QED Model of Massless Neutrino Oscillation in the Geometric Representation of Clifford Algebra

Peter Cameron

Abstract

All experimental data is consistent with massless neutrinos. There exist possibilities other than rest mass differences to explain oscillation. The two-component photon wavefunction is comprised of electric and magnetic flux quanta, coupled by Maxwell's equations. In the basic photon-electron interaction of QED, opposing phase shifts of the electron's inductive and capacitive impedances decouple the photon's flux quanta, breaking Maxwell's equations, transferring energy and momentum. Extending the two-component Dirac wavefunction (scalar charge and bivector magnetic moment) to the full eight-component vacuum wavefunction in the geometric representation of Clifford algebra permits assigning topological magnetic charge to the spin 1 3D pseudoscalar. A simple three-component neutrino wavefunction model might then be comprised of the two photon components, topologically protected by magnetic charge. Curiously, in SI units 1D vector magnetic flux quantum and 3D trivector magnetic charge quantum are numerically identical yet geometrically and topologically distinct. We discuss the mixing matrix that results from such a model.

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

Extending QED to Interactions of the Full Eight-Component Vacuum Wavefunction of the Geometric Representation of Clifford Algebra

DPF annual meeting
https://indico.cern.ch/event/1034469/

Jul 14, 2021, 4:45 PM previous talk

talk | Beyond Standard M... | Beyond Standard Model

15m

Track L (Zoom)

youtube link to dry run
https://www.youtube.com/watch?v=Q1bNkXmfUq8

- Clifford algebra in the geometric representation – vacuum wavefunction and geometric quantization
- wavefunction interactions – the geometric product
- the 'geometric S-matrix'
- physical manifestation – coupling constant and electromagnetic quantization
- the 'electromagnetic S-matrix'

a ten degree-of-freedom abstraction

QED Model of Massless Neutrino Oscillation in the Geometric Representation of Clifford Algebra

Jul 14, 2021, 5:00 PM this talk

talk | Beyond Standard M... | Beyond Standard Model

15m

Track L (Zoom)

- all experimental data are consistent with massless neutrino oscillation
- quantized impedance networks of wavefunction interactions – the connection to physical reality
- suspension of disbelief – BSM examples
- massless neutrino oscillation

lost in physics

Naturalness begets Naturalness: An Emergent Definition

Naturalness Revisited: not Spacetime, Spacephase

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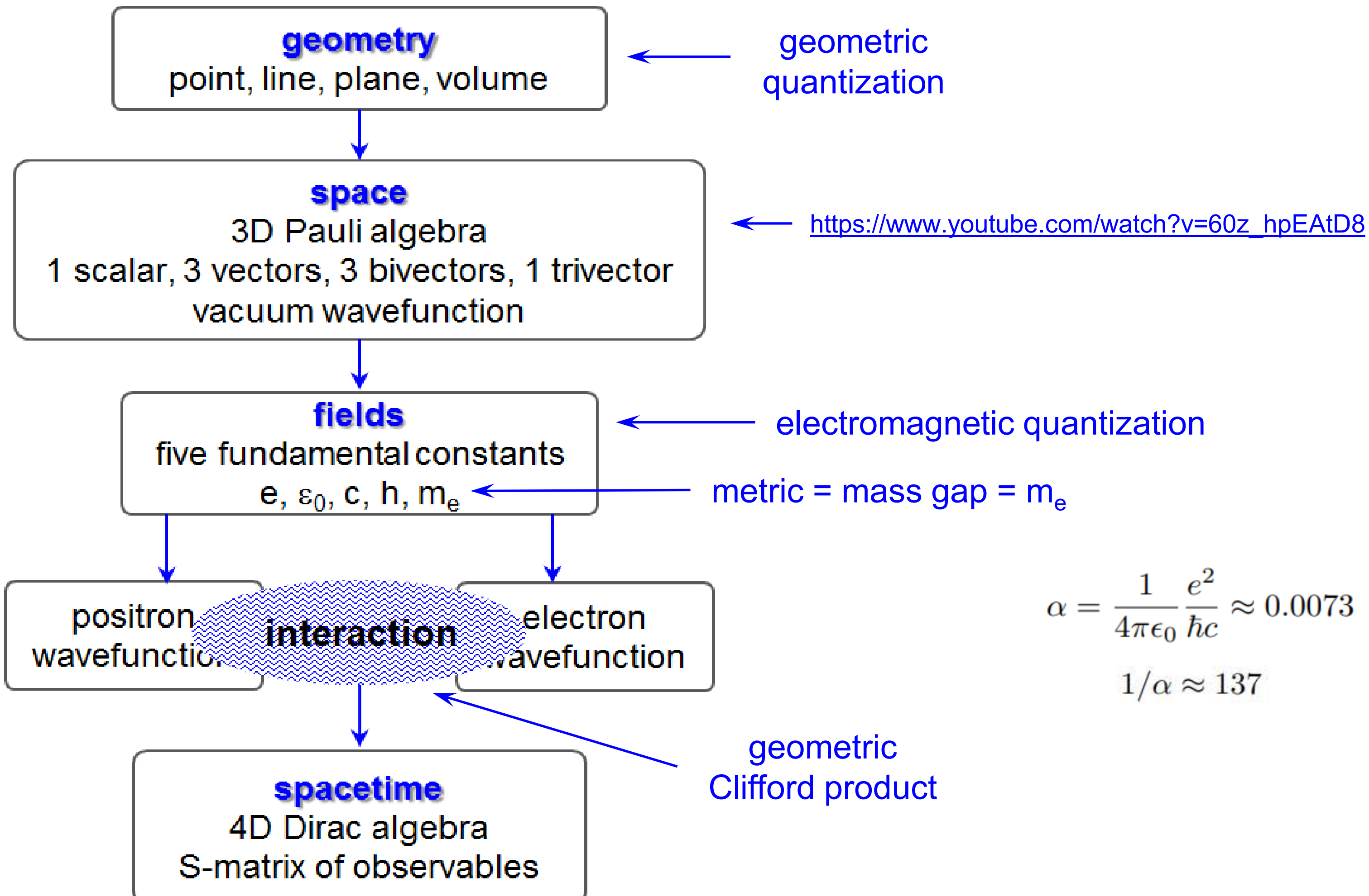
  - geometric product
  - electromagnetic scattering matrix,
  - unstable particle spectrum
- quantization of wavefunction interaction impedances
  - historical perspective on impedance matching
  - how impedance matching was lost in quantum mechanics
  - Mach's principle and mechanical impedances
- suspension of disbelief – an essential property of good fiction
  - unstable particle spectrum
  - impedance matching to the Planck length (and beyond)
  - impedance matching to boundary of the observable universe (and beyond)
  - chiral anomaly and pizero/eta/etaprime branching ratios
- massless oscillation and the mixing matrix
- motivation – muon collider topological lifetime enhancement at low energy

The Theoretical Minimum

Three assumptions – geometry, fields, and ‘mass gap’

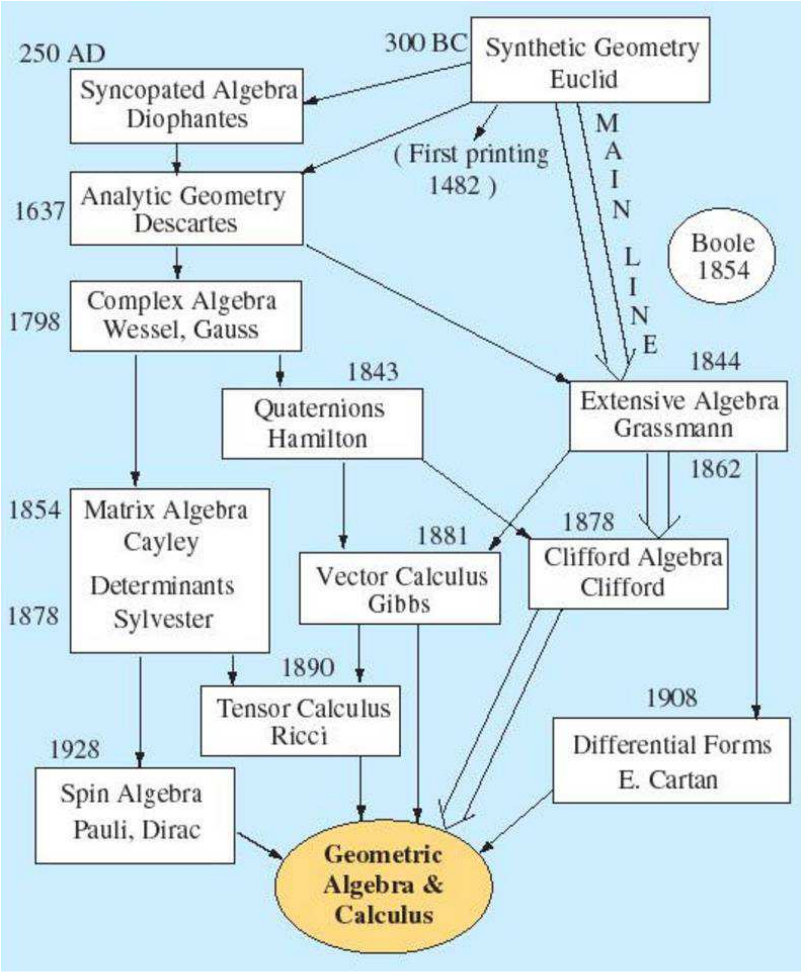


$$\alpha = \frac{1}{4\pi\epsilon_0}\frac{e^2}{\hbar c} \approx 0.0073$$

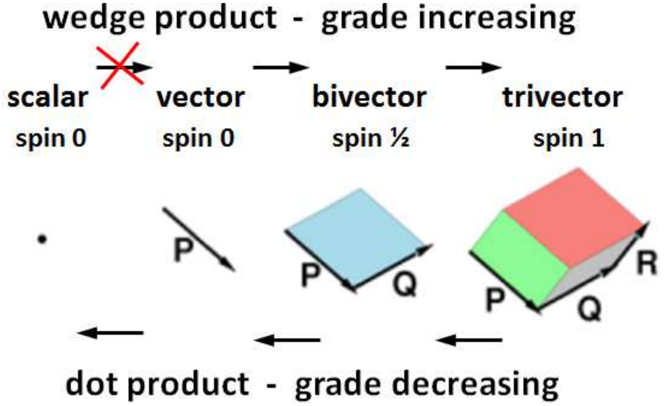
$$1/\alpha \approx 137$$

no free parameters
- emergence

"Geometric Algebra is the universal language for mathematical physics"



The 2002 Oersted Medal
was awarded to David Hestenes
by the American Physical Society for
"Reforming the mathematical
language of physics"



dynamic susy!
fermions to bosons, bosons to fermions

Given two vector bosons W and Z, the product WZ changes grades. In the product WZ = W·Z + W^Z, two grade 1 vector bosons transform to grade 0 scalar boson and grade 2 bivector fermion WZ = Higgs + top

Taken together, the four superheavies comprise a minimally complete
2D Clifford algebra – one scalar, two vectors, and one bivector

sum mode $m_Z + m_W = m_{top}$ *no Higgs mass here?*
difference mode $m_Z - m_W = m_{bottomonium}$

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  at low energy

	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*	$\phi_B\phi_B$	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}	$\phi_{E2}e$	$\phi_{E2}d_{E1}$	$\phi_{E2}d_{E2}$	$\phi_{E2}\phi_B$	$\phi_{E2}\phi_{E1}$	$\phi_{E2}\phi_{E2}$	$\phi_{E2}\mu_B$	$\phi_{E2}g$
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*

neutrino wavefunction is 3-body
impedance is scale invariant
topological

$g\phi_B\phi_{E1}$ δ_{cp} ?

