

**PRODROMOS CH. PAPADOPOULOS**

Teacher of Physics

# **BE SHADOWED BY REAL TIME**

**Modern Physics**

Real Space Time, Quasars, X-ray stellar sources  
and the Quantum effect of tidal forces on the event horizon

 **ZITI**  
PUBLICATIONS

*Each copy is signed by the author*

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«Οἱ αἰῶνες πρῶτον τοῦ Θεοῦ κτίσμα πεφήνασιν· ἐπειδὴ γὰρ ἀσώματος ἐστὶν ὁ Ὑψιστος, ἐν πρώτοις ἀσώματον, νοερὸν τε καὶ ἄϋλον τὸν περὶ αὐτοῦ ἐδημιούργησεν κόσμον. Ἡ ὑπόστασις τῶν αἰώνων τό μή ἐκλείπειν τοῦ εἶναι αὐτῶν τὴν παρέκτασιν. Ἡ δέ οὐσία αὐτῶν πνεῦμα ἓν, πολύμορφον καὶ θαυμαστότερον, ἐπτά σημείοις σταδιοδρομούμενον· ἐπὶ τούτοις ἔλαβον νοί οἱ τε ἄγγελοι καὶ ἄνθρωποι. Καὶ οἱ μὲν τοῦ βαδίζειν τὴν ἀρχὴν ἔλαβον· ὁ γὰρ Κύριος τὴν ζωὴν αὐτοῖς ἐχαρίσατο. Δημιουργήσας δέ τό πολύμορφον πνεῦμα τῶν αἰώνων, ἀπ' αὐτοῦ ἔλαβεν, ὡς ἀπὸ γῆς τό σῶμα, καὶ τὰς ἀχράντους καὶ παναγίας δυνάμεις τῶν οὐρανίων δυνάμεων ἀποκαταστήσας ἐδημιούργησεν».

Ὅσιος Ἀνδρέας, ὁ διὰ Χριστόν σαλός.

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Ἀφιερωμένο στήν μνήμη τῶν γονέων μου

## Autobiography and the originating idea of the book

The author studied Physics at Aristotle's University of Thessalonica. At first he worked on atomic physics and quantum chemistry in the National institute of research (Athens). Later he spend much time on programming computers in order to solve mathematical problems of statistics. Mainly about the correction of probability of an event in connection to objective factors which influence it. Another interest to him today is the teaching of physics lessons by the help of visual aids and simulation of experiments (Interactive Physics). But for many years he has been working on the subject he has loved since childhood, astrophysics. An accidental observation on the creation of invariant quantities of tensor calculus drove him to the invention of a new method of creating quantum equations in curved spaces. This method (between other cheering predictions as the Hawking emission of a "naked" black hole) can explain the spectra of X-ray stellar sources and quasars. It is about of a new interested physical phenomenon of tidal forces that is missing from modern astrophysics. Between others this new method and the quantum phenomenon of tidal forces are proposed in this book. Currently the author teaches in the 1<sup>st</sup> Gymnasium in the Yiannitsa city, where he was born. This book is not only of a research interest. It also includes an introduction on modern physics with philosophical dimensions. Thusly it is not only targeted to researchers, students and teachers of physics but also to any individual who loves the subject, as long as he has knowledge of basic mathematics and general physics.

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## THE TARGETS OF THE BOOK

The initial motive for publishing this book was to present three new research papers in astrophysics, which we shall refer to next. Additionally, this book will appeal to anyone interested in modern theoretical Physics (Quantum Physics and Relativity), with the presupposition that he has basic knowledge on Classical Physics and Mathematics (elements of differential calculus and algebra of matrices). It consists of two parts.

