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

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

Peter Cameron

"To understand the electron would be enough"

Einstein

'One Slide'

The Essential Point

Impedances govern the flow of energy

Classical or quantum impedances,
mechanical or electromagnetic,
fermionic or bosonic,
topological or geometric,...

Impedances govern the flow of energy

This is not a theoretical musing

This is a fundamental concept, of universal applicability

Generalization of quantum impedances extends the concept from the Lorentz impedance of the quantum Hall effect and the near and far-field photon impedances *to all quantum potentials and their associated forces and impedances* given The Essential Point,

'One Slide'

Define 'Impedance'

Impedance - a measure of the amplitude and **phase** of opposition to the flow of a current

conversion factor from mechanical to electrical impedance

- single force - electromagnetic [ohms] = [kg-m^2/coul^2-s]

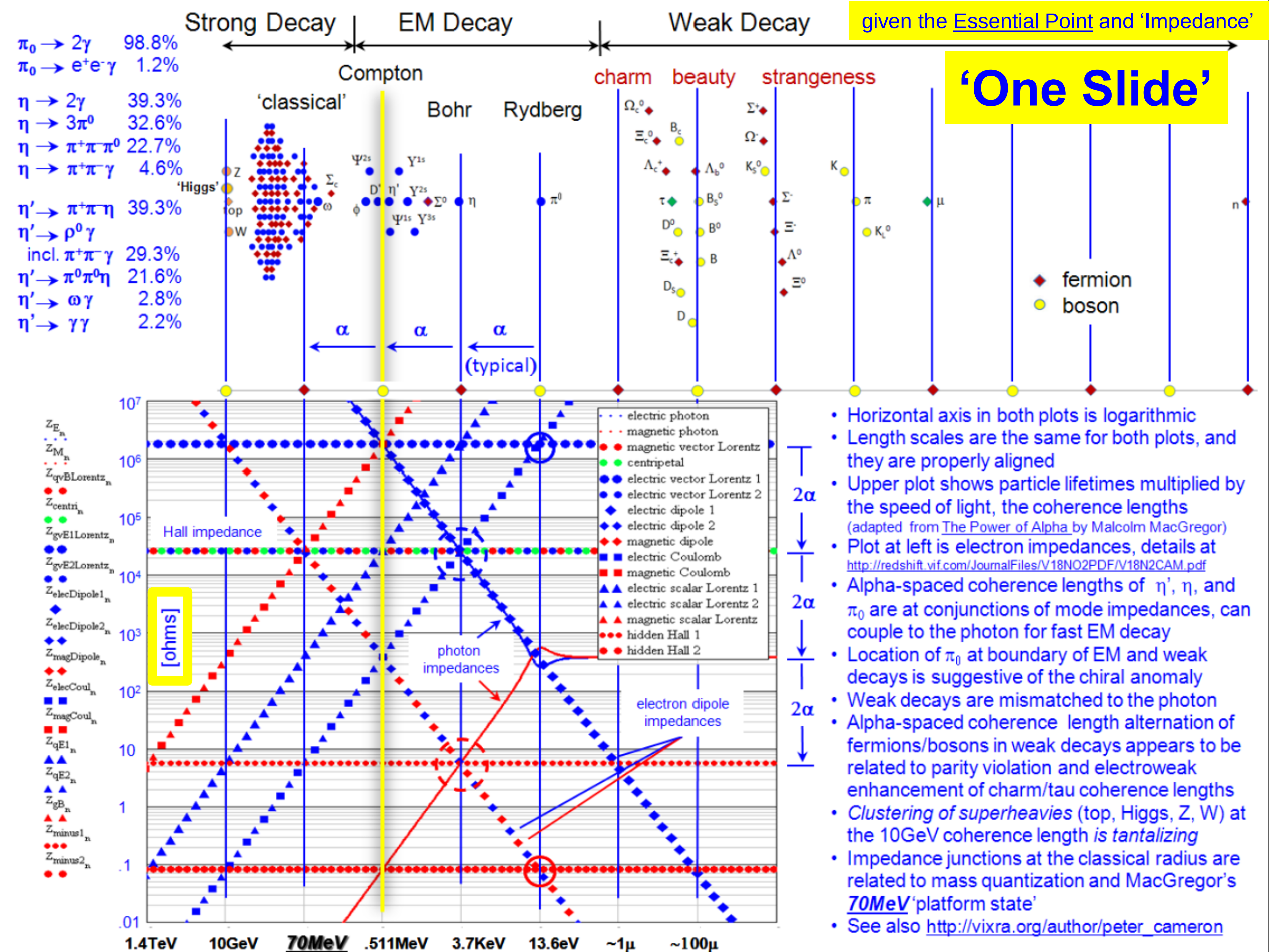
  or mechanical [kg/s]   mass flow, deBroglie wave,…
- coupled forces - electromechanical, magnetomechanical,…
- for now stay with **electromagnetic**
- resistance, inductance, capacitance

- **distinctions** between classical and quantum
  - classical resistance is incoherent (heat, noise,…)
  - quantum resistance is phase-coherent (no dissipation)
  - **phase** is ***not a single measurement observable*** in quantum mechanics
  - scale invariant quantum impedances cannot transmit energy, communicate only quantum phase (not a single measurement observable)

EPR, non-locality,…

- conjectures – all quantum impedances are topological?

  all classical impedances are geometric?



given the Essential Point and 'Impedance'
'One Slide'
Strong Decay
EM Decay
Weak Decay
$\pi_0 \rightarrow 2\gamma$ 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%
Compton
'classical'
Bohr
Rydberg
charm
beauty
strangeness
'Higgs'
Z
top
W
fermion
boson
α
α
α
(typical)
Hall impedance
[ohms]
photon impedances
electron dipole impedances
2α
2α
2α
electric photon
magnetic photon
magnetic vector Lorentz
centripetal
electric vector Lorentz 1
electric vector Lorentz 2
electric dipole 1
electric dipole 2
magnetic dipole
electric Coulomb
magnetic Coulomb
electric scalar Lorentz 1
electric scalar Lorentz 2
magnetic scalar Lorentz
hidden Hall 1
hidden Hall 2
10^7
10^6
10^5
10^4
10^3
10^2
10
1
.1
.01
1.4TeV
10GeV
70MeV
.511MeV
3.7KeV
13.6eV
~1μ
~100μ
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• 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

Presentation Goals - Understand, then Explore

- **understand** the 'One Slide'
  - ~~**essential point** - impedances govern the flow of energy~~
  - **origin** of impedance network – two body problem & Mach's Principle
  - **origin** of the coherence length plot – Malcolm MacGregor
  - **implications** of their strong correlation – personal paradigm shift
- **explore** the Implications ~ ten reasons one might want to know about quantum impedances:
  - elementary particle spectrum, chiral anomaly, *axions, EDM…*
  - gravity – extend the model to the Planck particle
  - state reduction and non-locality
  - black hole information paradox – Rochester, Fields,…
  - weak measurement and time symmetry – Berlin
  - quantum interpretations – Berlin
  - *dark matter*
  - ***condensed matter – $$ the bottom line $$***

Italics connote material in preparation

Optical Society of America
sponsored and refereed

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July 2012

Generalized Quantum Impedances: A Background Independent Model for the Unstable Particles

Peter Cameron*
Strongarm Studios
Mattituck, NY USA 11952

first posted July 2012

(Dated: April 26, 2013)

The discovery of exact impedance quantization in the quantum Hall effect was greatly facilitated by scale invariance. This letter explores the possibility that quantum impedances may be generalized, defined not just for the Lorentz force and the quantum Hall effect, 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 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.

INTRODUCTION

The model presented here [1–6]comprises

- quantization of electric and magnetic flux, charge, and dipole moment
- interactions between these three topologies - flux quantum, monopole, and dipole
- the photon
- confinement to a fundamental length, taken to be the Compton wavelength of the electron

Calculated transfer impedances of the interactions are presented as a function of spatial scale/energy. Possible roles for these impedances in the creation and structure of the unstable particles are discussed.

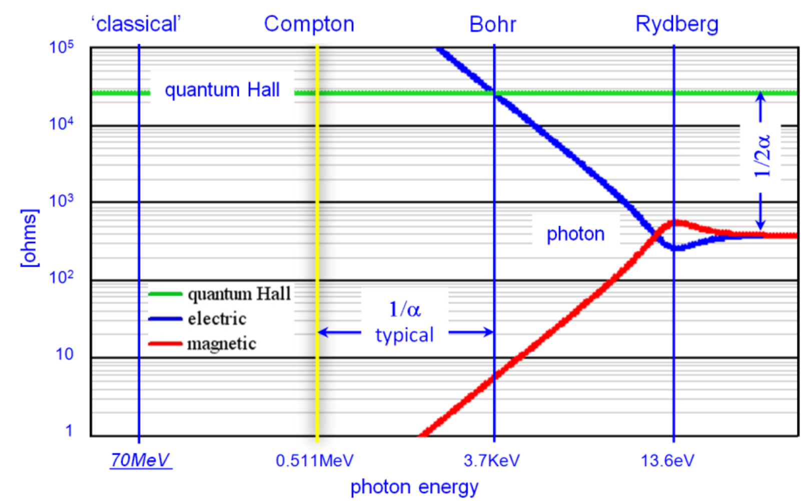
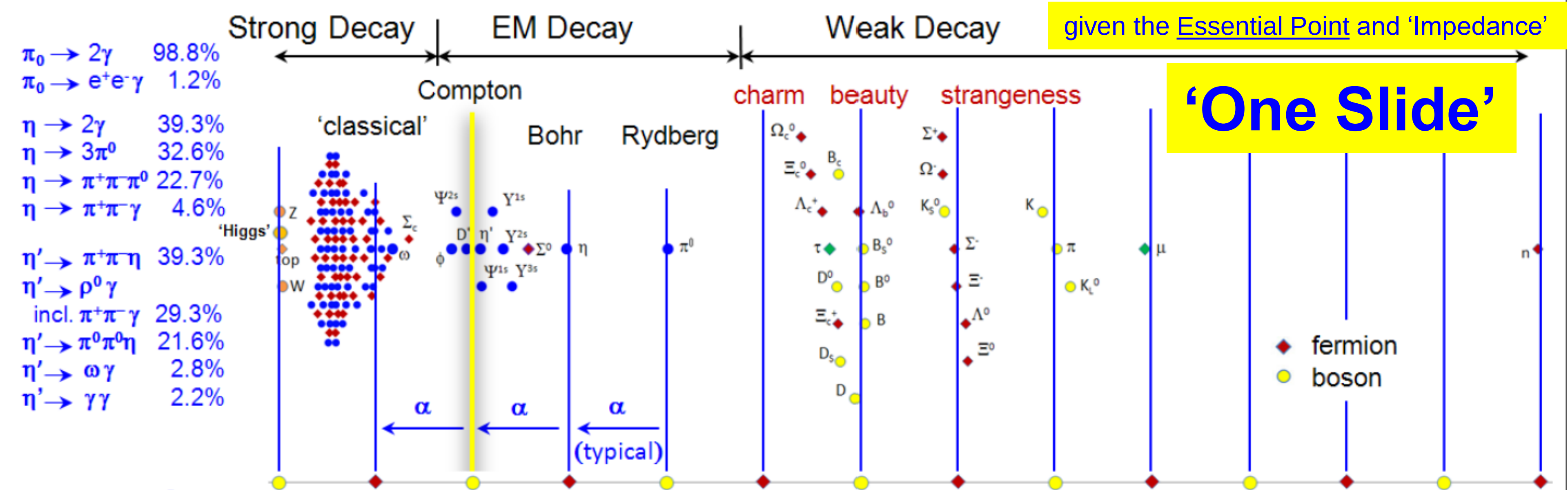
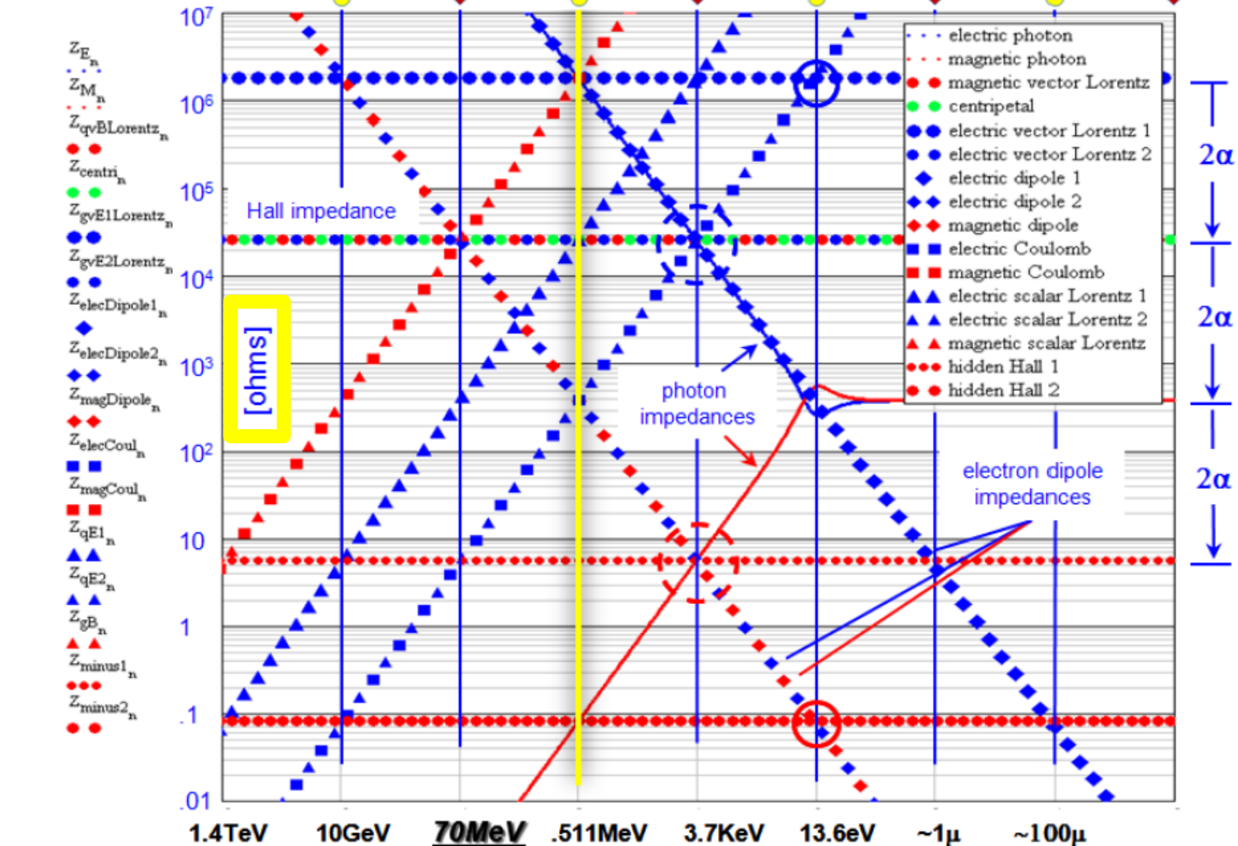