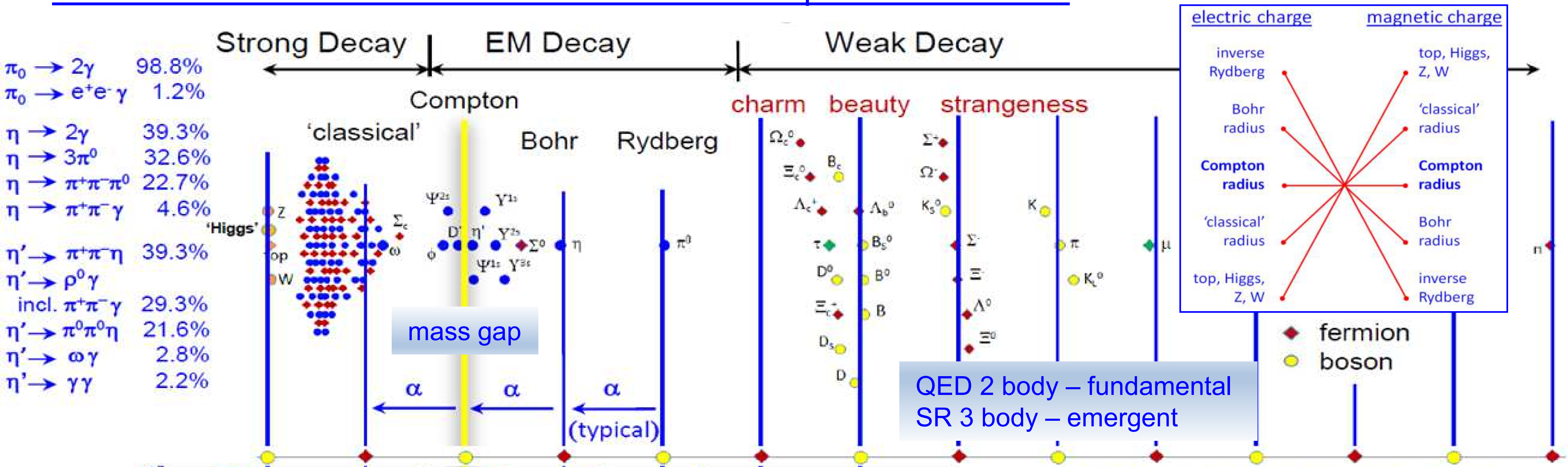
off diagonal
2-body modes

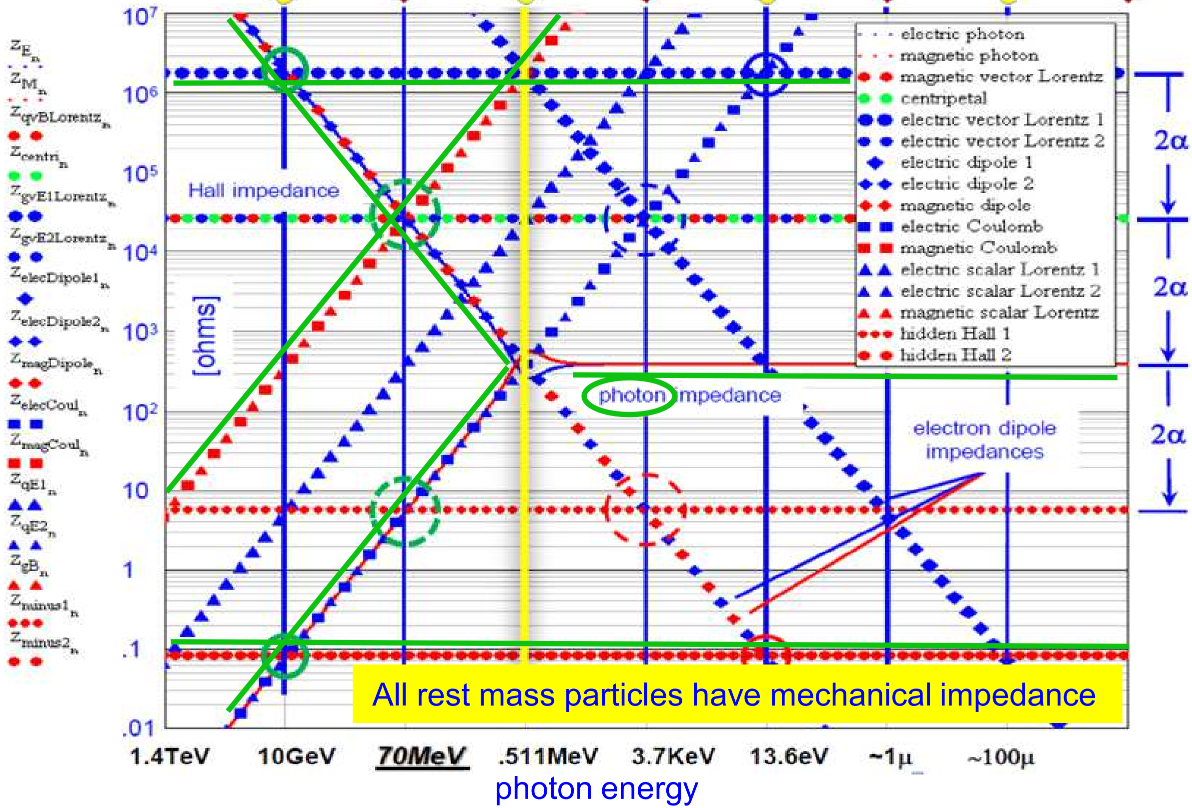
$\phi_B\phi_{E1}$	photon – topological and geometric
$g\phi_B$	scalar Lorentz – geometric
$g\phi_{E1}$	vector Lorentz – topological
	for muon collider? Proton EDM ring?

on diagonal 2-body modes
couple to antiparticle/vacuum

$\phi_B\phi_B$	null
$\phi_{E1}\phi_{E1}$	null
gg	scalar + pscalar entangled

Correlation of unstable lifetimes with nodes of impedance network





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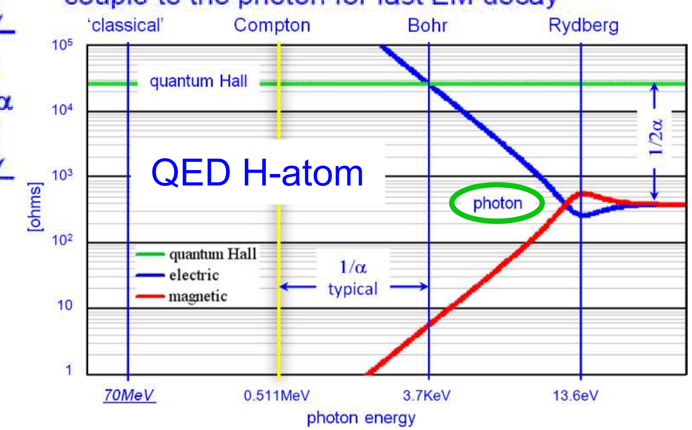
- Alpha-spaced coherence lengths of η', η, and π_0 are at conjunctions of mode impedances, can couple to the photon for fast EM decay



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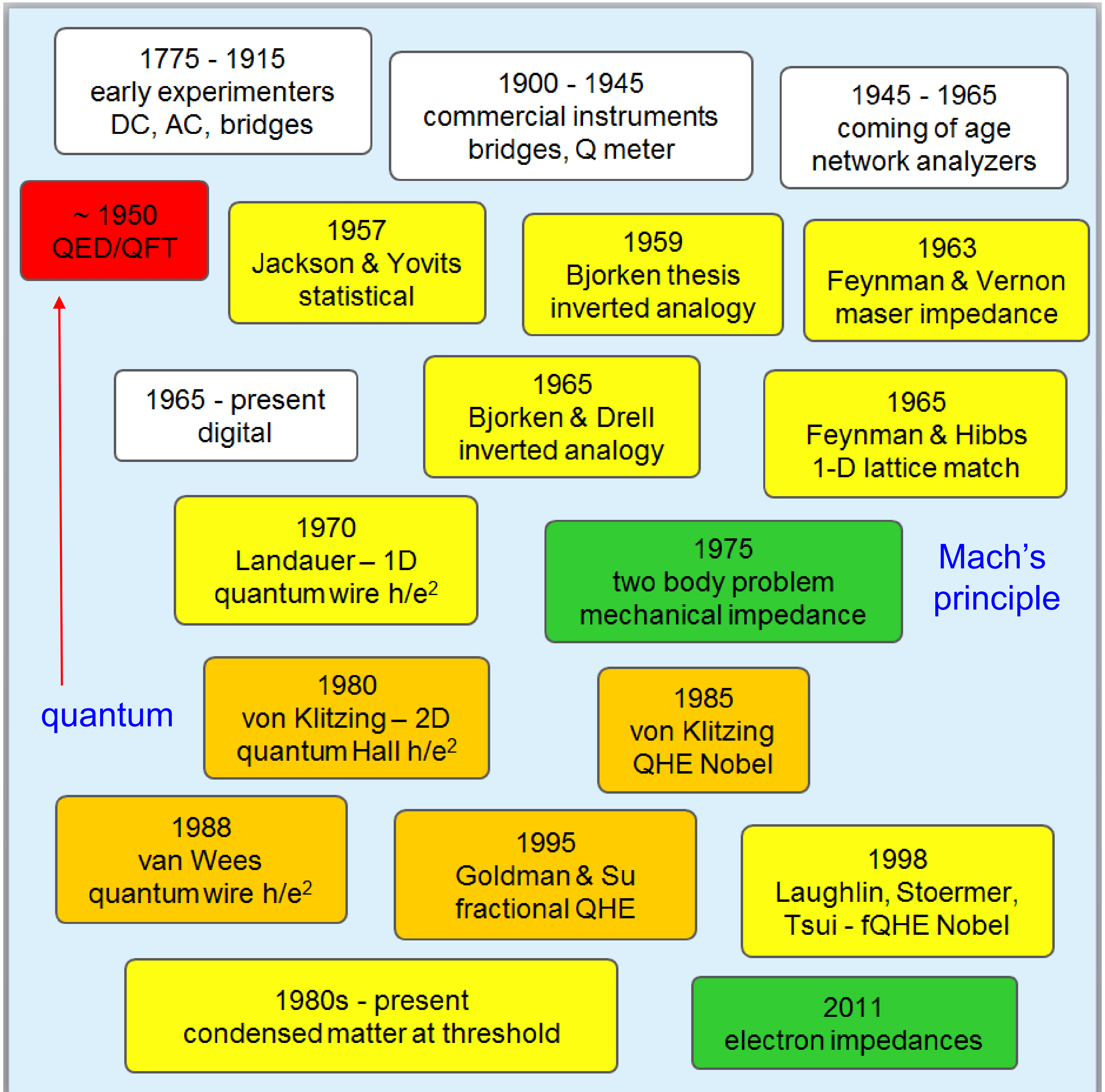
Impedance History

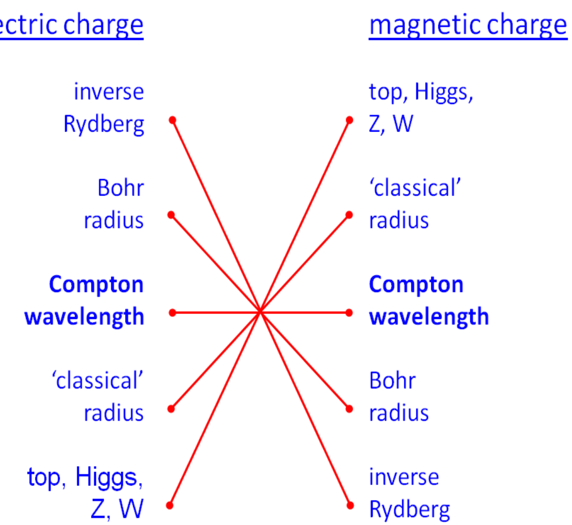


color code

white – classical
yellow – theory
gold – experiment
green - BSM

How Impedance matching was lost in QM

1. Topological inversion – units of mechanical impedance are [kg/s]. Intuitively one might expect that more [kg/s] would mean more mass flow. However more impedance means less flow. Thwarted Bjorken, Feynman,…
2. concept of ***exact*** impedance quantization did not exist until vonKlitzing et.al discovered QHE in 1980.
3. QHE was easy – scale invariant!
4. habit of setting fundamental constants to dimensionless unity h = c = G = Z = … = 1 let Z slip over the horizon.



Mismatches are Feynman's regularization parameters of QED.
Inclusion renders QED finite. This is what Bjorken discovered back in 1959, anticipated it would be a powerful tool, was led astray by the inversion of SI units.
Feynman had a student do a thesis on impedance matching to the maser.

