

# The Ephemeris

Focus and book reviews

## A theorem and proof for the total time derivative of a vector field as seen by a moving point

### The Theorem:

For any well-behaved vector field  $\mathbf{A}$  the time variation as seen by a moving point is given by

$$\frac{d\mathbf{A}}{dt} = \frac{\partial \mathbf{A}}{\partial t} + (\mathbf{v} \cdot \nabla) \mathbf{A} + (\mathbf{v} \cdot \nabla) \mathbf{v} \quad (1)$$

where  $\mathbf{v}$  is the velocity of the moving point.

The first term on the right gives the change due to the  $\mathbf{A}$  field itself. The second term on the right gives the apparent time change of the  $\mathbf{A}$  field at the point due to the motion of the point through a space changing  $\mathbf{A}$  field in the direction  $\mathbf{v}$ , an effect parallel to  $\mathbf{A}$ . The third term on the right gives the apparent time change of the  $\mathbf{A}$  field at the point due to the point changing its direction of motion, thereby producing an apparent rate of change in the direction of the  $\mathbf{A}$  field, an effect perpendicular to  $\mathbf{A}$ .

### The Proof:

Mathematically,

$$\frac{d\mathbf{A}}{dt} = \frac{d}{dt} [A_i(t, \mathbf{r}) \mathbf{e}_i] \quad (2)$$

where  $i = 1, 2$  and  $3$  indicate the three coordinate direction  $x$ ,  $y$  and  $z$ ,  $\mathbf{e}_i$  is a unit vector, and repeated indices are summed. Carrying out the differentiation yields

$$\frac{d\mathbf{A}}{dt} = \frac{\partial \mathbf{A}}{\partial t} + (\mathbf{v} \cdot \nabla) \mathbf{A} + \frac{A_i d\mathbf{e}_i}{dt} \quad (3)$$

The second term on the right,  $(\mathbf{v} \cdot \nabla) \mathbf{A} = (dx_i/dt)(\partial/\partial x_i) \mathbf{A}$ , follows from the fact that for a moving point with velocity  $\mathbf{v}$  the position  $\mathbf{r}$  appears to have the velocity  $\mathbf{v} = d\mathbf{r}/dt$ . The third term on the right follows from the fact that the moving point sees the Cartesian directions  $\mathbf{e}_i$  as changing with time.

Comparing Eqns. (1) and (3) it is now necessary to prove

$$(\mathbf{A} \cdot \nabla) \mathbf{v} = \frac{A_i d\mathbf{e}_i}{dt} \quad (4)$$

Considering the instantaneous circle for the motion of the point of radius  $r$  with coordinates chosen such that it lies in the  $xy$  plane, the unit Cartesian vectors become

$$\begin{aligned} \mathbf{e}_x &= \cos \phi \mathbf{e}_r - \sin \phi \mathbf{e}_\phi, \\ \mathbf{e}_y &= \sin \phi \mathbf{e}_r + \cos \phi \mathbf{e}_\phi, \end{aligned} \quad (5)$$

where  $\mathbf{e}_r$  is a unit vector in the radial direction of the instantaneous circle and  $\mathbf{e}_\phi$  is a unit vector in the increasing  $\phi$  direction. From the point of view of the moving point the velocities of  $\mathbf{e}_x$  and  $\mathbf{e}_y$  are negative and  $\mathbf{e}_r$  and  $\mathbf{e}_\phi$  appear fixed, so from Eqn. (5)

$$\begin{aligned} \frac{d\mathbf{e}_x}{dt} &= -\dot{\phi} (-\sin \phi \mathbf{e}_r - \cos \phi \mathbf{e}_\phi), \\ \frac{d\mathbf{e}_y}{dt} &= -\dot{\phi} (\cos \phi \mathbf{e}_r - \sin \phi \mathbf{e}_\phi). \end{aligned} \quad (6)$$

Substituting Eqns. (6) into the right side of Eqn. (4) yields

$$\frac{A_i d\mathbf{e}_i}{dt} = \dot{\phi} \begin{bmatrix} -(-A_x \sin \phi + A_y \cos \phi) \mathbf{e}_r \\ -(A_x \cos \phi + A_y \sin \phi) \mathbf{e}_\phi \end{bmatrix}. \quad (7)$$

