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Global Journal

of Science Frontier Research : A

Physics and Space Science

DISCOVERING THOUGHTS AND INVENTING FUTURE

Highlights

- Distortion of Einstein's
- Measurements of Zirconium
- Variation Characteristics
- Effect of Solar Radiation

Aurora
above Bear Lake, Alaska

Volume 12 | Issue 8 | Version 1.0

ENG

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Measurements of Zirconium Alloy Oxide Layers

By H. Frank
Czech Technical University

Introduction - This is an overview of results, presented at APCOM workshops since 2001, achieved at systematic measurements on samples of oxide films on tubes of Zr1Nb, ZIRLO and Zry-4W, used for fuel cladding in light water reactors, which had been grown in the Research Institute UJP [1] at VVER conditions in water of 360°C with various times from one day up to 4 years. In a high temperature aqueous environment oxides are formed by diffusion of oxygen ions through the built-up layer, combining with zirconium ionized by electron emission [2]. The corrosion of the zirconium is due to oxide formation by the transfer of electrons from the metal to the water, whereby oxygen ions flow in the opposite direction. Thus the corrosion rate depends largely on the electron motion, which is governed by the conductivity of the oxide layer. The investigation of the electrical properties of the oxide is therefore of interest for the understanding of the corrosion resistance of the Zircaloys. It is well known [2,3,4] that ZrO_2 is predominantly an electronic high-resistivity semiconductor with a low amount of ionic conduction (over room temperature). The band gap is approximately 5 eV, the work function 4.0 eV and the relative permittivity 22.

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MEASUREMENTS OF ZIRCONIUM ALLOY OXIDE LAYERS

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Measurements of Zirconium Alloy Oxide Layers

H. Frank

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II. Experimental

The oxide layers were grown on Zr1Nb, ZIRLO and Zry-4W tubes 30 mm long and of 9 mm outer diameter. Electrodes were either of 200 nm thick vacuum evaporated Au, or painted on of colloidal Ag (Degussa), or of sprayed on colloidal graphite to the specimens wrapped in Al-foil with circular openings of 6,0 mm diameter, and the samples mounted in a mini-thermostat with a maxim. temperature of 220°C. The abraded front ends of the tubes of shining zirconium metal were in direct contact with pressed-on copper electrodes, on which a thermo couple was mounted for temperature control. The current was measured with a two-electrode arrangement using only one contact to each electrode. A stabilized voltage source could be connected with the positive terminal to the zirconium metal contact, while the negative terminal was earthed to the pico-amperemeter common. The input terminal was connected via a contact spring to the sample electrode. The voltage drop of the pico-amperemeter was limited to 10 mV max. and could be neglected for source voltages larger than 2 V.

First the capacity was measured to assess the relative permittivity, then the I-V characteristics were measured, first at room temperature, and then at higher constant temperatures in steps of about 1/10 of the maximum voltage chosen as not to exceed the maximum field strength of $3x10^4$ V/cm.

III. Results

The currents measured ad various voltages, temperatures and times of observation gave data to compute the transport parameters. The electric current measurement was very time consuming.At applying a voltage, the current started at a value limited only by the resistance of the measuring circuit and dropped very slowly, taking minutes up to hours, to

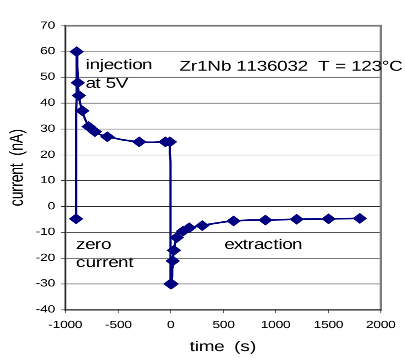

Figure 1 : Time dependence of injection and extraction (starting from zero current).

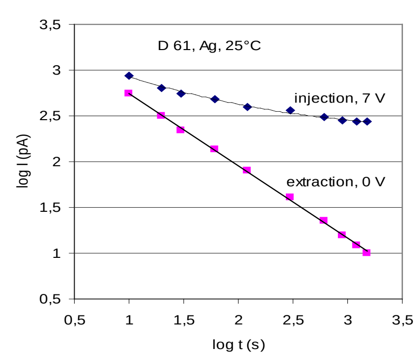

Figure 2 : Injection current + equilibrium at 7V and, lower, the pure extraction current.

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Asymptotically reach equilibrium condition (Fig.1). Readings were taken after equal time intervals, when the change during 1 minute was less then 1% of the final value.

a) I-V characteristics

The I-V characteristics of high-resistivity semiconductors start at low voltages with a linear part obeying Ohm´s law. At application of higher voltages the current rises faster due to the injection of majority

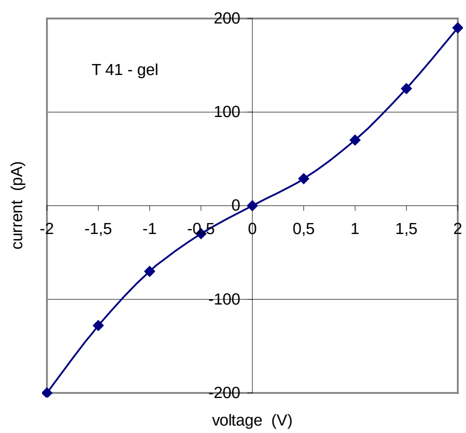

Figure 3 : Typical I-V characteristic, symmetrical.

consequence of temperature-activated liberation of trapped electrons and/or continuing oxidation in air. The space-charge limited current I_{sc}, i.e. the first term in eq. (1), obeys Child´s law [5]

$$I_{sc} = \frac{9}{8}\varepsilon\varepsilon_0 A\mu U^2 / w^3 = \mathrm{aU2} \qquad (2)$$

Where $\varepsilon\varepsilon_0$ is the relative and vacuum permittivity, respectively, A is the contact area, μ is the mobility of the free carriers, U the constant voltage and w the layer thickness.

The transition from the linear to the square part I_{sc} occurs at the characteristic voltage U_{ch}, when the rising space-charge limited current equals the linear ohmic part $I_o = bU$, i.e.

$$AU^2 = bU, \text{ or } U = U_{ch} = b/a \qquad (3)$$

The ohmic current is

$$I_o = U/R = Uen_0\mu w/A \qquad (4)$$

The characteristical voltage U_{ch} , using eqs.(2 and 4), yields

$$U_{ch} = en_0 w^2/\varepsilon\varepsilon_0 \qquad (5)$$

By this expression the concentration n_0 of the free carriers can be obtained,

$$n_0 = U_{ch}\varepsilon\varepsilon_0/ew^2 \qquad (6)$$

carriers building up a space charge, finishing with a space-charge limited additional part. The measured current values can be fitted to a second order polynomial

$$I = aU^2 + bU + c \qquad (1)$$

The zero current expressed by the constant c can be observed above room temperature as a

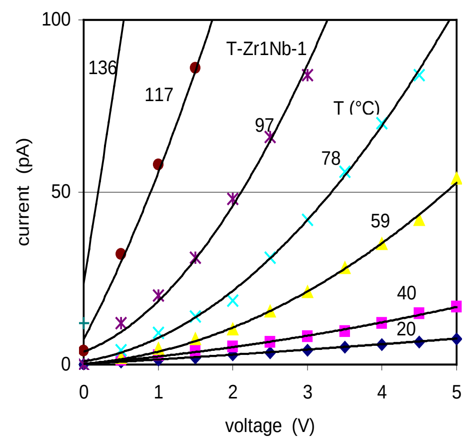

Figure 4 : Temperature dependent I-V *(positive voltage branch only).*

This is a simple way to assess the concentration of the free carriers n_0 which, with knowledge of the resistivity ρ measured in the vicinity of the origin, yields also the mobility μ .

An other way to assess the mobility is using eq.(2) directly.

b) Temperature dependence of the I-V characteristics

A typical example of I-V characteristics measured at rising temperature is in Fig.4.

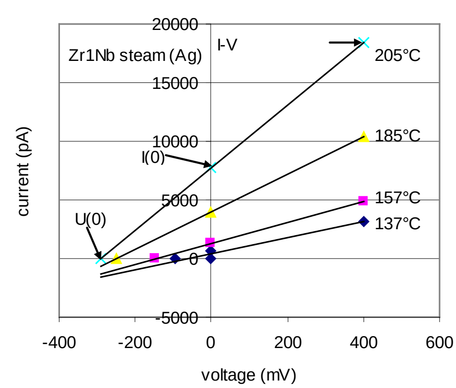

Figure 5 : I-V characteristics at higher temperatures, showing short-circuit current I(0) and open-circuit voltage U(0) at the origin.

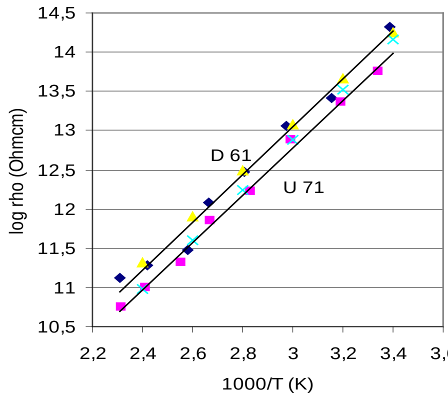

Figure 6 : Temperature dependence of resi-stivity ,with equal activation energy of doped and undoped Zircaloys.

At higher temperatures a zero current appears due to continuing oxidation in air, causing the characteristic not to pass through the origin, but at a negative zero voltage, as can be seen in Fig.5. The short- circuit current rises exponentially, the voltage only in a linear way.

The slope in Fig.5 corresponds to the ohmic term in eq.1 and determines the resistivity ρ of the sample. Plotting $\rho = f(1/T)$, as in Fig.6, gives the activation energy E of the free carriers.

The main result of the analysis of the data of many samples was that the high resistivity of the oxide of the Zircaloys is due to the extremely low mobility of the electrons, of the order of 10^{-9} cm^2/Vs, but their concentration is practically constant and of the order of $10^{14} cm^{-3}$.

c) Injection and extraction of space-charge

At application of voltage the flowing current builds up a space charge, until equilibrium is achieved. By shortening the contacts with the pico-amperemeter, the injected space charge flows out and gives rise to a negative extraction current, which is equal to the former (positive) injection current, see Fig.2, and obeys the power law,

$$I = B\,t^{-n}\ , \qquad (7)$$

With time t and exponent $n < 1$ [5]. The extracted charge Q can be computed by integration of the extraction current shown in Fig.2,

$$=Q \quad \int_{t_1}^{t_2} Bt^{-n}dt = B\left(t_2^{\,1-n} - t_1^{\,1-n}\right)/\left(1-n\right). \qquad (8)$$

It was shown that the charge Q is a linear function of the injection voltage and the slope $dQ/dU = C$ has the dimension of a capacity. The oxide layer behaves like a capacitor, having about tens of $\mu F/cm^{-3}$, which can be charged and discharged.

d) Influence of layer thickness

The thickness of the oxide layer depends on temperature and on oxidation conditions (water, steam, air). Near the metal-oxide interface a tetragonal hypostoichiometric layer of dark color with relatively high conductivity is formed (layer of the first kind) [8], which at thickness over 5 µm gradually transforms into a monoclinic white form (of the second kind) with a low concentration of oxygen vacancies and high resistivity. In Fig 7 the connection between resistivity and oxide layer thickness is shown. There is a pronounced tendency of resistivity, shown here with oxide samples of Zr1Nb of the first kind, to drop with slightly increasing thickness to very low values, with a power law dependence of approximately $\rho \sim w^{-10}$, whereas with increasing thickness of the oxide of the second kind with layer thickness w, the power law is $\rho \sim w^3$. The $\rho = f(w)$ dependence in Fig.7 then could be explained by varying contributions of the black and white oxide type.