Bjorken was perhaps not familiar with their work when writing his 1959 thesis[46]. In that thesis is an approach summarized[47] as "...an analogy between Feynman diagrams and electrical circuits, with Feynman parameters playing the role of *resistance*, external momenta as current sources, and coordinate differences as voltage drops. Some of that found its way into section 18.4 of..." the canonical text[48]. As presented there, the units of the Feynman parameter are [sec/kg], the units of mechanical *conductance*[5].

One of the black hole event horizon impedances is the 25812 ohm quantum Hall – scale invariant, topological, communicates phase only, can do no work.

J. Bjorken, "Experimental tests of Quantum electrodynamics and spectral representations of Green's functions in perturbation theory", Thesis, Stanford (1959) http://searchworks.stanford.edu/view/2001021

J. Bjorken, private communication (2014)

J. Bjorken, and S. Drell, *Relativistic Quantum Fields*, McGraw-Hill, section 18.4 (1965)

SRGW2021

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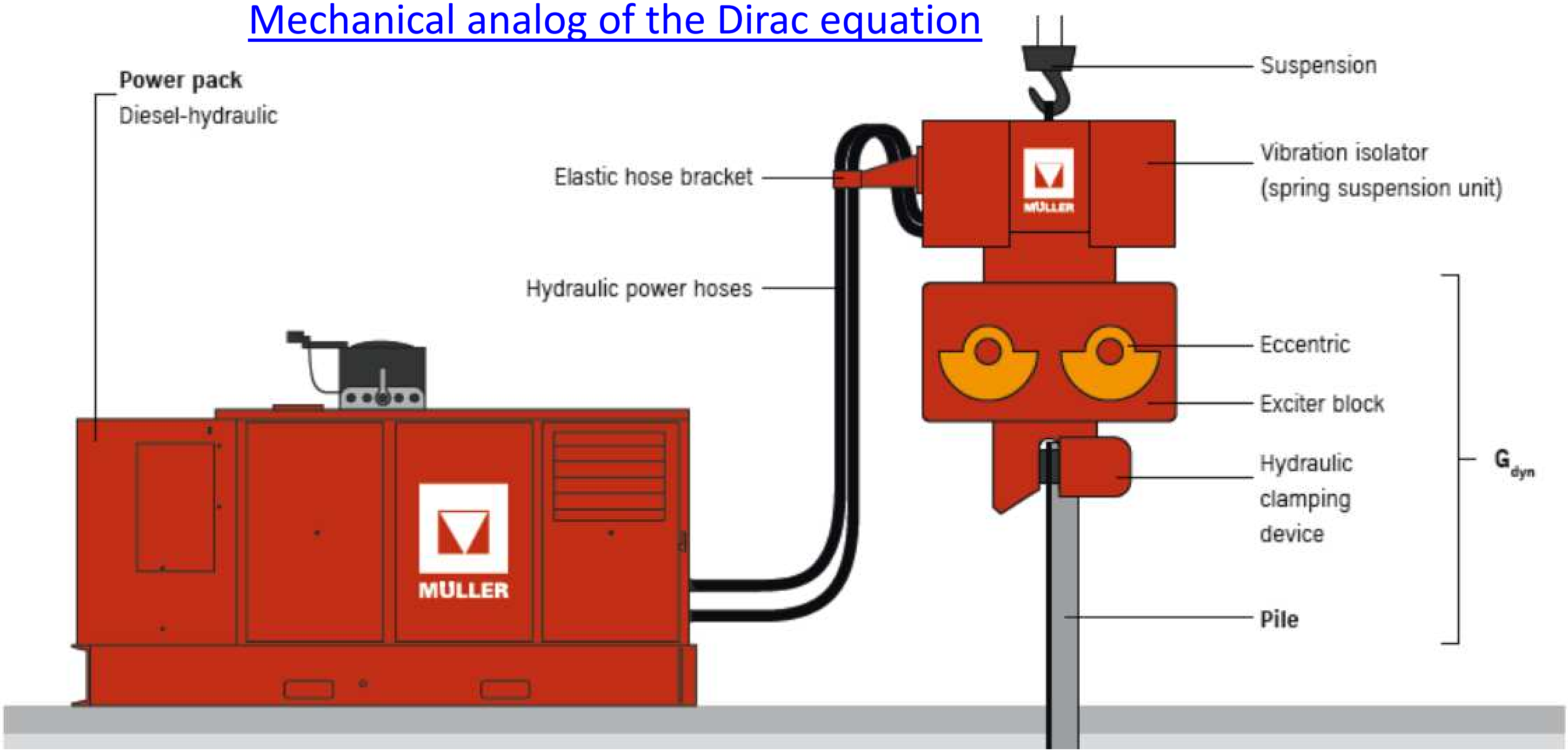
Mechanical analog of the Dirac equation



Synchronous counter-rotating eccentrics transform 2D rotation to 1D translations, are an analog to electron and positron spinors of Dirac equation counter-rotating in phase space.

A typical vibratory piledriver generates a sinusoidal inertial force of many tens or hundreds of tons, might be thought of as an `inertia wave generator'. Given equivalence of gravitational and inertial mass, it might also be called a gravitational wave generator.

The extent to which such a toy model might ultimately prove useful remains to be seen. For now it seems clear that it provides a simple shortcut to calculating quantized electromagnetic impedances

this is important – impedance matching governs amplitude and phase of energy transmission

GA is background independent

July 24, 1975

THE TWO BODY PROBLEM AND MACH'S PRINCIPLE

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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. The validity of such an analysis rests upon the premise that the co-ordinate frame does not interact with the physical system via any known physical laws, and that one is therefore free to choose whatever reference frame seems most useful.

A strong epistemological argument might be advanced against this reasoning. If sufficently rigorous constraints are placed upon the spatial properties of the interacting bodies, the introduction of an independent observer will have a radical effect upon the form of the equations which describe the interaction, to the extent that strongly differing concepts might be developed regarding such fundamental things as space, time, and matter. Newton

submitted to Am.J.Phys 1975
referees: 'No new physics here'
Published 2011 as an appendix to the Electron Impedances paper.
http://redshift.vif.com/JournalFiles/V18NO2PDF/V18N2CAM.pdf

Mass is quantized. All rest mass particles have quantized mechanical impedances.
EM conversion factor is squared inverse of line charge density $[m/coul]^2$
Resulting model has correct amplitudes and some phase information, but
mass is single field,
EM is two fields – orientational information needed to apply Maxwell's eqns is lacking.

pizza sauce

Apeiron, Vol. 17, No. 3, January 2010 193

matching to the 'mass gap'

Photon Impedance Match to a Single Free Electron

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It is not surprising that consideration of impedance matching the photon to the electron, or more specifically to the quantum of resistance at the length scale defined by the mass and angular momentum of the electron, has been long ignored in quantum electrodynamics. Conceptually the development of QED preceded the discovery of 'exact quantization' and the associated von Klitzing constant by many decades. Additionally, the relevance of the resistance quantum to photon interactions with a single free electron has only recently begun to be appreciated. In this note we offer a simple presentation of such an impedance match, briefly discuss the unexpected emergence of the fine structure constant from these simple first principles, and suggest how the procedure can be inverted to deliver a first principles calculation of the mass of the electron.

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

impedance network of the 'mass gap'

Electron Impedances

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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

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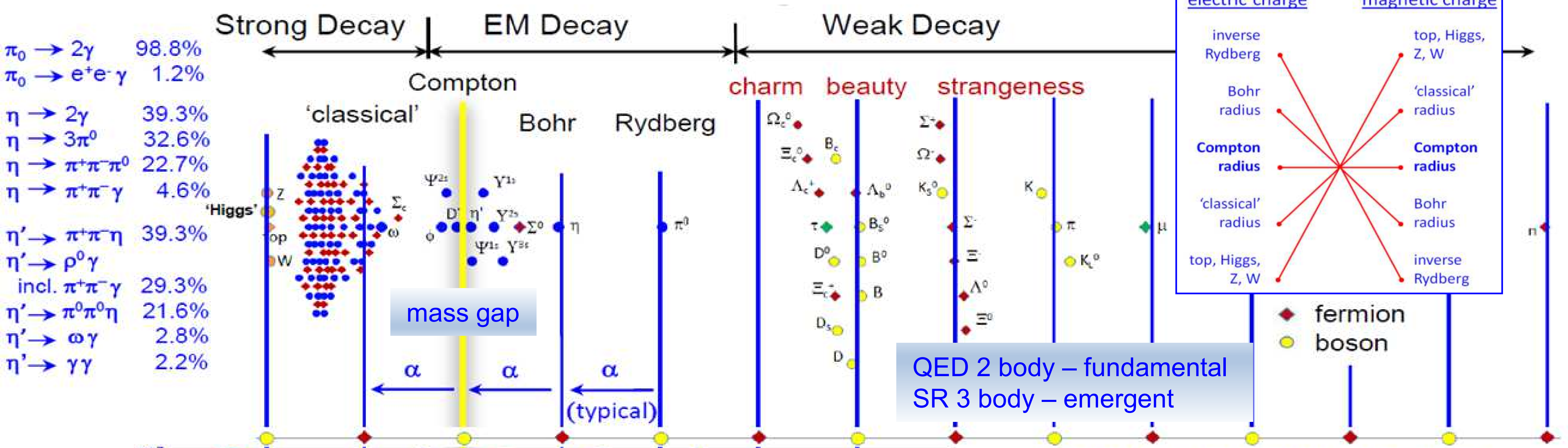
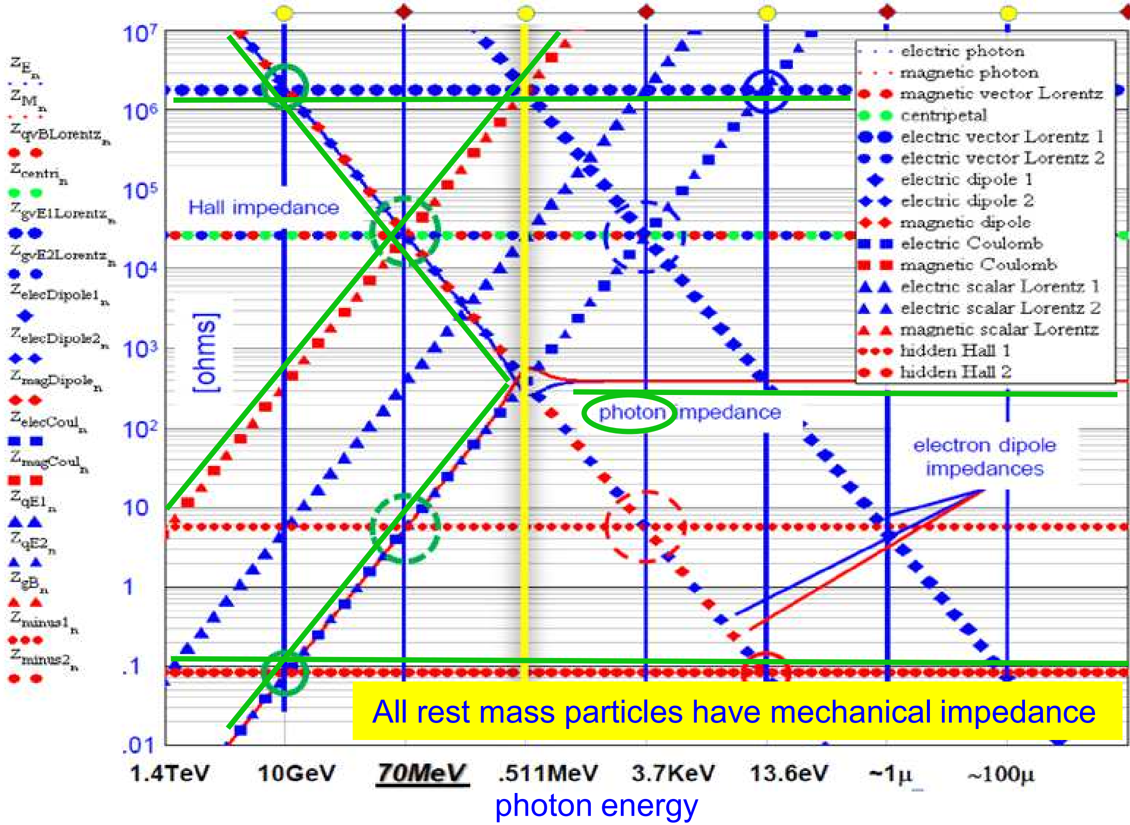
Correlation of unstable lifetimes with nodes of impedance network





