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Introduction to Electromagnetism According to Maxwell

(Electromagnetic Mechanics)
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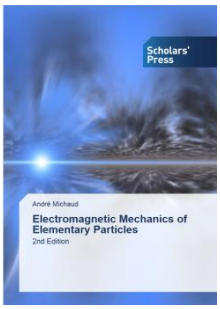
Introduction to Maxwell's initial electromagnetics theory with deeper analysis leading to the establishment at the subatomic level of clear mechanics of electromagnetic photons emission and absorption and of electron stabilization in atoms. The resulting discovery of the adiabatic nature of the energy induced in all elementary charged particles, related to Maxwell's first equation, tends to confirm the conclusion that Einstein reached towards the end of his life that gravitation seems to follow the pattern of electromagnetism.

Complement to the previously published monograph describing the electromagnetic mechanics of elementary particles:

Electromagnetic Mechanics of Elementary Particles – second Edition



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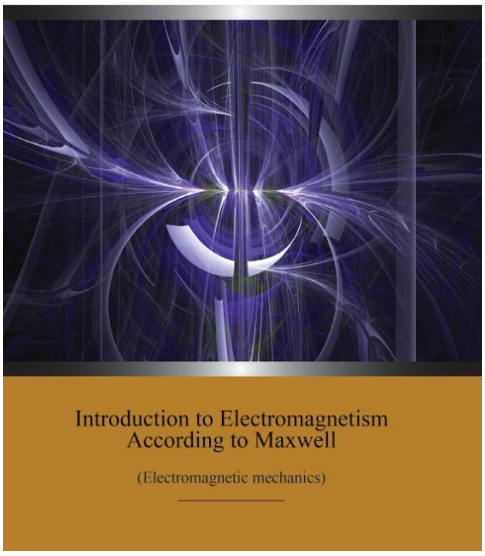

Also available in French, Spanish and German

Final integration of three major papers of the "***Electromagnetic Mechanics Project***" that were published after publication of the first monograph.

The 3 chapters of this monograph are expanded versions of 3 formally published papers referred to at the end of this presentation, which are freely available for separate downloads, except for **Appendix A** and **Appendix B** that are made available at the end of this document.

For presentation of the book, the Table of Contents as well as the Foreword are provided.

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"*Things happen in this world*
when someone makes them happen"

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Foreword

For the first mechanical explanation of electromagnetic photons emission and absorption by electrons to currently make sense in the physics community, the explanation can be made at this point in time only from four unfamiliar aspects of electromagnetism, two of which are very recent developments that are unfamiliar for this very reason, which are the trispatial geometry that was proposed in 2000 and Paul Marmet's derivation that was published only 3 years later, both of which must be correlated with Louis de Broglie's hypothesis about localized photon's possible inner electromagnetic structure and Maxwell's initial conclusion that both electric and magnetic fields have to induce each other for the existence of electromagnetic energy to be correctly described.

Unfortunately, both de Broglie's hypothesis and Maxwell's initial interpretation, although formally available in the literature, are themselves unfamiliar to most in the current physics community, which is why the sequence of arguments presented in Chapter 1 of this work is arranged in such a way as to progressively relate these four unfamiliar aspects with the main familiar conclusions previously drawn about elementary particles, to make more obvious how these four unfamiliar aspects harmonize with observation, and can consequently be used as a solid foundation to ultimately explain photon emission and absorption.

This unfamiliarity with the conclusions of Maxwell and de Broglie is mainly due to the dominance for the past century of the Copenhagen interpretation, a dominance that eventually became so absolute in the orthodox physics community, that many of the major seminal papers that were published by Max Planck, Albert Einstein and Louis de Broglie, among other major contributors to the advancement of knowledge in physics, who opposed this interpretation, are no longer referred to, and to this day, have not even been translated to English to be made available to the global physics community. Nowhere is the nefarious influence of the Copenhagen interpretation on the physics community better put in perspective than in an analysis published initially in German by Franco Selleri, subsequently translated to French and Spanish, under the title of "*Die Debatte um die Quantentheorie*" ("*The Debate about Quantum Theory*") [1].

This translation issue is currently in process of being addressed by organizations such as the *Minkowski Institute Press* founded by Vesselin Petkov, dedicated to making available in English many of these ground breading papers. Among the impressive list of such untranslated papers, my friend Fritz Lewertoff, who contributed in 2012 the first ever translation to English of Herman Minkowski's "*Das Relativitätsprinzip*" ("*The Relativity Principle*") [2], made me aware of two other major papers in this list, whose earlier translation could possibly have allowed progress to resume much sooner in fundamental physics, and that are now in process of being translated.

The first one is the text of a lecture given by Max Planck on November 12, 1930, titled "*Positivismus und reale Aussenwelt*" [3] ("*Positivism and the real outside world*"), in which he exposes the manner in which skepticism had been gaining ground in fundamental physics to the point of casting doubts on logical reasoning itself, and how such an attitude, that he had just witnessed being promoted 3 years before during the 1927 Solvey congress, was likely to mislead the community into the absence of progress that we have been observing for decades now in fundamental physics research. This damaging philosophy, that was actively promoted by Bohr, Heisenberg and Sommerfeld, became eventually known as the "*Copenhagen interpretation*", and, to the chagrin of all in the community who believe in the benefits of rationality, has become the dominant philosophy in the orthodox fundamental physics community for the past 90 years.