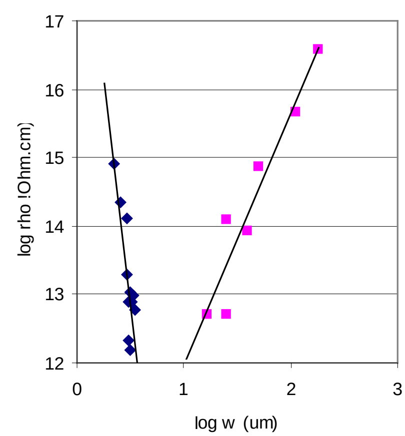

Figure 7 : Dependence of resistivity on layer thickness.

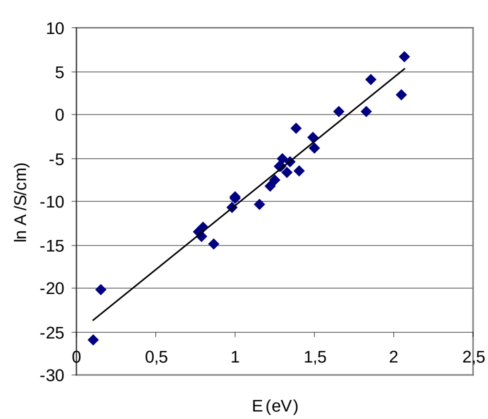

Figure 8 : Meyer –Neldel Rule $lnA = f(E)$.

Since ZrO_2 is a high resistivity oxide semiconductor, it is reasonable that the NMR would apply. Meyer and Neldel [9] found that the experimentally assessed temperature dependent conductivity of high resistivity semiconductors, $\rho = \rho_0 \exp(-E/2kT)$, obeys a simple relationship between activation energy E and the pre-exponential factor ρ_0. In Fig.8 the observed activation energies E for the series of specimens, listed in Fig.7, are plotted in dependence of $ln\, A$, where $A = 1/\rho_0$. Although A spans a wide range of 12 orders of magnitude, the experimental values of E follow a straight line with a slope of 14.9±0.04 with $T_0 = 388\ K$ and the isokinetic energy $E_0 = kT_0 = 33\ meV$. The importance of the MNR consists of the fact that different electrode metals, giving different values of activation energy and resistivity, will nevertheless have points lying on the same straight line with common isokinetic energy. The activation energy E is not a material constant, but is determined by the energy difference between the lattice defects and the lower edge of the conduction band.

IV. Conclusions

It has been demonstrated that the I-V characteristics consist of a linear part near the origin, followed by a quadratic space-charge limited current obeying Child´s law and a constant part. The injected charge can be again extracted as short-circuit current.The I-V characteristics, measured at different temperatures with their activation energy confirm the MNR.

The oxide films are not homogeneous, but consist of a substoichiometrcblack oxide layer of relatively high conductivity near the metal-oxide interface, and of an almost stoichiometric white layer of high resistivity [8]. Competition of both layer types produces a conductivity maximum for layers about 5 μm thick. Fully oxidized white layers are of monoclinic structure, whereas substoichiometric black layers with oxygen deficiency can have a tetragonal structure. Moreover, part of the layer near the surface can be porous so that applied electrode metal could enter the pores and alter the effective thickness of the layers, giving rise to erroneous measurement results.

From all carried-out measurements it follows that Zirconium oxide fits into the group of oxide semiconductors, where the (low) conductivity is provoked by stoichiometric deviations and not by doping. ZrO_2 is an n-type reduction semiconductor, conduction depending on missing oxygen, with a small part ionic current at higher temperatures due to continuing oxidation.

V. Acknowledgement

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Variation Characteristics of Photosynthetically Active Radition (PAR) Over Ilorin in the Tropics

By Ibrahim B.B & Usman. A
Kwara State Polytechnics, Ilorin

Abstract - The annual variation of photosynthetically active radiation (PAR) measured over five (5) years period (2005- 2010) at Ilorin (8^0 32'N, 4^0 34'E) was studied. The average daily and weekly PAR were obtained and plotted. The behavior of average daily PAR is similar to that obtained for the weekly average. There is a daily and weekly fluctuation in PAR throughout the year. The highest value of PAR is 33.96MJ/m^2/day which occurred during the Harmattan period and minimum during the rain period with a value of 22.816MJ/m^2/day. The average PAR for the Harmattan and Rain period is found to be 37.585 and 29.125MJ/m^2/day respectively, while the average annual PAR is 30.050MJ/m^2/day. When PAR is plotted against days of the year, the plot is described by a logarithm fit as $y= -1.39\ln(x) + 39.91$ with a weak correlation $R^2 = 0.387$. Also, when PAR is plotted against weeks of the year, the plot is best described by a logarithm fit as $y= -1.56\ln(x) + 34.74$ with correlation $R^2 = 0.524$.

Keywords : *photosynthetically active radiation, solar radiation, pyranometer.*

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VARIATION CHARACTERISTICS OF PHOTOSYNTHETICALLY ACTIVE RADITION PAR OVER ILORIN IN THE TROPICS

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I. Introduction

The quantitative and qualitative study of the solar radiation that reaches the earth's surface is of great importance for a vast range of human activities, linked to agriculture, forests, biology, animal husbandry, architecture engineering, industry and many others. Use of solar radiation in the establishment of the agricultural potential of a region has been highlighted by many researchers related to photosynthesis, evapotranspiration, water use efficiency, growth and crop productivity, in environmental controlled experiments in crop yield models, as well as climatic changes studies. (Leonordo et al, 2004)

The important of sunlight in vegetation is shown in photosynthesis process where carbondioxide and water in the presence of sunlight are synthesized to form carbonhydrate. The quantity of radiation available affects the climate of the region. The sunlight distribution, quantity of rainfall and temperature available also affects the agriculture of the sub-region such as the tropics (Owonubi, 1998). The equation for the photosynthesis process is

$$6CO_{2(liquid)} + 12H_2O_{liquid} + photon \rightarrow C_6H_{12}O_{6(aqeous)} + 6O_{2(gas)} + 6H_2O_{(liquid)}$$

The photon in the above equation is referred to as photosynthetically active radiation (PAR). PAR is often regarded as the spectral range of global radiation at wavebands spanning from approximately 0.4μm (400nm) through 0.7μm (700nm) which can be absorbed by photosynthesis system of plants (McCree, 1972; Alados & Alados-Arboledes, 1999; Jacovides et al, 2004). This portion of solar radiation spectrum is extremely important, because it is the solar energy source for vegetative photosynthesis to provide us with products such as food and fibre sources, biofuel carriers and additional material sources that support industrial process (Mariscal et al, 2000; Walker,2005; Myers,20005). It also plays very important roles in plant growth, and it is the principal factor in the rate of solar energy conversion into biological mediated energy. Therefore, it is a requirement parameter that must be studied to predict the production of plant products and biomass (Goudriaan & Vaa Laar, 1994; Asner & Wessman, 1999; and Mariscal et al, 2000).

Previous studies have shown that various aspect of PAR exhibit seasonal trends. For example, PAR flux density (PFD) was found to be much lower during the cool dry seasons and highest at hot dry season. Additionally, its daily changes significantly during warm wet seasons and but less during hot dry seasons (Finch et al, 2004). It was further found that daily and seasonal patterns of PAR are dependent on local climate conditions such as sky brightness, air clearness, solar elevation (Jacovides et al, 2004) and dewpoint temperature (Alados et al, 1996). PAR was also found to vary with time scale (Udo & Aro, 1999) and geographical region of assessment (Stigler & Musabilha, 1982; Udo & Aro, 1999), which makes local evaluation important for many applications.

Based on the importance of this parameter, it is therefore intended in this work to examine the annual and weekly variation of photosynthetically active radiation measured over five (5) years period (2005-

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2010). This is to specifically determine the effect of variation on the environment.

II. Material and Methods

The main data used for this study is the photosynthetically active radiation. It is being measured on a continuous basis at Ilorin using Eppley Precision Spectral Pyranometer (PSP) (SN1765F36) and calibration constant of 8 28 10^{-6} V/Wm^{-2}. The PSP has well documented calibration history and its calibration is redone every two years. Flux data generated are in Watts per meter squared (WM-2). Sampling rate of 1-second with integration time of 1-minute is maintained in compliance with the WRR (World Radiometric Reference) requirement. Linear regression is also done between calibration constant and data, and the useful constant obtained for calibration.

The equipment was set-up on the roof of a one-storey building (about 11m above the ground level) in the University of Ilorin, Ilorin, Nigeria. The sensor rod is about $1\frac{1}{2}$ m above the storey level surface. The data generated from this equipment are stored in CR10 Data-Logger before transfer to dedicated computer memory through an RS232 interface and thereafter archived.

Because the sample points were large, about One thousand, four hundred and forty values for each day. By this, the average daily and weekly data generated was found to give new data points that were closer to each other and with more discernible trend. Hence, the daily and weekly means of the measurements, over the five years is considered to be a good representative of the annual behavior.

III. Results and Discussion

The daily/weekly average profile of the PAR over the five years is drawn in fig 1&2. The onset of Harmattan came in about the beginning of November (Day 305)(week 44) and PAR was essentially constant until the middle of January (Day 19)(week 2) of the following year.

Then, after a minor dip in PAR about the middle of January, it rose to a local peak value about the end of January (Day 22)(week 4). This is followed by an approach to another minimum about the end of February and beginning of March (Day 57-61)(week 8-9). A new maximum was attained about the middle of April (Day105)(week15). This peak dropped to a low value after the middle of May (Day 136)(week19), but the drop may be due to increasing cloud and rain activities. These may reduce radiation in this wavelength range by absorption or scattering. The vegetation commences its green lush about late April (Day 113)(week 16) and the beginning of August (Day211)(week36). This is the period when PAR has its minimum value of 22.816MJ/m^2/day (Day151) (week 22).

Thereafter, there is a gentle increase until the end of October (Day 302) (week 45) and beginning of November (Day 306) (week 44) when Harmattan sets in again. It can be seen that despite the rains that commenced about May-June and became heavy in August and September, PAR continued to rise steadily. It could imply that Harmattan dust scatter more PAR to the ground than rain. It could also be attributed to clear air, cloud disappearing and hence higher penetrating of PAR during the period.

The highest value of PAR is 33.96MJ/m^2/day which occurred in early January (Day 6) (week 1). The average PAR for Harmattan Rain is found to be 37.585 and 29.125MJ/m^2/day respectively, while the average annual PAR is 30.050MJ/m^2/day. When PAR is plotted against days of the year, the plot is described by a logarithm fit as

$y = -1.39\ln(x) + 36.91$ with a weak correlation $R^2 = 0.387$. Also, when PAR is plotted against weeks of the year, the plot is best described by a logarithm fit as $y = -1.56\ln(x) + 34.74$ with correlation $R^2 = 0.524$.

IV. Conclusion

The period when PAR has its minimum value falls within the rain period while the period with its maximum value falls within the Harmattan period. Also, the average PAR for the Harmattan period is higher than the average annual value while the average PAR for the rain period is lower than the annual average. The period of minimum value of PAR is when plant green leaves are lush while the period of maximum value of PAR is when Harmattan dust arrives, leaves becomes dry. This implies that, it is not the amount of PAR that is most important for photosynthesis process to occur but it requires a significant amount of moisture.