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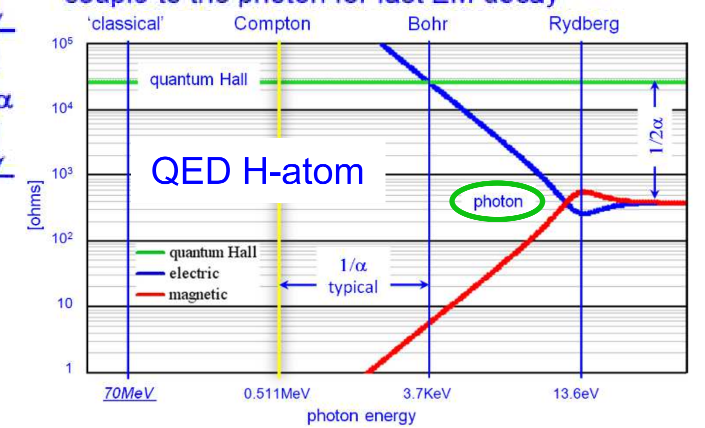
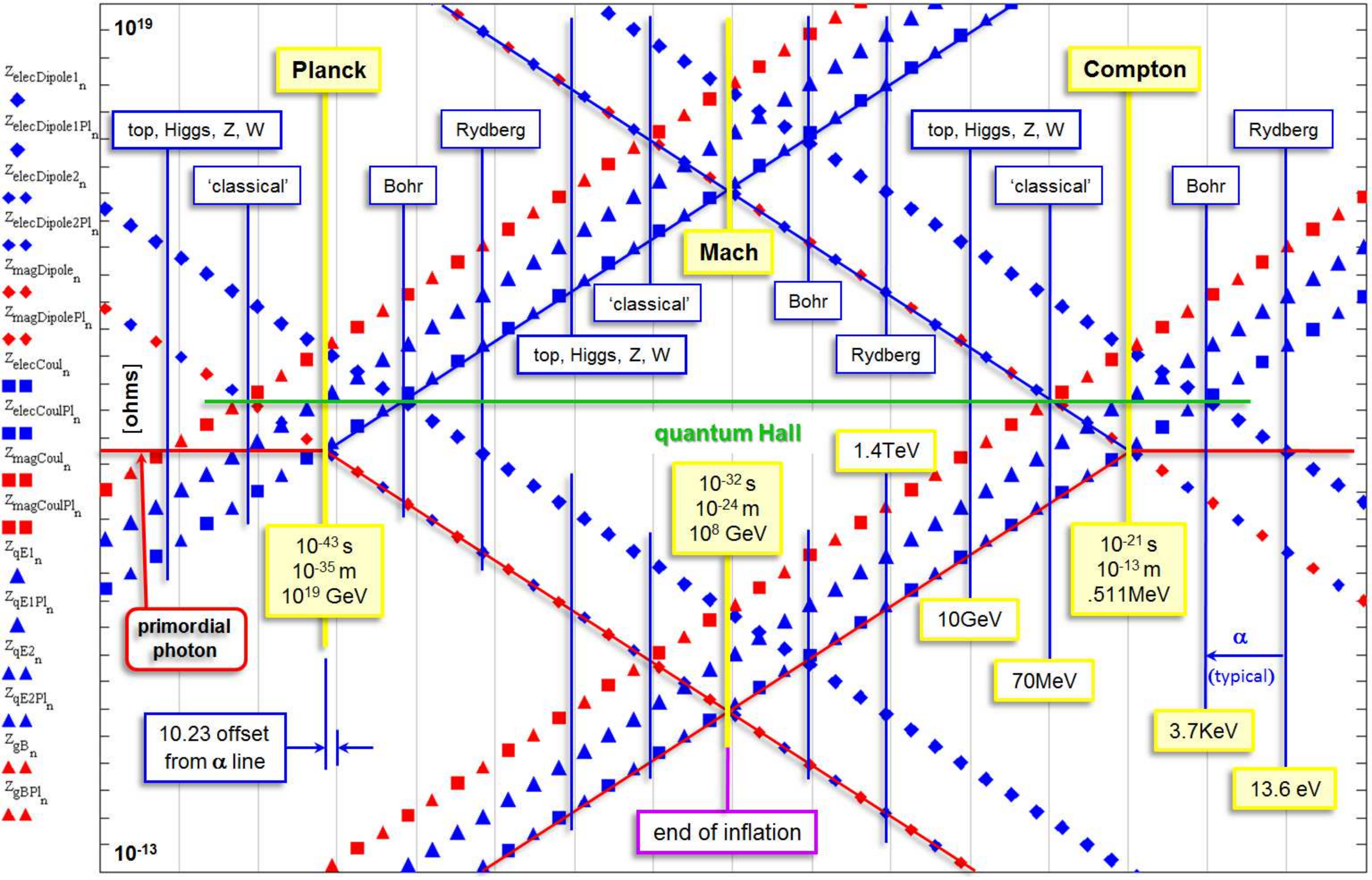
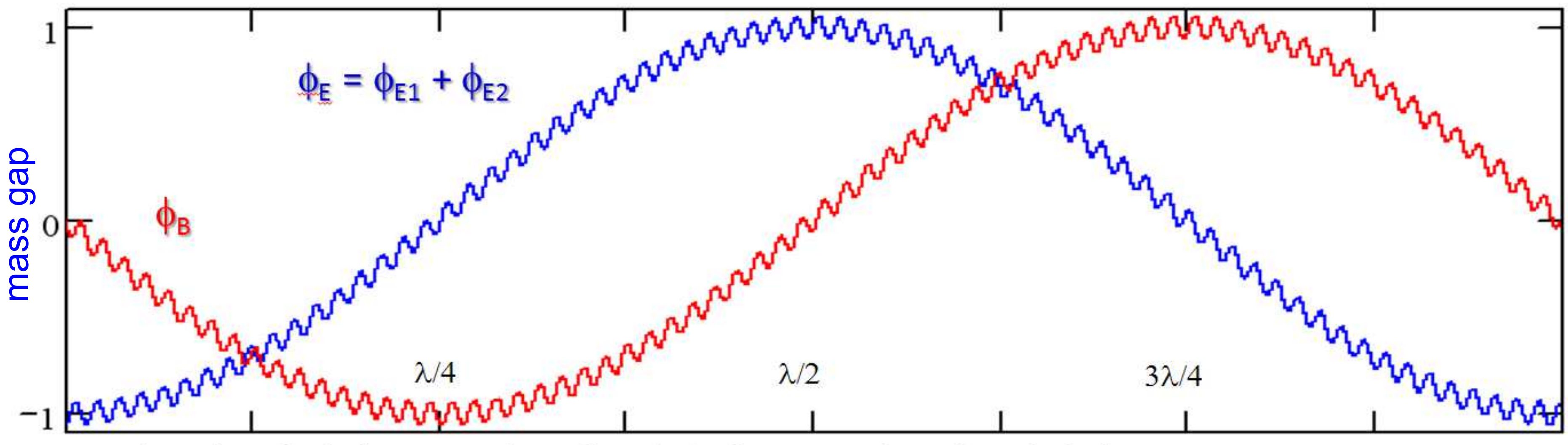


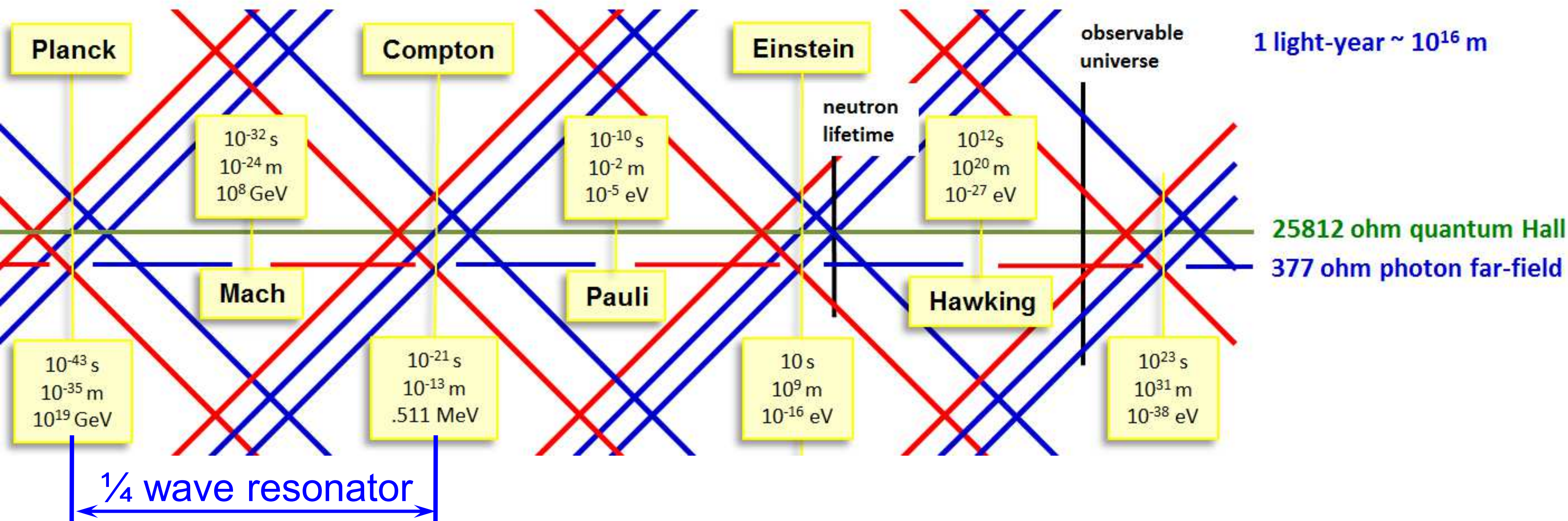
BSM example 2 – origin of gravitational mass, inflation, chirality, baryon asymmetry,…



https://www.osapublishing.org/abstract.cfm?uri=QIM-2013-W6.01

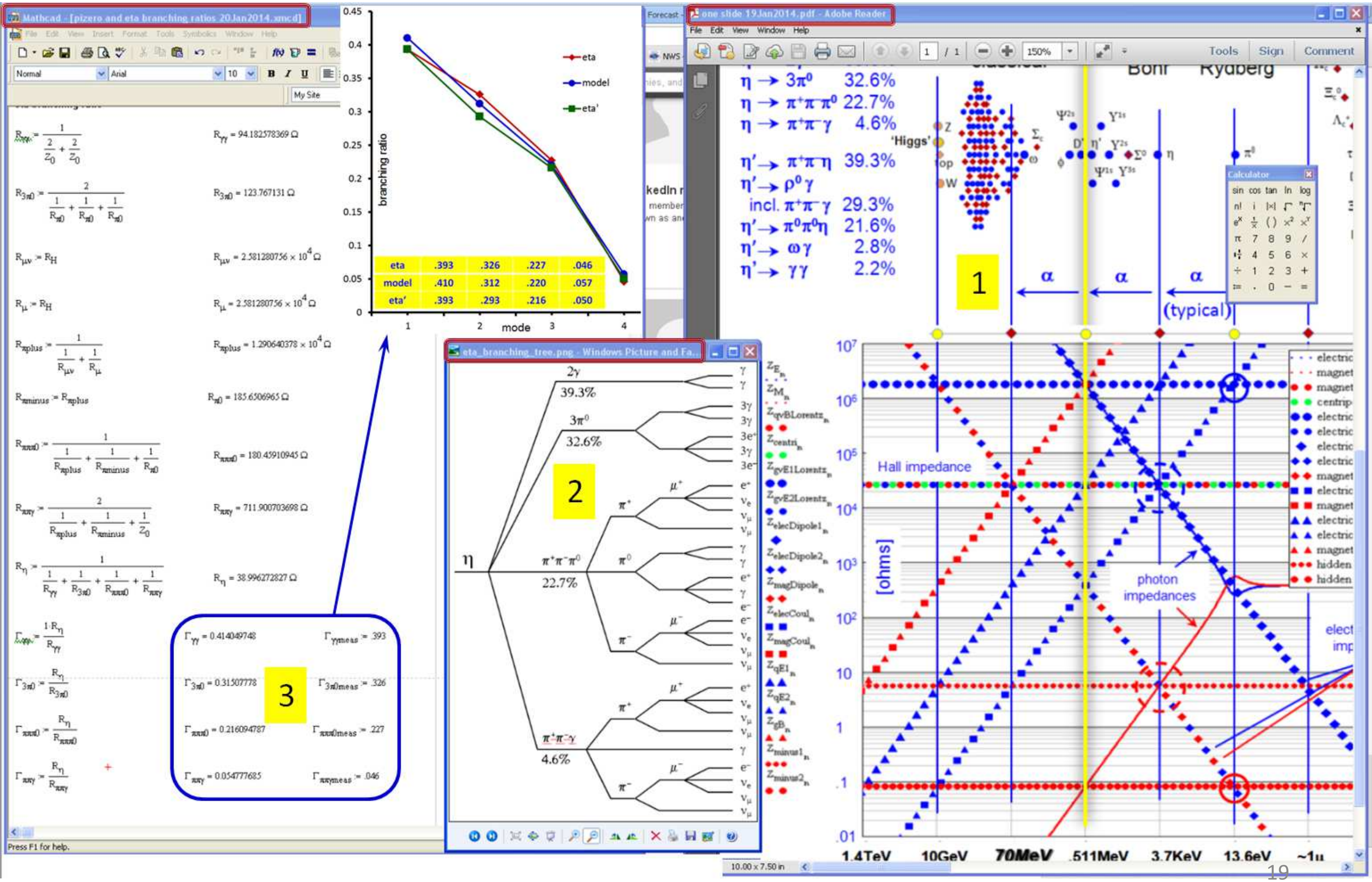
BSM example 3 mismatch attenuated Hawking photon ('graviton' is full 8-component wavefunction?)