The most striking statement in Planck's lecture is a remark that certainly was meant as a warning about the dangers of this skepticism with regard to logical reasoning that was gaining more and more ground at that time in the fundamental physics community, according to which we will never be able to understand reality at the fundamental level any more clearly than the vague outlines allowed by Heisenberg's statistical description method, which is an axiomatic dogma directly contradicted by the current state of our understanding of the subatomic level from the electromagnetic perspective:

"Ein Menschenkind, das seine eigene Zukunft als durch das Schicksal zwangsläufig vorherbestimmt ansieht, oder ein Volk, das den Prophezeiungen seines naturgesetzlich festgelegten Unterganges Glauben schenkt, bekundet damit in Wirklichkeit nur, daß es den rechten Willen zum Aufstieg nicht aufzubringen vermag." ([3], p. 34).

Translation:

"A human being who sees his own future as inevitably predetermined by fate, or a people who believes the prophecies of its downfall determined by natural law, in reality only shows that it cannot muster the right will to ascend."

Planck's concern about this loss of confidence in logical reasoning that seemed to become the orthodox belief in the fundamental physics community soon proved to have been justified, and already in 1953 Schrödinger bluntly denounced it in a work that still has not been translated to English to be made available to the international community ([4], p. 16). See quote of this denunciation in Section 2.1.

Planck's analysis clearly highlights the limited range of possibilities for progress offered by the statistical approach that was gaining ground in the physics research community compared to those offered by the dynamic approach, in the clear identification of the laws of nature.

The second text is an incredibly important paper from Albert Einstein dating back to 1910 [5], and that practically nobody has read nor referred to for the past century, for the simple reason that the only existing version of this text is a translation to French of the lost German original, titled "*Le Principe de relativité et ses conséquences dans la physique moderne*" ("*The Principle of Relativity and its Consequences in Modern Physics*").

The importance of this paper lies in the fact that it reveals that as early as 1910, Einstein already was aware of the 1:1 identity relation that exists between the electrodynamic force related to the acceleration of the electron charge *e* when subjected to an ***E***-field, and the gravitational force related to the acceleration of mass *m* of the same electron, as established by Newton for macroscopic masses, which he summarized with Equation (2) on page 143 of this paper:

"On peut, par exemple, obtenir de cette façon les équations du mouvement d'un point matériel de masse m portant une charge électrique e (par exemple un électron) et soumis à l'action d'un champ électromagnétique. On connaît, en effet, les équations du mouvement d'un point matériel à l'instant où sa vitesse est nulle. D'après les équations de Newton et la définition de l'intensité du champ électrique, on a:"

Translation:

"We can, for example, obtain in this way the equations of motion of a material point of mass m carrying an electric charge e (for example an electron) and subjected to the action of an electromagnetic field. We know, in fact, the equations of motion of a material point at the moment when its velocity is zero. According to Newton's equations and the definition of the electric field strength, we have:"

$$(2)\quad m\frac{\mathrm{d}^2x}{\mathrm{d}t^2} = e\mathbf{E}_x \quad ([5], \text{p. } 143)$$

This correct understanding on his part of the relation between the invariant rest mass and the invariant charge of the electron certainly explains his persisting intuition that gravitation had to be related to electromagnetism, as we will further analyze in Section 1.7.1. It is well known that towards the end of his life, he had became adamant that gravitation had to be related to electromagnetism, and was openly advocating that this avenue should be investigated, even if this meant that his brainchildren theories of Special Relativity (SR) and General Relativity (GR) had to be abandoned as physically inapplicable, that is, even if his theories ultimately turned out to only be "*a castle in the air*", as he wrote in 1954 [6].

In fact, the development of these *relativity* theories at the beginning of the 20th century came about due to an alleged impossibility of demonstrating absolute motion in the universe, giving precedence to the concept *of relative motion* as opposed to *absolute motion*, that was brought to

general attention by mathematician Henri Poincaré in a short note widely distributed by the French *Académie des Sciences*, in June of 1905. This issue will be addressed in Section 3.4, and Subsections 3.5.1 and 3.17.1.

Unfortunately, when Einstein formulated this recommendation that more attention should be given to electromagnetism a few years before he passed away in 1955, the Copenhagen interpretation had already conquered the whole fundamental physics research domain, as confirmed by Schrödinger's denunciation in 1953 (See Section 2.1), and the whole orthodox community apparently purposefully immediately rejected his recommendation without a second look, as reported in 1995 by Archibald Wheeler, a major Copenhagen interpretation opinion leader:

> *"A distinguished physicist even published in his very last years' works, the main point of which is to claim that gravitation follows the pattern of electromagnetism. This thesis, we cannot accept, and the community of physics, quite rightly, does not accept."*
>
> Archibald Wheeler, 1995. ([7], p. 391)

The unfortunate outcome of this outright rejection was a 40 years hiatus before this investigation could be re-initiated in the late 1990's, right after this author became aware of this comment by Wheeler in the work that he co-authored and published in 1995 with Ignazio Ciufolini [7]. This apparently incomprehensible refusal to proceed with fundamental research in such an important direction will be analyzed in Section 1.7.2.