V. Acknowledgement

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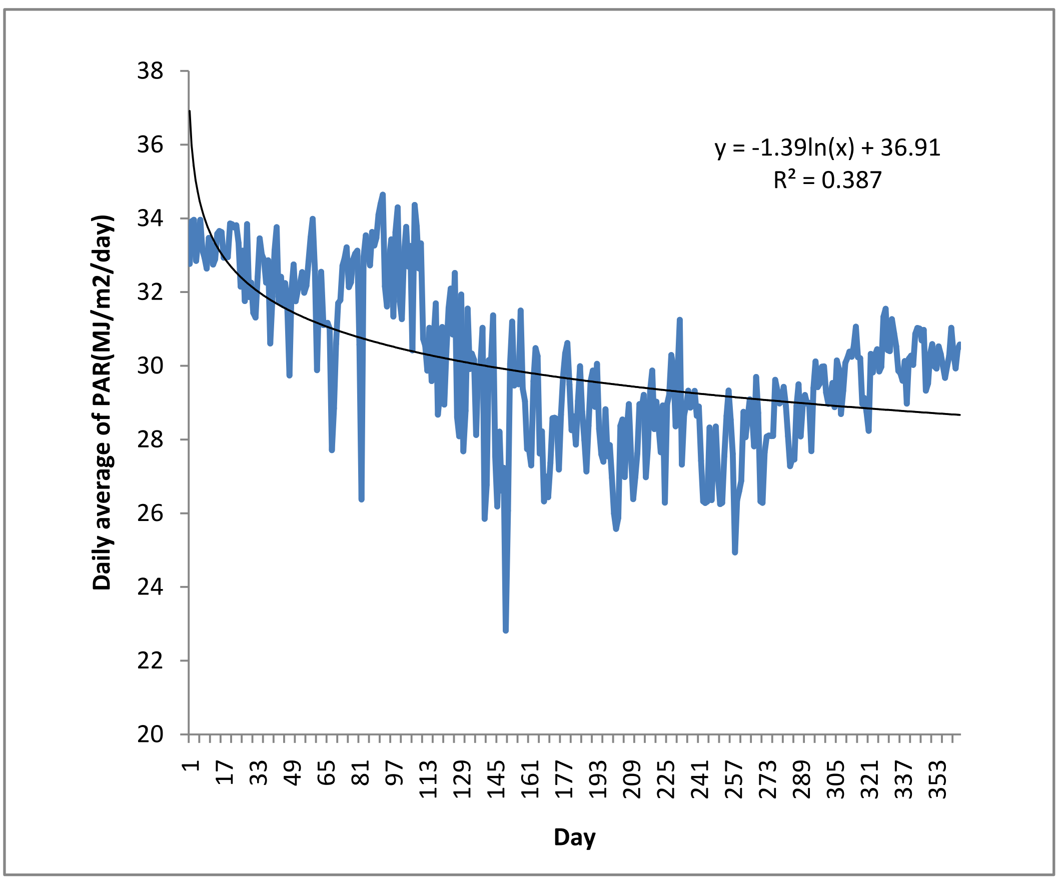

Figure 1 : Annual Daily Variation of Photosynthetically Active Radiation for the Five Years Period (2005-2010).

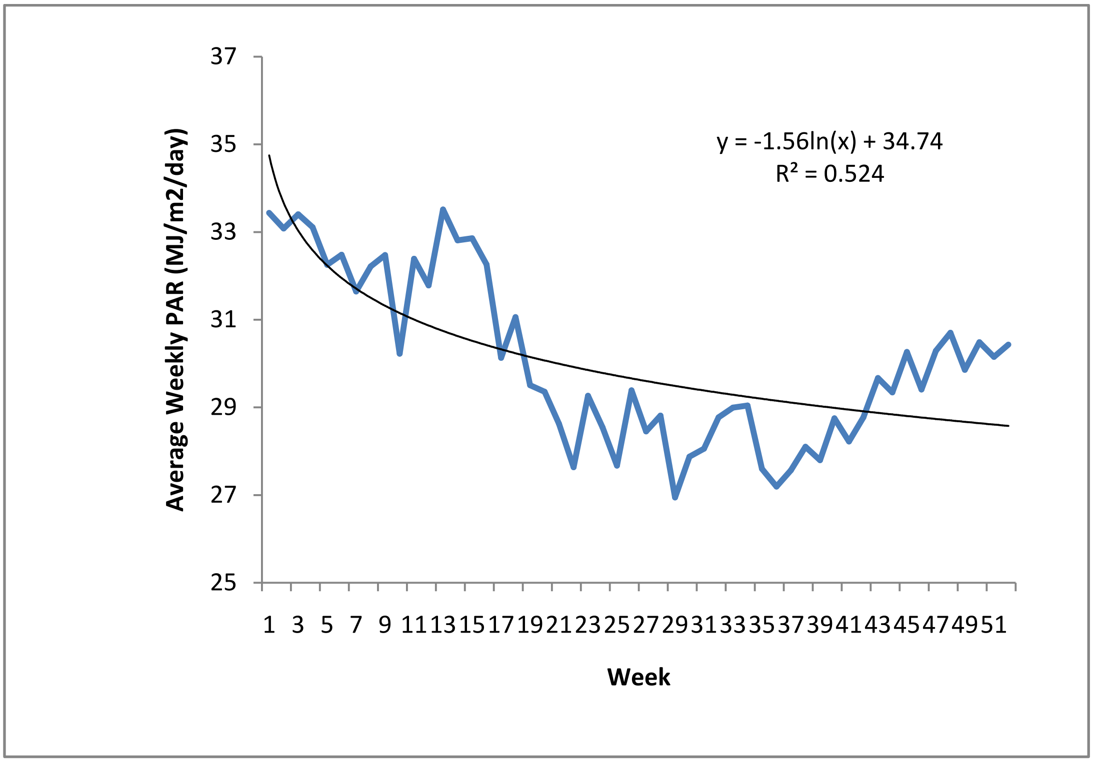

Figure 2 : Annual Weekly Variation of Photosynthetically Active Radiation for the Five Years Period (2005-2010).

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Local Lorentz Invariance and the Distortion of Einstein's Equivalence Principle

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Abstract - The local Lorentz symmetry says that the laws of physics are the same for all local inertial observers moving through space, regardless of their velocity and orientation. However, this notion of symmetry actually comes from the distortion of Einstein's equivalence principle by the Wheeler School because they do not understand the essence of its physics and its mathematical foundation adequately. To clarify this, Einstein's equivalence principle, quoted from Eins-tein, is compared with related theorems. A crucial point is that the Einstein-Minkowski condition is satisfied naturally as part of the physical process. It is pointed out also that Einstein's equivalence principle is supported by experiments. It is shown: 1) based on general relativity, a violation of the local Lorentz invariance is generally expected; 2) the interpreta-tion of Misner, Thorne, & Wheeler, in fact, disagrees with Einstein's equivalence principle; 3) mathematical analysis shows that their interpretation is a misleading distortion since it is valid only for the case of special relativity.

Keywords : lorentz symmetry; einstein's equivalence principle; pauli's version; wheeler's distortion; mathematical analysis; finite open covering theorem. 04.20.-q, 04.20.Cv.

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"Science sets itself apart from other paths to truth by recognizing that even its greatest practitioners sometimes err. …"

-- S. Weinberg, Physics Today, November 2005.

I. Introduction

Over the last decade, experiments [1, 2] on the violations of local Lorentz symmetry were conducted. It was specu-lated that the coefficients, which control the degree of Lorentz violation for a given type of particle or field, vanish when Lorentz symmetry holds exactly [3]. In essence, this symmetry says that the laws of physics are the same as required by special relativity for all (local) inertial observers moving through space, regardless of their velocity and orientation.

Many regard a violation of the local Lorentz symmetry as a violation of general relativity. However, this notion ac-tually comes from a distortion of Einstein's equivalence principle by Misner, Thorne, & Wheeler [4] as follows:

"In any and every local Lorentz frame, anywhere and anytime in the universe, all the (non-gravitational) laws of physics must take on their familiar special-relativistic form. Equivalently, there is no way, by experiments confined to infinitestimally small regions of space-time, to distinguish one local Lorentz frame in one region of space-time frame from any other local Lorentz frame in the same or any other region."

They claimed the above as Einstein's equivalence principle in its strongest form [4]. However, one should not take their view seriously since they even obtained, in their eq. (40.14), an incorrect local time of a particle at free fall. [1)]

Moreover, in their book "Gravitation" [4], there is no reference to Einstein's equivalence principle and the re-lated Einstein-Minkowski condition that are stated in his 1916 paper [5] or his subsequent well-known book [6]. In stead, they refer to Einstein's 1911 assumption [7] of equivalence between acceleration and Newtonian gravity and Pauli's version [8] that Einstein pointed out as a misinterpretation [9]. While many admire Einstein's intelligence, it is amazing that they were convinced that the 1916 Einstein's equivalence principle that Einstein insists as crucial were the same 1911 assumption of equivalence that has been proven invalid by the light bending experiments.

Like Pauli, they also did not refer to the related mathematical theorems [10]. Pauli's version [8] is as follows:

"For every infinitely small world region (i.e. a world region which is so small that the space- and time-variation of gravity can be neglected in it) there always exists a coordinate system K_0 (X_1, X_2, X_3, X_4) in which gravitation has no influence either in the motion of particles or any physical process."

Thus, Pauli initiated that, for any given point P, there is a small neighborhood of local Minkowski space. Apparently, Pauli did not see that the removal of gravity in a small region is different from a removal of gravity at one point, but Einstein does. In fact, Einstein [5] remarked, "For it is clear that, e.g., the gravitational field generated by a material point in its environment certainly cannot be 'transformed away' by any choice of the system of coordinates…"

Naturally, one may ask the following questions:

1) Does the interpretation of Misner et al. [4] agree with Einstein's equivalence principle?
2) If they do not agree, would their interpretation be valid in physics?
3) Is a violation of the local Lorentz invariance also a violation of general relativity?

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In this paper, we shall address the above questions with detailed analysis. It will be shown in this paper: 1) the in-terpretation of Misner et al. also does not agree with Einstein's equivalence principle; 2) mathematical analysis shows that the interpretation of Misner et al. is not valid in mathematics and physics; 3) based on general relativity and mathematics, a violation of the Lorentz invariance is generally expected (see Section 2).

General relativity is commonly considered as difficult to be understood because its theory of measurement is incompatible with the rest of physics. However, few recognize that Einstein's general relativity is not self-consistent yet. Moreover, the errors are often inextricably related; and thus to see an error, one must be able to trace the related errors. For instance, Gullstrand [11, 12] suspected that there is no dynamic solution and this is confirmed in 1995 [13-15]. For this, one must understand that the linearization of Einstein equation is invalid for the dynamic case since a dynamic solution of the linearized equation is not an approximation for a solution of the non-linear Einstein equation [15]. Before this, one must see that a field equation may not satisfy a physical requirement [13] and etc.

Nevertheless, to counter Gullstrand, in 1993 Princeton University published a book [16] by Christodoulou & Klai-nerman. They claimed that bounded *dynamic* solutions have been constructed, but actually have not shown that their initial dynamic set is non-empty [17-19]. Similarly, Misner et al. [4] invalidly claimed that their eq. (35.31) has a bounded plane-wave solution [20]; and Wald [21] invalidly claimed that his eq. (4.4.52) has a solution for the second order [22]. Wald [21; p. 183] also incorrectly extended the process of perturbation approximation to the case that the initial metric is not flat. These show that a biased belief can absurdly lead to collective mistakes in mathematics.

In current theory of general relativity, there are three kinds of errors: 1) errors that are related to misinterpretations of Einstein's equivalence principle [23]; 2) some physical principles that Einstein has implicitly used, but other theorists mis-interpreted or even ignored; 3) errors that can be traced back to earlier misunderstandings in physics and mathematics [13, 14]. They are the obstacles for the theoretical progress, and thus must be clearly rectified.

Many of these problems have been solved recently. For instance, the speculation of $E = mc^2$ being unconditionally true, has been proved as invalid for electromagnetic energy theoretically; and recently it has been directly verified by experiments that are not sensitive to the accuracy of electromagnetism [13, 14]. The non-existence of a dynamic solution is a problem discovered by Gullstrand [11, 12]. The principle of causality was implicitly used for symmetry consideration by Einstein [5, 6]; and it also is the underlying reason for Einstein's requirement for weak gravity [24].2) However, theorists such as Penrose [25] simply ignored it. Due to inadequate understanding of the principle of causality, some theorists accept solutions that violate Einstein's requirement for weak gravity [25, 26]. These problems are often due to, as shown by't Hooft [20, 27, 28], a failure in distinguishing between mathematics and physics. Einstein's theory of measurements, which Whitehead [29] pointed out as invalid, has been rectified as just what Einstein has practiced in calculations [5, 6].