From

$$\begin{aligned} \mathbf{e}_r &= \cos \phi \mathbf{e}_x + \sin \phi \mathbf{e}_y, \\ \mathbf{e}_\phi &= -\sin \phi \mathbf{e}_x + \cos \phi \mathbf{e}_y, \end{aligned} \quad (8)$$

Eqn. (7) becomes

$$\frac{A_i d\mathbf{e}_i}{dt} = \dot{\phi} (-A_y \mathbf{e}_x + A_x \mathbf{e}_y) \quad (9)$$

On the instantaneous circle the point has the velocity

$$\begin{aligned} \mathbf{v} &= \dot{\phi} r \mathbf{e}_\phi = \dot{\phi} r (-\sin \phi \mathbf{e}_x + \cos \phi \mathbf{e}_y) \\ &= \dot{\phi} (-y \mathbf{e}_x + x \mathbf{e}_y). \end{aligned} \quad (10)$$

Substituting Eqn. (10) into the left side of Eqn. (4) yields

$$\begin{aligned} (\mathbf{A} \cdot \nabla) \mathbf{v} &= \left( \frac{A_x \partial}{\partial x} + \frac{A_y \partial}{\partial y} \right) \phi(-y\mathbf{e}_x + x\mathbf{e}_y) \\ &= \dot{\phi}(-A_y\mathbf{e}_x + A_x\mathbf{e}_y). \end{aligned}$$

Since Eqns. (9) and (11) yield the identical result, Eqn. (4) has been proved as well. Hence, the theorem is proved.

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## Book Reviews

***Relativité et Substratum Cosmique by Joseph Levy, 230 pages, July 1996, (E-Mail: josephlevy1@compuserve.com). Éditions Lavoisier, 14 rue de Provigny, 94236 CACHAN Cedex, France (edition@Lavoisier.fr).***

This book can be seen as a critical study of the evolution of ideas in physics, notably in what concerns relativity and its relations with quantum mechanics. It provides a review of very historically important ideas that have influenced the development of the fundamental principles in modern physics. The book relates some of the author's ideas. The original ideas recalled in this book are not given as a doctrine to be followed, but as a basis for investigation for further studies.

The book recalls the theory of Fresnel, the experiments of Bradley, Fizeau (on the velocity of light in a moving medium), Michelson-Morley and Huygens. On the point of view of theoretical explanations, he discusses the reciprocal contraction of Einstein, which appears non-reciprocal for Lorentz and the interpretation related to the apparent and isotropic velocity of light of Einstein. The models of Builder and Prokovnik, Ives and Wentzl are also described.

In chapter three, the problem of Einstein's relativity is specially discussed. For example, the principle of relativity, the transformation of coordinates, the relativity of time and of space, clock synchronization, simultaneity, the twin paradox, the implications of equation  $E = mc^2$  and the incompatibility between Einstein's relativity and quantum mechanics. These theories are compared with many experimental

results like the experiments of Ives and Stillwell, Rossi and Hall (on the lifetime of the muon), the Sadeh, the Alväger, and the Hafele and Keating's experiments.

Some different approaches are discussed giving a transformation of coordinates, which does not involve the constancy of the velocity of light. For example, the author examines the work of Terletskii who uses four hypotheses: The principle of relativity, isotropy of space, uniformity of space and time, and the variation of mass. Some other transformations are also discussed.

The book also presents an interesting bibliography in which many references are accompanied with comments. Finally, the author presents some of his own papers (written in English), showing his own opinion about all these problems. He gives a critical analysis of the assumptions underlying the theories of Lorentz Poincaré and Einstein and brings to the fore the difficulties of these theories. This book can certainly be useful to those who have open minds, and to recall extensive discussions related to numerous theories and many experiments in relativity and in quantum mechanics. It does not give a final solution but it shows the disastrous incompatibility between the currently accepted models in relativity and in quantum mechanics. The book shows clearly that we have not reached the solution yet, and that there is a critical need to do more research looking for a logical solution.