The first part consists of three chapters where a brief and supervisory presentation of modern Physics is developed, namely Special Relativity Theory, General Relativity Theory and Quantum Physics (as well by low as by high or relativistic energies and Statistics Physics). These chapters could prove very useful to students and teachers who want to acquire knowledge of modern Physics, and moreover provide answers to key questions for a deeper comprehension of the theory. Hence these three chapters consist an introductory and self-contained appendix that gives the very basic knowledge necessary to study the second part of the book, which mainly consists of research. Special effort has been made for a logical and visual connection of fundamental concepts. For example, an effort was made for a comprehension on the local frame of reference and its deference from the general frame of reference, on the curvature of space-time and on the invariability of physical quantities. There are analytical clarifications, which are missing of the bibliography. Parts of the Einstein lectures have been explained, which seem ambiguous under first glance, but we prove here that the primary form of them (that is avoided in the usual bibliography) includes a considerable methodological and philosophical value. Such are the refraction of light rays in the gravitational field and the cosmological model. The basic knowledge about the total spectrum of modern Physics is gathered here in a way that permits anyone who is occupied with one part (for example Quantum Chemistry) to be informed in a satisfactory and quick manner on other parts (for example General Relativity), thus saving time.

In the second part, three unconventional research papers are presented. These are three articles, their abstracts and bibliography. The first is “The Quantum Theory of General Relativity”. In this an unconventional mathematical theory that creates quantum equations for particles moved in curved spaces is exposed. This creation is based on the tensor theory of creation invariant quantities that is also briefly presented in the first part of the book. It uses the metric tensor  $g_{\mu\nu}$  that prescribes the curvature of space (manifold) with an arbitrary majority of dimensions. As a first application of this theory, the four dimensional space-time of Schwarzschild of a black hole was chosen. The application of the mathematical method with the use of the absolute system of units ( $c = 1$ ,  $G = 1$ ,  $\hbar = 1$ ) creates the next quantum equa-

tion, with  $M$  the mass of a black hole and  $m$  the mass of the moving particle prescribed by the wave function  $\psi$  :

$$\nabla^2 \psi - \frac{2M}{r} \frac{\partial^2 \psi}{\partial r^2} - \left(1 - \frac{2M}{r}\right)^{-1} \frac{\partial^2 \psi}{\partial t^2} = m^2 \psi \quad (\text{a})$$

The solution of this equation for photons ( $m = 0$ ) on the event horizon of a black hole (abnormality of space-time) defines that from every distance  $\xi = r - R_s = r - 2M \ll R_s$  of the event horizon energies can be emitted to infinity with a maximum (relative to the observer at infinity) that is

$$E_{\max} \approx \frac{\xi}{R_s} \quad (\text{b})$$

But for great distances ( $\xi \gg R_s$ ) the result of the previous quantum equation of Schwarzschild space-time is different:  $\lim_{\xi \rightarrow \infty} E_{\max} = 1 = \text{Plank's limit of energies}$ . Evidently this result was expected for the flat space-time of the remote observer. Additionally a second way in the article is presented, namely these results can be extracted from the quantum equation  $\Delta E \cdot \Delta t \approx \hbar$  that results to  $E_{\max} \approx \xi/r$ . Moreover the relation (b) for marginal small distances  $\xi = 1$  gives the Hawking emission:  $E_H \approx 1/R_s$  for a naked black hole (without accretion disk around it) as a quantum instability of matter just on the event horizon that is found relative to the remote observer frame in an eternal breakdown. Additionally as we expected the quantum equation (a) is transformed to the known Klein-Gordon equation for the remote flat space-time ( $r \rightarrow \infty$ ) where the special theory of relativity is valid. In a second step we consider that matter falls on the event horizon (maybe coming from a giant escort star) creating an accretion disk of matter around. Calculating the critical distance  $\xi$  of the immateriality of nucleons as a result of the tidal forces (which become infinite just on the event horizon) and making use of the solution (b) as well as the method of Statistics Physics for the Bosse-Einstein gas we finally get the spectrum and the total power of a typical source as they are, for example the stellar source Cygnus X-1 and a common quasar. What is proven is that the frequency of the spectrum peak is approximately  $\bar{f}_0 \sim 1/\sqrt{M}$ , whereas the emitted power is  $P \sim M$ . The analytical results presented in the article are found in satisfactory agreement with the astrophysical observations. More accurate observations (experimental data) are proposed for the confirmation of the theory. If the exotic emission of the strange objects (system accretion disk –black hole) is really explained by this theory then from one side we shall have a simple explanation of these spectrums