However, errors of the first kind are essentially mathematical problems and are easier to be rectified. On the other hand, they are popular due to common inadequacy in pure mathematics among physicists. Eric J. Weinberg,3) the editor of the Physical Review D, insisted [30] that there is no difference in physics between Pauli's version and Einstein's. Moreover, John L. Friedman, Divisional Associate Editor of Phys. Rev. Lett., [30] advocated that the existence of local Minkowski space has replaced the equivalence principle that initially motivated it. A. Ashtekar, editor-in-chief of Gen. Rel. Grav., claims the Wheeler School as "well-established in science" (March 8, 2012).4) C. M. Will, editor-in-chief of Class. & Quant. Grav., has a Ph. D. (1971) from Caltech under Kip Thorne.5) Thus, to help such a majority, further de-tailed analysis would be needed. Now, let us address what is Einstein's equivalence principle [5, 6].

II. Validity of Einstein's Equivalence Principle and its Misrepresentations

Although most theorists agree with Einstein [5, 6] that his equivalence principle is the foundation, there is no book or reference, other than Einstein's own work, that can state and explain his principle correctly. In fact, many often con-fused the 1916 principle with Einstein's 1911 assumption of equivalence [7]. Another source of confusion is that many theorists have mistaken Pauli's invalid version [8] as Einstein's equivalence principle [4, 31].

In the book "Gravitation" [4], there is no reference to Einstein's equivalence principle (i. e. [5] and [6]). Instead, it misleadingly refers to Einstein's invalid 1911 assumption [7] and Pauli's invalid version [8]. Thus, due to their influence, Einstein's equivalence principle was often mistakenly regarded the same as the 1911 assumption.6) Moreover, many simply cannot tell the difference between the principle of 1916 and the assumption of 1911 [30-32]. 7)

Einstein's equivalence principle [5, 6] leads to the Einstein-Minkowski condition, on which the time dilation and space contractions are based. On his equivalence principle, Einstein [6] wrote:

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'Let now K be an inertial system. Masses which are sufficiently far from each other and from other bodies are then, with respect to K, free from acceleration. We shall also refer these masses to a system of co-ordinates K', uniformly accelerated with respect to K. Relatively to K' all the masses have equal and parallel accelerations; with respect to K' they behave just as if a gravitational field were present and K' were unaccelerated. Overlook-ing for the present the question as to the "cause" of such a gravitational field, which will occupy us later, there is nothing to prevent our conceiving this gravitational field as real, that is, the conception that K'; is "at rest" and a gravitational field is present we may consider as equivalent to the conception that only K is an "allowable" sys-tem of co-ordinates and no gravitational field is present. The assumption of the complete physical equivalence of the systems of coordinates, K and K', we call the "principle of equivalence;" this principle is evidently intimately connected with the law of the equality between the inert and the gravitational mass, and signifies an extension of the principle of relativity to coordinate systems which are non-uniform motion relatively to each other.'

Later, Einstein made clear that a gravitational field is generated from a space-time metric. What is new in Einstein's equivalence principle in 1916 is the claim of the Einstein-Minkowski condition as a consequence for gravity.

Moreover, the Einstein-Minkowski condition has its foundation from mathematical theorems [10] as follows:

Theorem 1. Given any point P in any Lorentz manifold (whose metric signature is the same as a Minkowski space) there always exist coordinate systems (x^μ) in which $\partial g_{\mu\nu}/\partial x^\lambda = 0$ at P.

Theorem 2. Given any time-like geodesic curve Γ there always exists a coordinate system (the so-called Fermi coordinates) (x^μ) in which $\partial g_{\mu\nu}/\partial x^\lambda = 0$ along Γ.

In these theorems, the local space of a particle is locally constant, but not necessarily Minkowski. However, after some algebra, a local Minkowski metric exists at any given point and along any time-like geodesic curve Γ.

What Einstein added to the Einstein-Minkowski condition is that such a locally constant metric must be naturally Minkowski [6, 31]. Note that these theorems imply that gravity may not be transformed away in a small region by a coordinate transformation. In fact, Einstein [5; p.144] remarked with a counter example to Pauli's version.[8)]

Misner et al. [4] make essentially the combined errors of Pauli and the 1911 assumption. However, they are not alone in misinterpreting Einstein's equivalence principle. Will [33] claimed "'Equivalence' came from the idea that life in a free falling laboratory was equivalent to life without gravity." The British Encyclopedia also stated Einstein's Equi-valence Principle incorrectly and ignored the Einstein-Minkowski condition [31]. Instead of rectifying their errors, the Royal Society and the Physical Review also supported them!

Thorne [34] even criticized the distortion of his student [33, 35] as if Einstein's as follows:

"In deducing his principle of equivalence, Einstein ignored tidal gravitation forces; he pretended they do not ex-ist. Einstein justified ignoring tidal forces by imagining that you (and your reference frame) are very small."

However, Einstein has already explained these problems in his letter of 12 July 1953 to Rehtz [9] as follows:

"The equivalence principle does not assert that every gravitational field (e.g., the one associated with the Earth) can be produced by acceleration of the coordinate system. It only asserts that the qualities of physical space, as they present themselves from an accelerated coordinate system, represent a special case of the gravitational field."

Moreover, Einstein [6] explained to Laue, "What characterizes the existence of a gravitational field, from the empirical standpoint, is the non-vanishing of the $\Gamma^l{}_{ik}$ (field strength), not the non-vanishing of the R_{iklm}."

Following the misidentification of Fock [36], the Wheeler School [37] later also claimed that Einstein's equivalence principle was invalid. [9)] Although Einstein's equivalence principle was clearly illustrated only recently [13, 14], [10)] the Wheeler School [4] should bear some responsibility of their misinformation on this principle by ignoring both crucial work of Einstein, i. e., references [5] and [6]. However, the fact that Einstein has not given a clear example to illustrate his principle is also partially responsible.

Since Einstein did not provide an explicit example to illustrate the Einstein-Minkowski condition, a careless reader could mistake the 1911 assumption of equivalence as the 1916 equivalence principle. It is not until 2007 that a metric for uniform gravity [31] for a uniform acceleration "a" was published as follows:

$$ds^2 = (c^2 - 2U)\, dt'^2 - (1 - 2U/c^2)^{-1} dx'^2 - (dy'^2 + dz'^2), \quad (1)$$

where

$$U(x', t') = (at)_t^2/2 \quad \text{and} \quad cdt' = cdt - (at/c)dx'[1 - (at/c)^2]^{-1}$$

Here $c^2 > (at)^2$, and "a" is the acceleration of system K'(x' y' z') with respect to K(x, y, z, t) in the x-direction. Metric (1) shows the Einstein-Minkowski condition and thus the time dilation and space contractions clearly. For those Γlik related to accelerations, please see [31]. Moreover, metric (1) is equivalent to the metric

$$ds^2 = (c^2 - a^2t^2)dt^2 - 2at\, dtdx' - dx'^2 - (dy'^2 + dz'^2) \qquad (2)$$

that was derived by Tolman [38], but his earlier form (2) does not show the related Einstein-Minkowski condition clearly. It was a surprise that U is actually time-dependent, and this explains the earlier failures in the derivation of such a metric [39]. Thus, the 1916 principle can be expressed in terms of a metric, and Fock [36] is clearly wrong.

Moreover, Einstein's equivalence principle has been further illustrated by considering a disk K' uniformly rotating w. r. t. an inertial system (x, y, z, t), a metric for the disk of space K' (x', y', z') is derived [23].

According to Landau & Lifshitz [40], the metric is

$$ds^2 = (c^2 - \Omega^2 r^2)\, dt^2 - 2\Omega r^2\, d\phi' dt - dr^2 - r^2\, d\phi'^2 - dz'^2, \qquad (3)$$

Where Ω is an angular velocity relative to an inertial system K (x, y, z, t), z and z' coincide with the rotating axis, and $r^2 = x^2 + y^2 = x'^2 + y'^2$. Metric (3) is equivalent to its canonical form,

$$ds^2 = (c^2 - \Omega^2 r'^2)\, dt'^2 - dr'^2 - (1 - \Omega^2 r'^2/c^2)^{-1} r'^2\, d\phi'^2 - dz^2, \qquad (4a)$$

where

$$cdt' = cdt - (r\Omega/c)\, rd\phi'[1 - (r\Omega/c)^2]^{-1}. \qquad (4b)$$

However, (4b) is not integrable [23] because local time dt' is related to different inertial systems at different r or time t.

The fact that the local time t'is not a global time was a problem that leads to the rejection by the editor of the Royal Society [23]. This rejection is incorrect since validity of metric (4) can be derived theoretically with special rela-tivity. Experimentally, the time dilation from metric (4a) for the local metric, $ds^2 = c^2dT^2 - dX^2 - dY^2 - dz^2$, is

$$dT = [1 - (r\Omega/c)^2]^{1/2}\, dt'. \qquad (4c)$$

From (3'b) the local clock resting at K', if observed from K, would have

$$dt' = dt. \quad \text{and} \quad dT = [1 - (r\Omega/c)^2]^{1/2}\, dt. \qquad (4d)$$

Moreover, as Kundig [41] has shown, the time dilation (3'd) is valid for a local clock fixed at K'. Note also that this gra-vitational effect cannot be eliminated with a linear acceleration; thus the claim of Fock [36] and the Wheeler School [4] on equivalence of gravity and linear acceleration is clearly wrong. Since Einstein's equivalence principle has experimen-tal supports, the 1993 Nobel Committee press release should not frivolously reject this principle implicitly [42].

Moreover, the above analysis clarifies a puzzle why Einstein [5, 6] seemed to be able to derive the time dilation and space contractions of a rotating disk with only special relativity. Now, it is clear that Einstein's derivation is based on invalid applications of special relativity and the results are incorrect. *Note that Einstein also used such invalid claims to justify his adaptation of the notion of distance from a Riemannian space* [5, 6]. Whitehead [29] has pointed out such an adaptation is not valid in physics, but he did not go deep enough to find out what actually went wrong,

III. Implications of Einstein's Equivalence Principle and the Distortions of the Wheeler School

In general relativity, Einstein's equivalence principle actually would imply:

In any and every local Lorentz frame, anywhere and anytime in the universe, all the (non-gravitational) laws of physics must take on approximately their familiar special-relativistic form. Also, there is possibly a way, by experiments to distinguish one local Lorentz frame in one region of space-time frame from any other local Lo-rentz frame in the same or any other region.

Thus, in the interpretation of Misner et al. [4], the phrase "must take on" should be changed to "must take on approx-imately" Also, the phrase, "experiments confined to infinitesimally small regions of space-time" does not make sense since experiments can be conducted only in a finite region. Also, there is possibly a way, by experiments to distinguish local Lorentz frames. Thus, a violation of the Lorentz invariance is not necessarily a violation of general relativity, and in fact is generally expected as suggested by the above theorems.

Moreover, in their eq. (40.14) they got an incorrect local time of the earth.[1)] Thus, these three theorists [4] not only were very far from being an expert, but also failed in understanding the basics of general relativity [5, 6].[11)]

Furthermore, in mathematical analysis, there is a big difference between for each point "there is a local Minkowski metric with a small region where special relativity is approximately valid" from "there is a small region where special relativity is valid"; and no matter how small the region is. However, many cannot tell the difference because they may not know the famous theorem on open coverings for a bounded closed set in mathematical analysis. An editor of mathematical physics even claimed such mathematical analysis does not make any difference.[11)] Thus, owing to such a level in mathematics, understandably the errors of the Wheeler School were accepted without being questioned.

The finite sub-covering theorem states that any open covering of a bounded closed set, has a finite sub-covering for such a closed set [43].[12)] Now, consider that for any point there is a neighborhood where special relativity is valid. Then it is obvious that such neighborhoods form an open covering for any closed set. Thus, for instance, a closed sphere would have a finite sub-covering of open neighborhoods where special relativity is valid.

It is crucial to note that, in a finite dimensional space, if the intersection of two open sets is non-empty, it contains an open subset. Consider a common open subset of two connected neighborhoods, then, the metrics in this subset are all Minkowski with respect to each of the local coordinate system. (Note that this would not follow if the local Minkowski metric is valid only at one point of a given neighborhood.) It thus follows that these two local coordinate systems are related by a Lorentz transformation according to special relativity. Therefore, one can choose any of the local coordinate system as the coordinate system for the union of the two open neighborhoods.