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***Nuclear Transmutation: The Reality of Cold Fusion by Tadahiko Mizuno (English Translator: Jed Rothwell) Infinite Energy Press, Concord, NH. First published in Japanese, 1997, Kogakusha Copyright. English translation 1998, Introduction by Jed Rothwell, Foreword by E. F. Mallove. ISBN 1-892925-00-1, 151 pages, 22 color plates, \$29.95, available from Infinite Energy Press, P.O. Box 2816, Concord, NH 03302-2816, <http://www.infinite-energy.com>.***

Early workers in cold fusion, in attempting to follow the electrolysis recipe of Pons-Fleischmann, seldom bothered to analyze their palladium cathodes after these had or had not produced “excess heat.” This is a pity, because in hindsight it might have cut years off the initial period of stumbling-in-the-dark from which, after a decade, this nascent science has not yet fully emerged. A study of these cathodes, such as the author of this book has made, suggests several observations of critical importance for the future evolution of the electrolytic approach (which is one of several now emerging). For one thing, it seems highly likely that the nuclear processes that are “chemically” stimulated occur very near the surface of the cathode material. For another, it is clear from the variety of transmutations (“alchemy”) taking place in the surface layer that perhaps as much fission as fusion is occurring. Hence some practitioners have suggested renaming the field “chemically assisted nuclear reactions” (CANR)—not that any such ruse will remove the curse under which the Cold Fusion Dutchman flies.

Many other useful hints for routes of progress in this fascinating new science can be gleaned from this brief summary of the author’s experiences and accomplishments. A Ph.D. in applied physics, Mizuno is presently an assistant professor of nuclear engineering at Hokkaido University. His work covers a wide spectrum, from the first Japanese reports of cold fusion neutron measurements ten years ago to more recent studies on transmutation products

and on cold fusion applications of “proton conductors,” whatever they may be. (Despite a splendid and largely successful effort by the author to write for the layman, an occasional technical term slips by without much definition.) His translator justly refers to him as a “one-man R&D consortium.” This is the type of mind, coupled with the patience and endurance of a Marie Curie, that is needed to make worthwhile contributions to what proves to be a uniquely refractory field—one in which science (for lack of theory) must follow technical discovery, not lead it.

We who live in this time and are interested in science are privileged thus to be present at the birth (and perhaps the premature death from starvation) of a truly new science ... just as new as was the science of mechanics in the time of Galileo. A truly new science is something that by definition automatically affronts the science already established. From time immemorial, long before Galileo, the old science has been and remains *academic science*. I am no historian of the subject, but have heard it claimed that the Church was incited to do its notorious hatchet job on Galileo by academic scientists—the same ones who declined to look through his telescope.

Is it not marvelous how through the shuddering millennia academia runs true to form? We who might have a scholarly wish to learn about Galileo’s trials do not have to hunt through archives in the musty attics of Widener, the Library of Congress, or the Bibliothèque Nationale. We can read about them (in the persons of Pons, Fleischmann, Bockris, and other modern martyrs to scientific curiosity) in our daily newspapers and in such widely-distributed books as meet the prerequisite of kicking the struggling new science while it is down. History probably has forgotten the names of the academic “authorities” who ridiculed Galileo, just as it will forget the names of their modern counterparts. But we, you and I, do not have to forget the latter. They have strutted

before us for years now in the media, airing their half-informed pontifications that cold fusion is dead, that it is a scam or fraud, that it is “pathological science,” *etc.* So, we have a leg up on history. We know without the drudgery of historical research the roster of our modern academic “authorities” whose reactions to the threat of a new science (that might stick a pin in their old science) knee-jerked them out of their labs and into the headlines as quick as Bob’s-your-uncle.

These authorities, to be sure, lack a Church Militant to snatch their chestnuts out of the fire for them ... but they possess something better in a Government Flatulent, which makes sure that all federal grants for science go only to the deserving (themselves) and not a taxpayers’ penny to cold fusion researchers, now destitute and mostly buying their instruments out of their own pockets. That fits perfectly the pattern established so long ago. Yet ... try hard to think of any gamble, any risk in the whole prospectus of modern science that, if successful, would provide a more significant benefit for the groaning taxpayers of the world than cold fusion—a comparatively cheap and clean heat source, without limitations of critical mass. Stumped? Me, too.