FIG. 1. Photon and electron impedances as a function of spatial scale as defined by photon energy

$$Z_M = Z_0 \left| \frac{1 + \frac{\lambda}{ir}}{1 + \frac{\lambda}{ir} + \left(\frac{\lambda}{ir}\right)^2} \right|$$





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The chiral potential is inverse square. The family of inverse square potentials includes the vector Lorentz potential of the quantum Hall and Aharonov-Bohm effects, and the centrifugal, Coriolis, and three body potentials. The associated impedances are scale invariant, quantum Hall being the most familiar. Modes associated with scale invariant impedances communicate only quantum phase, not an observable in a single quantum measurement. Modes associated with scale dependent impedances, including among others those of the 1/r monopole and $1/r^3$ dipole potentials, communicate both phase and energy. Making this clarifying distinction between phase (relative time) and energy explicit presents a new perspective on the anomaly. This approach is introduced via the Rosetta Stone of modern physics, the hydrogen atom. Precise impedance-based π^0, η, and η' branching ratio calculations are presented as ratios of polynomials in powers of the fine structure constant, followed by discussion. Mass generation via chiral symmetry breaking is not addressed in the present paper.

axion implications,...

INTRODUCTION

Anomalies may be defined as "...breakings of classical symmetries by quantum corrections, which arise when the regularizations needed to evaluate small fermion loop Feynman diagrams conflict with a classical symmetry of the theory."[1] Stephen Adler

In a finite quantum theory chiral symmetry appears to be broken only by weak interactions. The presence of the anomaly in strong and electromagnetic quantum field theory (QFT) calculations[1–8] seems to be an inevitable result of the regularization needed to remove infinities before mass and charge renormalizations can be accomplished. However, one has a choice - in the presence of the anomaly *either* chiral symmetry *or* gauge invariance must be broken.

gauge invariant (no covariant derivative) and finite (no renormalization)

The impedance approach is gauge invariant. Gauge invariance is built in. Complex impedances shift phases. Complex quantum impedances shift quantum phases. The scale invariant impedance associated with the chiral potential[9, 10] communicates quantum phase and only quantum phase[11–13]. No need for the covariant derivative. One need only take the appropriate impedances into account.

The phase-only character of inverse square potentials, their incapacity to do work, is emphasized in the related case of the centrifugal potential of the free Schroedinger particle by Holstein[14]. The symmetry is understood to be scale invariance (unbroken sans regularization).

The impedance approach is finite Impedance is a geometric concept, depends on size and shape. In the limit of the small, the point/singularity is infinitely mismatched to you and I. We cannot share energy with it. While presumably equally decoupled, the quantum limit of the large is more subtle, in the emergent realm of the classical, and ultimately the cosmological. In both limits, small and large, divergences are removed by the impedance mismatches. Regularization and renormalization are not necessary.

The anomaly does not arise in the impedance approach, a result of the finiteness and gauge invariance.

π^0 branching ratio calculation – experimental values in parentheses

$$Z_{\gamma\gamma} = \frac{1}{\frac{1}{Z_0} + \frac{1}{Z_0}} = \frac{Z_0}{2} = 188.37\,\Omega \qquad (1)$$

and that of the $e^+e^-\gamma$ mode as

$$Z_{ee\gamma} = \frac{1}{\frac{1}{R_H} + \frac{1}{R_H} + \frac{4\alpha^2}{Z_0}} = \frac{Z_0}{4\alpha^2 + 4\alpha} = 12\,813\,\Omega \qquad (2)$$

where $R_H = \frac{Z_0}{2\alpha}$ is the quantum Hall resistance, so that

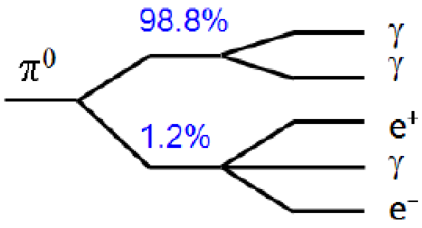
$$Z_{\pi 0} = \frac{1}{\frac{1}{Z_{\gamma\gamma}} + \frac{1}{Z_{ee\gamma}}} = \frac{Z_0}{4\alpha^2 + 4\alpha + 2} = 185.64\,\Omega \qquad (3)$$

and the branching ratios are

for photons
no α in the numerator

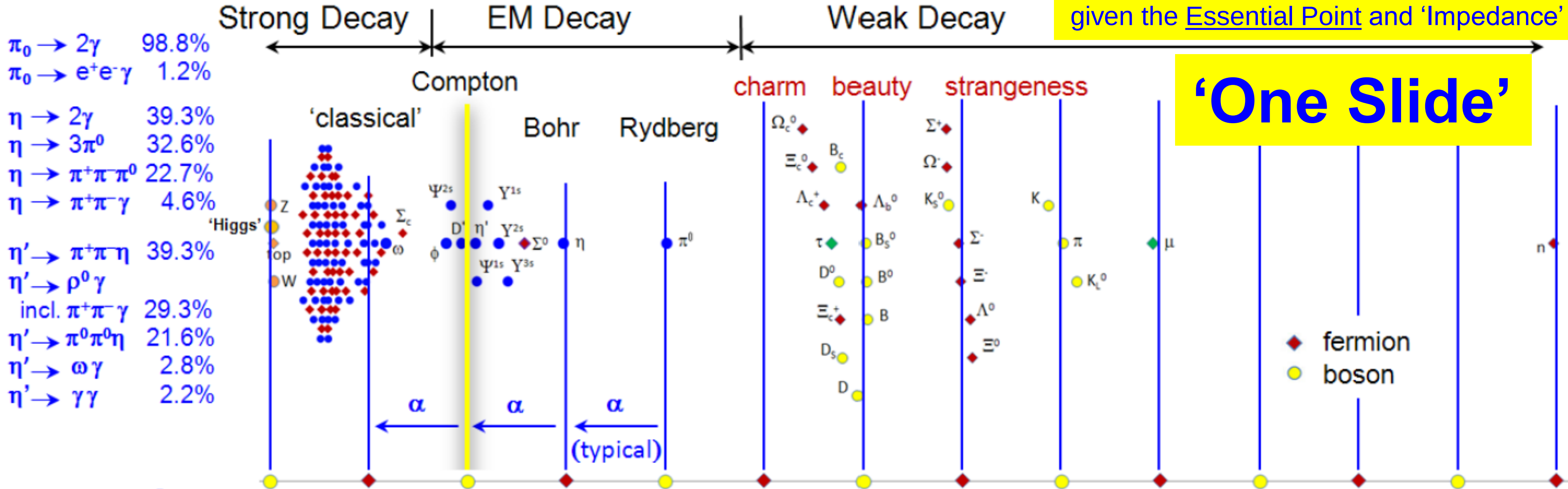
$$\Gamma_{\gamma\gamma} = \frac{Z_{\pi 0}}{Z_{\gamma\gamma}} = \frac{1}{2\alpha^2 + 2\alpha + 1} = 0.9855\,(0.988) \qquad (4)$$

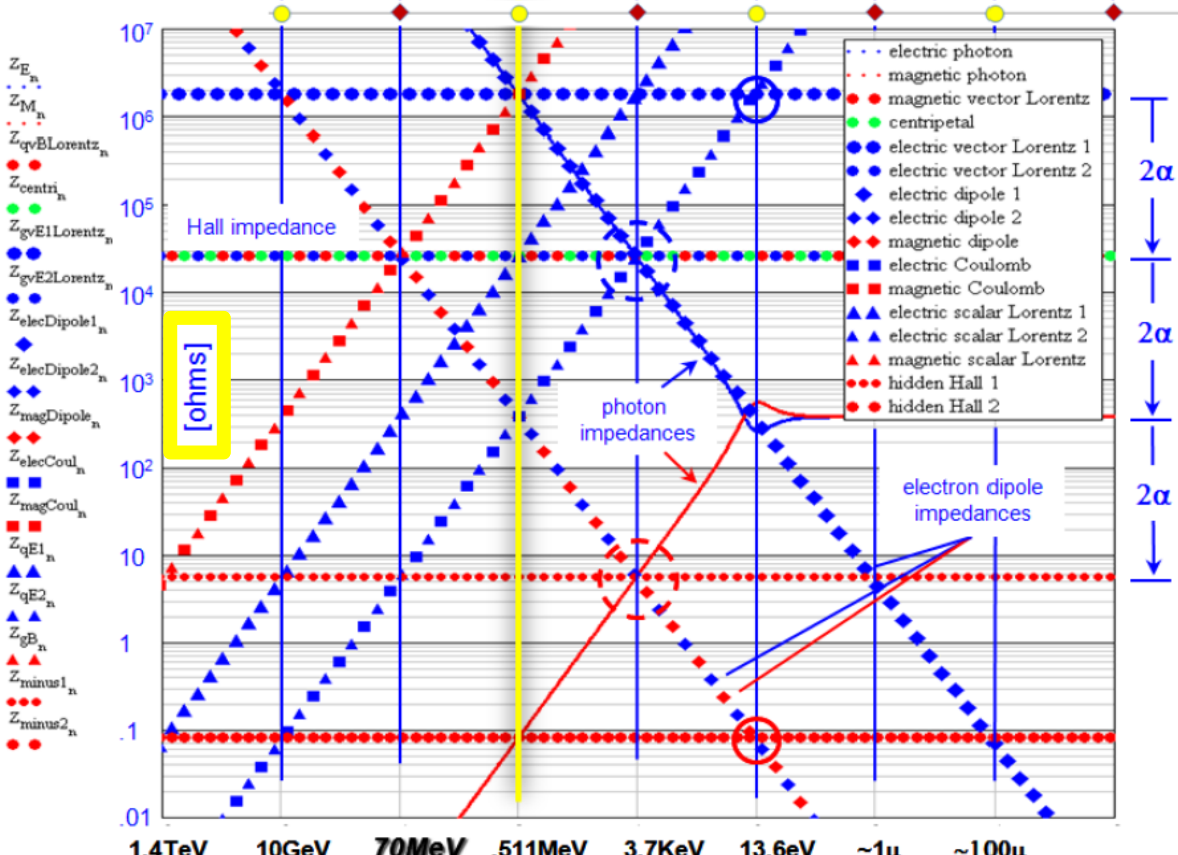
$$\Gamma_{ee\gamma} = \frac{Z_{\pi 0}}{Z_{ee\gamma}} = \frac{2\alpha^2 + 2\alpha}{2\alpha^2 + 2\alpha + 1} = 0.0145\,(0.012) \qquad (5)$$



given the Essential Point and 'Impedance'