It follows that one can start from an open neighborhood and extend its local coordinate system to an open set that is the union of all the connected open sets that form a covering of an closed set. This implies that any finite closed subset of the space is a Minkowski space. Thus, the notion of local Lorentz invariance is meaningful essentially only for the case of special relativity. In other words, the interpretation of Pauli [8] is invalid in mathematics.13) Since only mathematical analysis at the undergraduate level is used, this testifies the inadequacy in pure mathematics of many physicists.14)

Moreover, the assumed existence of a local small region that satisfies special relativity leads to the misidentification of the principle to the 1911 assumption that states the equivalence of gravitation and acceleration. Subsequently, Wald [21] takes a "modern point of view" that abandons Einstein's equivalence principle. In fact, this is the incorrect view of the 1993 Nobel Committee for physics [42]. Many theorists probably suspected that Einstein's equivalence principle is in conflict with Einstein's covariance principle [13, 14].

IV. The Conflict Between Einstein's Equivalence Principle and his Covariance Principle

In general relativity, Einstein's covariance principle is actually in conflict with his equivalence principle. Perhaps, this is the underlying reason that the Wheeler School distorted the latter.

Einstein's equivalence principle implies that the time dilation and the space contractions can be measured [5, 6], and therefore should be unique for a given frame of reference. On the other hand, the covariance principle would imply different gauges for the same frame as equivalent in physics. In fact, Einstein actually obtained distinct space contractions from different gauges [5, 6]. However, if one reads carefully, Einstein actually only assumed, but did not prove his equivalence principle to be valid for the gauge considered. Hence, it is possible that only one gauge is valid for the equivalence principle, i.e. the covariance principle is actually invalid. 15)

Consider the shortest distance r_0 from a ray to center of the sun and the impact parameter b, one has

$$b \approx 2\kappa M + r_0\,, \quad \text{but} \quad b \approx \kappa M + r_0 \tag{5}$$

from the harmonic and the Schwarzschild gauges respectively [27]. Thus, Einstein's covariance principle is invalid.

However, the covariance principle is Einstein's remedy for his theory of measurement. For its justification, Einstein had used special relativity; and this probably was why Whitehead's criticisms [29] of Einstein's theory of measurement being invalid, was rejected [13, 14]. The problem is finally settled after it is discovered that Einstein's justifications were actually based on invalid applications of special relativity [13, 14]. 16) This also means that nobody can claim to be an expert of general relativity since they did not even understand special relativity adequately.17)

Another major problem among the "experts" is that many are still misunderstanding Einstein's equation as having dynamic solutions and wave solutions.18) For instance, Misner et al. consider their plane-wave equation equation,

$$d^2L/du^2 + L(d\beta/du)^2 = 0, \qquad \text{where}$$
$$L = L(u),\ \ \beta = \beta(u),\ \ u = ct - x, \tag{6}$$

and c is the light speed. They [4] claimed that there exists a bounded wave solution of the following form as follows:

$$ds^2 = c^2dt^2 - dx^2 - L^2\left(e^{2\beta}dy^2 + e^{-2\beta}dz^2\right). \tag{7}$$

The truth is, however, that their equation (6) has no bounded solution [13].

On the other hand, many attempted to justify the existence of the dynamic solution and the wave solution with un-bounded time-dependent solutions [24-26] in spite of disagreement with Einstein's requirement on weak gravity. They thought the covariance principle was a convenient excuse to accept unbounded solutions. However, a problem remains that the calculation of the radiation for the binary pulsars needs a bounded dynamic solution.

In short, sources of errors are not only the rejection of Einstein's equivalence principle, but also the acceptance of Einstein's invalid covariance principle [27].19) In addition to the mistake due to a failure in distinguishing physics from mathematics [20, 28], the Wheeler School has a special need because the covariance principle is used for their theory of black holes [4, 21, 27]. Moreover, they probably were aware of the inconsistency between Einstein's covariance principle and Einstein's equivalence principle since they used a different approach to derive the light bending [4].

Perhaps, the Wheeler School chose Einstein's invalid "covariance principle" because it is closely related to gauge invariance that has a long history starting from electrodynamics. Subsequently, gauge invariance has been formally de-veloped in 1954 to non-Abelian gauge theories such as the Yang-Mills-Shaw theory [44, 45]. They extended the gauge invariance to the cases of the Non-Abelian gauges in terms of mathematics. However, as shown by Aharonov & Bohm [46] in 1959, the electromagnetic potentials actually are physically effective; and, as shown by Weinberg [47], all the physical non-Abelian gauge theories are not gauge invariant such that masses can be generated. Yet, one may argue that whether this is really what happens in Nature is still entirely open. The crucial point is, however that for a non-Abelian theory in physics, there are different elements representing distinct particles, and thus the whole theory cannot be gauge invariant.20) Thus, gauge theories also support Einstein's covariance principle being invalid.

V. Conclusions and Remarks

The attempt [4] to replace Einstein's equivalence principle (1916) with the equivalence assumption (1911) and/or Pauli's version [30] leads to great confusions [13]. Journals including the Physical Review 1) and the Royal Society, accept unbounded solutions as valid [24] and other crucial errors [13, 30]. Theorists such as 't Hooft [28] even failed to tell the difference between physics and mathematics [20]. This error eventually leads to the implicit rejection of Einstein's equivalence principle by the 1993 Nobel Committee for Physics [42]. As a consequence, courses in general relativity of almost all, including the well-known universities, are affected.21) Thus, for the progress of physics, it is necessary to rectify the damages done to general relativity [4, 33-35, 37, 48]. 22)

A related problem was that many were reluctant to question, accepted but unverified assumptions, and misin-terpreted scientific evidence [13-15, 21]. These often result in that accumulated errors become not only prevailing but also dominating. Fortunately, Dr. Daniel Kulp [49], however, is an exception and has recently discontinued such practices. Thus, the current position of the Physical Review is that they are not yet convinced of the recent theoretical developments [48], but no longer object to the criticisms toward the Physical Review D.

Up to 1990, Zhou Pei-Yuan of Peking University probably was the only known theorist, rejecting the covariance principle but accepting Einstein's equivalence principle [50, 51]. Moreover, Zhou could have discovered that lineariza-tion to obtain an approximate wave solution is invalid if his student and friends had not made surprising mistakes [52, 53]. However, nobody would continue the experiments on local light speeds that Zhou initiated [51, 54] because the works of Zhou on relativity have been misunderstood and also distorted.23) Many blindly adapt the views of Princeton University as representing the truth, without adequate examination [55].24) This problem is perpetuated by the claim of gauge invariance by C. N. Yang [44] who also masqueraded to be an expert of general relativity [56, 57].25)

Thus, the distortion of Einstein's equivalence principle is the initial obstacle to progresses in general relativity eve-rywhere,26) including China [55, 58]. The invalid acceptance was, in part, due to that many still do not understand the principle of causality adequately [20, 24-28]. Owing to physical and mathematical inadequacy, Misner et al. [4] created a distortion of the Einstein-Minkowski condition, the so-called "local Lorentz invariance". This could unfairly give fur-ther damages to the reputation of Einstein. Now, it is clear that experimental tests should give unfavorable results [2].

In summary, the main source of errors is unexpectedly the Princeton University.27) To deny their errors, Christodou-lou and Klainerman [16] claimed that they have constructed dynamic solutions of the Einstein equation. However, this only exposed their incompetence at the undergraduate level further [15-19, 57].28) Nevertheless, this does support con-siderable questionable "claims" from collapsing immediately. Then, they even succeeded in converting the 1993 Nobel Committee for Physics into agreeing with their erroneous views. Another consequence was that Christodoulou had re-ceived dubious honors from his supporters and many physicists were misled (Wikipedia).

It should be noted that after the Shaw Prize award of his errors, Christodoulou has been elected to be a member of U.S. National Academy of Sciences (2012). Now, it is clear that the problem is far beyond an invalid award but proba-bly involves the credibility of US academic honor. Fortunately, the advocates for Christodoulou have run out of valid excuses since their errors can be illustrated with mathematics at the undergraduate level. Nevertheless, some theorists still pretend that no valid objections have ever existed as Hawking did.29) Fortunately, the American Physical Society led by Kulp etc. has awakened up to examine physics according to evidence. Note that Einstein emerges from the recti-fications as a even better theorist since his conjecture of unification is proven as necessary [13]. Moreover, since the Wheeler School and their associates are unable to put the genii back to the bottle,30) a better choice for them would be to work on new developments such as the charge-mass interaction [48].

VI. Acknowledgments

The author is grateful to Prof. I. Halperin for information on the mathematical theorems, related to Einstein's equi-valence principle. Special thanks are to and Prof. Wong Yuen-fat for valuable comments and S. Holcombe for useful suggestions. This work is supported in part by Innotec Design, Inc., U. S. A. and the Chan Foundation, Hong Kong.

VII. Endnotes

1. Liu [59], Wald [21] and Weinberg [60] do not make the same mistake, but Ohanian & Ruffini [37] do.
2. The editor of the Physical Review considered the rejection of Einstein & Rosen to a gravitational wave solution being incorrect since the singularity identified by them is removable. However, their rejection is actually valid since such a solution violates Einstein's requirements on weak gravity. Subsequently,'t Hooft came up with a bounded solution in vacuum, but without a valid source; and thus the principle of causality is violated again [20].
3. Eric J. Weinberg obtained his Ph. D. (1973) in physics from Harvard University under Prof. Sidney Coleman. He graduated with BA (1968) from Manhattan College, which is famous for engineering and applied sciences. Ap-parently, his inadequate background in pure mathematics is shown in his erroneous judgments as an editor. This illustrates that pure mathematics can also be important in physics although it may not be used very often.
4. It is clear that A. Ashtekar was unaware of their mistakes [4] at the undergraduate level on crucial calculations of waves [13]. His thesis, "*Asymptotic Structure of the Gravitational Field at Spatial Infinity*", seems to just inherit the errors of Wald [21] since there is no bounded dynamic solution for the Einstein equation [15]. Ashtekar failed to see in his quantum gravity that the photons must include gravitational energy [13, 14, 61].
5. Like his thesis advisor Thorne [4], mathematical physicist C. M. Will is known for his mathematical errors at the undergraduate level. In particular, Will insists on his errors, on $E = mc^2$ being unconditional [33, 62].
6. To guard against misjudgments, the Nobel Prize Committee allows a long time delay to settle possible errors. However, this method is not effective when theorists practice authority worship of the 16th century [42].
7. In the book of Liu [59], though referred to Einstein [5], also refers to others who misinterpreted Einstein's equiva-lence principle [4, 31]. Liu also claimed that Einstein's equivalence principle is not rigorously valid.
8. In effect, Einstein pointed out that the versions of both Misner et al [4] and Pauli [8] are invalid in physics.
9. The misidentification of Fock [36], Ohanian & Ruffini [37] and Wheeler and etc. on Einstein's equivalence prin-ciple has projected an unfair and incorrect image of Einstein since the 1911 assumption has been proven incorrect. Fock has the excuse of being for the campaign of the Soviet Union, but the motivation of others is not clear.
10. Hsu & Hsu [39] failed to get a transformation between an inertial frame and a uniformly accelerated frame.
11. However, based on Misner et al, [4], Fields Medalists S. T. Yau and E. Witten have [15] assumed uniqueness of coupling signs in the positive energy theorems [63, 64] as Hawking did [21]. Moreover, B. L. Z. Nachtergaele, editor of the J. of Math. Phys. does not see a problem in the mathematics of Misner et al. [4] (June 22, 2012).
12. For a finite sub-covering theorem in general topology, one can read the book by Kelley [65].
13. One might ask why mathematicians (including the Field Medalists E. Witten (1990), and S. T. Yau (1982) whose works have been closely related to general relativity) also failed to discover the distortions of the Wheeler School (a rather simple problem for mathematicians) if the non-existence of dynamic solutions is a too complicated prob-lem. The answer seems to be that they are very careless or put it under a better light, they trust the physicists.
14. Theorists, including Nobel Laureate 't Hooft, the Editor-in-Chief of the Foundation of Physics, still agrees with the misinterpretation of the Wheeler School because he also has similar problems in mathematics [20].
15. Einstein's covariance principle is regarded as similar to gauge invariance in a gauge theory in particle physics. Understandably, C. N. Yang, who initiated the Yang-Mills-Shaw theory [44, 45] based on the notion of total gauge invariance, would disagree with P. Y. Zhou [50, 51] of Peking University, who first pointed out the invalidity of Einstein's covariance principle. It turns out that Yang-Mill-Shaw theory is actually invalid in physics. Thus, it is misleading to call a non-Abelian gauge theory as a Yang-Mill theory. As pointed out by Weinberg [47], in a phys-ical gauge theory, gauge invariance applies only formally to the Lagrangian, but gauge invariance is necessarily broken due to physical considerations such as the well-known spontaneous broken symmetry etc. Such a broken symmetry is similar to the case that a valid gauge must be chosen in general relativity [13, 14].
16. That theorists including Einstein make mistakes related to special relativity are not rare incidences. For instance, Nobel Laureate, 't Hooft also made