Our government is too careful with our pennies to part with a single one of them, or even to allow patents, for cold fusion schemes. Are you grateful to have your taxes administered with such rigorous rectitude by bureaucrats humbly eager to take the word of academic know-it-alls? Recollect the behavioral standard set by the intellectual ancestors of those know-it-alls, in declining to look through Galileo’s telescope. For the sake of form, a few of our current crop of academic Authorities did initially snatch a *look* at cold fusion, but then in their rush to judgment almost broke a leg getting out of the lab. If you think real research is done that way, read this book.

And keep in the back of your mind that the US government is a federation of states, many

of which encourage their citizens to gamble in state-run lotteries—justifying such a tax on stupidity as a fiscal mechanism for lets-pretend reduction of other taxes. If the taxpayers were as mindful of their interests as their paternalistic governments claim to be, I suggest they would take their lottery money in wagonloads and gamble it on cold fusion research, leaving the bureaucrats as the only people selfless enough to buy lottery tickets. After all, the lottery payoff is seldom more than a taxable \$100 million in inflated paper money. *The cold fusion payoff is the long-term future of mankind.* The whole theory of taxation as a support for government is that government knows better how to spend your money than you do. In view of the record, how do you feel about that particular theory?

Well, don’t rush to judgment on that one. First, inform yourself. Dip into this little book. It’s an easy read, highly anecdotal, a factual account and a simple testament from the heart. In only one chapter do any equations appear, and they are likely to be mostly familiar to readers with a physics background. The overwhelming impression one gets of the author is that he is a real scientist, behaving as a real scientist must when confronting the challenge of a genuinely new science. As such, he is a model to inspire youth and to sweeten the sour taste left by those latter-day scientific “professions” that flaunt the name of science and cloak their blatant, short-term self-interests in its mantle. He is also a very lucky man, lucky in his department head (another electrochemist), who encouraged him to continue his research when his all-knowing academic colleagues tried to stop him, and lucky in his discoveries. Though modest, these are fundamental to the new CANR science, of which he is one of the outstanding pioneers. To experience such discoveries is a privilege granted to few people. Is his luck our luck? Has he solved the mysteries of “heat after death,” of unlimited controllable power, of something for nothing? Alas, no ... he has not been that lucky, nor has anyone else

...yet. But he is still looking, trying, working, thinking.

CANR science is in its infancy, its Edisonian stage. That comes even before taxonomy. It is the bluebottle stage in which experimentalists buzz about blindly, trying this and that, without the slightest help from theory. Every truly *new* science must pass through this most trying stage and on beyond to where theory can work *with* experiment instead of against it ... but I think none other in history has had to face in its infancy such unanimous and concentrated malevolence of opposition from the very sources (the academic world's "best and brightest") that ought in principle to champion it. As I say, we in our generation happen to be privileged to witness how it is that new science comes to pass. And a frightening thing it is to see, if I may say so. For nowadays it comes to pass through a few individuals climbing with bloody fingernails a wall of man-made opposition and opprobrium that no purveyor of fiction could imagine or dare to hypothesize.

How few those individuals are, how most of them are old now and dying off, with no successors among the self-oriented young, what a parlous near-run thing it will be if humankind actually brings off this deliberately manmade near-impossibility—the frightening sense of all

that is what this book conveys, through its simple narration of fact. Here we see the flip side of Kuhn's aphorism that new ideas prevail through the dying-off of their detractors: New ideas can equally well die through the dying-off of their supporters. And in neither case does the outcome necessarily correlate with either scientific progress or human benefit.

The book made me feel that cold fusion, or some morally equivalent physical phenomenon, is indeed real, as the title claims. And it makes me aware of the unpaid debt all of us already owe to a few hardy individuals with the tenacity, stupidity, self-abnegation, call it what you will, to persevere in this intrinsically difficult research area so blighted in our time by the witch-curse of witless, arrogant, anti-scientific, physics Authority. If there exists somewhere a young physicist who cares no more for his personal well-being than for that of his grandchildren, I hope he will read this book and somehow allow it and his conscience to persuade him to join the "few." His colleagues will make sport of him, his wife will leave him, his government will unfund him and be praiseworthy if it doesn't jail him ... but the grandchildren of all of us may thank him.