'One Slide'





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eta and eta' branching ratios calculated from impedance matches

$$\Gamma_{\gamma\gamma} = \frac{Z_\eta}{Z_{\gamma\gamma}} = \frac{8}{20\alpha^2 + 68\alpha + 19} = 0.410\,(0.393) \quad (14)$$

no factor of α in the numerator
true for all photon branches

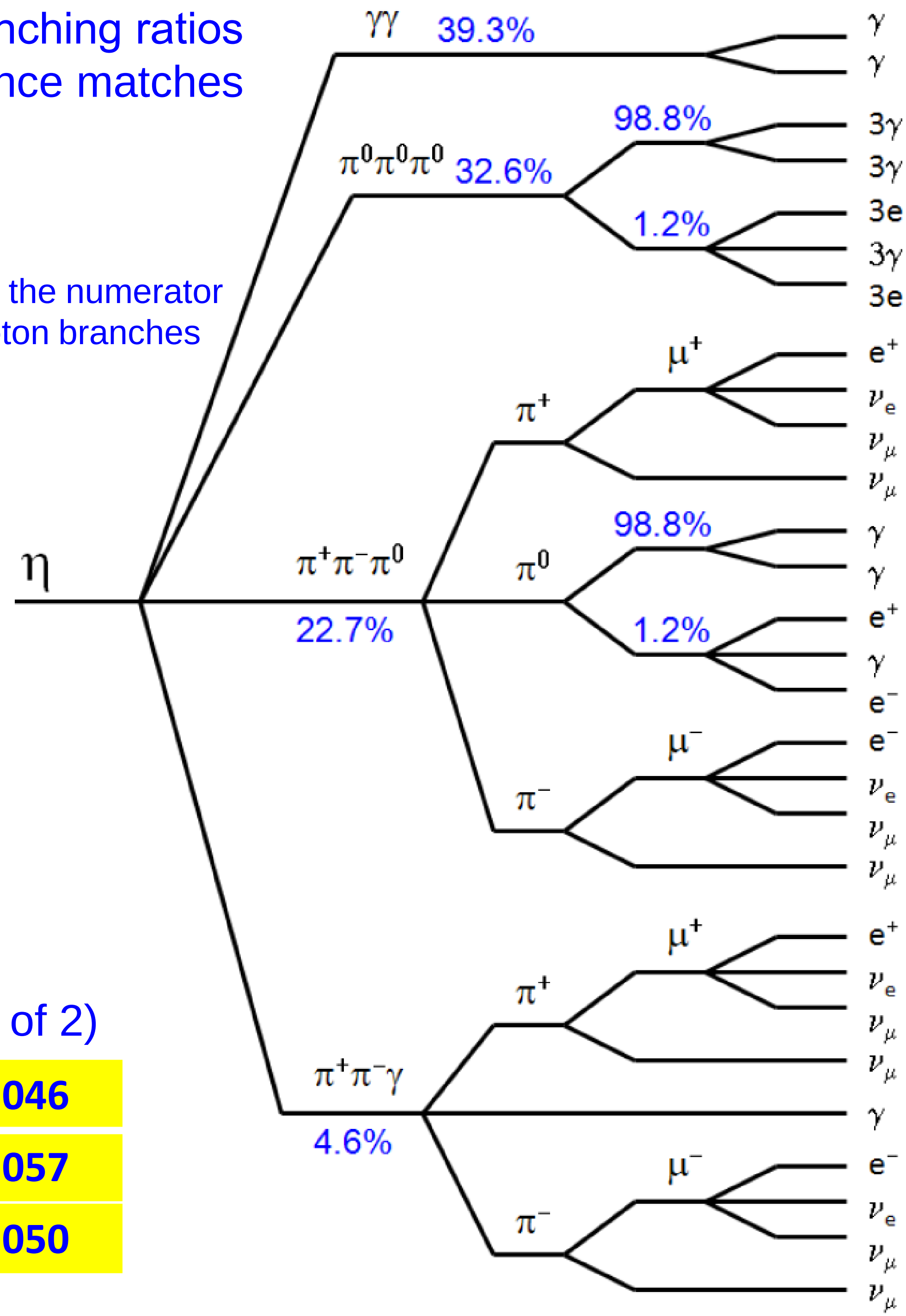
$$\Gamma_{3\pi 0} = \frac{Z_\eta}{Z_{3\pi 0}} = \frac{3(4\alpha^2 + 4\alpha + 2)}{20\alpha^2 + 68\alpha + 19} = 0.312\,(0.326) \quad (15)$$

$$\Gamma_{\pi\pi\pi 0} = \frac{Z_\eta}{Z_{\pi\pi\pi 0}} = \frac{2(4\alpha^2 + 20\alpha + 2)}{20\alpha^2 + 68\alpha + 19} = 0.220\,(0.227) \quad (16)$$

$$\Gamma_{\pi\pi\gamma} = \frac{Z_\eta}{Z_{\pi\pi\gamma}} = \frac{16\alpha + 1}{20\alpha^2 + 68\alpha + 19} = 0.057\,(0.046) \quad (17)$$

excellent fit to the data (however, factors of 2)

eta	**.393**	**.326**	**.227**	**.046**
model	**.410**	**.312**	**.220**	**.057**
eta'	**.393**	**.293**	**.216**	**.050**



from the chiral anomaly note

DISCUSSION

Historical Perspective on Quantum Impedances

Impedances govern the flow of energy. This is a fundamental concept of universal applicability. Historically, it has been overlooked in quantum theory.

The 1980 discovery[22] of a new fundamental constant of nature, the Nobel Prize discovery of exact impedance quantization in the quantum Hall effect, was greatly facilitated by scale invariance. This classically peculiar impedance is topological, the measured resistance being independent of the size or shape of the Hall bar. Prior to that discovery, impedance quantization was more implied than explicit in the literature[23–28].

In the 1959 thesis of Bjorken[25] is an approach summarized[29] 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[26]. As presented there, the units of the Feynman parameter are [sec/kg], the units of *mechanical conductance* [15]. Form factors are proportional to conductances, inversely proportional to resistances.

With the confusion that resulted from interpreting conductance as resistance, and more importantly lacking the concept of quantized impedance, the anticipated intuitive advantage of the circuit analogy[26] was lost and the possibility of the jump from well-considered analogy to a photon-electron impedance model was not realized.

Like the first Rochester Conference on Coherence and Quantum Optics in 1960, the 1963 paper/thesis by Vernon and Feynman[27] on the "Interaction of Systems" was motivated by the invention of the maser. It is a particularly suggestive combination of the languages of the electrical engineer and the physicist. The authors devoted a thesis to the concepts needed for impedance matching to the maser. However, lacking again was the explicit concept of quantized impedance in the maser.

Had exact impedance quantization been discovered in 1950 rather than 1980, one wonders whether the impedance concept might have found its way into the foundation of QED at that time, before it was set in the bedrock, to underpin rather than illuminate electroweak theory, QCD, and gravity[12, 30–39].

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Italics connote material in preparation

July 24, 1975

THE TWO BODY PROBLEM AND MACH'S PRINCIPLE

Peter Cameron

2210 Water Street

Port Huron, Michigan 48060

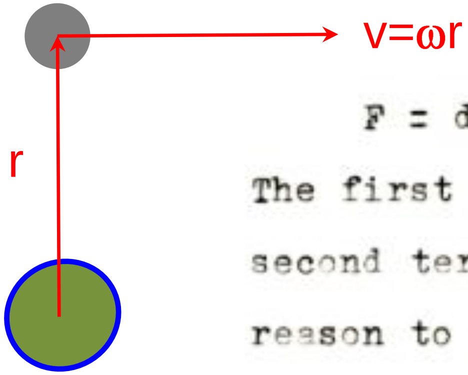
The classical analysis of the two-body problem is frequently complicated by the introduction of a system of co-ordinates which is independent of either of the bodies. The validity of such an analysis rests upon the premise that the co-ordinate frame does not interact with the physical system via any 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

vibratory piledriver/extractor

the foundation of all that followed

It took 35 years to understand where it fits



what waves in the deBroglie wave?

0

$$F = d(mv)/dt = m\omega^2 r + v\,dm/dt$$

The first term has no meaning and must be discarded. The second term would also seem to be meaningless. We have no reason to suspect that m_1 varies in time, and nothing in our initial conditions seems to require that m_1 be a point mass, a circumstance which would deprive us of the ability to observe radial velocity. Either we accept the second force term as counter-balancing the gravitational attraction or we regard the whole situation as senseless. Nothing in the initial conditions requires that the problem is senseless, so we write

$$v_{rad}\,dm_1/dt = Gm_1m_2/r^2 \quad \text{or}$$

$$dm_1/dt = (Gm_1m_2/v_{rad})(1/r^2) \tag{1}$$

In writing this we note that it was neccessary to take $v=v_{rad}$ to maintain the co-linearity of forces. The quantity Gm_1m_2/v_{rad} has units of angular momentum, which suggests

$$dm_1/dt = L/r^2 \tag{2}$$

system composed of elementary particles. The Bohr model of the hydrogen atom is a familiar example. As before, we consider uniform circular motion (n=1), we consider the proton to be the center of mass, and we require that relativistic corrections be negligible and that the intrinsic angular momentum and magnetic fields of the particles be ignored. The law of force is

$$dp/dt = q^2/4\pi e_o r^2$$

Following the line of reasoning previously developed, we write this as

$$dm_e/dt = (q^2/4\pi e_o v_{rad})(1/r^2) \qquad (3)$$

conversion factor [kg/sec] to [ohms]

which for the Bohr atom n=1

$$dm_e/dt = \hbar/r^2$$

$$Z_{centri} := \frac{h}{\lambda bar_e^2} \cdot \frac{\lambda bar_e^2}{e^2} = \frac{h}{e^2} = 2.5812807554 \times 10^4 \, \text{ohm}$$

a result which is similar in form to the previously analyzed gravitationally bound system.

this is the quantum 'centripetal impedance', equal to the quantum Hall impedance

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

a challenge – find the near-field photon impedance in any of the standard grad school E&M texts

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. 17, No. 3, July 2010

reminder – impedances govern the flow of energy

Possible Origin of the 70MeV Mass Quantum

Peter Cameron
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Upton, NY 11973
cameron@bnl.gov

The absence of three fundamental entities from the experimental evidence is notable. The search for two, the magnetic monopole and the electric dipole moment, is extensively documented in the literature. The third, the electric flux quantum, is remarkably absent. One is tempted to speculate that these circumstances are related, and that exploration of the electric flux quantum might shed light upon, and beyond, the absence of the magnetic monopole and the electric dipole. This note presents a tentative early effort to find a guidepost or two along the road to such an exploration, or at least a compass that permits the choice of direction. What emerges is a possible origin of the 70MeV platform state. While documentation of this mass quantum (it is simply the mass of the electron divided by the fine structure constant) in the literature is not so starkly absent as for the electric flux quantum, it is surprisingly sparse.