errors related to special relativity in his 1999 Nobel Lecture [66]. One may note also that many theorists, including this author, did not discover Einstein's error before 2005.
17. Since there is no authority for general relativity, everybody has to argue with evidences.
18. A half of the 2011 Shaw Prize was awarded to Christodoulou [56] for his errors against Gullstrand [11, 12]. If the Shaw Prize had checked whether there is a solution that can satisfy the claims of Christodoulou, they could have found his errors. However, maybe we should be a little bit easy on the Shaw Prize Committee since a number of Nobel Laureates also made such a mistake. For instance, Nobel Laureates, G.'t Hooft and F. Wilczek also failed to see that there is no dynamic solution for the Einstein equation [15, 22, 53]. Moreover, as shown in their Nobel lectures,'t Hooft [66] who does not understand special relativity adequately, regarded the electric energy of a charged particle contributes to its inertial mass, and Wilczek [67] failed to see that $m = E/c^2$ is not generally valid.
19. Rectifications in general relativity are necessary since there is no radiation reaction force. Although an accelerated massive particle would create radiation [22], the metric elements in the geodesic equation are generated by other particles [5]. Nevertheless, this does not affect the validity of Einstein's equivalence principle [68].
20. C. N. Yang seems still fail to understand the logic that a non-Abelian theory in physics cannot be gauge invariant. Nevertheless, a mathematical foundation of studying non-Abelian gauge theories was laid down by Yang-Mills [44] and Shaw [45], but a non-Abelian gauge theory in physics is not really a Yang-Mills-Shaw theory.
21. Misinterpretations of Einstein's equivalence principle and the invalid speculation $E = mc^2$, being as mass and energy unification [68-70], are prevailing in university courses such as MIT's open course Phys. 8.033, and Stan-ford's open lectures on Einstein's Theory of Relativity by L. Susskind. Susskind also omits crucial issues and overlooked errors in mathematics and physics at the undergraduate level. Theorists, including some editors, be-lieved the speculation that any energy would always create the attractive gravity; but it is actually invalid [50].
22. As Feynman [71] pointed out, many in gravitation are incompetent. For instance, an error is the failure to see the impossibility to have a dynamic solution [13, 14], and the misinterpretation of the Hulse-Taylor experiments [15]. This error has far reaching consequences in theoretical developments such as the singularity theorems [15, 21].
23. In fact, L. Z. Fang misinterpreted Zhou's theory, and I discovered this only after I read a paper [72] of his student.
24. Some theorists still failed to see that linearization is not valid for the dynamic case [73] since 1993 [57, 74].
25. Under the leadership of C. N. Yang & K. Young whose errors in general relativity [73] were pointed out in 1993 [74], the 2011 Shaw Prize awarded to Christodoulou is not the only problem. The 2008 Prize in Astronomy was awarded to R. Genzel, "in recognition of his outstanding contributions in demonstrating that the Milky Way contains a super-massive black hole at its centre". However, Genzel himself is not 100% sure.
26. B. Richter [75] comments, "… I think some of what passes for the most advanced theory these days is not really science." Many theorists just have not been able to be out from their past errors [9, 31, 53, 54, 56, 57, 76].
27. However, this does not diminish my respect to this institute. My respected teachers such as Prof. A. J. Coleman and Prof. I. Halperin, who was my advisor for my degrees in mathematics, were graduated from Princeton.
28. In sciences, the defense of an error often leads to the exposition of other errors.
29. In his visit to China, Hawking still claimed that his invalid theory is based on general relativity only. Nevertheless, the Chinese physicists bought such a claim because they were also out-dated then.
30. It was claimed that the puzzle of pioneer anomaly of NASA has been solved with an improved model. A problem is, as a discoverer of the anomaly commented, that such a model can be made to fit essentially any data at all.

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Combined Effect of Solar Radiation and Solar Tide Perturbations on the Spacecraft Rosetta About the Comet Wirtanen

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Abstract - The purpose of the present paper is twofold . First, is to give summary on Rosetta spacecraft, the first mission ever to orbit and land on a comet which is Wirtanen comet. The second, which is the most important, is to establish general computational algorithm which could be used for the motion of a spacecraft orbiting about asteroid or comet, taking due account of the combined effect of solar radiation and solar tide. The algorithm was applied for the late stage of Rosetta mission about the Wirtanen comet, staring at 10 June 2011, and the variations of the coordinates and velocities are illustrated graphically in the range $f \in [0, 2\pi]$.

Keywords : *solar tide, solar radiation, motion of spacecraft about comet or asteroid.*

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Strictly as per the compliance and regulations of :

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M. A. Sharaf [α] & L.A.Alaqal [σ]

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I. Introduction

After ESA's highly successful mission of the spacecraft Giotto to Halley's comet a number of international space probes were sent to explore the cometary system. This is because, comets preserve information from the time of formation of our Solar System, 4600 million years ago. Landing on a comet and analyzing its surface is seen as a major scientific milestone to improve our understanding of the origin of the Sun and the planets including Earth. Apart from that, it is a unique technological challenge!

Coping with the present day explorations of comets by spacecraft, the present paper is devoted with twofold. First, is to give summary on Rosetta spacecraft, the first mission ever to orbit and land on a comet which is Wirtanen comet. The second, which is the most important, is to establish general computational algorithm which could be used for the motion of a spacecraft orbiting about asteroid or comet, taking due account of the combined effect of solar radiation and solar tide. The algorithm was applied for the late stage of Rosetta mission about the Wirtanen comet, staring at 10 June 2011, and the variations of the coordinates and velocities are illustrated graphically in the range $f \in [0, 2\pi]$.

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II. Rosetta Mission

Rosetta is a robotic spacecraft of the European Space Agency on a mission to study the comet Wirtanen .It was launched on 2 March 2004 on an Ariane 5 rocket and will reach the comet by mid 2014. Rosetta consists of two main elements: the Rosetta space probe (See Fig.1) and the Philae lander(see Fig.2).

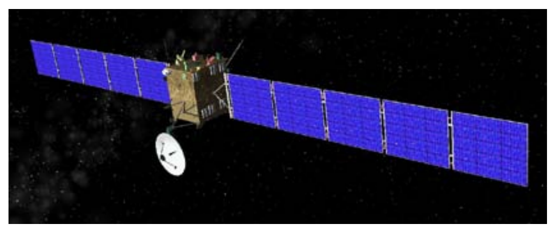

Figure 1 : The Rosetta space probe.

Figure 2 : The Philae lander.

The space probe is intended to orbit and perform long-term exploration of the comet at close quarters. On 10 November 2014 the Philae lander will attempt to land and perform detailed investigations on the comet's surface. When it touches down on the comet, the Rosetta lander will use three different techniques (self-adjusting landing gear, harpoons, and ice screws in the landing pads). These ensure that once it has arrived on the surface of the comet, it stays there.Both the probe and the lander carry a large complement of scientific experiments designed to complete the most detailed study of a comet ever attempted.

The probe is named after the Rosetta Stone. The Rosetta Stone was discovered in 1799 by a French soldier in Napoleon's army near the town of Rashid on the River Nile. It proved the key to finally deciphering Egyptian hieroglyphics. The lander is named after the Nile island Philae where an obelisk was found that helped decipher the Rosetta Stone. Hoping in that, the Rosetta mission to be also the key that unlocks the secrets of how life began on Earth.

Rosetta spacecraft specifications are:

Total Launch Mass: 3,000 kg

Propellant: 1,670kg

Philae Comet Lander: 100kg

Main Structure: 2.8 x 2.1 x 2.0 meters

Diameter of solar arrays: 32 meters

Instructions from the ground take up to 50 minutes to reach the spacecraft, so Rosetta must have the 'intelligence' to look after itself. It uses sophisticated on-board computers and software whose tasks include data management, attitude, and orbit control. European Space Operations Centre in Darmstadt, Germany will control the Rosetta spacecraft operations. ESA's 35 m ground station in New Norcia, near Perth, West Australia will relay spacecraft data.

The planned timeline for the mission after its launch:

1- First Earth flyby (March 4, 2005)
2- Mars flyby (February 25, 2007)
3- Second Earth flyby (November 13, 2007)
4- Flyby of asteroid 2867 Šteins (September 5, 2008)
5- Third Earth flyby (November 13, 2009) (see Fig.3)
6- Flyby of asteroid 21 Lutetia (July 10, 2010)
7- Deep-space hibernation (June 2011 - January 2014)
8- Comet approach (January–May 2014)
9- Comet mapping / Characterization (August 2014)
10- Landing on the comet (November 2014)
11- Escorting the comet around the Sun (November 2014 - December 2015)
12- End of mission (December 2015)

Figure 3 : First view of Earth as Rosetta approaches home 13 November 2009.

The illuminated crescent is centered roughly around the South Pole (South at the bottom of the image). The outline of Antarctica is visible under the clouds that form the striking south-polar vortex. Pack ice in front of the coastline with its strong spectacular reflection is the cause for the very bright spots on the image.

III. Computational Developments

In studying the motion of a spacecraft orbiting about comet or asteroid, the combined effect of solar radiation and solar tide should be taken into account. The situation of such problem can allow us to consider the central body as a sphere, and neglect gravitational perturbations. Upon these assumptions the following analysis is devoted.

a) The Equations of motion

The equations of motion of the spacecraft in the non –uniformly rotating pulsating system, when we take the true anomaly f, as the new independent variable rather than the time t are given as (Scheeres 2012)

$$x'' - 2y' = \frac{1}{1 + e\cos f}\left[\frac{-x}{r^3} + \beta + 3x\right], \qquad (1.1)$$

$$y'' + 2x' = \frac{1}{1 + e\cos f}\left[\frac{-y}{r^3}\right], \qquad (1.2)$$

$$z'' + z = \frac{1}{1 + e\cos f}\left[\frac{-z}{r^3}\right], \qquad (1.3)$$

Where the prime indicate differentiation with respect to the true anomaly f, e the eccentricity of spacecraft, and β is constant and describes the relative acceleration of the solar radiation pressure on the spacecraft. These equations have a close affinity with the elliptic restricted three –body problem (Sharaf and Abouelmagd 2012).It is significant to note that Equations (1) only contains two parameters, the eccentricity of the orbit e and the normalized effect of the solar radiation pressure β and that the equations are periodic in the true anomaly f.