T. E. Phipps, Jr.



***Extended Electromagnetic Theory-Space-Charge in Vacuo and the Rest Mass of the Photon. By B.Lenert and S.Roy, World Scientific Series in Contemporary Chemical Physics vol 16, 1998.***

Most physicists would assert that all the major problems associated with the effects of electromagnetic radiation can be solved with the application of the classical equations of Maxwell. These include the famous displacement current introduced by Maxwell himself. When applied to propagation *in vacuo* they give rise to the well-known solutions giving propagating transverse (and only transverse) waves. In re-

cent years, however, a number of authors have given serious consideration to modifications and reinterpretations of these classical equations in which longitudinal solutions also arise. These include Evans, Munera and Guzman, Chubykalo and Smirnov-Rueda and the authors of this monograph, Lehnert and Roy.

The approach taken in this book is to modify the classical equations by assuming the existence of a non-zero electrical conductivity for the vacuum. These gives rise to an extra term proportional to  $\partial E/\partial t$  in the wave equation. The physical interpretation of this term leads to a loss (and not "loose" as appears in

this text) of photon energy as it propagates through the vacuum, *i.e.* it gives rise to “tired light”.

It also gives rise to plane and axisymmetric modes having longitudinal field components and also the conclusion that photons should have a non-zero rest mass. The solutions of their wave equation gives axisymmetric wavepackets some of which give a photon-like particle. The attractive feature of these solutions is that they immediately dispense with wave/particle dualism. The modeled photon embodies simultaneously wave and particle features. Another attractive feature of these models is that the field distributions are continuous over the entire space and no singularities arise. These models yield features which are entirely consistent with the established features of photons, *i.e.* a total electric charge of zero, a total magnetic moment of zero but with a non-zero magnetic field in the vicinity of the photon.

The consequences of these considerations are far-reaching. They include a natural explanation for the Hubble Law without requiring the Big Bang theory. If this is to be accepted then alternate accounts of the cosmic microwave background radiation (CMBR) and its proper-

ties. These difficulties are discussed. In particular, the anisotropy of the CMBR is shown to be consistent with the anisotropy in the velocity of light which arises once a non-zero photon rest mass is considered. One weakness in this book’s treatment of the cosmological implications of non-zero vacuum conductivity and non-zero rest mass for the photon is that the cosmological abundance of elements is known to be completely in agreement with the Big Bang model. The problem of accounting for the cosmological abundance of elements is not discussed at all in this book. It is always possible in this author’s opinion that some of the cosmological red shift could be accounted for on the basis of “tired light”, as advocated by these authors, without having to completely reject Big Bang theory now widely accepted by the astronomical community.

This book is well written and it offers solutions to difficult conceptual problems with the widely accepted view of electromagnetic radiation and the nature of photons which deserve serious attention.

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### **The Bookshelf**

*Instantaneous Action at a Distance in Modern Physics: “Pro” and “Contra”* Edited by Andrew E. Chubykalo (Ed.) (University of Zacatecas, Zacatecas, Mexico), Viv Pope (Swansea, UK) and Roman Smirnov-Rueda (University of North Wales, Bangor, UK) (In Contemporary Fundamental Physics, Valerie V. Dvoeglazov, Editor) 1999, 475 pages. ISBN 1-56072-698-9. \$145.

*Photon and Poincare Group* Valeri Dvoeglazov (Ed.) (University of Zacatecas, Zacatecas, Mexico) (In Contemporary Fundamental Physics, Valeri V. Dvoeglazov, Editor) 1999. 430 pages. ISBN 1-56072-718-7. \$135.

*The Weyl-Dirac Theory and Our Universe*, Mark Israelit (University of Haifa-Oranim, ISRAEL) (In Contemporary Fundamental Physics, Valeri V. Dvoeglazov, Editor) 1999, 165 pages, ISBN 1-56072-690-3. \$115