(which today are a puzzle of modern astrophysics because the mechanism of the accretion disk heating remains unknown) and from the other we shall dispose a way of localization and studying the black holes through their spectrums. This would be an absolute confirmation of their existence. According to these results a stellar naked black hole (without accretion disk around it) would transform to energy every small quantity of matter (even a single nucleon) and then could emit  $\gamma$  - rays to infinite, if this matter falls on the event horizon coming from a great distance. This last prediction could open another way for confirmation of the theory, if isolated emissions (or a kind of explosions) of  $\gamma$  - rays could be observed. The deference here is that the emission is considered as a new simple quantum physical phenomenon that happens at infinitely small distances from the event horizon and it is not generated from an unknown mechanism of abnormal friction and gas heating at a distance possibly of many kilometers that the modern astrophysics supposes, but cannot explain satisfactory. On the other hand the history of Physics instructs that nature laves simple and distinct physical phenomenon, which are come straight from mathematical consistent scientific theories. By the way these infinitely small distances of the order of the nucleon diameter really define a place where the strength and the rate of change of field have the critical values to produce the enormous emitted power through the surface of the accretion disk.

The second article is titled “Is time an equivalent dimension to the other three dimensions of space?”. A model of a four dimensional world is proposed where the Pythagorean theorem takes its normal form:  $s^2 = x^2 + y^2 + z^2 + (ct)^2$  instead of the known form  $s^2 = x^2 + y^2 + z^2 - (ct)^2$  that Einstein proposed at his lecture in Princeton University (May 1921). It is proven in this article that the model of imaginary time (or equivalently real parameter  $t$  but  $g_{00} = -1$ ) is a result of a special selection of the frame of reference on the spherical three-membrane of space of the known universe, because we are trapped on this space-membrane. Finally there is proof that the two models are equivalent. But in this way the four dimensional world of real time recalls the world of Plato or the century of theologians. Imaginary time measured by our clocks seems as a shadow that real time leaves on the three dimensional membrane of common space as the title of this book implies. Additionally, this article includes a visual (graph) model for teaching this world in a manner that is easily understandable by every one. This technique relies on hiding one of the three dimensions of space as we would hypothetical entities of two dimensions to perceive the two dimensional curved spherical surface of Earth to present it as a simple periphery of a circle comprehensive in their two dimensional perception, because the periphery is one dimensional curved space that needs the perception of two dimensional Euclidean space. Moreover we analyze equations for projection of four dimensional objects in our three dimensional common space in a way that can be viewed by stereoscopic methods as is the virtual reality technique. This last product may prove useful in art.

The third article is a brief cosmological application on the Robertson-Walker space-time depending on the method of the first article. Target of this article is the Quantum Mechanics of the early universe. A first result is the satisfactory prescience of the Hubbell expansion at a great distance from the beginning.

Conclusively the target of this book is from one side a complement of the bibliography of the theoretical Physics relative to the basic concepts and from the other to publish the three articles. The indispensably tools of the reader are elementary knowledge of the classical Physics and deferential calculus, Algebra of matrices and elements of differential Geometry. From this point of view this book is useful to students of Physics and Mathematics in combination with other handbooks. The effort in the first part has as a main target to cover the basic concepts and Mathematical techniques (as the tensor analysis) to one who disposes only very elementary knowledge of Physics and Mathematics. Few parts of the theory (as the relativistic transformation of the Maxwell equations) are asked through some exercises in the first part of the book but the most exercises have been constructed on the research way of this book and they intent to a complete comprehension of the theory.