For numerical applications, Equations (1) are better written as a first order system as follows

$$x' = u, \quad (2.1)$$

$$y' = v, \quad (2.2)$$

$$z' = w, \quad (2.3)$$

$$u' = 2v + \frac{1}{1+e\cos f}\left[\frac{-x}{r^3} + \beta + 3x\right], \quad (2.4)$$

$$v' = -2u + \frac{1}{1+e\cos f}\left[\frac{-y}{r^3}\right], \quad (2.5)$$

$$w' = -z + \frac{1}{1+e\cos f}\left[\frac{-z}{r^3}\right]. \quad (2.6)$$

b) Orbit determination of spacecraft Rosetta about the comet Wirtanen

i. *The Constants*

The constants $\beta, e,$ the gravitational parameter μ and the orbital parameter p are (Scheeres 2012)

$$\beta = 28.5 \;\; ; \; e = 0.658 \;\; ; \; \mu = 3\times10^{-7}\,\mathrm{km}^3/\mathrm{s}^2 \;\; ; \; p = 1.752\ \mathrm{AU}$$

ii. *The orbital elements of Wirtanen comet*

The orbital elements of Wirtanen comet have been determined by Muraok (cited in Noton 1998) from 83 observations between 1985 and 1997 as follows

$a = 3.0991080\ \mathrm{AU}$

$e = 0.6567522$

$\text{Time at perihelion} = 2450521.7\,\text{Juliandays}$

$\omega = 356.342^{\circ}$

$\Omega = 82.205^{\circ}$

$inc = 11.722^{\circ}$

$\text{period} = 5.456\ \text{years}$

iii. *The initial position and velocity*

The initial position and velocity of the spacecraft Rosetta relative to Wirtanen comet at zero time: t_0 = 00.0hrs, 10 June 2011 are (Noton 1998)

position :	-0.100	0.200	0.020	million km
velocity :	0.210	-0.560	-0.050	km/s

iv. *The starting value of the true anomaly*

The starting value of the true anomaly f_0 for the numerical solution of the differential equations of motion could be obtained as follows

The zero time $t_0 = 2455722.5$ Julian days .

The semi-major axis

$$a = p/(1-e^2) = 462220155.6\ \mathrm{km}$$

The mean motion

$$n = \sqrt{\mu/a^3} = 4.762127849\times10^{-12}\,\mathrm{rad/day}.$$

The mean anomaly $M = nt_0 = 0.00001169\,\mathrm{rad}$.

The eccentric anomaly E from Kepler equation

$$M = E - e\sin E \Rightarrow E = 0.0000341813\,\mathrm{rad}.$$

The true anomaly

$$f_0 = 2\tan^{-1}\left(\sqrt{\frac{1+e}{1-e}}\tan\frac{E}{2}\right) = 0.00431211^{\circ}.$$

Consequently, we shall consider $f_0 = 0^{\circ}$

v. *The variations of the position and velocity in the range* $\mathbf{f} \in [0, 2\pi]$

Solving the differential equations of motion using the above conditions we get for the variations of the position and velocity of the spacecraft Rosetta in the range $f \in [0, 2\pi]$ the following results which are displayed graphically as follows

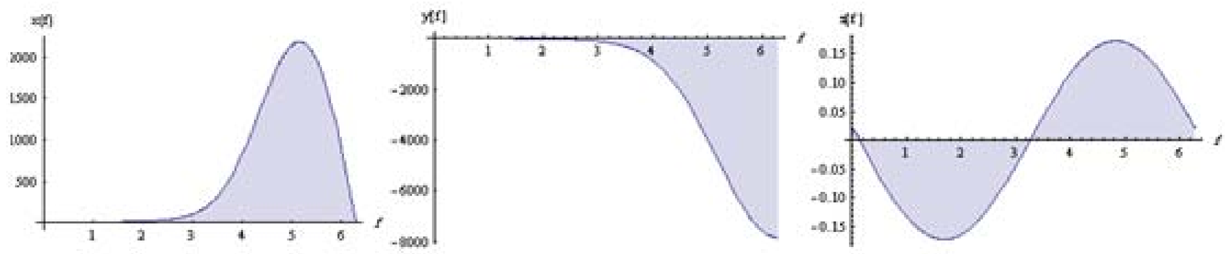

Figure 4 : The variations of position of the spacecraft Rosetta in the range $f \in [0, 2\pi]$.

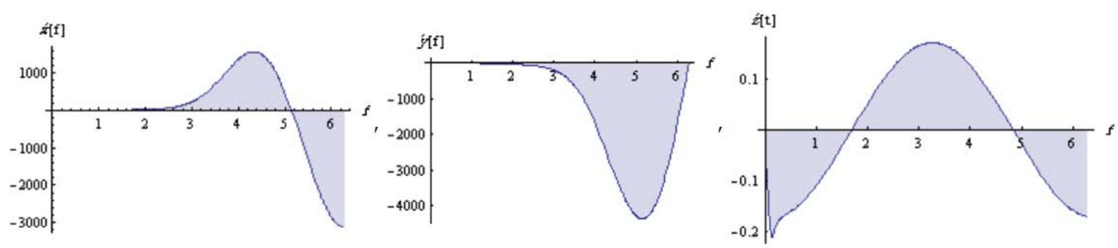

Figure 5 : The variations of velocity of the spacecraft Rosetta in the range $f \in [0, 2\pi]$.

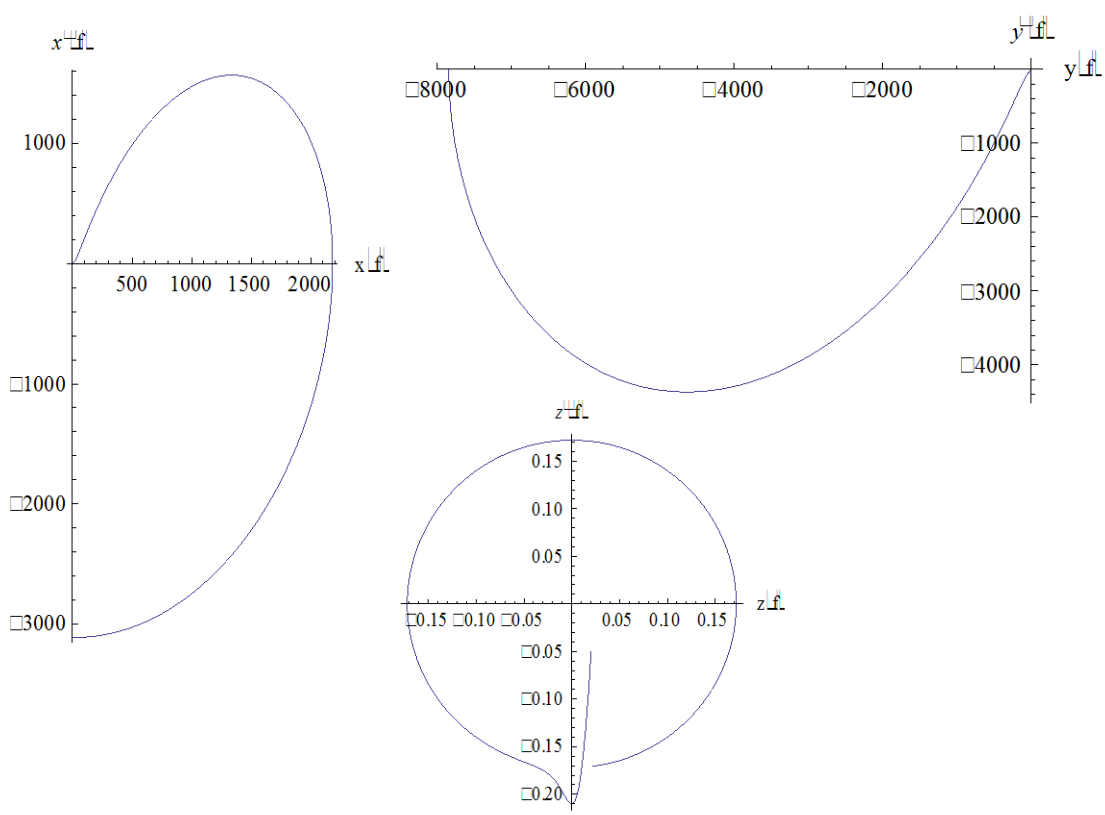

Figure 6 : Parametric plots between position and velocity.

IV. Conclusion

In the present paper ,a general computational algorithm was establish for the motion of a spacecraft orbiting about asteroid or comet, taking due account of the combined effect of solar radiation and solar tide. The algorithm was applied for the late stage of Rosetta mission, staring at 10 June 2011, and the variations of the coordinates and velocities are illustrated graphically in the range $f \in [0, 2\pi]$.

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20. Use good quality grammar: Always use a good quality grammar and use words that will throw positive impact on evaluator. Use of good quality grammar does not mean to use tough words, that for each word the evaluator has to go through dictionary. Do not start sentence with a conjunction. Do not fragment sentences. Eliminate one-word sentences. Ignore passive voice. Do not ever use a big word when a diminutive one would suffice. Verbs have to be in agreement with their subjects. Prepositions are not expressions to finish sentences with. It is incorrect to ever divide an infinitive. Avoid clichés like the disease. Also, always shun irritating alliteration. Use language that is simple and straight forward. put together a neat summary.

21. Arrangement of information: Each section of the main body should start with an opening sentence and there should be a changeover at the end of the section. Give only valid and powerful arguments to your topic. You may also maintain your arguments with records.

22. Never start in last minute: Always start at right time and give enough time to research work. Leaving everything to the last minute will degrade your paper and spoil your work.

23. Multitasking in research is not good: Doing several things at the same time proves bad habit in case of research activity. Research is an area, where everything has a particular time slot. Divide your research work in parts and do particular part in particular time slot.

24. Never copy others' work: Never copy others' work and give it your name because if evaluator has seen it anywhere you will be in trouble.

25. Take proper rest and food: No matter how many hours you spend for your research activity, if you are not taking care of your health then all your efforts will be in vain. For a quality research, study is must, and this can be done by taking proper rest and food.

26. Go for seminars: Attend seminars if the topic is relevant to your research area. Utilize all your resources.

27. Refresh your mind after intervals: Try to give rest to your mind by listening to soft music or by sleeping in intervals. This will also improve your memory.

28. Make colleagues: Always try to make colleagues. No matter how sharper or intelligent you are, if you make colleagues you can have several ideas, which will be helpful for your research.

29. **Think technically:** Always think technically. If anything happens, then search its reasons, its benefits, and demerits.

30. Think and then print: When you will go to print your paper, notice that tables are not be split, headings are not detached from their descriptions, and page sequence is maintained.

31. Adding unnecessary information: Do not add unnecessary information, like, I have used MS Excel to draw graph. Do not add irrelevant and inappropriate material. These all will create superfluous. Foreign terminology and phrases are not apropos. One should NEVER take a broad view. Analogy in script is like feathers on a snake. Not at all use a large word when a very small one would be sufficient. Use words properly, regardless of how others use them. Remove quotations. Puns are for kids, not grunt readers. Amplification is a billion times of inferior quality than sarcasm.

32. Never oversimplify everything: To add material in your research paper, never go for oversimplification. This will definitely irritate the evaluator. Be more or less specific. Also too, by no means, ever use rhythmic redundancies. Contractions aren't essential and shouldn't be there used. Comparisons are as terrible as clichés. Give up ampersands and abbreviations, and so on. Remove commas, that are, not necessary. Parenthetical words however should be together with this in commas. Understatement is all the time the complete best way to put onward earth-shaking thoughts. Give a detailed literary review.

33. Report concluded results: Use concluded results. From raw data, filter the results and then conclude your studies based on measurements and observations taken. Significant figures and appropriate number of decimal places should be used. Parenthetical remarks are prohibitive. Proofread carefully at final stage. In the end give outline to your arguments. Spot out perspectives of further study of this subject. Justify your conclusion by at the bottom of them with sufficient justifications and examples.

34. After conclusion: Once you have concluded your research, the next most important step is to present your findings. Presentation is extremely important as it is the definite medium though which your research is going to be in print to the rest of the crowd. Care should be taken to categorize your thoughts well and present them in a logical and neat manner. A good quality research paper format is essential because it serves to highlight your research paper and bring to light all necessary aspects in your research.

INFORMAL GUIDELINES OF RESEARCH PAPER WRITING

Key points to remember:

- Submit all work in its final form.
- Write your paper in the form, which is presented in the guidelines using the template.
- Please note the criterion for grading the final paper by peer-reviewers.