The project that the present work is part of is meant to repair the damage caused by this rejection, by exploring and analyzing the subatomic magnitude level of physical reality from the long established experimental foundations of electromagnetism, by means of an expansion to Maxwell's 3D vectorial space. Among the various aspects of the subatomic level that will be analyzed, Sections 1.26 and 1.27 cover what the study of electromagnetism leads to with regard to gravitation, apparently confirming that Einstein's conclusion that gravitation follows the pattern of electromagnetism may well have been right.

Most of the freely available previously published papers in this project, that refocus the conclusions drawn about the various observed phenomena at the subatomic level according to this new perspective, have been regrouped in a monograph published separately [8]. The three remaining articles that were subsequently published, also in open access, including the final synthesis of the project, are now being regrouped in the present work.

Chapter 1 reproduces the content of the article cited as Reference [9] Titled "*Electromagnetism according to Maxwell's Initial Interpretation*" formally published in January of 2020 and that constitutes the final synthesis of this project. The required sequence of arguments is organized in this chapter so as to progressively connect all four unfamiliar aspects initially mentioned with the main familiar conclusions previously drawn about elementary particles, to make more obvious to what extent these unfamiliar aspects harmonize with observation, and can consequently be used as a solid foundation to ultimately explain photon emission and absorption.

Chapter 2 reproduces the content of the article cited as Reference [10] titled "*The Hydrogen Atom Fundamental Resonance States*", formally published in April 2018. It retraces the origins of Quantum Mechanics and refocuses its understanding according to the conclusions of its initial originators, who were Louis de Broglie and Erwin Schrödinger, to finally explain, in context of the previously mentioned expanded space geometry, why electrons cannot crash onto atomic nuclei in Nature, but are rather captured in various stable stationary action orbitals at some distances from these nuclei.

Finally, Chapter 3 reproduces, with a few complementary Subsections, the content of the article cited as Reference [11] titled "*Gravitation, Quantum Mechanics and the Least Action Electromagnetic Equilibrium States*" formally published in November 2017. It provides a simplified overview of the states and processes described in the series of articles that were regrouped in the monograph titled "*Electromagnetic Mechanics of Elementary Particles*", that was published separately in 2017 [8]. So that the present introduction to electromagnetism can serve as an index into both the complete series of freely available papers, and also into the related monograph, all references to the separate papers will also refer the specific chapters that integrate them into the monograph, for readers who prefer to use the integrated monograph.

A certain amount of overlap of the descriptions will be observed between all three chapters, but since each chapter reproduces the actual content of a separately published paper, it was chosen not to reduce these overlaps so as not to interfere with the equations numbering sequences, and most importantly, not to interfere with the specific lines of reasoning that each paper was meant to emphasize. This allows all three chapters to remain independent of each other so they can be read in any order without prejudice.

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A very recent positive development occurred regarding the three articles reproduced and completed as Chapters 1, 2 and 3 of this book, which can only accelerate the re-familiarization of the community with Maxwell's original interpretation and thus contribute to the better understanding of physical reality that it seems to favor.

The paper titled "*Electromagnetism according to Maxwell's Initial Interpretation*" reproduced as **Chapter 1** was chosen to be republished as Chapter 4 with a new title, to account for the clearer explanation of the reason why Einstein suspected that gravitation might be related to electromagnetism, in the book titled "*New Insights into Physical Science Vol. 10*", which is part of a collection that pre-selects articles deemed worthy of attention from the global offering, to be put at more immediate disposal of the community.

The paper titled "*The Hydrogen Atom Fundamental Resonance States*" reproduced as **Chapter 2** was chosen to be republished as a chapter of the Book titled "*New Insights into Physical Science Vol. 6*", by "*Book Publisher International*", whose aim is to provide the global academic community with works that its editors deem worth of attention in the global offering. The title of the republished article was changed to "*An Overview of The Hydrogen Atom Fundamental Resonance States*" due to its having been expanded to include some Sections from the articles being reproduced as **Chapter 1** and **Chapter 3** of the present book. These new sections cover the mechanics of photon emission and absorption initially published in Reference [9], object of **Chapter 1**, and the analysis and resolution from the trispatial perspective of the "*absolute motion / relative motion*" conundrum previously published in Reference [15].

Finally, the paper titled "*Gravitation, Quantum Mechanics and the Least Action Electromagnetic Equilibrium States*" reproduced and expanded in **Chapter 3** was chosen to be republished as one of the chapters of the eBook titled "*Prime Archives in Space Research*", by *Vide Leaf Prime Archives*, whose aim is to promote scientific research in the world by making research results considered state-of-the-art available to young researchers to facilitate their application in their research practices.

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10 more articles were published after this second monograph was issued, to complete this documentation project of the electromagnetic mechanics domain. Here are links to them up to its concluding paper published in July of 2024.

Some of them were also republished upon invitation from editors as book chapters in the *Publisher International* book collection. These increased versions are linked instead of the original papers for easier access to these final versions, with the original paper linked in the entry page of these chapters.