*\* I would like to thank Mrs Anna Lazaridou for the syntax and structure correction of the English version of this book.*

Prodromos Ch. Papadopoulos – teacher of Physics.

## THE COSMIC HYPER SPHERE

The strongest argument that supports the existence of a fourth geometrical dimension is the fact that every four dimensional vector or four-vector (a geometrical object) remains invariant relative to all frames of reference but the same doesn't happen with the well known three-vectors of classical Physics. This deference is easily perceptible when the velocities of moving bodies are very close to the velocity of light. Saying that a vector is invariant, we refer to the geometrical object "vector" and not to the vector coordinates because they are different in respect to two frames of reference in relative motion. The corresponding property in classical Physics would be the invariability of a three-vector  $\Delta\vec{r}$  of an orientated road (with length  $|\Delta\vec{r}|$ ) in respect to two different Cartesian frames  $Oxyz$  and  $O'x'y'z'$ . But the three coordinates  $\Delta x, \Delta y, \Delta z$  of this three-vector are different relatively to these two frames of reference. Namely  $\Delta\vec{r} = \vec{e}_1\Delta x + \vec{e}_2\Delta y + \vec{e}_3\Delta z = \vec{e}'_1\Delta x' + \vec{e}'_2\Delta y' + \vec{e}'_3\Delta z'$ . Because in the real world one more dimension exists that is time, generally for a material point with velocity  $\vec{v} = \Delta\vec{r} / \Delta t$  the correct expression is the next equation of Minkowski:  $\Delta\vec{s} = \Delta\vec{r} + \vec{e}_0\Delta t = \Delta\vec{r}' + \vec{e}'_0\Delta t'$ . We conclude that not the three-vector but the geometrical object four-vector  $\Delta\vec{s}$  remains invariant relative to the different Cartesian four-frames of reference  $Oxyzt$  and  $O'x'y'z't'$ . Moreover we conclude that the internal product  $\Delta s^2 = \Delta\vec{s} \cdot \Delta\vec{s}$  would be invariant. The Physics of the 20<sup>th</sup> century leads to a new perception: "The theory of Relativity and the Quantum Mechanics (principle of uncertainty) prove that the basis of the Physical Laws are not the objects and the events independent of the observer but rather this basis is the subjective measurements (observations) in combination with an unknown Reality".

Now imagine the immense three-space of our planetary system with the Sun as a big shiny sphere at the center and the other remote stars (other suns) and galactic nebulas as a distant background. In reality this wonderful world is richer by one more dimension. Furthermore this four dimensional world is richer than the "three dimensional" as the "three dimensional" is richer than the two dimensional one of a two-dimensional membrane surface. We imagine the world as three dimensional because we have a poor perception of a very small part of it, as for example, one could consider a small part of a spherical membrane as a flat square that is perceptible by a poorer two dimensional perception. In this way you imagine that the distant stars are found somewhere else, out of our imaginary three dimensional Euclidean space, because their light travels on curved lines (geodesics lines, which are the most abridged paths) belonging to a four dimensional real world (space-time) that we can't perceive optically as a geometric entity. This is the real cosmos of the universe. That is when we imagine the wonderful three-space of planets it resembles one which we simply imagine as a square instead of a real cube. As a simpler exam-

ple, consider the shadow of a cube on a page. Obviously the cube doesn't belong to the two dimensional space of the page surface but it lies in the three dimensional area of the room. Moreover you imagine that although the relative velocities of the stars are small relative to the velocity of light (as are the velocities of the stars and planets) in the real world all stars and the other cosmic objects of the universe have an extra motion along the fourth dimension (with the velocity of light) which is a non-perceptible phenomenon.