Where in this network do we want to match for SRGW? How?

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



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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	$\phi_B\phi_B$	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}	$\phi_{E2}e$	$\phi_{E2}d_{E1}$	$\phi_{E2}d_{E2}$	$\phi_{E2}\phi_B$	$\phi_{E2}\phi_{E1}$	$\phi_{E2}\phi_{E2}$	$\phi_{E2}\mu_B$	$\phi_{E2}g$
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
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neutrino wavefunction is 3-body
impedance is scale invariant
topological

$g\phi_B\phi_{E1}$ δ_{cp} ?

off diagonal
2-body modes

$\phi_B\phi_{E1}$ photon – topological and geometric
$g\phi_B$ scalar Lorentz – geometric
$g\phi_{E1}$ vector Lorentz – topological
for muon collider? Proton EDM ring?

on diagonal 2-body modes
couple to antiparticle/vacuum

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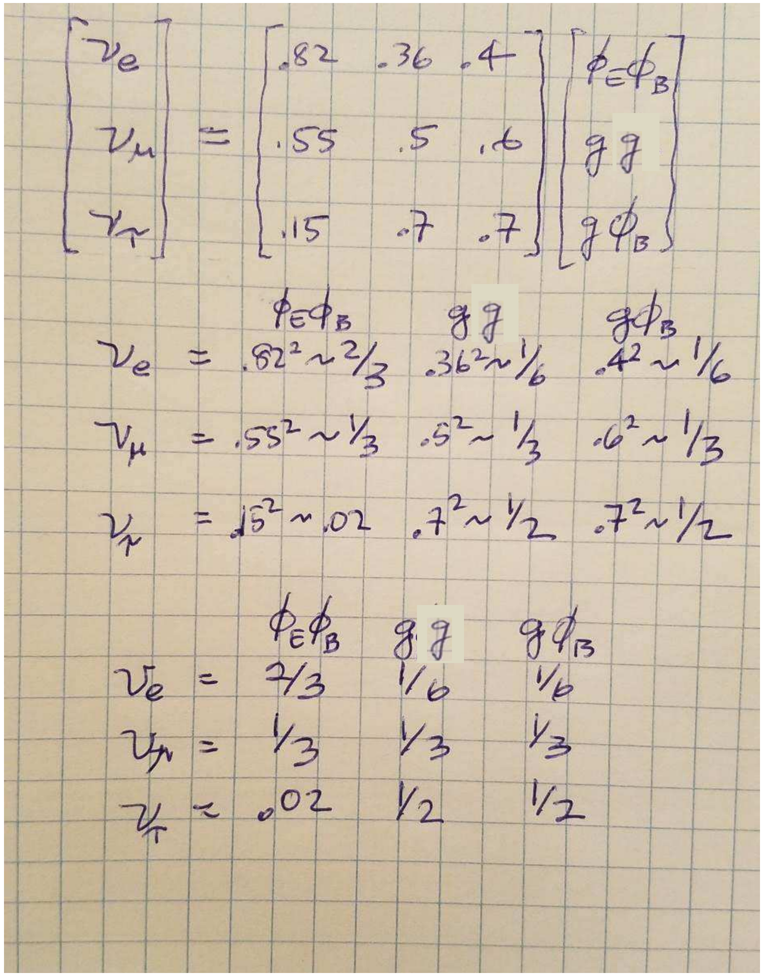
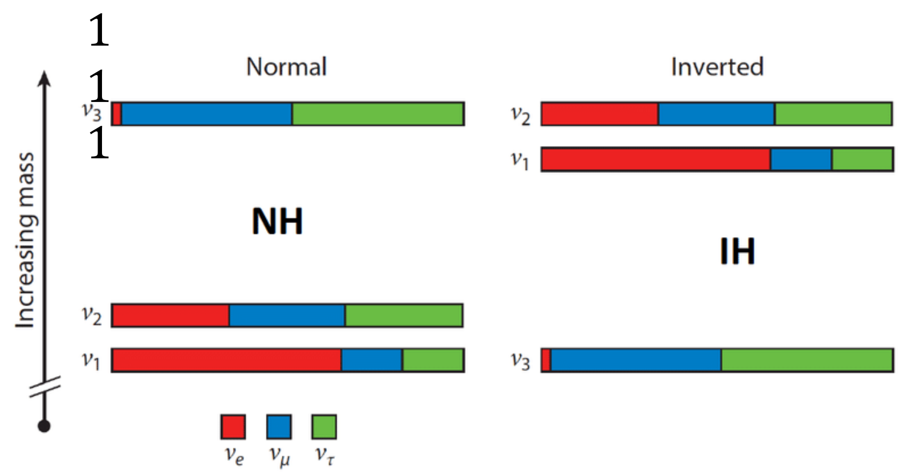
$\phi_{E1}\phi_{E1}$ null
gg scalar + pscalar entangled

Neutrino modes as PMNS 'mass states'



Magnetic charge is 'topological dual' of electric
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.



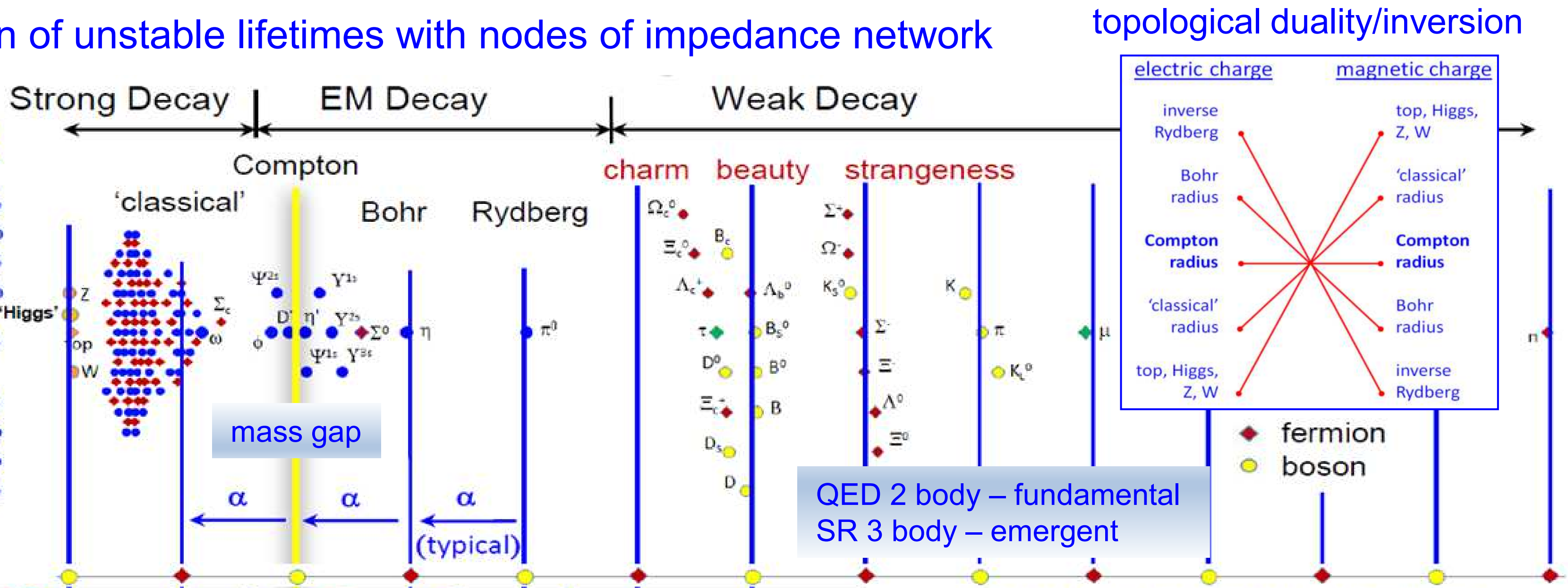
How to calculate?
[The quantum vacuum at the foundations of classical electrodynamics]
[The quantum vacuum as the origin of the speed of light]
These two papers show how to calculate free space impedance of vacuum fermions when excited by the photon.
Next step - include magnetic charge and find vacuum impedance structure excited by neutrino.
This should permit to calculate the PMNS matrix.

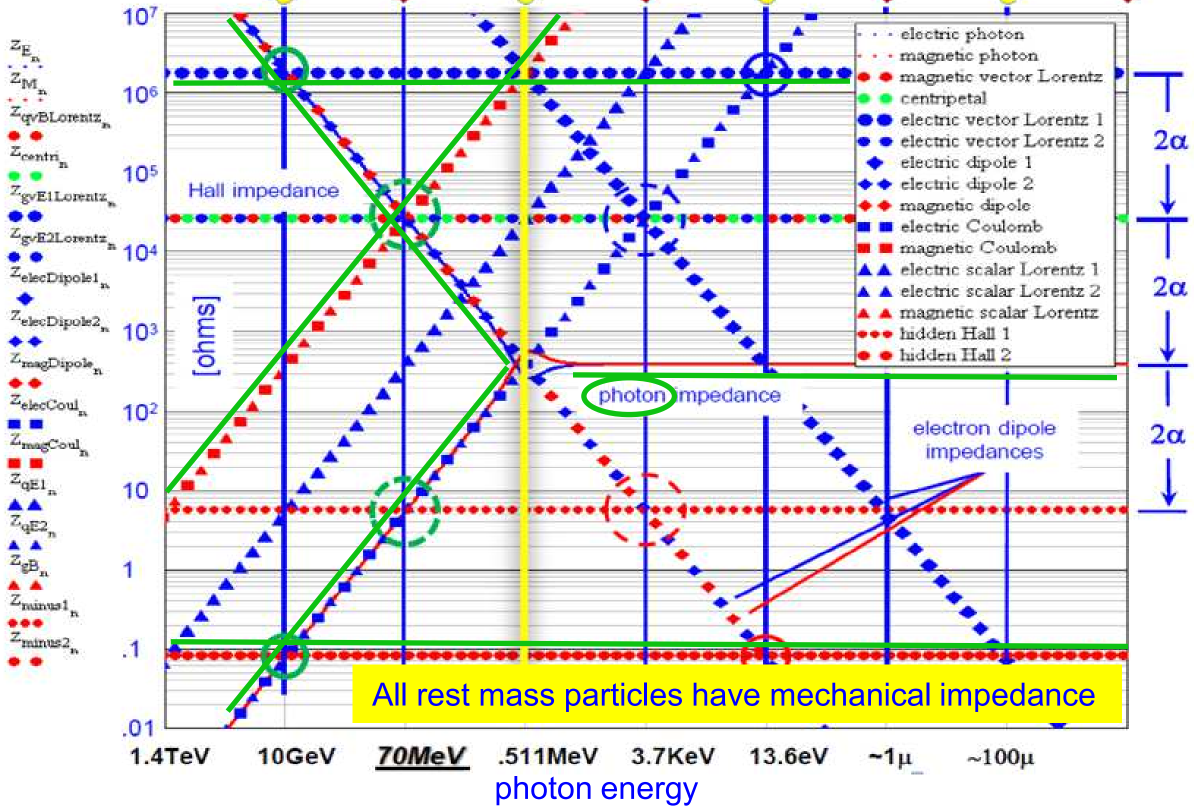
Correlation of unstable lifetimes with nodes of impedance network