2021 - De Broglie's Double-Particle Photon

2021 - On adiabatic processes at the subatomic level

2021 - Last Challenge of Modern Physics: Perspective to concept and model analysis

2021 - Our Electromagnetic Universe

2022 - Demystifying the Lorentz Force Equation

2023 - Electromagnetic and Kinematic Mechanics Synchronized in their Common Vector Field

2023 - Peer-reviwers comments

2024 - Evolution From the Complex Plane to the Quaternion Coordinate System to the Trispatial Geometry

2024 - Critical Analysis of the Origins of Heisenberg's Uncertainty Principle

2024 - From $E=m_0c^2$ in normal space to $E=m_0c_Ic_K$ in the complex configuration Spaces

Here are links to the **15** papers that were integrated in the first monograph:

2007 - Field Equations for Localized Individual Photons and Relativistic Field Equations for Localized Moving Massive Particles

2013 - From Classical to Relativistic Mechanics via Maxwell

2013 - Unifying all Classical Force Equations

2013 - Expanded Maxwellian Geometry of Space Geometry and the Photon Fundamental LC Equation

2013 - The Mechanics of Electron-Positron Pairs Creation in the 3-Spaces Model

2013 - The Mechanics of Neutron and Proton Creation in the 3-Spaces Model

2013 - The Mechanics of Neutrinos Creation in the 3-Spaces Model

2013 - Deriving ε_o and μ_o from First Principles

2013 - On the Einstein-de Haas and Barnett Effects

2013 - On the Electron Magnetic Moment Anomaly

2013 - Proposal of an invariant mass reference for the kilogram

2013 - The Corona Effect

2013 - Inside Planets and Stars Masses

2013 - On the Magnetostatic Inverse Cube Law and Magnetic Monopoles

2016 - The Birth of the Universe and the Time Dimension

And finally the **3** papers integrated in this second monotraph:

2020 - Gravitation, Quantum Mechanics and the Least Action Electromagnetic Equilibrium States

2020 - Overview of the Hydrogen Atom Resonance States

2020 - Emphasizing Electromagnetism according to Maxwell's Initial Interpretation

For a grand total of **28** papers published in the project, of which **9** were republished in final versions upon invitation as chapters in specialized book collections.

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Appendix A

A.1. Derivation of the Relativistic Energy-Momentum Equation

Reference [17] mentions on page 835 that combining equations $E=\gamma m_o c^2$ and $p=\gamma m_o v$ should generate the complete relativistic energy-momentum Equation (2.41), but it does not offer the detailed derivation of this equation: $E^2=(pc)^2+(mc^2)^2$.

So, here is for convenience the complete step by step derivation of this famous equation:

$$E = \gamma m_0 c^2 \qquad p = \gamma m_0 v \tag{A.0}$$

$$\frac{E}{m_0 c^2} = \frac{1}{\sqrt{1-v^2/c^2}} \qquad \frac{p}{m_0 v} = \frac{1}{\sqrt{1-v^2/c^2}}$$

$$\left(\frac{E}{m_0 c^2}\right)^2 = \frac{1}{\sqrt{1-v^2/c^2}} \qquad \left(\frac{p}{m_0 v}\right)^2 \frac{v^2}{c^2} = \frac{v^2/c^2}{\sqrt{1-v^2/c^2}}$$

$$\frac{E^2}{m_0{}^2 c^4} = \frac{1}{\sqrt{1-v^2/c^2}} \tag{A.1} \qquad \frac{p^2}{m_0{}^2 c^2} = \frac{v^2/c^2}{\sqrt{1-v^2/c^2}} \tag{A.2}$$

Subtracting term for term momentum Equation (A.2) from mass Equation (A.1), we obtain:

$$\frac{E^2}{m_0{}^2 c^4} - \frac{p^2}{m_0{}^2 c^2}\frac{c^2}{c^2} = \frac{1}{\sqrt{1-v^2/c^2}} - \frac{v^2/c^2}{\sqrt{1-v^2/c^2}} \tag{A.3}$$

$$\frac{E^2}{m_0{}^2 c^4} - \frac{p^2 c^2}{m_0{}^2 c^4} = \frac{1}{\sqrt{1-v^2/c^2}} - \frac{v^2/c^2}{\sqrt{1-v^2/c^2}}$$

$$\frac{E^2 - p^2 c^2}{m_0{}^2 c^4} = \frac{1\text{-}v^2/c^2}{1\text{-}v^2/c^2} = \frac{\gamma}{\gamma} \tag{A.4}$$

$$\frac{E^2 - p^2 c^2}{m_0{}^2 c^4} = \frac{\gamma^2}{\gamma^2}$$

$$\gamma^2\left(E^2 - p^2 c^2\right) = \gamma^2 m_0{}^2 c^4$$

$$\gamma^2 E^2 - \gamma^2 p^2 c^2 = \left(mc^2\right)^2 \quad \text{where } \gamma m_o = m$$

$$\gamma^2 E^2 = \left(pc\right)^2 + \left(mc^2\right)^2 \quad \text{where } p = \gamma m_o v = mv \tag{A.5}$$

And finally $E=\gamma E$ and we obtain Equation (2.41):

$$E^2 = \left(pc\right)^2 + \left(mc^2\right)^2 \tag{2.41}$$

Considering step (A.4) during the derivation sequence, there is a strong temptation to simplify both occurrences of the γ Lorentz factor to 1 before proceeding, but this leads to the often encountered and erroneous non-relativistic version $E^2=(pc)^2+(m_o c^2)^2$, which is frequently given as being the ultimate representation of the Special Relativity theory, but which is indeed simply Newtonian, since such a simplification to 1 has for consequence that all occurrences of the γ factor disappear from the equation. Consequently, only the classical value of the ΔK momentum energy is then provided to the rest mass of the particle in motion, on top of leaving out the $\Delta m_m c^2$ magnetic energy component of the carrying energy that electromagnetically oscillates transversely and provides the velocity related relativistic mass increment which is transversely measurable.