The world of Physics resembles a mysterious performance that is being played on an immense stage of four dimensions, namely, time of duration and length, amplitude and altitude which confines the solid bodies. The three last dimensions are conceivable through our daily experience but time, the first of them, is impressed on our minds as a continuous flow of events and not as a geometrical distance like the three spatial dimensions. However, time as well flows in a system of bodies where each of them is found at absolute rest, relative to the others. The secret is hiding in the content of matter of these motionless bodies because matter is composed from a majority of elementary energy amounts, which are called quantum of energy and they are moving perpetually in a world of at least four geometrical dimensions. We can consider that these quantum are trapped in the interior of very deep wells composed by the strong field forces of elementary particles. We can also imagine that these potential wells, confined by three dimensional walls of hyper-cylinders, which expand their axes along the fourth dimension that is time direction. Because the quantum follows crooked line orbits of successive reflections on the three dimensional hyper-cylinder walls they all have a parallel motion along time direction, whereas the very small movements of potential wells along the other three spatial directions compose the known macroscopic motions of the solid bodies in the common three dimensional space. The first motions along time direction constitute the rest mass energy of bodies that according to Einstein is the time coordinate of the cosmic momentum  $E = mc^2$  and the second kind of motions along the spatial coordinates coincide with the spatial coordinates of the cosmic momentum. If the presence of a gravitational field would decelerate these quantum motions relative to another system of bodies (frame of reference) then time in the first system (frame of reference) would go slowly relative to the second one because all the macroscopic motions are collections of these elementary quantum motions. However in this process the substance of forms is found to the motion of energy quantum so we could say that this motion is the basis of energy quantum existence. In a hypothetical world by one dimension poorer the simulation of the previous four dimensional real model would be a balloon that is blown up because the material points of its elastic membrane make not only vibrations on this membrane but they have one more motion along the radius that corresponds to time dimension of the previous real model. Moreover the axes of the potential wells correspond to the radiuses of the balloon.

The four dimensions expand outside the potential wells which configure the macrocosm of human historical events as well as the megacosm including cosmo-

logical events of about 100 billion galaxies of our observed universe. Every such galaxy (except quasars which are considered as underage galaxies with big central black holes) consists of hundreds of billions of stars like the sun. Obviously some of the stars have planets around them as our sun. According to the modern consideration all galaxies and quasars belong on the three dimensional spherical membrane that is our common space at a great distance. This three dimensional membrane is blown up and expanding in a strange four dimensional Euclidean space-time. As we said our mind can't have geometrical perception and so we simulate this world by a two dimensional membrane of a common balloon. On this perceptible membrane we can imagine all the galaxies. The center obviously corresponds to the event of the Big Bang and the radius to the cosmic vector of time. If we imagine our galaxy as a pole of this spherical membrane we can understand that our mind imagines the world as a tangent plane (on the pole) where the 100 billions of galaxies are projected. This plane in our real state has one dimension more and it is the illusion of the common Euclidean three dimensional space (like a big cube expanding into infinity) whereas the real cosmic membrane is not Euclidean but spherical as we said. And finally all cosmic objects are projected again on a sphere, the celestial sphere, that corresponds to a circle on the tangent plane of the simulating, poorer by one dimension, model. If we consider nature as an infinite quantity including infinite number of universes with different Laws we must conclude that the origin and basis of nature is hypernatural. The same would be our conclusion if we consider the existence of a lone universe with an inconceivable beginning, the Big Bang. Under this image of the reality a question appears without scientific answer: "nature or creation?" Any religious answer couldn't be proven scientifically because the religious laboratory is merely the person himself. "The personal apocalypse of God for example". This personal apocalypse can't be searched scientifically. This is a real wall between science, a human technique, and the religious personal relationship with God and this wall will remain until the end of this world as a boundary between Physics and Hyper Physics. Socrates, the Greek philosopher, taught the objectivity of the existence of the truth. In other words Reality is the objectivity above our subjective considerations, right or wrong. But human history proves that there are subjective experiences of Reality beyond the scientific laboratory experiences. Additionally, the main criterion of truth in science as well as in religion is the fact that truth should not contain contradiction. The above statement could be as well a strong argument against the mixing (συγκρητισμός) of different religions or dogmas. During 500 years of history of experiments and mathematical calculations we can arrive to a "naïve" sketch of the reality. The deeper substance of nature remains continuously inconceivable. This process is difficult and very slow. Almost a qualitative progress every century. We illustrate the pessimistic ascertainment of Born: "We arrived at the end of our trip to the soundings of matter. We searched for solid ground and we didn't find it. The deeper we penetrate the more the world becomes more fleeting, intangible and foggy".