Final Points:

A purpose of organizing a research paper is to let people to interpret your effort selectively. The journal requires the following sections, submitted in the order listed, each section to start on a new page.

The introduction will be compiled from reference matter and will reflect the design processes or outline of basis that direct you to make study. As you will carry out the process of study, the method and process section will be constructed as like that. The result segment will show related statistics in nearly sequential order and will direct the reviewers next to the similar intellectual paths throughout the data that you took to carry out your study. The discussion section will provide understanding of the data and projections as to the implication of the results. The use of good quality references all through the paper will give the effort trustworthiness by representing an alertness of prior workings.

Writing a research paper is not an easy job no matter how trouble-free the actual research or concept. Practice, excellent preparation, and controlled record keeping are the only means to make straightforward the progression.

General style:

Specific editorial column necessities for compliance of a manuscript will always take over from directions in these general guidelines.

To make a paper clear

· Adhere to recommended page limits

Mistakes to evade

- Insertion a title at the foot of a page with the subsequent text on the next page

- Separating a table/chart or figure - impound each figure/table to a single page
- Submitting a manuscript with pages out of sequence

In every sections of your document

· Use standard writing style including articles ("a", "the," etc.)

· Keep on paying attention on the research topic of the paper

· Use paragraphs to split each significant point (excluding for the abstract)

· Align the primary line of each section

· Present your points in sound order

· Use present tense to report well accepted

· Use past tense to describe specific results

· Shun familiar wording, don't address the reviewer directly, and don't use slang, slang language, or superlatives

· Shun use of extra pictures - include only those figures essential to presenting results

Title Page:

Choose a revealing title. It should be short. It should not have non-standard acronyms or abbreviations. It should not exceed two printed lines. It should include the name(s) and address (es) of all authors.

Abstract:

The summary should be two hundred words or less. It should briefly and clearly explain the key findings reported in the manuscript--must have precise statistics. It should not have abnormal acronyms or abbreviations. It should be logical in itself. Shun citing references at this point.

An abstract is a brief distinct paragraph summary of finished work or work in development. In a minute or less a reviewer can be taught the foundation behind the study, common approach to the problem, relevant results, and significant conclusions or new questions.

Write your summary when your paper is completed because how can you write the summary of anything which is not yet written? Wealth of terminology is very essential in abstract. Yet, use comprehensive sentences and do not let go readability for briefness. You can maintain it succinct by phrasing sentences so that they provide more than lone rationale. The author can at this moment go straight to shortening the outcome. Sum up the study, with the subsequent elements in any summary. Try to maintain the initial two items to no more than one ruling each.

- Reason of the study - theory, overall issue, purpose
- Fundamental goal
- To the point depiction of the research
- Consequences, including definite statistics - if the consequences are quantitative in nature, account quantitative data; results of any numerical analysis should be reported
- Significant conclusions or questions that track from the research(es)

Approach:

- Single section, and succinct
- As a outline of job done, it is always written in past tense
- A conceptual should situate on its own, and not submit to any other part of the paper such as a form or table
- Center on shortening results - bound background information to a verdict or two, if completely necessary
- What you account in an conceptual must be regular with what you reported in the manuscript
- Exact spelling, clearness of sentences and phrases, and appropriate reporting of quantities (proper units, important statistics) are just as significant in an abstract as they are anywhere else

Introduction:

The **Introduction** should "introduce" the manuscript. The reviewer should be presented with sufficient background information to be capable to comprehend and calculate the purpose of your study without having to submit to other works. The basis for the study should be offered. Give most important references but shun difficult to make a comprehensive appraisal of the topic. In the introduction, describe the problem visibly. If the problem is not acknowledged in a logical, reasonable way, the reviewer will have no attention in your result. Speak in common terms about techniques used to explain the problem, if needed, but do not present any particulars about the protocols here. Following approach can create a valuable beginning:

- Explain the value (significance) of the study
- Shield the model - why did you employ this particular system or method? What is its compensation? You strength remark on its appropriateness from a abstract point of vision as well as point out sensible reasons for using it.
- Present a justification. Status your particular theory (es) or aim(s), and describe the logic that led you to choose them.
- Very for a short time explain the tentative propose and how it skilled the declared objectives.

Approach:

- Use past tense except for when referring to recognized facts. After all, the manuscript will be submitted after the entire job is done.
- Sort out your thoughts; manufacture one key point with every section. If you make the four points listed above, you will need a least of four paragraphs.
- Present surroundings information only as desirable in order hold up a situation. The reviewer does not desire to read the whole thing you know about a topic.
- Shape the theory/purpose specifically - do not take a broad view.
- As always, give awareness to spelling, simplicity and correctness of sentences and phrases.

Procedures (Methods and Materials):

This part is supposed to be the easiest to carve if you have good skills. A sound written Procedures segment allows a capable scientist to replacement your results. Present precise information about your supplies. The suppliers and clarity of reagents can be helpful bits of information. Present methods in sequential order but linked methodologies can be grouped as a segment. Be concise when relating the protocols. Attempt for the least amount of information that would permit another capable scientist to spare your outcome but be cautious that vital information is integrated. The use of subheadings is suggested and ought to be synchronized with the results section. When a technique is used that has been well described in another object, mention the specific item describing a way but draw the basic principle while stating the situation. The purpose is to text all particular resources and broad procedures, so that another person may use some or all of the methods in one more study or referee the scientific value of your work. It is not to be a step by step report of the whole thing you did, nor is a methods section a set of orders.

Materials:

- Explain materials individually only if the study is so complex that it saves liberty this way.
- Embrace particular materials, and any tools or provisions that are not frequently found in laboratories.
- Do not take in frequently found.
- If use of a definite type of tools.
- Materials may be reported in a part section or else they may be recognized along with your measures.

Methods:

- Report the method (not particulars of each process that engaged the same methodology)
- Describe the method entirely
- To be succinct, present methods under headings dedicated to specific dealings or groups of measures
- Simplify - details how procedures were completed not how they were exclusively performed on a particular day.
- If well known procedures were used, account the procedure by name, possibly with reference, and that's all.

Approach:

- It is embarrassed or not possible to use vigorous voice when documenting methods with no using first person, which would focus the reviewer's interest on the researcher rather than the job. As a result when script up the methods most authors use third person passive voice.
- Use standard style in this and in every other part of the paper - avoid familiar lists, and use full sentences.

What to keep away from

- Resources and methods are not a set of information.
- Skip all descriptive information and surroundings - save it for the argument.
- Leave out information that is immaterial to a third party.

Results:

The principle of a results segment is to present and demonstrate your conclusion. Create this part a entirely objective details of the outcome, and save all understanding for the discussion.

The page length of this segment is set by the sum and types of data to be reported. Carry on to be to the point, by means of statistics and tables, if suitable, to present consequences most efficiently.You must obviously differentiate material that would usually be incorporated in a study editorial from any unprocessed data or additional appendix matter that would not be available. In fact, such matter should not be submitted at all except requested by the instructor.

Content

- Sum up your conclusion in text and demonstrate them, if suitable, with figures and tables.
- In manuscript, explain each of your consequences, point the reader to remarks that are most appropriate.
- Present a background, such as by describing the question that was addressed by creation an exacting study.
- Explain results of control experiments and comprise remarks that are not accessible in a prescribed figure or table, if appropriate.
- Examine your data, then prepare the analyzed (transformed) data in the form of a figure (graph), table, or in manuscript form.

What to stay away from

- Do not discuss or infer your outcome, report surroundings information, or try to explain anything.
- Not at all, take in raw data or intermediate calculations in a research manuscript.

- Do not present the similar data more than once.
- Manuscript should complement any figures or tables, not duplicate the identical information.
- Never confuse figures with tables - there is a difference.

Approach

- As forever, use past tense when you submit to your results, and put the whole thing in a reasonable order.
- Put figures and tables, appropriately numbered, in order at the end of the report
- If you desire, you may place your figures and tables properly within the text of your results part.

Figures and tables

- If you put figures and tables at the end of the details, make certain that they are visibly distinguished from any attach appendix materials, such as raw facts
- Despite of position, each figure must be numbered one after the other and complete with subtitle
- In spite of position, each table must be titled, numbered one after the other and complete with heading
- All figure and table must be adequately complete that it could situate on its own, divide from text

Discussion:

The Discussion is expected the trickiest segment to write and describe. A lot of papers submitted for journal are discarded based on problems with the Discussion. There is no head of state for how long a argument should be. Position your understanding of the outcome visibly to lead the reviewer through your conclusions, and then finish the paper with a summing up of the implication of the study. The purpose here is to offer an understanding of your results and hold up for all of your conclusions, using facts from your research and generally accepted information, if suitable. The implication of result should be visibly described. Infer your data in the conversation in suitable depth. This means that when you clarify an observable fact you must explain mechanisms that may account for the observation. If your results vary from your prospect, make clear why that may have happened. If your results agree, then explain the theory that the proof supported. It is never suitable to just state that the data approved with prospect, and let it drop at that.

- Make a decision if each premise is supported, discarded, or if you cannot make a conclusion with assurance. Do not just dismiss a study or part of a study as "uncertain."
- Research papers are not acknowledged if the work is imperfect. Draw what conclusions you can based upon the results that you have, and take care of the study as a finished work
- You may propose future guidelines, such as how the experiment might be personalized to accomplish a new idea.
- Give details all of your remarks as much as possible, focus on mechanisms.
- Make a decision if the tentative design sufficiently addressed the theory, and whether or not it was correctly restricted.
- Try to present substitute explanations if sensible alternatives be present.
- One research will not counter an overall question, so maintain the large picture in mind, where do you go next? The best studies unlock new avenues of study. What questions remain?
- Recommendations for detailed papers will offer supplementary suggestions.

Approach:

- When you refer to information, differentiate data generated by your own studies from available information
- Submit to work done by specific persons (including you) in past tense.
- Submit to generally acknowledged facts and main beliefs in present tense.

Administration Rules Listed Before Submitting Your Research Paper to Global Journals Inc. (US)

Please carefully note down following rules and regulation before submitting your Research Paper to Global Journals Inc. (US):

Segment Draft and Final Research Paper: You have to strictly follow the template of research paper. If it is not done your paper may get rejected.

- The **major constraint** is that you must independently make all content, tables, graphs, and facts that are offered in the paper. You must write each part of the paper wholly on your own. The Peer-reviewers need to identify your own perceptive of the concepts in your own terms. NEVER extract straight from any foundation, and never rephrase someone else's analysis.
- Do not give permission to anyone else to "PROOFREAD" your manuscript.
- Methods to avoid Plagiarism is applied by us on every paper, if found guilty, you will be blacklisted by all of our collaborated research groups, your institution will be informed for this and strict legal actions will be taken immediately.)
- To guard yourself and others from possible illegal use please do not permit anyone right to use to your paper and files.

CRITERION FOR GRADING A RESEARCH PAPER (COMPILATION)
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Topics	Grades		
	A-B	**C-D**	**E-F**
Abstract	Clear and concise with appropriate content, Correct format. 200 words or below	Unclear summary and no specific data, Incorrect form Above 200 words	No specific data with ambiguous information Above 250 words
Introduction	Containing all background details with clear goal and appropriate details, flow specification, no grammar and spelling mistake, well organized sentence and paragraph, reference cited	Unclear and confusing data, appropriate format, grammar and spelling errors with unorganized matter	Out of place depth and content, hazy format
Methods and Procedures	Clear and to the point with well arranged paragraph, precision and accuracy of facts and figures, well organized subheads	Difficult to comprehend with embarrassed text, too much explanation but completed	Incorrect and unorganized structure with hazy meaning
Result	Well organized, Clear and specific, Correct units with precision, correct data, well structuring of paragraph, no grammar and spelling mistake	Complete and embarrassed text, difficult to comprehend	Irregular format with wrong facts and figures
Discussion	Well organized, meaningful specification, sound conclusion, logical and concise explanation, highly structured paragraph reference cited	Wordy, unclear conclusion, spurious	Conclusion is not cited, unorganized, difficult to comprehend
References	Complete and correct format, well organized	Beside the point, Incomplete	Wrong format and structuring

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