Apeiron, Vol. 18, No. 1, January 2011

Magnetic and Electric Flux Quanta: the Pion Mass

Peter Cameron cameron@bnl.gov
Brookhaven National Laboratory
Upton, NY 11973

'paradox' is in reference to origin of Bohr magneton

The angular momentum of the magnetic flux quantum is balanced by that of the associated supercurrent, such that in condensed matter the resultant angular momentum is zero. The notion of a flux quantum in free space is not so simple, needing both magnetic and electric flux quanta to propagate the stable dynamic structure of the photon. Considering these flux quanta at the scale where quantum field theory becomes essential, at the scale defined by the reduced Compton wavelength of the electron, exposes variants of a paradox that apparently has not been addressed in the literature. Leaving the paradox unresolved in this note, reasonable electromagnetic rationales are presented that permit to calculate the masses of the electron, muon, pion, and nucleon with remarkable accuracy. The calculated mass of the electron is correct at the nine significant digit limit of experimental accuracy, the muon at a part in one thousand, the pion at two parts in ten thousand, and the nucleon at seven parts in one hundred thousand. The accuracy of the pion and nucleon mass calculations reinforces the unconventional common notion that the strong force is electromagnetic in origin.

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

Electron Impedances

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Upton, NY 11973
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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

Generalized Quantum Impedances:
A Background Independent Model for the Unstable Particles

Peter Cameron*
Strongarm Studios
Mattituck, NY USA 11952

first posted July 2012

(Dated: April 26, 2013)

The discovery of exact impedance quantization in the quantum Hall effect was greatly facilitated by scale invariance. This letter explores the possibility that quantum impedances may be generalized, defined not just for the Lorentz force and the quantum Hall effect, 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 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.

INTRODUCTION

The model presented here [1–6]comprises

- quantization of electric and magnetic flux, charge, and dipole moment
- interactions between these three topologies - flux quantum, monopole, and dipole
- the photon
- confinement to a fundamental length, taken to be the Compton wavelength of the electron

Calculated transfer impedances of the interactions are presented as a function of spatial scale/energy. Possible roles for these impedances in the creation and structure of the unstable particles are discussed.

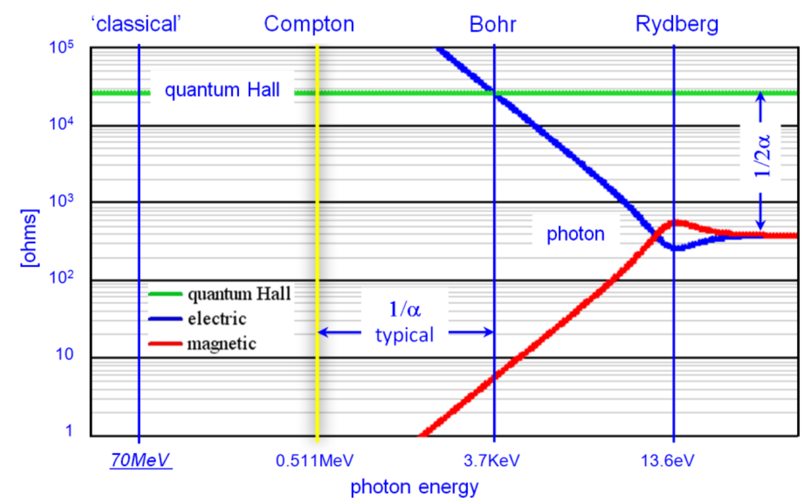

FIG. 1. Photon and electron impedances as a function of spatial scale as defined by photon energy

$$Z_M = Z_0 \left| \frac{1 + \frac{\lambda}{ir}}{1 + \frac{\lambda}{ir} + \left(\frac{\lambda}{ir}\right)^2} \right|$$

MECHANICAL IMPEDANCE

While the concept of electrical impedance is comfortably familiar to any electrical engineer and many physicists, mechanical impedance [1] is more obscure. It is defined as [19]

$$Z_{mech} = \frac{F}{v}$$

where F is the applied force and v the resulting velocity. The form is similar to Newton's second law written as

$$m = \frac{F}{a}$$

where m is the mass to which the force is applied and a is the resulting acceleration.

Taking the force F to be, for example, the centrifugal force

$$F_{centri} = \frac{mv^2}{r}$$

gives the centrifugal impedance

$$Z_{centri} = \frac{mv}{r}$$

where r is the radius of curvature of the path of the mass acted upon by this force.

second page of previous slide

The centrifugal force is in some sense a mechanical equivalent of the vector Lorentz force present in the quantum Hall effect. Like the Lorentz force, it is velocity dependent. Unlike velocity dependent forces other than the Lorentz and centrifugal forces, it is not dissipative. Like the Lorentz force, it is perpendicular to the direction of motion, and hence can do no work.

Defining v by the deBroglie relation $v = \frac{h}{mr}$ yields the simple form

$$Z_{centri} = \frac{h}{r^2}$$

The units of mechanical impedance are [kg/s], those of electrical impedance [ohm] = [(kg/s)(m/Coul)^2]. Taking the second term on the right hand side, the line charge density term, to be a conversion factor between mechanical and electrical impedances and the charge to be the charge quantum e gives

$$Z_{centri} = \frac{h}{r^2}\frac{r^2}{e^2} = \frac{h}{e^2} \simeq 25\,812.8\Omega$$

This impedance is numerically and symbolically identical to the scale invariant quantum Hall impedance, and is plotted in figure 2 (green dots).

The method presented in the above example can be used to calculate quantum impedances for forces other than the centrifugal and vector Lorentz forces. The impedance plot of figure 2 shows results from such calculations [2].

Presentation Goals - Understand, then Explore

- **understand** the One Slide
  - ~~**essential point** - impedances govern the flow of energy~~
  - ~~**origin** of impedance network – two body problem & Mach's Principle~~
  - **origin** of the coherence length plot – Malcolm MacGregor
  - **implications** of their strong correlation – personal paradigm shift
- **explore** the Implications ~ ten reasons one might want to know about quantum impedances:
  - ~~elementary particle spectrum, chiral anomaly,~~ *axions, EDM…*
  - gravity – extend the model to the Planck particle
  - state reduction and non-locality
  - black hole information paradox – Rochester, Fields,…
  - weak measurement and time symmetry – Berlin
  - quantum interpretations – Berlin
  - *dark matter*
  - ***condensed matter – $$ the bottom line $$***

Italics connote material in preparation

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[9] **viXra:1402.0064** *replaced on 2014-06-10 07:16:24*, (83 unique-IP downloads)

An Impedance Approach to the Chiral Anomaly
Authors: Peter Cameron
Category: High Energy Particle Physics

February 2014

[8] **viXra:1311.0143** *replaced on 2013-12-11 22:25:43*, (136 unique-IP downloads)

Quantum Interpretation of the Impedance Model
Authors: Michaele Suisse, Peter Cameron
Category: Quantum Physics

November 2013

[7] **viXra:1310.0043** *replaced on 2013-12-04 15:17:55*, (237 unique-IP downloads)

Delayed Choice and Weak Measurement in the Nested Mach-Zehnder Interferometer
Authors: Peter Cameron
Category: Quantum Physics

October 2013

[6] **viXra:1306.0102** *submitted on 2013-06-15 05:02:17*, (122 unique-IP downloads)

Poster for the Rochester Conference on Quantum Optics and Information
Authors: Peter Cameron
Category: Quantum Physics

June 2013

[5] **viXra:1304.0078** *replaced on 2013-04-20 08:41:41*, (67 unique-IP downloads)

Abstract of Poster Accepted for the Fields Conference on Quantum Information
Authors: Peter Cameron
Category: Quantum Gravity and String Theory

April 2013

[4] **viXra:1304.0036** *replaced on 2013-07-23 22:56:22*, (215 unique-IP downloads)

A Possible Resolution of the Black Hole Information Paradox
Authors: Peter Cameron
Category: Quantum Physics

April 2013

this is synthesis of these

[3] **viXra:1303.0039** *replaced on 2013-05-11 14:40:00*, (386 unique-IP downloads)

Quantum Impedances, Entanglement, and State Reduction
Authors: Peter Cameron
Category: Quantum Physics

March 2013

[2] **viXra:1211.0052** *replaced on 2013-04-10 11:46:31*, (263 unique-IP downloads)

Background Independent Relations Between Gravity and Electromagnetism
Authors: Peter Cameron
Category: Quantum Gravity and String Theory

November 2012

[1] **viXra:1207.0022** *replaced on 2013-04-26 11:09:42*, (310 unique-IP downloads)

Generalized Quantum Impedances: A Background Independent Model for the Unstable Particles
Authors: Peter Cameron
Category: High Energy Particle Physics

July 2012

Background Independent Relations between Gravity and Electromagnetism

Peter Cameron

Planck particle model
Is electron model at
Planck length

The model presented here [1–6]comprises

- quantization of electric and magnetic flux, charge, and dipole moment
- interactions between these three topologies - flux quantum, monopole, and dipole
- the photon
- confinement to a fundamental length, taken to be the Compton wavelength of the Planck particle

Calculated transfer impedances of the interactions are presented as a function of spatial scale/energy. Possible

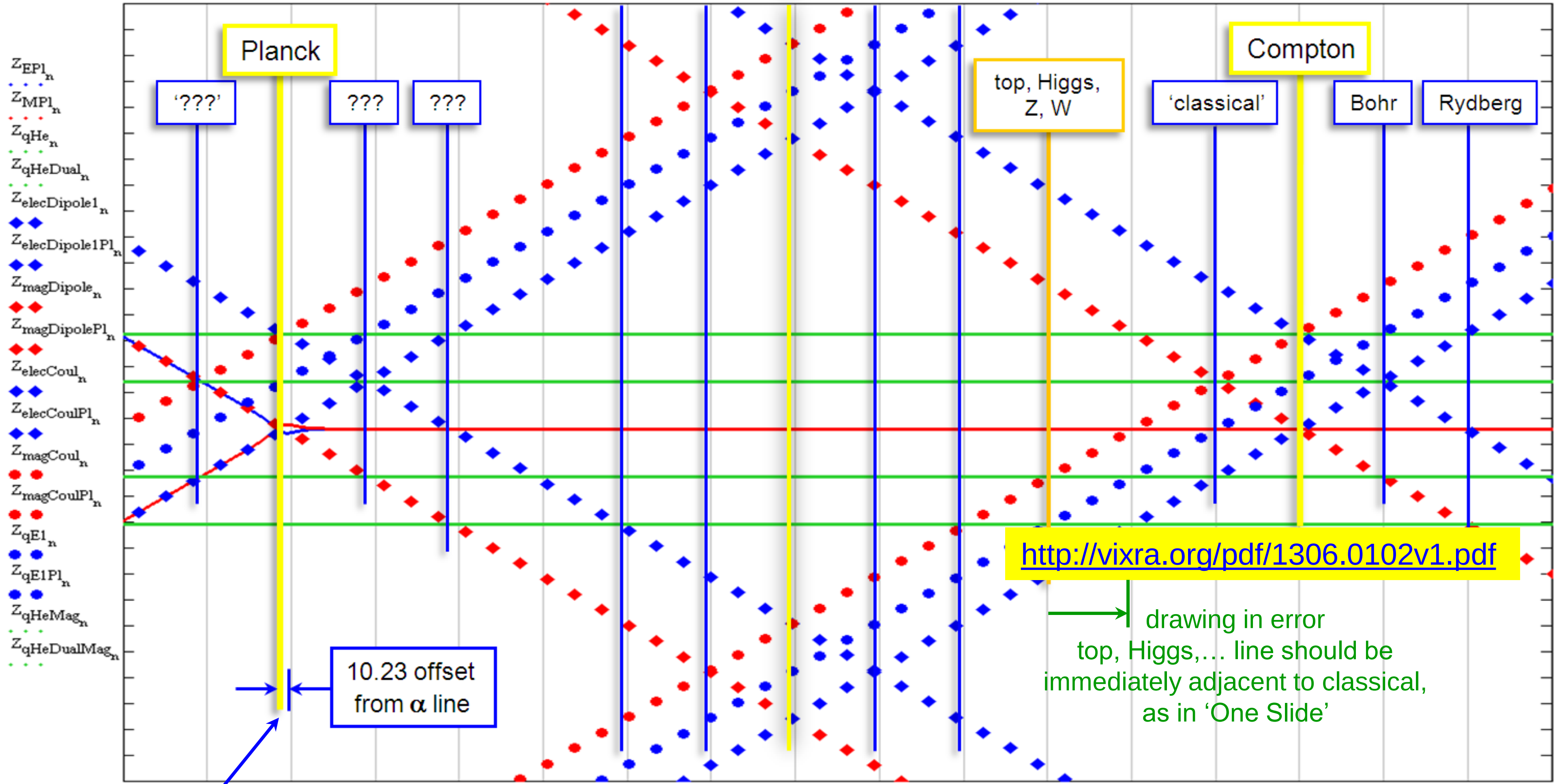
Received: date / Accepted: date

first posted on vixra November 2012

Abstract As every circuit designer knows, the flow of energy is governed by impedance matching. Classical or quantum impedances, mechanical or electromagnetic, fermionic or bosonic, topological,... To understand the flow of energy it is essential to understand the relations between the associated impedances. The connection between electromagnetism and gravitation can be made explicit by examining the impedance mismatch between the electrically charged Planck particle and the electron. This mismatch is shown to be the ratio of the gravitational and electromagnetic forces between these particles.

