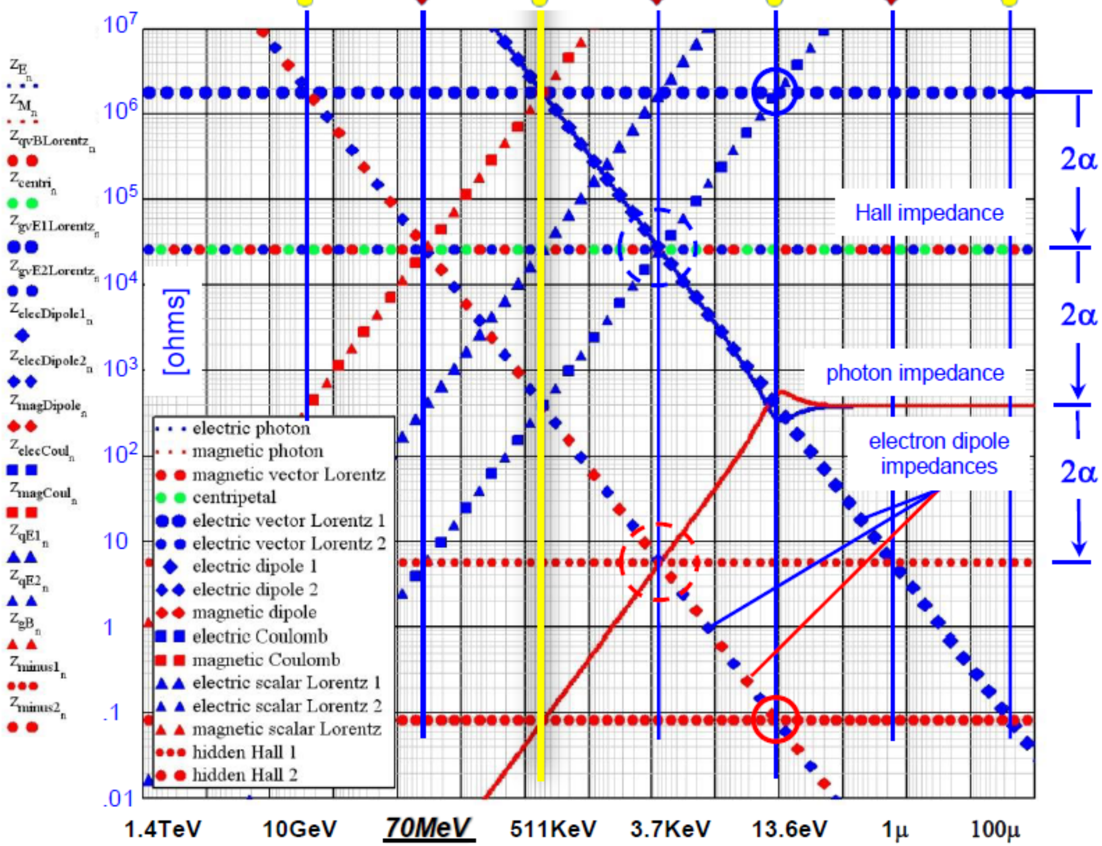
Magnetic charge (trivector) and flux quantum (vector) are
numerically equal (SI units) but topologically distinct.
Adding magnetic charge to photon to comprise the neutrino is topological.
Photon is topologically protected.
Absence of right handed neutrino follows from the math - octonion algebra of eight-component wavefunction is not three-component associative.



please note inversion of modes and wavefunctions in these two figures – not sure where things got flipped

8-component octonion wavefunction is the eight degree-of-freedom string of string theory. The octonion gains two additional DOFs from assigning E and B fields to the components, yielding the ten dimensions of string theory.





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- Plot at left is electron impedances, details at http://redshift.vif.com/JournalFiles/V18NO2PDF/V18N2CAM.pdf
- Alpha-spaced coherence lengths of η', η, and π_0 are at the conjunctions of mode impedances, can couple to the photon for fast EM decay
- Weak decays are mismatched to the photon
- Alpha-spaced coherence length alternation of fermions/bosons in weak decays appears to be related to parity violation and electroweak enhancement of charm/tau coherence lengths
- Clustering of superheavies (top, Higgs, Z, W) at the 10GeV coherence length is tantalizing
- Impedance junctions at the classical radius are related to mass quantization and MacGregor's ***70MeV*** 'platform state'