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

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

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





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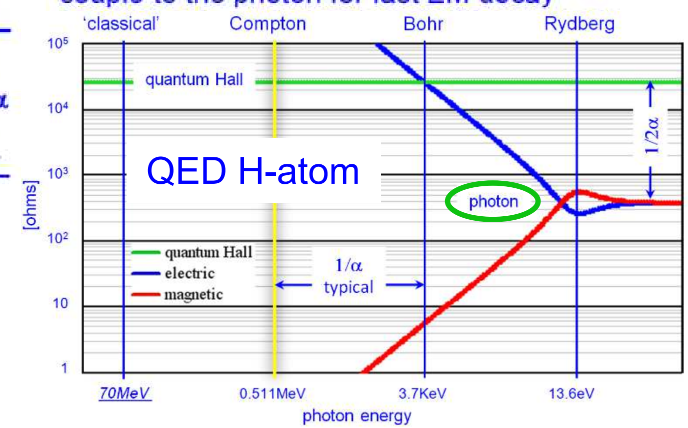
- Alpha-spaced coherence lengths of η', η, and π_0 are at conjunctions of mode impedances, can couple to the photon for fast EM decay



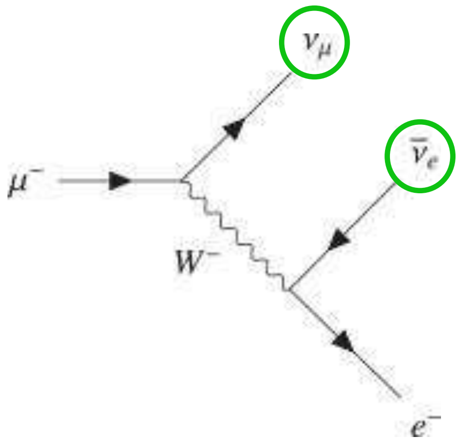
Outline

- summary – four slides from the previous talk
  - theoretical minimum
  - geometric product
  - electromagnetic scattering matrix,
  - unstable particle spectrum
- quantization of wavefunction interaction impedances
  - historical perspective on impedance matching
  - how impedance matching was lost in quantum mechanics
  - Mach's principle and mechanical impedances
- suspension of disbelief - essential property of good fiction
  - unstable particle spectrum
  - impedance matching to the Planck length (and beyond)
  - impedance matching to boundary of the observable universe (and beyond)
  - chiral anomaly and pizero/eta/etaprime branching ratios
- massless oscillation and the mixing matrix
- → motivation – muon collider topological lifetime enhancement at low energy

Sustaining Wavefunction Coherence via Topological Impedance Matching: Stable Polarized Muon Beams at 255 x 255 GeV/c?

Peter Cameron
Brookhaven National Laboratory - retired
(Dated: January 1, 2020)

"What the Hell is Going On?" is Peter Woit's 'Not Even Wrong' blog comment on Nima Arkani-Hamed's view of the barren state of LHC physics, the long-dreaded Desert[1].
Two essential indispensibles - geometric wavefunctions and quantized impedances of wavefunction interactions - are absent from particle theory, the community oblivious, mired in the consequent four decades of stagnation. Synthesis of the two offers a complementary Standard Model perspective, examining not conservation of energy and its flow between kinetic and potential of Hamiltonian and Lagrangian, but rather what governs amplitude and phase of that flow, quantum impedance matching of geometric wavefunction interactions. Applied to muon decay, the model suggests that translation gauge fields (RF cavities) of relativistic lifetime enhancement might be augmented by introducing rotation gauge fields of carefully chosen topological impedances to an accelerator.



Terrell rotation on the light cone

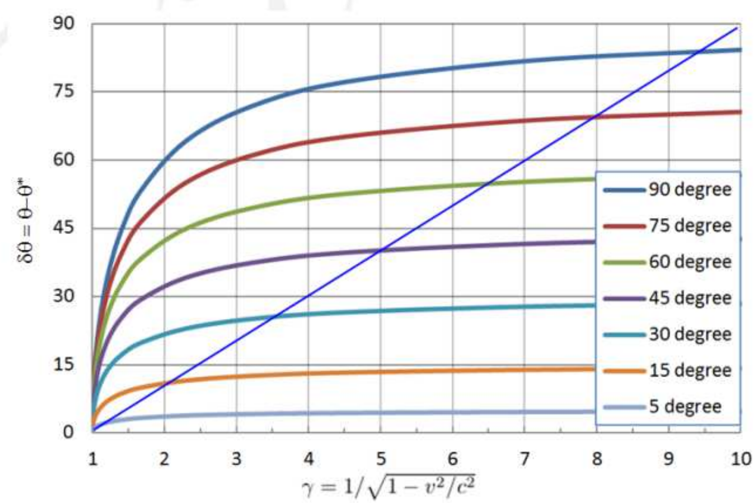
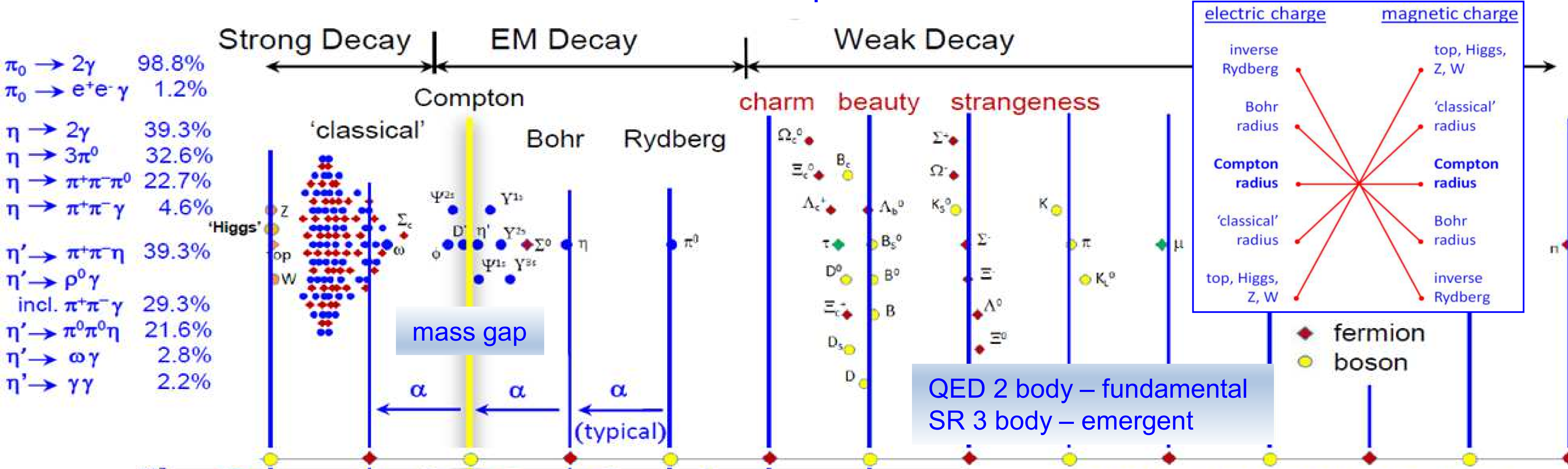
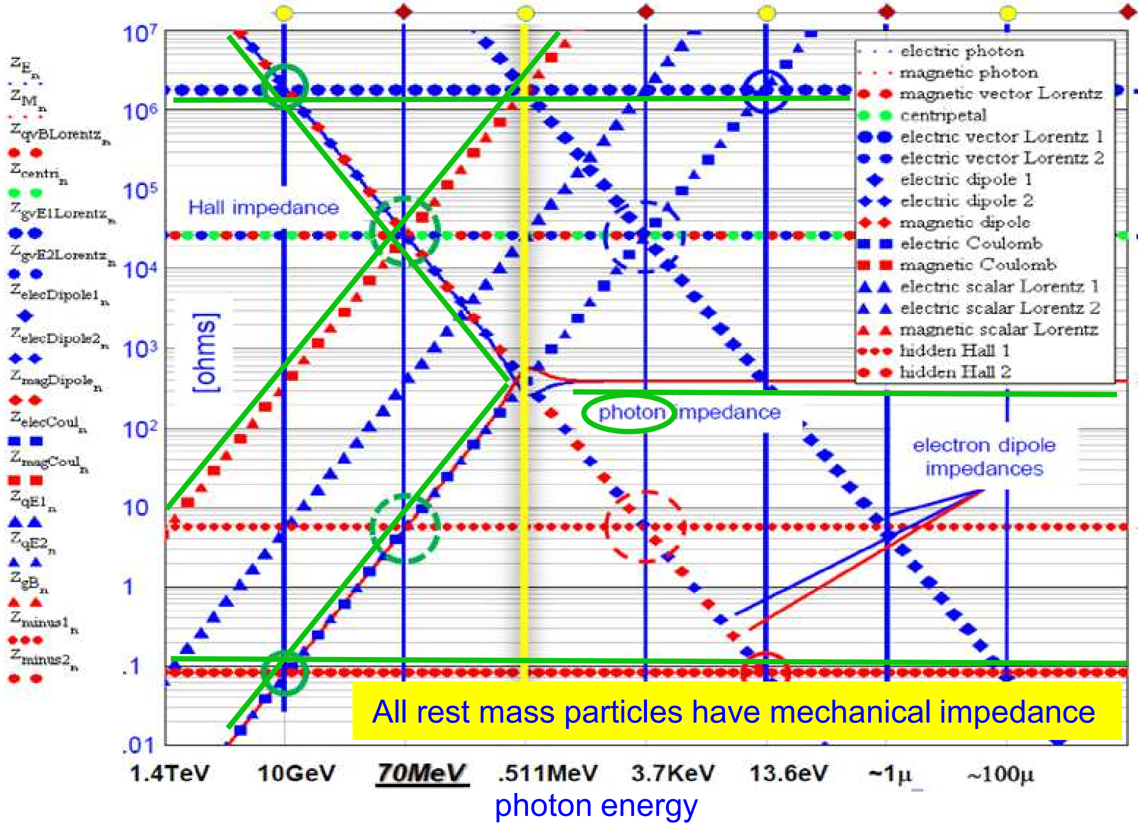


FIG. 9: Lifetime enhancement of special relativity (blue diagonal) and phase shifts of Terrell rotation (left axis) as a function of γ.

Correlation of unstable lifetimes with nodes of impedance network





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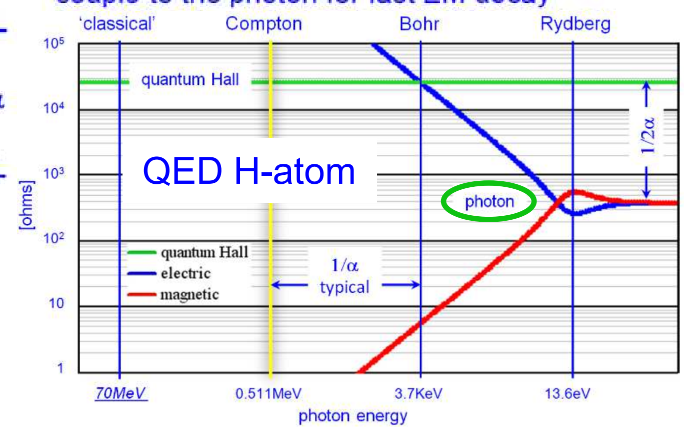


backup

NEUTRINO 2020

Neutrino 2020

June 22, 2020 to July 2, 2020
US/Eastern timezone

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

Overview
Contribution List

Massless Neutrino Oscillation via Maximally Natural Vacuum Wavefunction

Two essential conceptual structures - geometric representation of Clifford algebra wavefunctions and quantized impedances of wavefunction interactions - are absent from theorists' toolkits. Their synthesis offers complementary Standard Model perspectives, focusing not on Lagrangian flow of energy and information between kinetic and potential, but rather what governs amplitude and phase of that flow - impedance matching of wavefunction interactions. Photon excitation of two-component Dirac spinor vacuum wavefunctions permits calculation of permittivity ϵ_0 and permeability μ_0, and from these the scale-invariant 377 ohm far-field vacuum impedance seen by the photon. This suggests extending the method to near-field of the full eight-component vacuum wavefunction of geometric Clifford algebra. Such a model offers maximally natural three-component massless neutrino oscillation via the additional vacuum impedance phase shifts, with absence of right-handed neutrinos required by failure of three-component associativity in the eight-component Clifford algebra octonion.