The proper procedure is then to square the mutually reducible γ factor occurrences, so they can be reunited with the two occurrences of m_o as the development proceeds.

At face value, fusing the last occurrence of the squared γ factor with the squared energy (γ^2E^2) may seem to be problematic, but considering that this factor is a dimensionless quantity (See Section 3.5), it can be multiplied with the *energy* component without any adverse effect for the integrity of the equation and simply increases the total energy amount on the left side of the equation to the same relativistic value that it now has on the right side.

A note of caution must also be aired regarding the mathematically unsound and deeply anchored urban legend in the physics community that it suffices to set m to zero in the $(mc^2)^2$ term of Equation (2.41) to reduce the equation to $E=pc$, that would then supposedly provide the energy of a free moving photon.

This is ignoring the basic mathematical rule that if an element of an equation is set to zero in one of its terms, it has to also be set to zero in all other terms, including in term $(pc)^2$ in the present case, since steps (A.0) and (A.4) reveal that the momentum p symbol can only be defined in context as being equal to mv in the energy-momentum equation, and cannot be made equal to $\lambda v/c$ according to any logical derivation.

Moreover, the analysis carried out in this work reveals that to proceed in this manner is doubly erroneous because $p=mv$ provides only half the energy of the massive particle carrier-photon, that is, only its ΔK momentum energy half-quantum, while $p=\lambda v/c$ provides the total energy of a free moving photon, that is, its ΔK momentum energy half-quantum plus the $\Delta m_m c^2$ energy of its transversely oscillating electromagnetic half-quantum.

Consequently, proceeding to set m to zero only in the $(mc^2)^2$ mass term of the energy-momentum equation without setting it in context to zero in the $(pc)^2$ momentum term reveals a logical inconsistency tantamount to a level of mathematical illiteracy quite reminiscent of the logical inconsistency observed with defective Equation (7.1.2) found in Reference [7], that apparently drew no attention in the formal physics community, as analyzed in Section 1.7.2.

Mathematics is a language that must be learned to the same level of proficiency as for engineering applicability before fundamental physics issues are studied in depth, otherwise havoc such as that wrought by the Copenhagen interpretation is likely to affect the community again. Indeed, it can be observed that the scientists who most strongly influenced the evolution of theoretical physics, such as Gauss, Maxwell, Minkowski and Poincaré, all were in reality high-level mathematicians who coherently synthesized the equations that were established from confirmed experimental data obtained by hands-on experimentalists.

A.2. The Trispatial Energy-Momentum Equation

It should be noted that the traditional relativistic energy-momentum equation (2.41) is not used anywhere to make any calculations due to its complexity of resolution. The new trispatial energy-momentum Equation (1.50) however:

$$E_e = \Delta K + \Delta m_m c^2 + m_0 c^2 \tag{1.50}$$

is easy to use for any motion related energy calculation, since its two components ΔK and $\Delta m_m c^2$ are always equal by structure, and there is no need to use the γ factor to resolve it.

Contrary to relativistic equation (2.41), m_o appears in only one of its terms. Therefore, in case of Equation (1.50) it is effectively sufficient to set m_o to zero in the term $m_o c^2$ to reduce the equation to $E=\Delta K+\Delta m_m c^2$, which then effectively becomes Equation (2.13) of the particle's carrier-photon, which is also one of the standard equations to calculate the energy of an electromagnetic photon.

$$E = \Delta K + \Delta m_m c^2 \tag{2.13}$$

Knowing then the energy of every term of the equation, whether for Equation (1.50) or Equation (2.13), it becomes easy to calculate the velocity of the particle using one of the two equations (1.33):

$$v = c\frac{\sqrt{\lambda_C\left(4\lambda+\lambda_C\right)}}{\left(2\lambda+\lambda_C\right)} \quad \text{or} \quad v = c\frac{\sqrt{4EK+K^2}}{2E+K} \tag{1.33}$$

See also Section 3.5.1.

A.3. The Equation towards which special relativity, kinematic mechanics, and electromagnetic mechanics seamlessly converge

Paul Marmet rediscovered in 2003 the direct relation that exists between the effective mass increase of the accelerating electron and the simultaneous increase of its magnetic field, as initially discovered by G.F.C. Searle in 1897 from a different perspective.