Keywords background independence · scale invariance · quantum impedance · network theory · scattering matrix · near field · Planck particle · state reduction · information theory

Figure 4 of the Rochester Conference Poster



impedance continuity at event horizon suggests impedance model sees gravity in 'flat space'

G is gone – one less fundamental constant it cancels out in the impedance calculation

What is the origin of 10.23 offset?

Quantum Impedances, Entanglement, and State Reduction

Peter Cameron*
Strongarm Studios
Mattituck, NY USA 11952

first draft posted
March 2013

(Dated: May 11, 2013)

The measurement problem, the mechanism of quantum state reduction, has remained an open question for nearly a century. The 'quantum weirdness' of the problem was highlighted by the introduction of the Einstein-Podolsky-Rosen paradox in 1935. Motivated by Bell's Theorem nonlocality was first experimentally observed in 1972 by Clauser and Freedman in the entangled states of an EPR experiment, and is now an accepted fact. Special relativity requires that no energy is transferred in the nonlocal collapse of these entangled two-body wavefunctions, that no work is done, no information communicated. In the family of quantum impedances those which are scale invariant, the Lorentz and centrifugal impedances, satisfy this requirement. This letter explores their role in the collapse of the wave function.

A Possible Resolution of the Black Hole Information Paradox

Peter Cameron
Strongarm Studios, PO Box 1030, Mattituck, NY 11952
petethepop@aol.com

Abstract: Nonlocal reduction of entangled states is clarified by considering the role of background independent scale-invariant quantum impedances in decay/decoherence of unstable elementary particles, providing simple resolution of the black hole information paradox.

OCIS codes: 030.1640 Coherence, 270.5585 Quantum information and processing

OSA refereed, as was Berlin Conference

1. Introduction

Decay of the unstable particles offers the possibility of informing nonlocal reduction of entangled states. Both follow from phase decoherence (with the resultant complication that phase is not an observable in state reduction). Unlike entangled states, where unitary evolution of the two (or more) body wave function requires nonlocal phase coherence, in the case of the unstable particles the essential coherence is self-coherence.

4. The Black Hole Information Paradox

An earlier note [8] calculated the impedance mismatch between the electron and the Planck particle. This mismatch is precisely equal to the ratio of the gravitational and electromagnetic forces between these two particles, indicating that the quantum impedance approach is valid at the event horizon, and perhaps beyond, to the singularity (which is completely decoupled by the infinitely large impedance mismatch at the dimensionless 'point').

As regards the paradox, if the scale invariant impedances are valid at the event horizon and responsible for nonlocal state reduction, and the holographic principle applies, then the paradox is removed.

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  - quantum interpretations – Berlin
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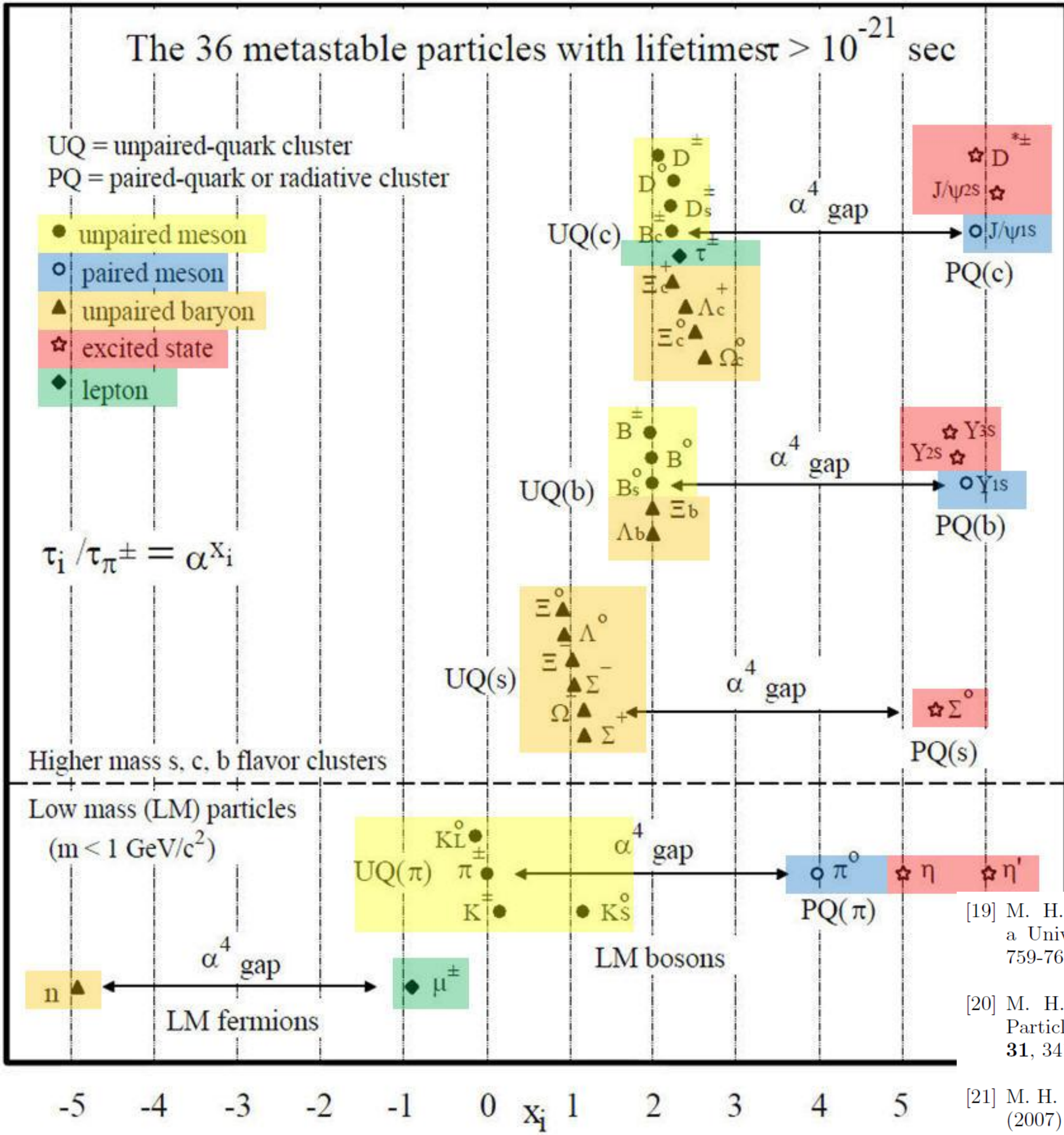
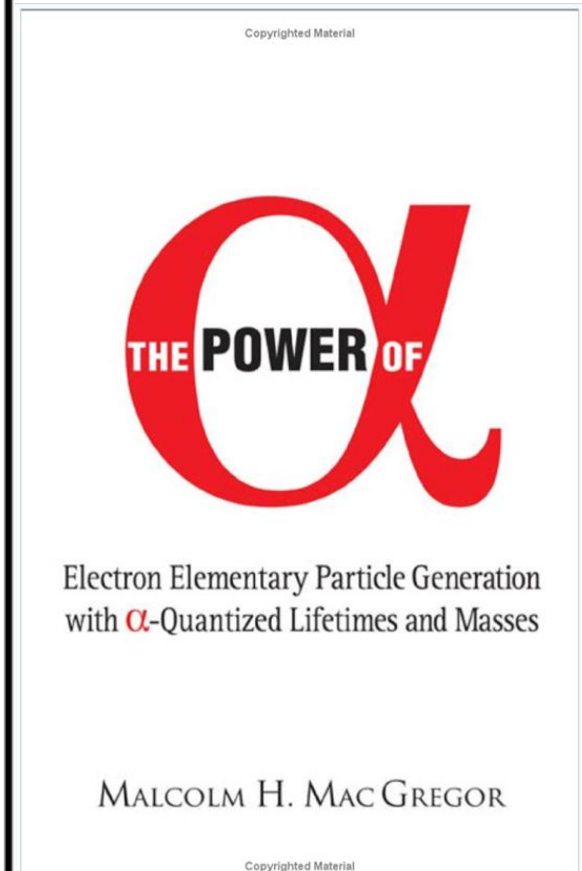


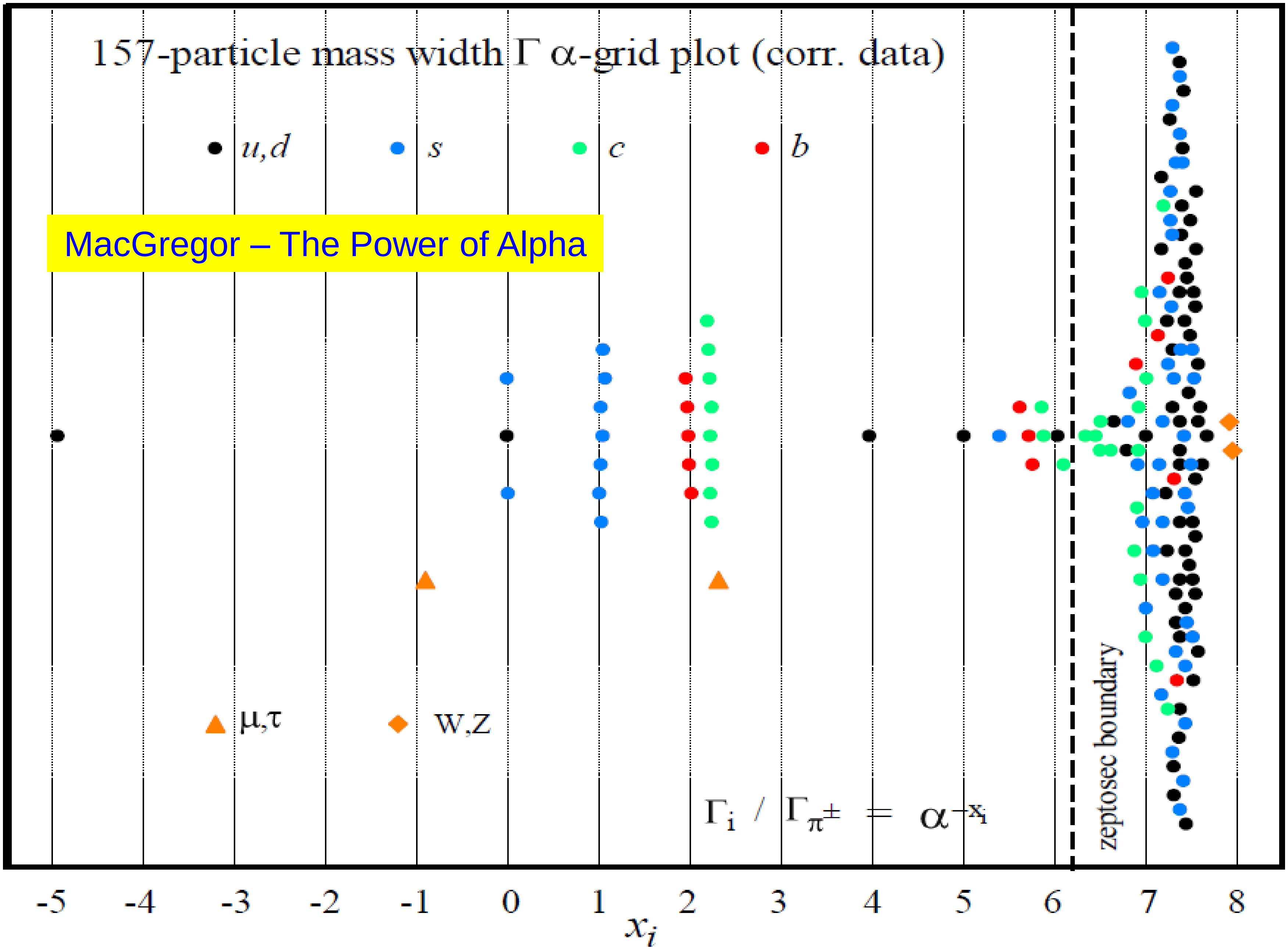


[19] M. H. MacGregor, "The Fine-Structure Constant as a Universal Scaling Factor", Lett. Nuovo Cimento **1**, 759-764 (1971)