## DEAD STARS AND TIME TRAVEL

In studying Astrophysics we learn that stars are sometime born and sometime even die. They are born from the condensation of mass from Galactic gases and die as a result of great explosions after billions of years. Our sun, one of about 200 billion similar stars in our Galaxy, was born 5 billion years ago and will die in about 5 billion years by a final explosion. What would remain after this explosion would be a very dense object with a mass a thousand times greater than Earth's mass, called White Dwarf. There are other greater and more heated stars than the sun, which die with more stout explosions. These explosions make the star glow billions of times more as the nuclear fire of the explosion bucks to the immense area of the dark space matter millions of times greater than our planet and with velocities which sometimes are close to the velocity of light (300000 Km/s). These super brilliant stars are called Supernovas. Such a star was observed recently in 1987 in the "near" galaxy of Magellan. The theory of stellar explosion as well as the stellar collapse was confirmed exultantly because the particles which reached Earth's surface, after a trip of 160000 years, had the properties that had been provided by the calculations. The calculations were based on the General Relativity Theory and on Quantum Physics. The inner temperature of the star reached 50 billion degrees Kelvin. These explosions take place in a matter of a few hours or days but the expansion of emitted materials continues for ever. Fortunately the previous explosion of SN1987 was 160000 light years away. If such a stellar explosion took place for example at our "close" star Sirius whose distance from Earth is about 10 light years (about 100 trillions of Kilometers), the radioactive rays will reach Earth after a trip of 10 years, which would sterilize every kind of life on Earth although this radioactivity would be diluted millions of times. What will remain after such a stellar explosion is something very dense. A super dense object. A dead star. What is this? This may be a white dwarf or a star neutron or a black hole. The result depends on the remaining matter.

The question that you could have now is why stars die with an inconceivable power explosion. The reason is found in the core of the star, that is its nucleus, where the thermonuclear reactions take place during billions of years. These reactions are fueled with heat energy, which is radiated in space. Really the end of a star life is near when its nuclear fuel (as they are isotopes of hydrogen, carbon, nitrogen and so on) begins to exhaust. At this time the rate of the thermonuclear reactions decreases, the average temperature of the star decreases too. But as the temperature decreases gravity tries to squash it, as a result there is no counterbalance and consequently the star begins to collapse, because the gravitational forces, which compress the stellar matter is greater than the thermal impulsion, that is inverse to the gravity and so it acts a dilation trying to catapult the stellar matter out into space. So by this first contraction the remaining thermonuclear fuels in the star core begin to contract,