Mini-abstract

Muon collider lifetime enhancement requires understanding vacuum and neutrino wavefunctions

Terrell rotation on the light cone

LaGrangian permits one to write and solve differential equations for wavefunction energy eigenstates

Impedance analysis starts with the vacuum wavefunction of Clifford algebra (the math language of QM), in these talks uses simple algebra to study energy flow between eigenstates.

A new window on quantum physics. More user friendly LaGrangian once up on the short learning curve.

QED Model of Massless Neutrino Oscillation in the Geometric Representation of Clifford Algebra

Jul 14, 2021, 5:00 PM

15m

Track L (Zoom)

talk | Beyond Standard M... | Beyond Standard Model

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

Speaker

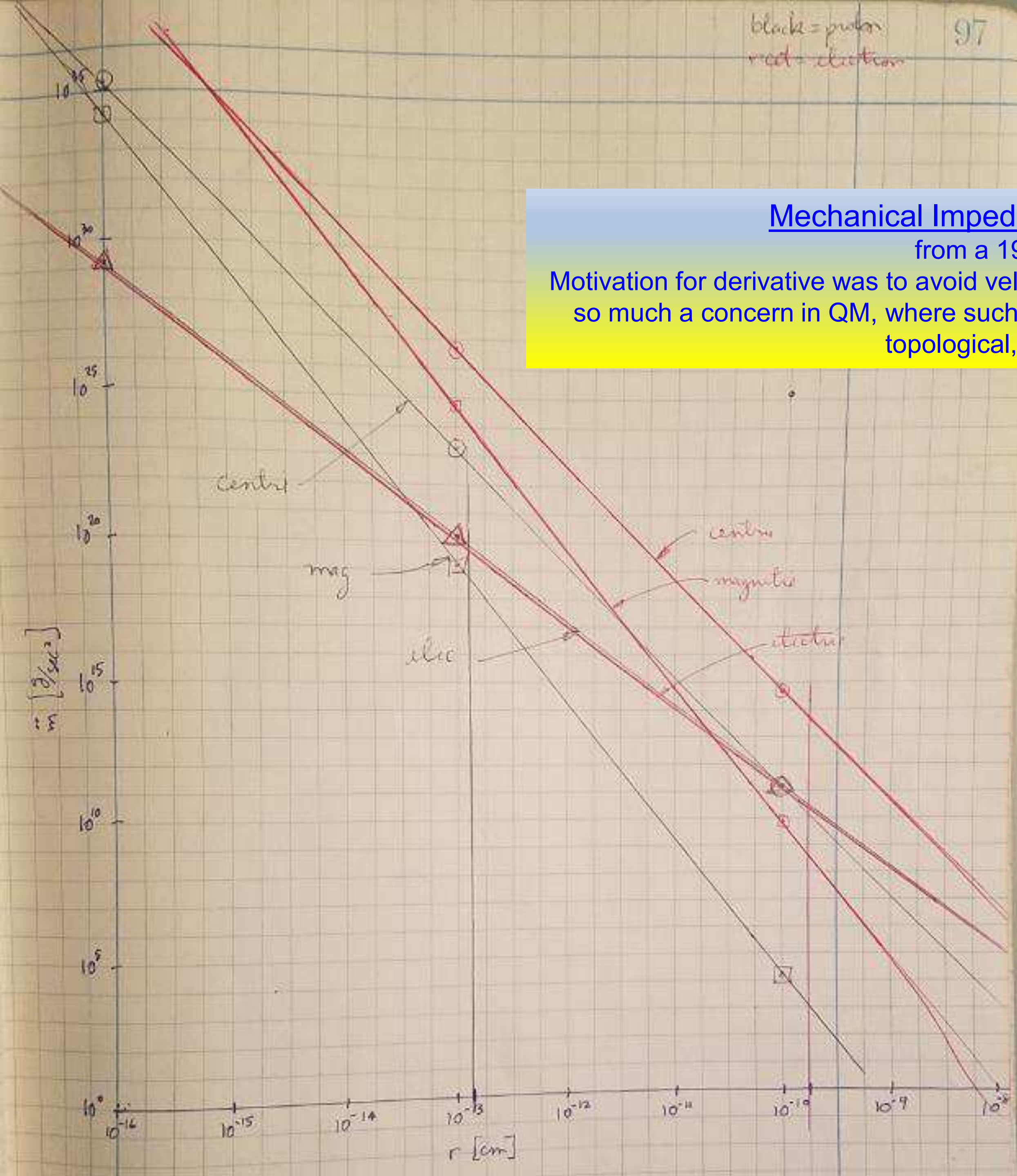
peter cameron (Brookhaven Lab (ret...

proton stabilizes neutron

Description

All experimental data is consistent with massless neutrinos. There exist possibilities other than rest mass differences to explain oscillation. The two-component photon wavefunction is comprised of electric and magnetic flux quanta, coupled by Maxwell's equations. In the basic photon-electron interaction of QED, opposing phase shifts of the electron's inductive and capacitive impedances decouple the photon's flux quanta, breaking Maxwell's equations, transferring energy and momentum. Extending the two-component Dirac wavefunction (scalar charge and bivector magnetic moment) to the full eight-component vacuum wavefunction in the geometric representation of Clifford algebra permits assigning topological magnetic charge to the spin 1 3D pseudoscalar. A simple three-component neutrino wavefunction model might then be comprised of the two photon components, topologically protected by magnetic charge. Curiously, in SI units 1D vector magnetic flux quantum and 3D trivector magnetic charge quantum are numerically identical yet geometrically and topologically distinct. We discuss the mixing matrix that results from such a model.

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

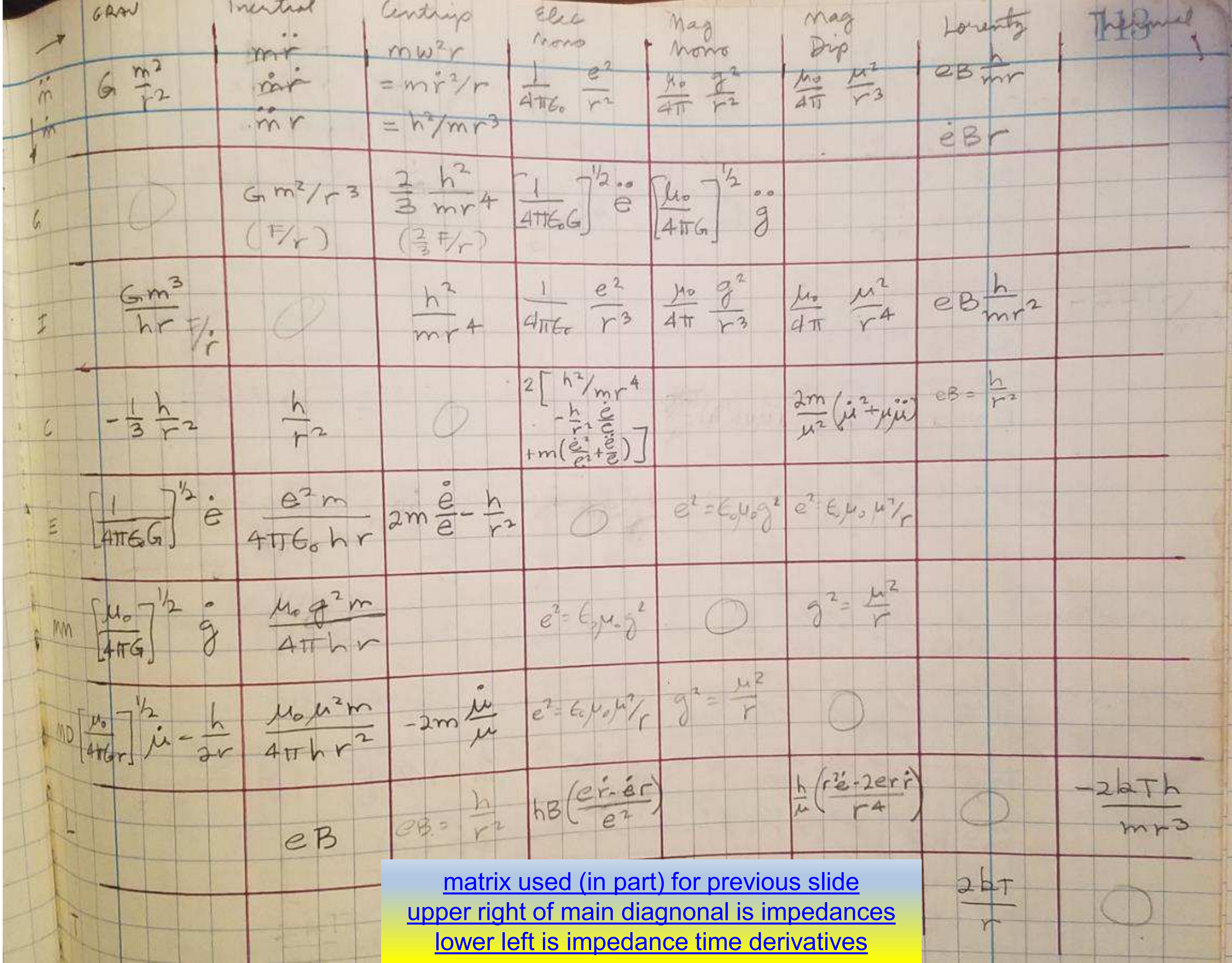


Mechanical Impedance Time Derivatives

from a 1982 notebook

Motivation for derivative was to avoid velocity-dependent dissipative impedances. Not so much a concern in QM, where such impedances are not dissipative, but rather topological, scale invariant.