[20] M. H. MacGregor, "The Electromagnetic Scaling of Particle Lifetimes and Masses", Lett. Nuovo Cimento **31**, 341-346 (1981)

[21] M. H. MacGregor, The Power of Alpha, World Scientific (2007) see also http://70mev.org/alpha/

MacGregor's lifetime plot with his factor of 2, 3, and 4 corrections



from 2011 – making the connection between impedances and lifetimes

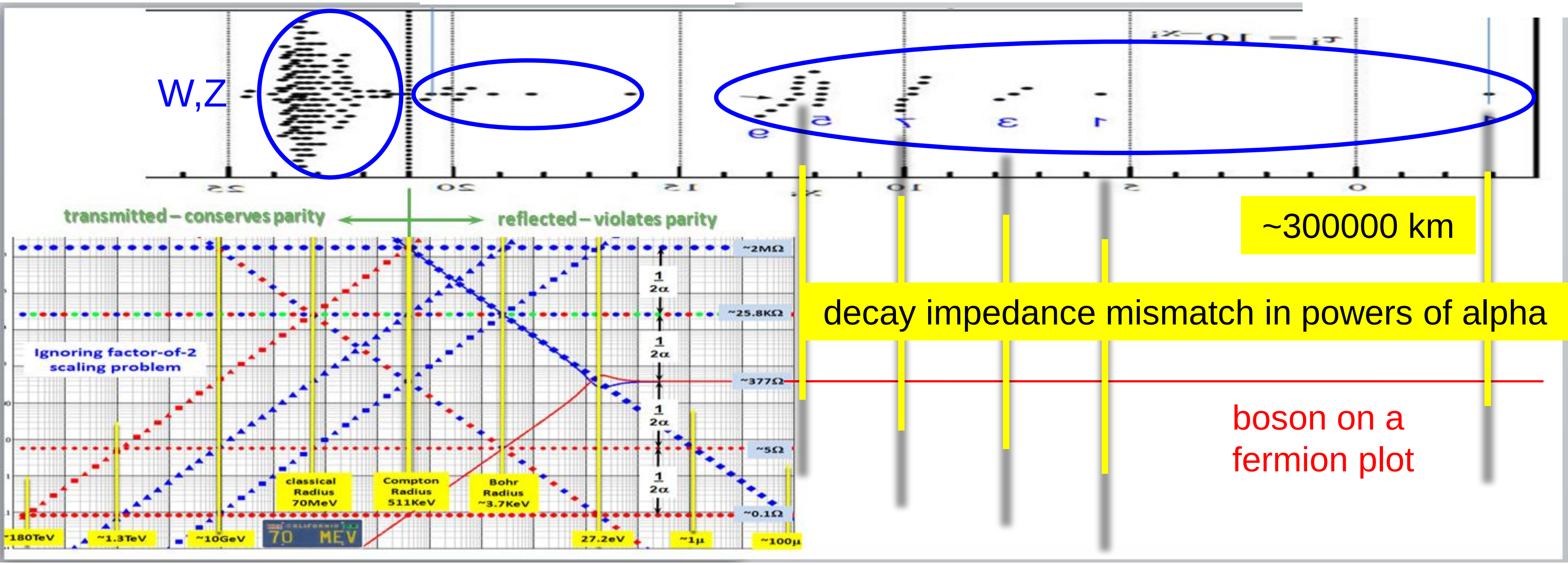
Full Spectrum (neutrino?) of Unstable Particle Lifetimes

From previous slide with horizontal axis reversed

strong decay

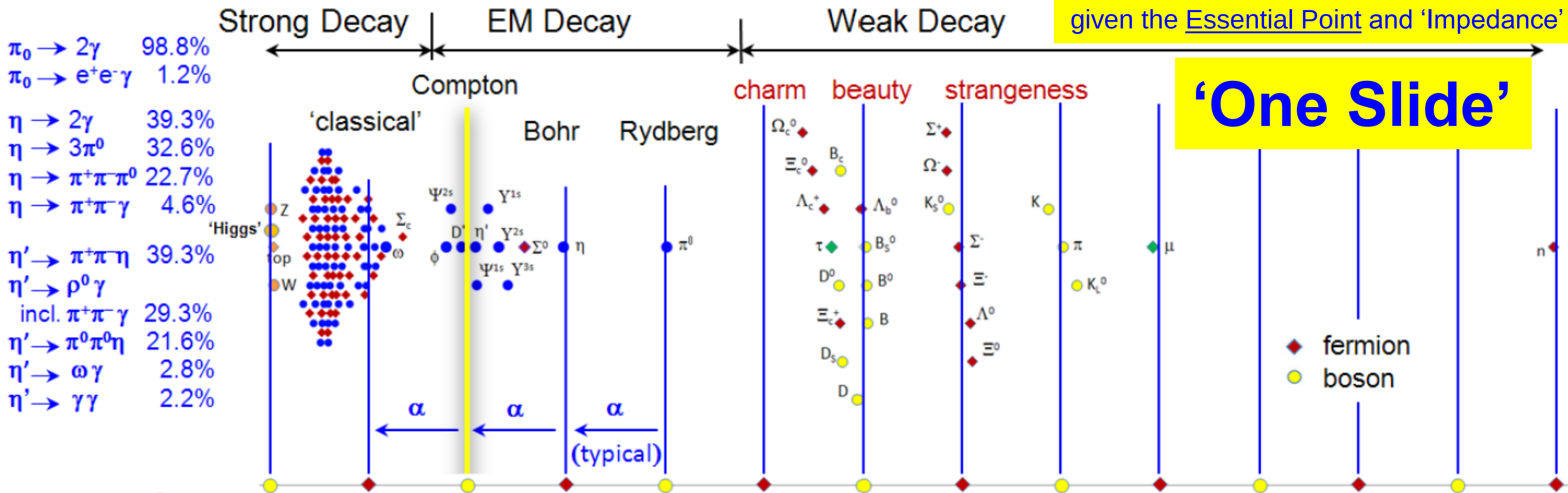
electromagnetic decay

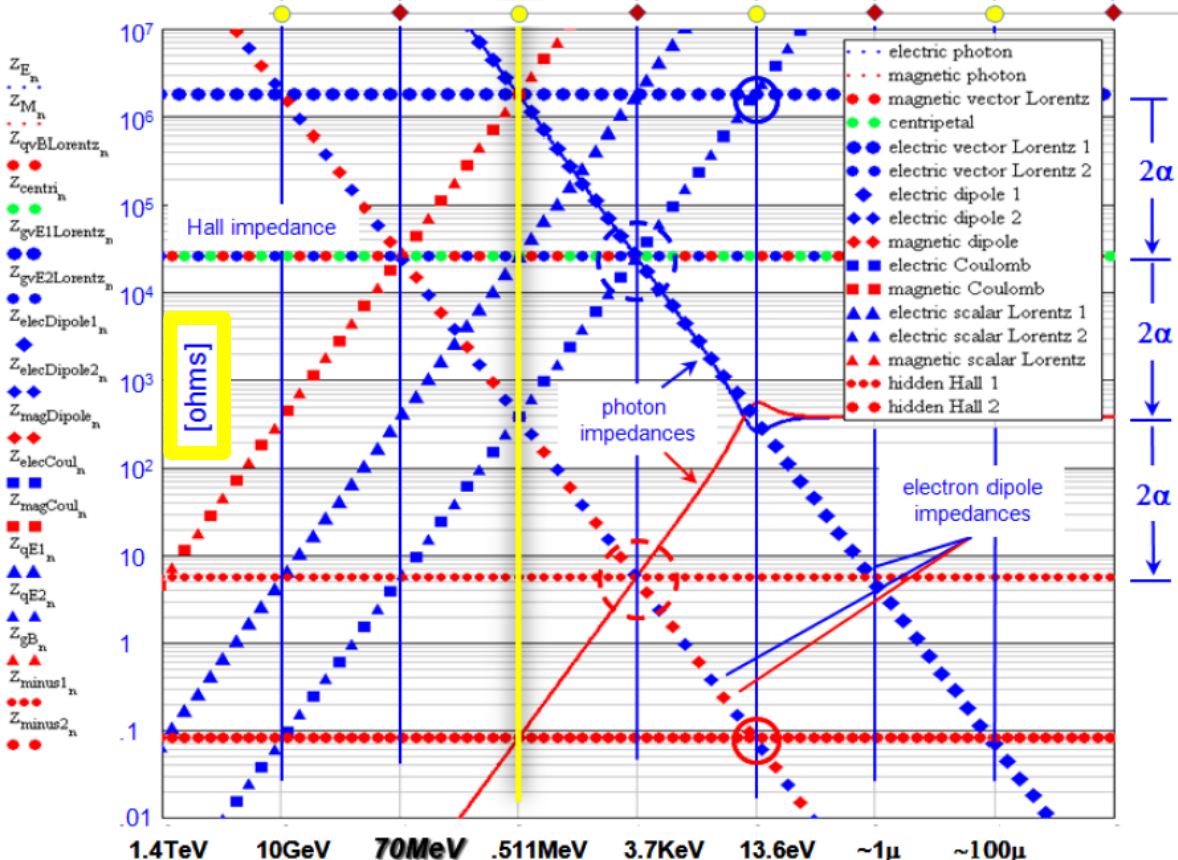
weak decay



Electromagnetic decays are possible only when the impedance match is reasonably good, Unstable particles that exist on longer time/length scales than the Rydberg cannot impedance match to the photon, require parity violation and the neutrino given the Essential Point and ‘Impedance’

‘One Slide’





- 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
- 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

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Delayed Choice and Weak Measurement in the Nested Mach-Zehnder Interferometer

accepted for presentation at the 2014 Berlin Conference on Quantum Information and Measurement

Peter Cameron
Strongarm Studios
Mattituck, NY USA 11952
petethepop@aol.com

OSA refereed, as was the Rochester Conference. This paper was motivated by Lev Vaidman's excellent talk at Rochester.

Abstract: This note discusses interpretation of recent weak nested interferometer measurements in terms of state vectors traveling both forward and backward in time. A compatible quantum impedance interpretation is presented. Delayed choice variants are proposed.

OCIS codes: 000.2658, 270.5585

5. Conclusion

There appears to be a connection between invariant impedances, weak measurement, and time symmetry. Invariant impedances transfer no energy, only phase. Weak measurement measures phase, which is acausal. Thus the impedance model is compatible with a TSVF of state vectors coupled by invariant impedances only. A test of the TSVF interpretation would then look for f1 and f2 with insertion of BS2 after the photon has passed (!) and before $t=3\sqrt{2}$.

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Viewpoint: What Can we Say about a Photon's Past?

Jeff Lundeen, *Department of Physics, University of Ottawa, MacDonald Hall, 150 Louis Pasteur Road, Ottawa, Ontario K1N 6N5, Canada*

Published December 9, 2013 | Physics **6**, 133 (2013) | DOI: 10.1103/Physics.6.133

An experiment demonstrates that even when physicists think a quantum particle has followed a single path it might not have.