now more than before at the normal star balance. The obvious result is the abrupt growth of the rate of thermonuclear reactions and the star begins the phase of over heating. This over heating produces an enormous impulsion that is inverse and now greater than the gravitational forces and then this moves the stellar material outwards. The stellar mater begins to move atrociously outwards and the star blows up, until the temperature of stellar materials is reduced sufficiently and then the gravity outplace again and the star begins to contract again. Indeed a part of the stellar matter is launched for ever into space and does not return to the star. The star can die after a few such contractions and dilations. The mechanism of remaining matter compression depends on the gravity. The star that has been blown up, has exhausted a great part of its thermonuclear fuels from which it derives its heat during the billions years. The rate of the thermonuclear reactions in the stellar core increases as gravity compresses these remaining thermonuclear fuels, uninterruptedly more. Unfortunately for the collapsing star, at this final stage the impulsion forces of the nuclear heat is uninterruptedly little smaller than the gravitational forces trying to squash the star. Let us remember that the intensity of a gravitational field on the surface of a spherical mass  $M$  with a radius  $r$ , increases inversely proportional to the square of the radius  $r$ , that is  $g = MG/r^2$ . Suppose for example that at a moment the radius of the spherical star that is collapsing, is 30000 Km. If after a time of 1sec this radius will became half of the previous, that is 15000 Km, then the gravity does not become two times greater but accordingly to the previous formula:  $2^2 = 4$  times. If in the meantime the thermal impulsion has been increased less than 4 times, the gravitational forces of squash will be preceded by the thermal impulsion and consequently the condensation will be continued. So although the temperature of the star increases continuously (as it is being compressed ) and it reaches a colossal high, the thermal impulsion can't get the victory from the gravity to make a new explosion. The gravity as a giant palm compresses continuously the star, defeating the thermal impulsion that in some cases is equivalent to the impulsion that would produce over  $10^{30}$  thermonuclear bombs of Hydrogen. Who could stop the contraction of the star ? Who finally could barricade the road to the crescent gravity? There are three scenarios. In the first case of White Dwarfs this is the Quantum pressure of the electrons of stellar matter, which is being compressed allots uninterruptedly less space to these electrons. Quantum Mechanics teaches that the elementary particles of matter, as are the electrons, resemble "phantoms" which at a given moment are "everywhere and nowhere". But when space for their motion is confined the result is the increment of the probability of electrons appearance in this space and so increases as well their momentum and their energy, namely the uncertainty principle:  $\Delta p \cdot \Delta x \sim \hbar$  is applied. The second scenario refers to the star neutrons where the stellar mass is greater than the mass of the previous scenario and so the quantum pressure does not inflict to counterbalance gravity. The let space now for the electron motions in the interior of the atoms is annihilated and consequently the electrons fall on their corresponding protons of nucleus to forming neutrons in contact. Finally the star becomes

an enormous atomic nucleus with a diameter of about 20 Km! The most prize sphere of the universe. Now the gravity has to confront the resistance of very greater nuclear forces of adjoined neutrons and the crash is given over. At last the star balances at a new “terrible” state. In the third scenario of black holes the stellar mass is so great ( about 4 times the mass of the sun) so neither the resistance of nuclear forces can resist the increasing gravitational forces to stop the collapse. After the forces of the nuclear field there isn’t some other kind of forces to resists the gravity that now has acquired an intensity that is a trillion times greater than the intensity of the Earth gravity. The gravity here overpowers for ever. The adjoined neutrons of stellar mater penetrate each in other swallowing that we call space and time. The terminal velocity of escaping inside a spherical surface around the black hole (that is called event horizon) is greater than the limit  $c = 300000$  Km/sec and so nothing can escape from there. An invisible hole of space-time. This dead star is called a black hole.