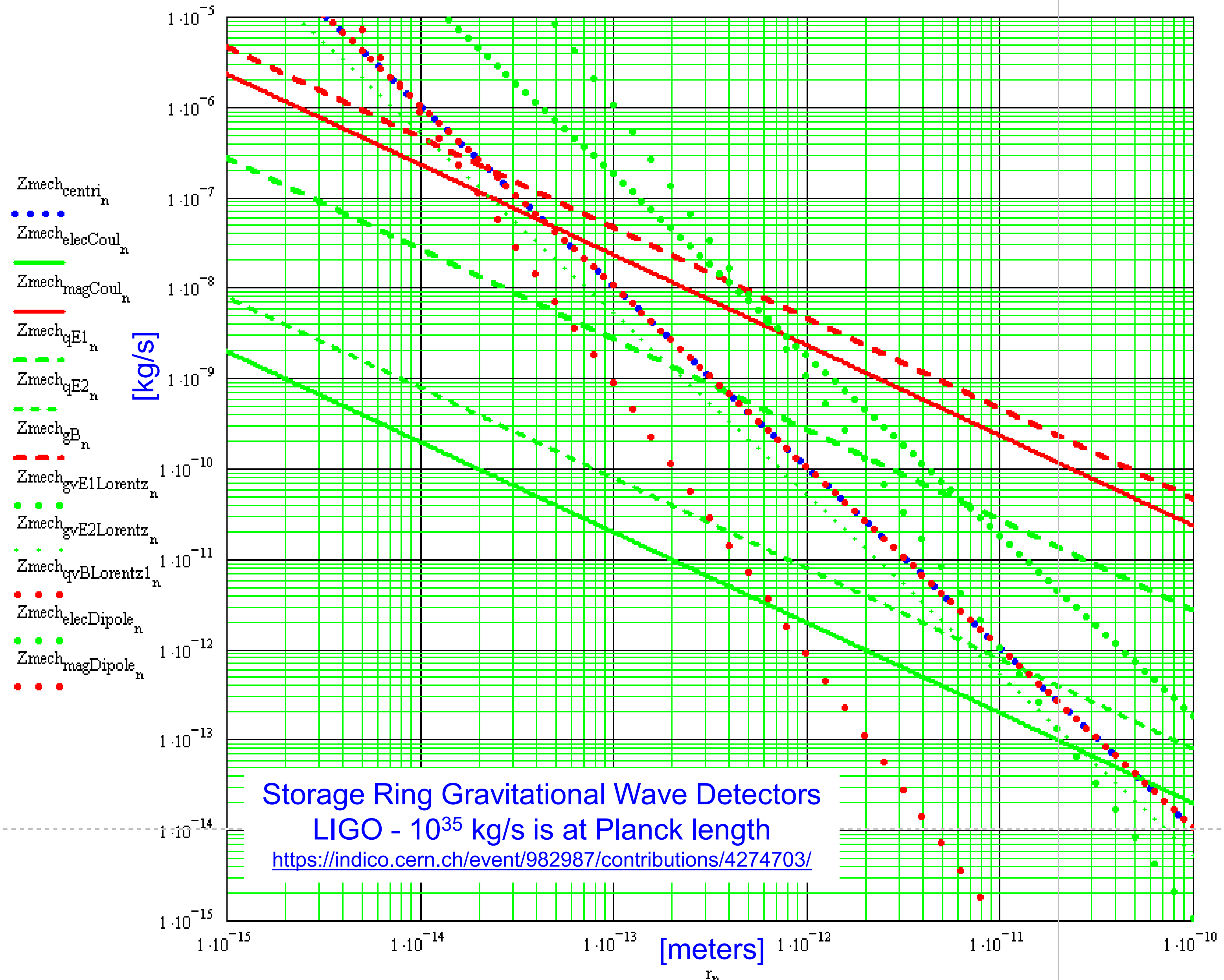
three potentials – $1/r$, $1/r^2$, and $1/r^3$ - are shown here for proton and electron



[matrix used (in part) for previous slide](#)
[upper right of main diagnonal is impedances](#)
[lower left is impedance time derivatives](#)

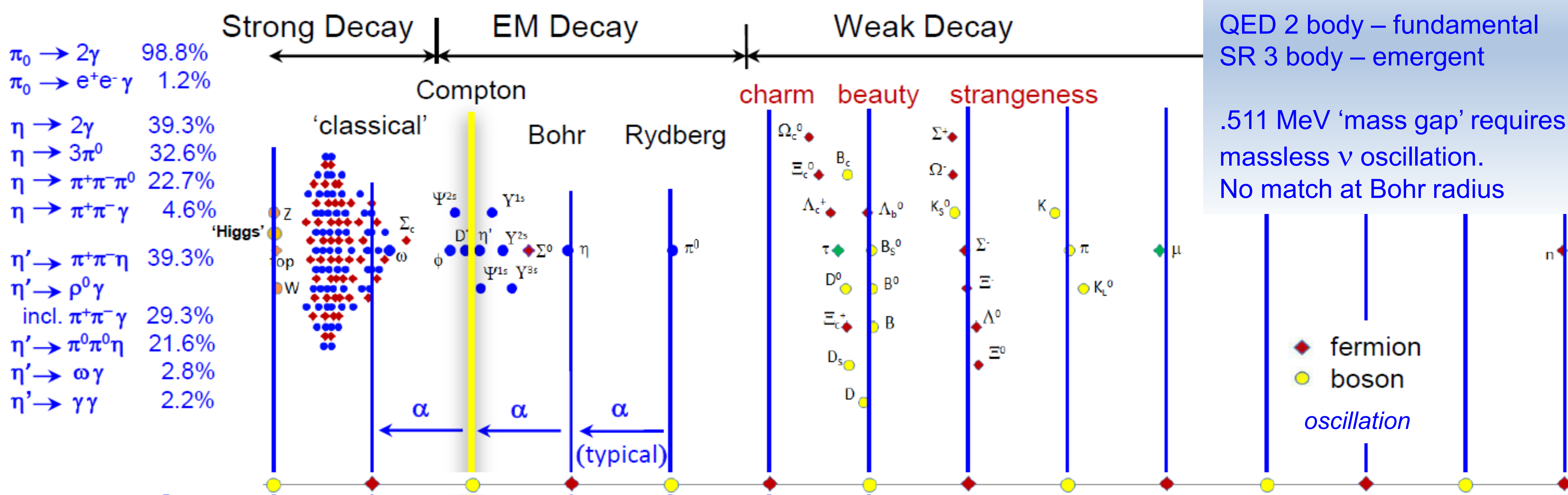
Mechanical Impedances

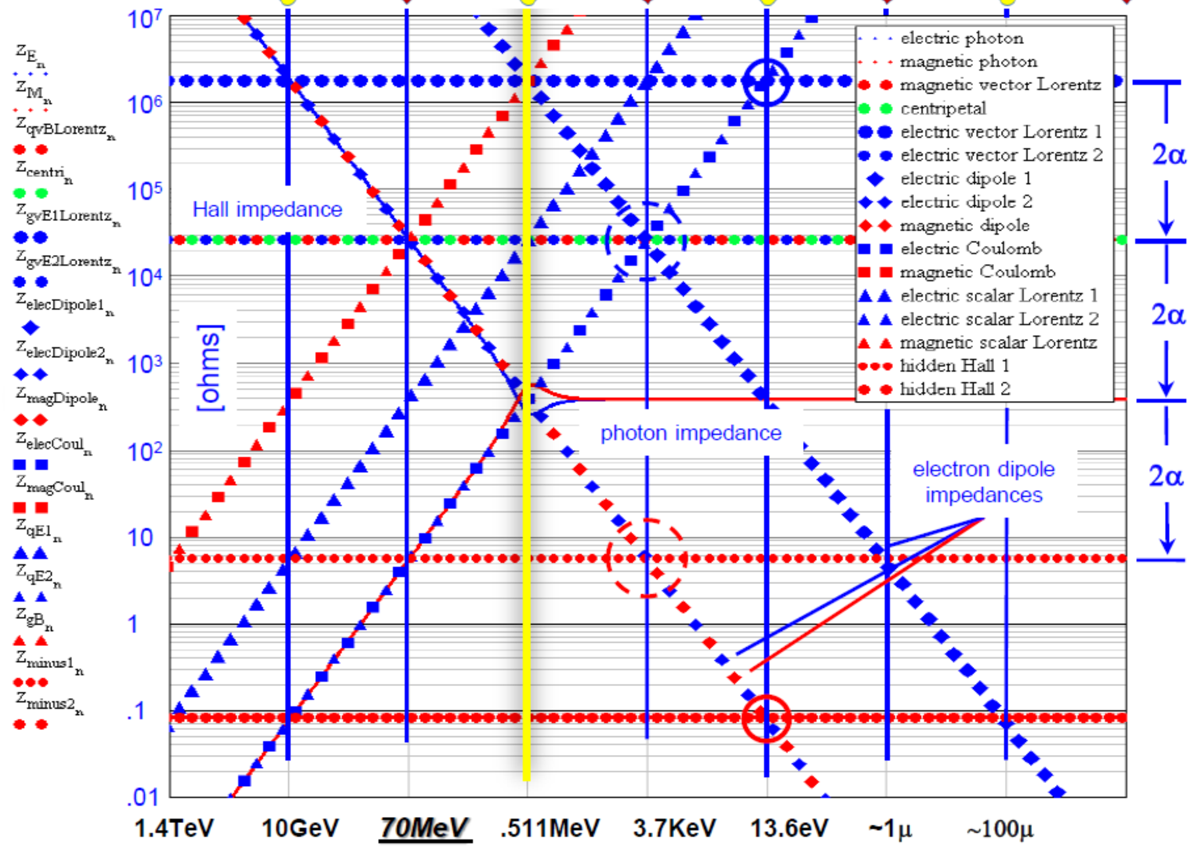
all rise at shorter length scales – inductive (advances phase)



QED 2 body – fundamental
SR 3 body – emergent

.511 MeV 'mass gap' requires massless ν oscillation.
No match at Bohr radius





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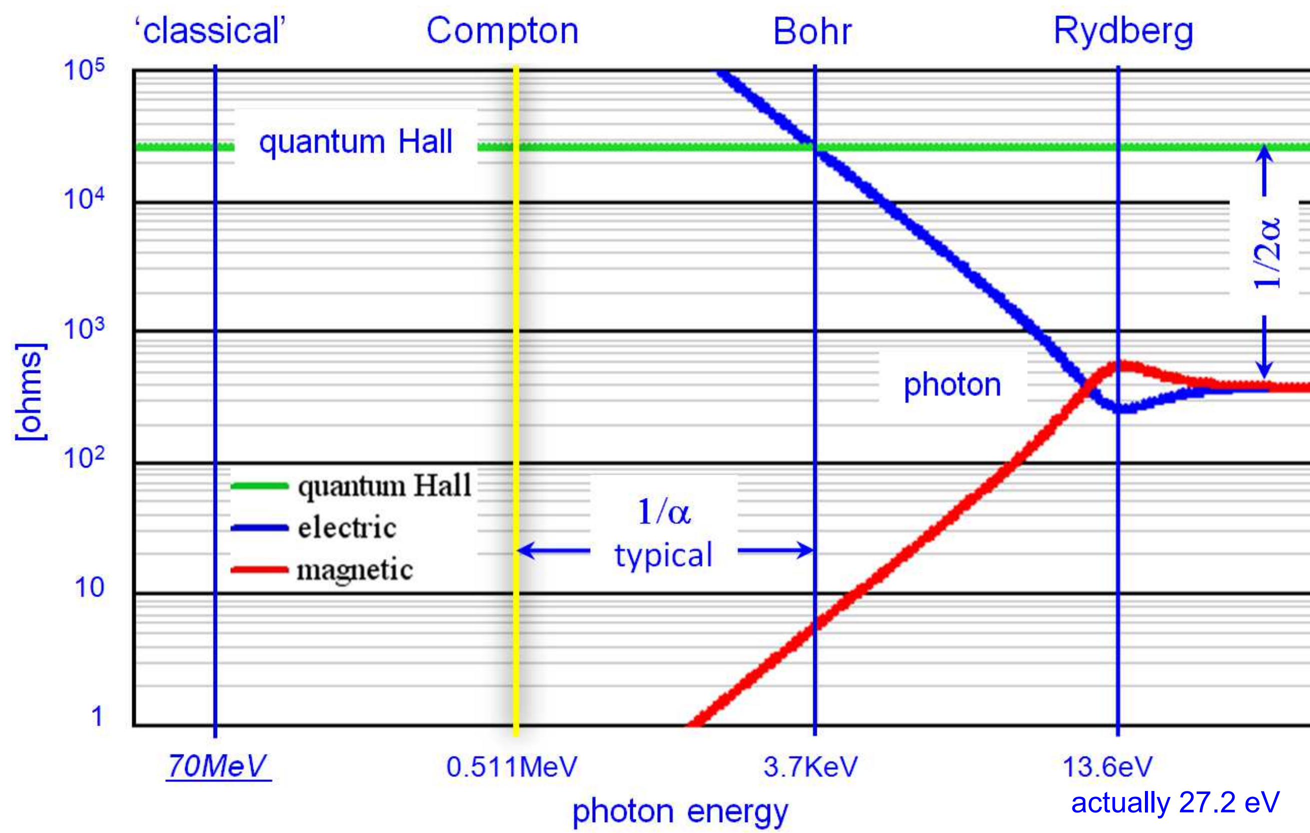
- Alpha-spaced coherence lengths of η', η, and π_0 are at conjunctions of mode impedances, can couple to the photon for fast EM decay
- Location of π_0 at boundary of EM and weak decays is suggestive of the chiral anomaly
- Weak decays are mismatched to the photon
- Alpha-spaced coherence length alternation 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'
- See also http://vixra.org/author/peter_cameron

ionization of the Hydrogen atom (where is the proton?)



Photon near-field impedance is not to be found in physics textbooks, curriculum, or journals.
What governs amplitude and phase of energy/information transmission in QED is absent from formal education of the physicist