Quantum Interpretation of the Impedance Model

accepted for presentation at the 2014 Berlin Conference on Quantum Information and Measurement

Michaele Suisse and Peter Cameron
Strongarm Studios
Mattituck, NY USA 11952
michaele.suisse@gmail.com, petethepop@aol.com

OSA refereed, as was the Rochester Conference

Abstract: Quantum Interpretations try to explain emergence of the world we observe from formal quantum theory. Impedances govern the flow of energy, are helpful in such attempts. We include quantum impedances in comparisons of selected interpretations.
OCIS codes: 000.6800, 270.5585

Index	Interpretation	Authors	non-local?	probabilistic?	hidden variables?	wavefcn real?	wavefcn collapse?	universal wavefcn?	observer role?	unique history?
30	Objective Collapse	GRW 1986, Penrose 1989	Yes	Yes	No	Yes	Yes	No	No	Yes
30	Transactional	Cramer 1986	Yes	Yes	No	Yes	Yes	No	No	Yes
30	Quantum Impedances	Cameron & Suisse 2013	Yes	Yes	No	Yes	Yes	No	No	Yes
25	Relational	Rovelli 1994	No	Yes	No	No	Yes	No	No	agnostic
23	Quantum Logic	Birkhoff 1936	agnostic	agnostic	No	agnostic	No	No	No	Yes
17	Ithaca	Mermin 1996	No	Yes	No	No	No	No	No	No
15	Consistent Histories	Griffiths 1984	No	agnostic	No	agnostic	No	No	No	No
15	Copenhagen	Bohr & Heisenberg 1927	No	Yes	No	No	Yes	No	Yes	Yes
9	Qbism	Caves, Fuchs, Schack 2002	No	Yes	No	No	Yes	No	Yes	No
6	Orthodox	von Neumann 1932	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes
-3	Many Worlds	Everett 1957	No	No	No	Yes	No	Yes	No	No
-18	de Broglie – Bohm	de Broglie 1927, Bohm 1952	Yes	No	Yes	Yes	No	Yes	No	Yes

Fig. 1. Comparison of the Interpretations. The Index parameter quantifies the strength of agreement between a given interpretation and the rest of the table. Values in the Index column are calculated by adding a point for entries that agree with a given interpretation, subtracting for entries that disagree, and giving half values for the agnostics.

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from the Electron Impedances note

	'spinor' **flux quantum**	monopole **charge quantum**	dipole **dipole quantum**
electric	dark	observable	dark
magnetic	observable	dark	observable

the constituents of the impedance model

from the chiral anomaly note

'Dark' Modes and Anomalies

The impedance plot of figure 2 is not complete.

Absent are the longitudinal dipole-dipole impedances, the longitudinal and transverse charge-dipole impedances (the charge-dipole impedances are a subset of the scale invariant three body impedances), and the Coriolis impedance. There may be others, and likely are. Given the spin dependence of the weak interaction, one would expect that adding the longitudinal impedances to the figure would give additional insight into the weak decays, probably essential for instance in impedance-based calculations of those branching ratios.

[88] T. Datta, "The fine structure constant, magnetic monopoles, and the Dirac charge quantization condition", Lett. Nuovo Cim. **37** 2 (1983) http://link.springer.com/article/10.1007

Present in the plot are several impedances that (excepting the unstable particle spectrum) are absent in our observations of the world, do not couple to the photon, namely those associated with the electric flux quantum, magnetic monopole, and electric dipole. Figure 6 shows the alternation with topological complexity.

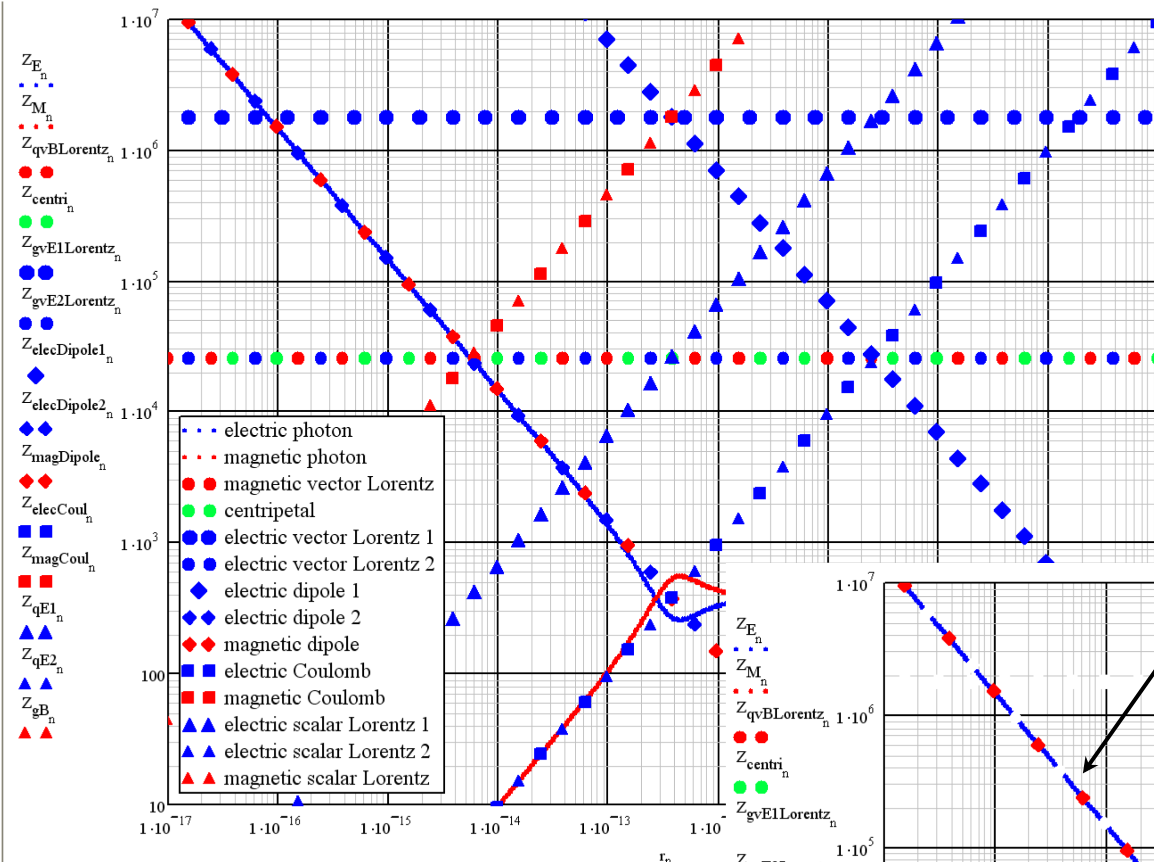
We see the magnetic flux quantum, electric monopole, and magnetic dipole in the stable particles which comprise our physical world, but not their electromagnetic complements. It seems that the only place we see these 'dark' components is in the unstable particle spectrum. This broken symmetry is partially understood in terms of the relative strengths of the magnetic and electric charge quanta[12, 88], and might have a not-yet-obvious role in the chiral anomaly.

bonus - EDM

$$\mu_B = \frac{e\hbar}{2m_e c}$$

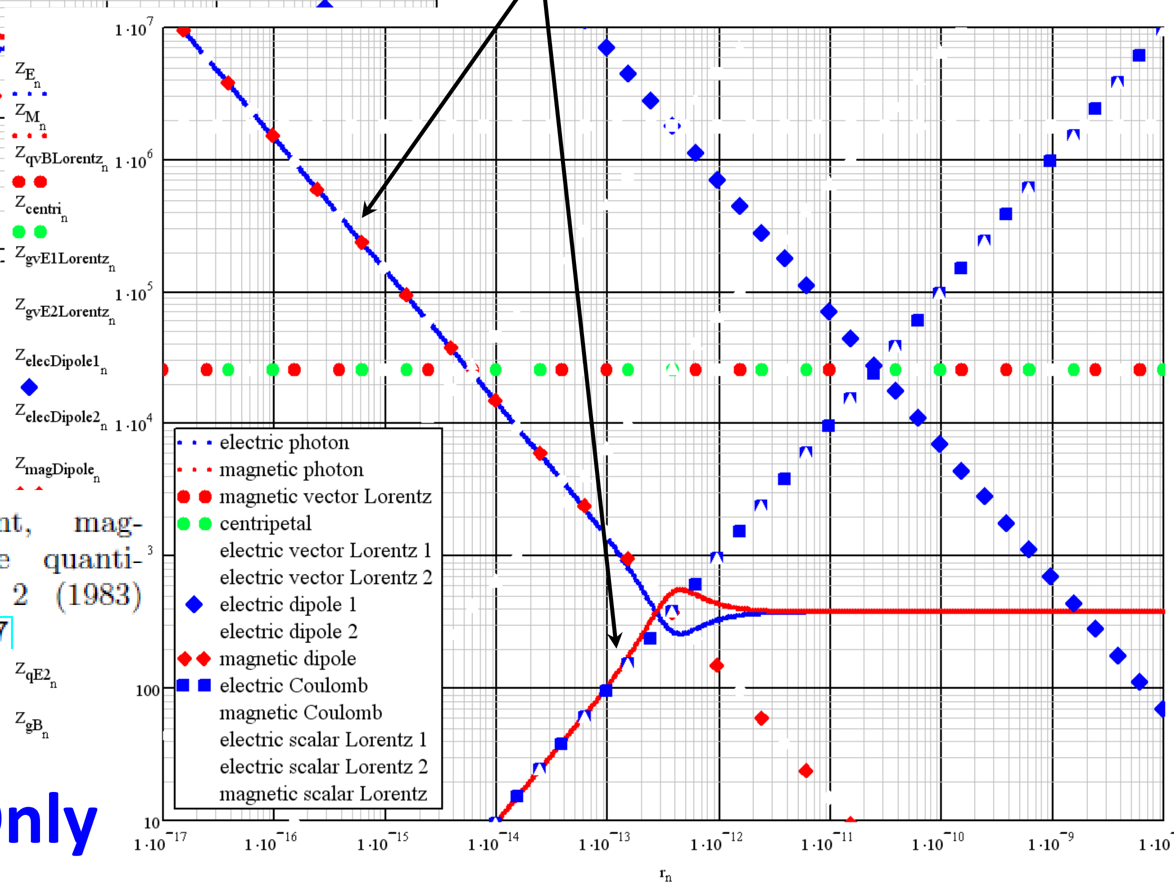
a product of electric charge ***e*** and distance ***h/mc*** define EDM, not MDM.

in near field of the observables the electric flux quantum is coupling to magnetic impedance, and magnetic flux quantum to electric impedance.



Observable + Dark

[88] T. Datta, "The fine structure constant, magnetic monopoles, and the Dirac charge quantization condition", Lett. Nuovo Cim. **37** 2 (1983) http://link.springer.com/article/10.1007



Observable Only

Presentation Goals - Explore, then Understand

- **explore** the Implications ~ ten reasons one might want to know about quantum impedances:
  - ~~elementary particle spectrum, chiral anomaly~~, *axions, EDM…*
  - ~~gravity – extend the model to the Planck particle~~
  - ~~state reduction and non-locality~~
  - ~~black hole information paradox – Rochester, Fields,…~~
  - ~~weak measurement and time Symmetry – Berlin~~
  - ~~quantum interpretations – Berlin~~
  - ~~*dark matter*~~
  - ***condensed matter – $$ the bottom line $$***

Italics connote material in preparation

- **understand** the One Slide
  - ~~**essential point** - impedances govern the flow of energy~~
  - ~~**origin** of impedance network – two body problem & Mach's Principle~~
  - ~~**origin** of the coherence length plot – Malcolm MacGregor~~
  - **implications** of their strong correlation – personal paradigm shift

condensed matter – $$ the bottom line $$

- if the concept of generalized quantum impedances is eventually perceived and accepted to be of some value, the **practical realizations** will of course be in **condensed matter**.
- a good place to start is perhaps impedance matching all (or as many as possible) of the electron impedances to the graphene lattice
- helpful references might be found in the bibliography of the chiral anomaly note, as shown here and on the following pages

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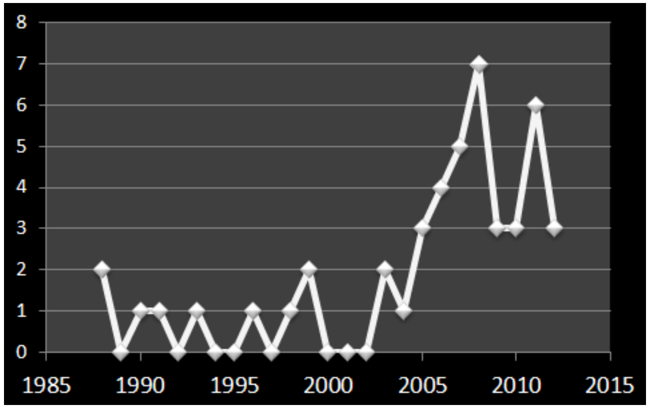

- at right is a plot of 'relevant papers per year'

of the references on the following three slides, where relevant is taken to mean potentially useful in understanding possible roles of generalized quantum impedances in condensed matter. Coverage ends mid-2012.

Trending upwards nicely.