When our star, the sun, will become a white dwarf it will have the bulk of the Earth, whereas now the sun is about 1500000 times greater. In the case of star neutrons and the black holes the matter is found at exotic states. The cause as we said is the gravity, a tireless and unbroken force that makes the star to gobble itself in few fractions of second to change the properties of the known space and time around it. A neutron star is a mass made up from adjoined neutrons, where the density of the matter reaches the enormous value of the atomic nucleus. A dessert spoon from such matter will be trillions Kg. The distortion of space-time has began. From the previous we easily understand that in the case of black holes the condensation is more great and the density theoretically tends to the infinite. Today by the help of satellite telescopes and other instruments we have discovered white dwarfs, star neutrons and we have suspicions that some stellar sources hide black holes inside. The event horizon is a spherical surface with radius  $R_s = 2MG/c^2$  around a black hole with mass  $M$ . Every material object as well as light rays when passing the event horizon are lost for ever from the known universe and they go to an unknown mysterious world. As the inferno of Dante. Even light can’t escape the interior of the event horizon. But how can we locate black holes? The opportunity comes from the cases where a giant star is escort of a black hole that steals material from the star escort. The incoming matter forms an accretion disk above the event horizon. The materials are heated at temperatures which sometimes reach the order of millions of degrees. The mechanism that heats the matter of accretion disk has not been investigated sufficiently yet. In the following article “The Quantum Mechanics of General Relativity” a theory is presented with an application that explains the heating of accretion disks as a new physical phenomenon. This application is made for the X-ray stellar source of Cygnus X-1 (a binary system consisting of a possible black hole probably with 10 times the mass of our sun, orbiting around the mass center with the escort giant star HDE 226868, over a period of 5-6 days and at a distance of 2,5 Kpc or about 8000 years of light from the earth) as well as the quasar sources where enormous energy



may be produced by a similar mechanism of entrance matter in enormous black holes with mass a billion times greater than the mass of Cygnus X-1. A clock setting near the event horizon works very slow. If a clock approached the horizon and then returns back to the flat space-time the clock would measure for example 1 year and in the meantime in the flat space-time, on Earth, 100 years would have passed. That is 1 year for an imaginary escort of the clock corresponds to 100 years on the Earth. This is “the travel in time”. Einstein proved that time is a 4<sup>th</sup> dimension of the three dimensional common space and the total structure is the space-time. The reason that we can't perceive time as a geometrical distance is due to the three dimensional ability of the perception of our brain but the universe at its great areas is proven to be a four dimensional creature. To understand it, let to imagine a living two dimensional creature as “decal”, that percepts only two dimensional things as they are the flat circles the flat triangles and so on. This two dimensional creature is unable to perceive three dimensional things as humans, trees, mountain and so on. The creature can understand these things only theoretically by mathematical process. The geometry of spaces with arbitrary number of dimensions and with every curvature is the geometry of Riemann-Gauss and depends on the tensors analysis. A four dimensional elementary vector  $d\vec{s}$  is invariant relative to all frames of reference (flat and curved) but the four coordinates  $dx, dy, dz, dt$ , are not invariant. Namely we can write the following:

$ds^2 = g_{\mu\nu} dx^\mu dx^\nu = \text{invariant}$  with  $\mu, \nu = 0, 1, 2, 3$  and  $g_{\mu\nu}$  represents the metric tensor. For the special case of flat space-time (Euclidean) is valid that

$$[g_{\mu\nu}] = I \Rightarrow ds^2 = -(dx^0)^2 + (dx^1)^2 + (dx^2)^2 + (dx^3)^2 = \text{invariant},$$

with  $dx^0 = cdt$  and where  $dx^1 = dx$ ,  $dx^2 = dy$ ,  $dx^3 = dz$  are the known spatial coordinates of the four vector  $d\vec{s}$ . The components  $dx, dy, dz$  are the components (coordinates) of  $d\vec{s}$  on the three axes of an orthogonal frame  $Oxyz$  but the 4<sup>th</sup> component  $dx^0 = cdt$  is the component on the imaginary axis of time. The distance  $ds = AB$  adjoins two space-time points A, B, which are two events. We can understand now the generalization of Pythagorean theorem in 4 dimensional space-time:

$$ds^2 = dx^2 + dy^2 + dz^2 - c^2 dt^2.$$

As we approach the event horizon the dimension of time  $cdt$  is being dilated and the dimension of space along the directory of black hole radius  $R_s$  is being contracted. The result is that time moves slower relative to the Earth frame. A frozen eternal world. Truly we are living in a very big and paradox world that justifies our faith and hope to an infinite creator. But in the marvel of our abridged life the greatest force of life is revealed. Love.