Marmet's starting point was the Biot-Savart equation:

$$\left(I = \frac{dQ}{dt} = \frac{d(Ne)}{dt} = \frac{d(Ne)v}{dx}\right) \rightarrow d\mathbf{B} = \frac{\mu_0 I}{4\pi r^2}\sin(\theta)\,dx = \frac{\mu_0 v}{4\pi r^2}\sin(\theta)\,d(Ne) \rightarrow \quad \mathrm{B_i} = \frac{\mu_0\, e^- v}{4\pi r^2} \tag{A6}$$

$$\rightarrow M = \left\{\frac{\mu_0 e^2 v^2}{2(4\pi)^2 c^2 r^4}\right\} 2\pi \int_0^{\pi} \sin(\theta)\,d\theta \int_{r_e}^{\infty} r^{-2}\,dr \rightarrow \quad \mathrm{M}_{\substack{\text{Electron}\\ \text{Magnetic}\\ \text{mass}}} = \frac{\mu_0 e^2 v^2}{8\pi r_e c^2} = \frac{m_e}{2}\frac{v^2}{c^2} \rightarrow \mathrm{M}_0 = \frac{\mu_0 e^2}{8\pi r_e} = \frac{m_e}{2} \tag{A7}$$

Leading to

$$\rightarrow \quad \mathrm{M - M_0} = \Delta \mathrm{m_m} \rightarrow \quad \Delta \mathrm{K} = \frac{\left(\mathrm{m_e} + \Delta \mathrm{m_m}\right)\mathrm{v}^2}{2} \rightarrow E_{\substack{\text{Carrier}\\ \text{photon}\\ \text{energy}}} = \Delta \mathrm{K} + \Delta \mathrm{m_m} c^2 \rightarrow \left(\Delta \mathrm{K} = \Delta \mathrm{m_m} c^2\right) \tag{A8}$$

$$\rightarrow \quad \mathbf{E_{Induced} = E_{translational} + E_{magnetic\ mass\ increment}}$$

$$\rightarrow \mathrm{E}_{\substack{\text{Carrier}\\ \text{photon}}} = \frac{hc}{2\lambda} + \left[\mathrm{E}_{\text{elec.}}\cos^2(\omega t) + \mathrm{E}_{\text{mag.}}\sin^2(\omega t)\right] \rightarrow \mathrm{E}_{\substack{\text{Carrier}\\ \text{photon}}} = \frac{hc}{2\lambda} + \left[\frac{e^2}{2C_\lambda}\cos^2(\omega t) + \frac{L_\lambda\, i_\lambda^{\,2}}{2}\sin^2(\omega t)\right] \rightarrow \tag{A9}$$

From which emerged the de Broglie trispatial double-particle photon/carrier-photon fields equation:

$$E\,\vec{I}\,\vec{i} = \left(\frac{hc}{2\lambda}\right)_{\mathrm{X}} \vec{I}\,\vec{i} + \left[2\left(\frac{\varepsilon_0 \mathbf{E}_{2\lambda}^{\,2}}{4}\right)_{\mathrm{Y}} (\vec{J}\,\vec{j}, \vec{J}\,\vec{j}\,)\cos^2(\omega t) + \left(\frac{\mathbf{B}_{2\lambda}^{\,2}}{2\mu_0}\right)_{\mathrm{Z}} \overleftrightarrow{K}\,\sin^2(\omega t)\right] V_{2\lambda} \tag{A10}$$

And the electron rest mass energy trispatial fields equation:

$$m_e c^2 \vec{\mathbf{0}} = \left[\frac{\varepsilon_0 \mathbf{E}_e^{\,2}}{2} V\right]_Y \vec{\mathbf{J}}\,\vec{\mathbf{i}} + \left[2\left(\frac{\varepsilon_0 \boldsymbol{\nu}_e^{\,2}}{4}\right)_X (\vec{\mathbf{I}}\,\vec{\mathbf{j}}, \vec{\mathbf{I}}\,\vec{\mathbf{j}})\cos^2(\omega t) + \left(\frac{\mathbf{B}_e^{\,2}}{2\mu_0}\right)_Z \overleftrightarrow{\mathbf{K}} \sin^2(\omega t)\right] V_e \qquad \text{(A11)}$$

Whose combination explains why the Lorentz gamma factor is not required to calculate the whole range of velocities possible for the electron:

$$V = \frac{\alpha^5 \lambda^3}{2\pi^2}, \quad \mathbf{E} = \frac{\pi e}{\varepsilon_0 \alpha^3 \lambda^2}, \quad \mathbf{B} = \frac{\pi \mu_0 e c}{\alpha^3 \lambda^2} \text{ and } \boldsymbol{\nu} = \frac{\pi e}{\varepsilon_0 \alpha^3 \lambda^2} \qquad \text{(A12)}$$

For energy calculation purposes:

$$\left[\left(\frac{\varepsilon_0 \boldsymbol{\nu}_{\lambda c}^{\,2}}{2}\right)\times 1 + \left(\frac{\mathbf{B}_{\lambda c}^{\,2}}{2\mu_0}\right)\times 0\right] = \left[\left(\frac{\varepsilon_0 \boldsymbol{\nu}_{\lambda c}^{\,2}}{2}\right)\times 0 + \left(\frac{\mathbf{B}_{\lambda c}^{\,2}}{2\mu_0}\right)\times 1\right] \text{ and } \left[\left(\frac{\varepsilon_0 \mathbf{E}_{\lambda}^{\,2}}{2}\right)\times 1 + \left(\frac{\mathbf{B}_{\lambda}^{\,2}}{2\mu_0}\right)\times 0\right] = \left[\left(\frac{\varepsilon_0 \mathbf{E}_{\lambda}^{\,2}}{2}\right)\times 0 + \left(\frac{\mathbf{B}_{\lambda}^{\,2}}{2\mu_0}\right)\times 1\right] \qquad \text{(A13)}$$