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[87] R. Collins, "The Doppler Origin of deBroglie Waves", APS preprint server (1998)

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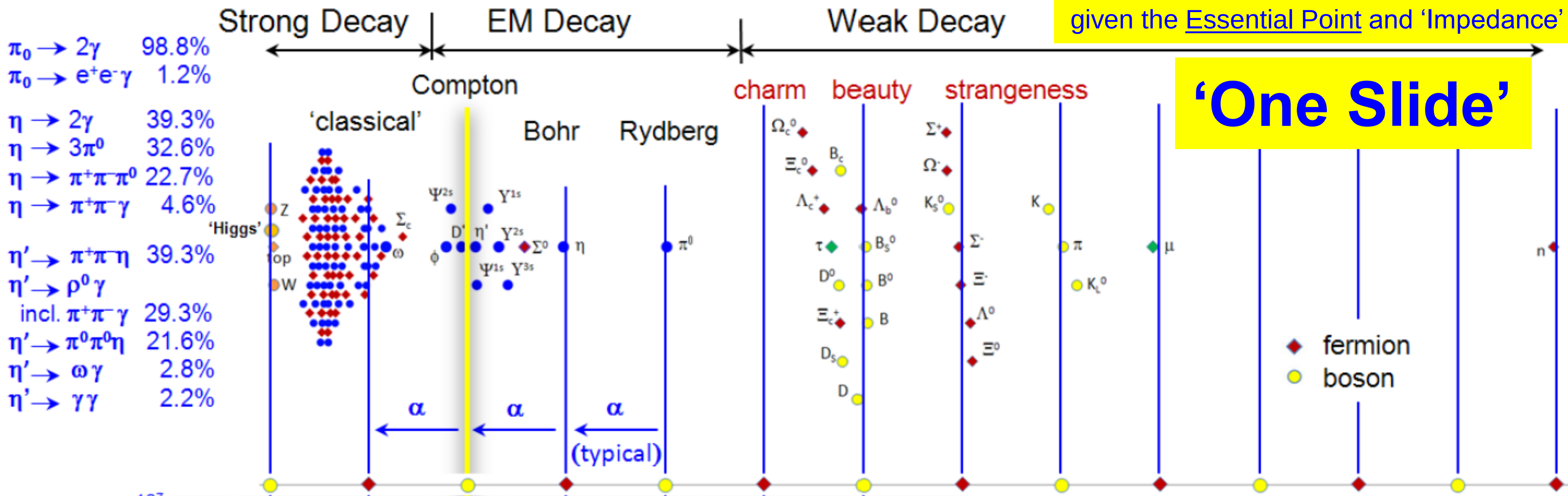
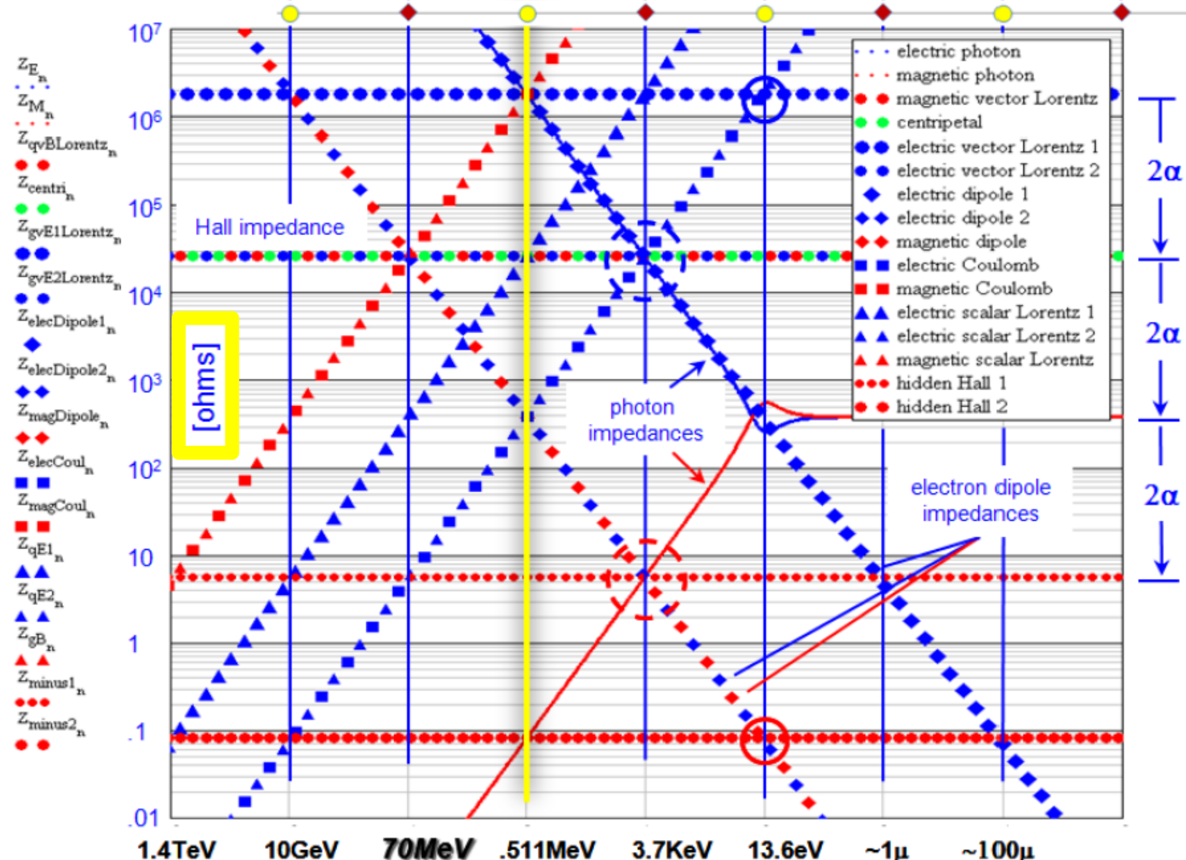
Thank You for Your Time and Attention

given the Essential Point and 'Impedance'

'One Slide'





- 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
- 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

backup slides

Impedance Units

conversion factor **m/coul**

- Mechanical – force $F = grad(V)$

space gradient is absent in electrical → topological 'anomaly'

$$F = m\ddot{x} + \boldsymbol{R}\dot{x} + kx$$

[kg-m/s²] = [kg][m/s²] + [**kg/s**][m/s] + [kg/s²][m]

Real part is velocity ($\dot{x}$) dependent and dissipative

Imaginary part results in phase shift

- Electrical – potential V

conversion factor **m²/coul²**

$$V = L\ddot{q} + \boldsymbol{R}\dot{q} + \frac{q}{C}$$

[volt] = [henry][coul/s²] + [**ohm**][coul/s] + [coul/farad]

[kg-m²/coul-s²] = [kg-m²/coul²][coul/s²] + [**kg-m²/coul²-s**][coul/s]

+ [coul]/[kg-m²/coul²-s²]

real part is current ($\dot{q}$) dependent and dissipative

- Vector Lorentz force – 'mechanical' quantum Hall impedance

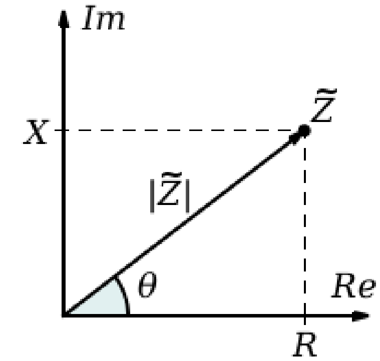
$F = \boldsymbol{qB} \cdot \dot{x}$ confine flux quantum to electron Compton circle gives $\boldsymbol{B}$

[kg-m/s²] = [**kg/s**][m/s]

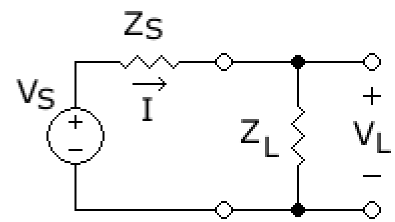
this is 9 digits numerically correct

Real part is velocity dependent and **NOT** dissipative (ie 'quantum')

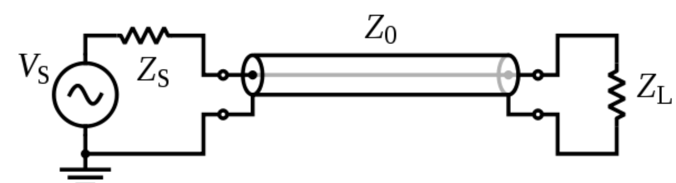
Electrical Impedance



- Ratio of potential (voltage) to flow (of charge)
- Ohm's law $Z = V/I = |Z|e^{-i\theta}$ 2π periodicity
  ohm = [kg-m^2/coul-s^2]
- For maximum power transfer (no reflection)
  $Z_{source} = Z^*_{load}$ (here phase is an observable)



- Transmission line $Z_{max} < Z_0$
  modulo 2π it has 'scale invariant impedance'
  phase match from length



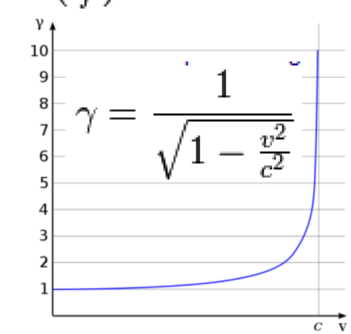
- Wave impedance in free space (scale invariant in far field)
  $Z_0 = \mathrm{sqrt}(\mu_0/\varepsilon_0) \sim 377\Omega$ $c = 1/\mathrm{sqrt}(\mu_0\varepsilon_0)$
  bosonic – photon (W, Z, glue,… ?)
- Wave impedance in waveguide

TM
$$Z = Z_0\sqrt{1-\left(\frac{f_c}{f}\right)^2}$$

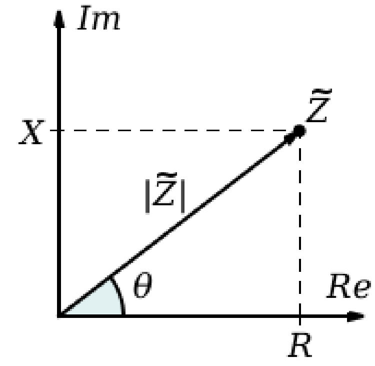
TE
$$Z = \frac{Z_0}{\sqrt{1-\left(\frac{f_c}{f}\right)^2}}$$

- Wave impedance in quantum waveguide/wire
  quantum Hall impedance $R_K = h/e^2 = 25812.807557(18)\ \Omega$
  transverse size determines number of modes
  Impedance is real (no phase shift) and non-dissipative

superconducting

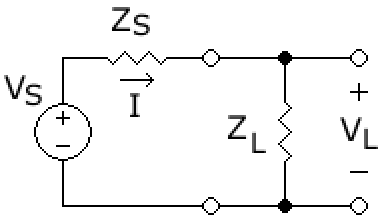


Mechanical Impedance



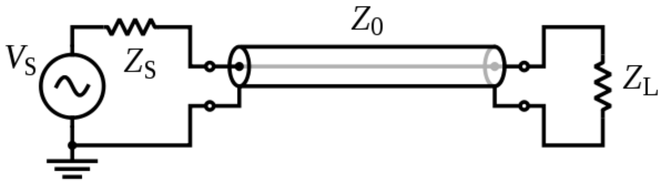
- Ratio of potential gradient (force) to (mass) flow
- 'Ohm's law' $Z = F/dv = |Z|e^{-i\theta}$ 2π periodicity
- Units $Z[\frac{kg}{s}] = F[\frac{kg-m}{s^2}]/dv[\frac{m}{s}]$ deBroglie?
- For maximum power transfer (no reflection)

  $Z_{source} = Z^*_{load}$ (here phase is an observable)



- Transmission line $Z_{max} < Z_0$

  modulo 2π it has 'scale invariant impedance'



- Wave impedance in free space (ie ballistic conduction)

  quantum Hall impedance $R_K = h/e^2 = 25812.807557(18)\ \Omega$

  fermionic – single free electron (mean free path > coherence length)
- Wave impedance in quantum waveguide, quantum resonator,…

  again quantum Hall impedance – all real and **non-dissipative**
- Are there other possible quantum impedances?

  One can define the (quantum) force resulting from interacting with every (quantum) potential, and from that the corresponding **quantum impedance**