	Momentum Kinetic energy in X-Space (normal space)	Energy located in Y and Z configuration spaces making up the inert rest mass of the electron and that of the magnetic mass of its carrier-photon
Rest mass Energy ($m_o c^2$)		$\left[\left(\frac{\varepsilon_0 \mathbf{E}_{\lambda c}^{\,2}}{2}\right)_Y + \left(\frac{\mathbf{B}_{\lambda c}^{\,2}}{2\mu_0}\right)_Z\right] V_{\lambda c}$
Carrier-photon energy $\Delta K + \Delta m_m c^2$	$\left(\frac{hc}{2\lambda}\right)_X$	$\left[\left(\frac{\mathbf{B}_{\lambda}^{\,2}}{2\mu_0}\right)_Z\right] V_{\lambda}$
Total relativistic Mass energy (mc^2)		$\left\{\left[\left(\frac{\varepsilon_0 \mathbf{E}_{\lambda c}^{\,2}}{2}\right)_Y + \left(\frac{\mathbf{B}_{\lambda c}^{\,2}}{2\mu_0}\right)_Z\right] V_{\lambda c} + \left[\left(\frac{\mathbf{B}_{\lambda}^{\,2}}{2\mu_0}\right)_Z\right] V_{\lambda}\right\}$

$$E^2 = (pc)^2 + (mc^2)^2 \quad \Rightarrow \quad E = \sqrt{(pc)^2 + (mc^2)^2} \qquad \text{(A14)}$$

$$E_{Total} = \sqrt{(pc)^2 + (mc^2)^2} = \Delta K + \Delta m_m c^2 + m_0 c^2 = \left(\frac{hc}{2\lambda}\right)_X + \left\{\left[\left(\frac{\mathbf{B}_{\lambda}^{\,2}}{2\mu_0}\right)_Z\right] V_{\lambda} + \left[\left(\frac{\varepsilon_0 \mathbf{E}_{\lambda c}^{\,2}}{2}\right)_Y + \left(\frac{\mathbf{B}_{\lambda c}^{\,2}}{2\mu_0}\right)_Z\right] V_{\lambda c}\right\} \qquad \text{(A15)}$$

The electron carrier-photon is slowed down from its default velocity c by its ΔK momentum energy having to propel the inert electron rest mass on top of propelling its own inert magnetic mass complement.

The only variable in the whole set of electromagnetic mechanics trispatial equations is the photon/carrier-photon wavelength. All other numerical parameters [Equations (A12)] are well established standard physical constants.

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Appendix B

B.1. Maxwell's equations

Maxwell's Equations			
	==========Allowed by Maxwell's initial conclusion==========		
	====Allowed by the Lorenz Gauge interpretation====		
	Atomic, Macroscopic and Astronomical orders of magnitude		Subatomic order of magnitude
	Integral Form	Differential form	First Level Form
1	$\oint \mathbf{E}\cdot d\mathbf{S} = {}^{q}\!/_{\varepsilon_0} = \boldsymbol{\Phi}_{\mathbf{E}}$	$\nabla\cdot\mathbf{E} = \rho/\varepsilon_0$	$\mathbf{E}_{\lambda} = \frac{\pi e}{\varepsilon_0 \alpha^3 \lambda^2}$
2	$\oint \mathbf{E}\cdot d\mathbf{l} = -d\left(\int \mathbf{B}\cdot\hat{n}dS\right)/dt = -d\boldsymbol{\Phi}_{\mathbf{B}}/dt$	$\nabla\times\mathbf{E} = -\partial\mathbf{B}/\partial t$	$\nu = \frac{\mathbf{E}_{\lambda_C}\times\Delta\mathbf{E}_{\lambda}}{\mathbf{B}_{\lambda_C}+\Delta\mathbf{B}_{\lambda}}$
3	$\oint \mathbf{B}\cdot d\mathbf{S} = 0$	$\nabla\cdot\mathbf{B} = 0$	$\mathbf{B}_{\lambda} = \frac{\mu_0 \pi e c}{\alpha^3 \lambda^2}$
4	$\oint \mathbf{B}\cdot d\mathbf{l} = \mu_0\left(\mathbf{i} + \varepsilon_0 d\left(\boldsymbol{\Phi}_{\mathbf{E}}\right)/dt\right)$	$\nabla\times\mathbf{B} = \mu_0\left(\mathbf{J} + \frac{\varepsilon_0\partial\mathbf{E}}{\partial t}\right)$	$c = \frac{\mathbf{E}_{\lambda}}{\mathbf{B}_{\lambda}}$

B.2. Equations for the atomic, macroscopic and astronomical orders of magnitude

The set of equations known as Maxwell's equations were developed in reality by Gauss, Faraday and Ampere from physically carried out experiments. Maxwell's major contribution to science, after analysis of the observed fact that changing magnetic fields induce current in conducting wires, and that reciprocally, as previously discovered by Oersted, that current circulating in a wire induce a magnetic field around the wire, was his intuition that such mutual induction of electric and magnetic fields could occur in space without material supports such as magnets and electric wires.

This led him to relate this hypothesis to the enigma of light propagation, after Faraday informed him, as mentioned at the beginning of Section 1.1, that when he placed a glass plate between the poles of an electromagnet, the magnetic field caused the polarization plane of the light passing through the plate to rotate.

He then drew the conclusion that light had to be actual electromagnetic energy, and since the range of visible light frequencies was rather limited, that is, from about 405 THz for red light to about 790 THz for violet light, that this limited range had to be part of a potentially more complete spectrum with other frequencies, that would be invisible to us this time, and that would extend in both directions, that is, higher than the 790 THz of violet light and shorter than 405 THz for red light

His hypothesis in this regard was first confirmed 20 years later when Hertz confirmed the existence of radio frequencies. The rest is history, and his continuous wave theory of electromagnetic energy has proven completely successful in dealing with electromagnetic energy all the way from the atomic to the astronomical level of magnitude.

Maxwell's first equation is actually Gauss's equation for the electric field, which is a generalization of the Coulomb law, establishing a potential electric interaction field, by removing one charge from the Coulomb equation (See Subsection 1.7.1).

The second equation, derived from Faraday's law of induction means that a variation of a magnetic field is required for an electric field to be produced. In the context of the localized point-like fields of the present model, it can be interpreted without modification as meaning that any variation of the magnetic aspect of an electromagnetic event is mandatorily accompanied by a corresponding inverse variation of its electric aspect.

The third equation corresponds to Gauss's law for magnetism, that defines a potential magnetic interaction field as a counterpart to the potential electric field defined by the first equation, and implies that as much *magnetic* energy flows out of a given volume containing the source of the field as flows in, hence the resulting zero value.

The forth equation, derived from Ampere's law and named the Ampere-Maxwell equation, initially accounting for the observation that a magnetic field is produced by an electric current in a wire, which Maxwell then extended to the conclusion that a magnetic field is also produced by a changing electric field and reciprocally, even without material support, which constitutes Maxwell's greatest discovery.

B.3. Equations for the subatomic order of magnitude

The four first level electromagnetic equations for the subatomic order of magnitude were developed during the first wave of derivations after Paul Marmet's finding, and were published in 2007 in the "*International IFNA-ANS Journal*" at Kazan State University ([30], [8] Chapter 4).

The term "*first level*" refers to the fact that, contrary to Maxwell's equations as traditionally referred to in all reference works, and as presented above, the subatomic level equations are just one step removed from displaying the complete set of constants and variables, that can immediately be used to calculate a physical value, just like the Coulomb Equation (2.19). The analysis of the reason why the elaboration of such first level equations is required for progress to be made in fundamental physics was made in Section 27 of reference [25].

The first level Gauss electric equation was developed as Equation (40) in reference [30]. See Section 2.7 for an example of use:

$$\mathbf{E}_{\lambda} = \frac{\pi e}{\varepsilon_0 \alpha^3 \lambda^2} \tag{B.1}$$

as well as first level Gauss magnetic equation as Equation (34) in the same reference:

$$\mathbf{B}_{\lambda} = \frac{\mu_0 \pi e c}{\alpha^3 \lambda^2} \tag{B.2}$$

The first level electric composite ***E*** field equation required to calculate the velocity of a massive charged particle, which is in fact the completely resolved ***E*** field of the Lorentz equation F=q(***E*** + ***v*** x ***B***) was then resolved as Equation (58) in the same reference, and is here completely developed for convenience:

$$\mathbf{E} = \mathbf{E}_{\lambda_C} \times \Delta\mathbf{E}_{\lambda} = \frac{\pi e}{\varepsilon_0 \alpha^3} \frac{\left(\lambda^2 + \lambda_C{}^2\right)\sqrt{\lambda_C\left(4\lambda + \lambda_C\right)}}{\lambda^2 \lambda_C{}^2 \quad \left(2\lambda + \lambda_C\right)} \tag{B.3}$$

The first level magnetic composite ***B*** field equation required to calculate the velocity of a massive charged particle, which is the completely resolved ***B*** field of the Lorentz equation, was resolved as Equation (49) in the same reference, and is completely developed here for convenience:

$$\mathbf{B} = \mathbf{B}_{\lambda_C} + \Delta\mathbf{B}_{\lambda} = \frac{\pi \mu_0 e c \left(\lambda^2 + \lambda_C{}^2\right)}{\alpha^3 \quad \lambda^2 \lambda_C{}^2} \tag{B.4}$$

Equations (B.3) and (B.4) can then be used directly to calculate the velocity of a charged massive particle with traditional equation ***v=E/B***. Similarly, Equations (B.1) and

(B.2) can be used directly to calculate the velocity of any free moving photon with equation $\boldsymbol{c=E_\lambda/B_\lambda}$.

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Other papers in related projects

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INDEX - General Neurolinguistics – Conceptual Thinking