Fractal dimension structure of Cosmos and its mathematical foundations

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Abstract Fractal dimension structure of the Cosmos are explored, and the mathematical foundation, which include the expressions of fractal dimension differential and calculus, regular space integral solutions of fractal dimension differential equations, the fractal calculus definitions of fractal measure as well as the measure computational equation of self-similar fractal, fractal dimension calculus and fractal measure are given. As annotation, an equation of the relation between neutrons and protons in nuclei and its periodical solutions as well as atomic number limit are discussed.

Keywords Cosmos, fractal dimension structure, fractal dimension calculus, fractal differential equation, fractal measure, atomic number limit

Yan Kun. Fractal dimension structure of Cosmos and its mathematical foundations[J]. Progress in Geophysics(in Chinese), 2004, 19(3): 709～716. DOI:10.3969/j.issn.1004-2903.2004.03.036.
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Energy-exchange descriptions on the superluminal velocity and quantum fractal

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Abstract In this paper, consider taking the vacuum as a form of medium, which preliminary shows that the vacuum has the backgrounds at the several levels interaction each other, and it can block or quickly transfer the specific mechanical vibration, and the vacuum has the natural frequency oscillation (or the vacuum ripple), by exploring the constancy of light velocity in the vacuum, energy-exchange equation and vortex shedding wavelength equation in Karman vortex-street, expressional forms of equation of the one-way velocity of light (also equation of the one-way speed of light, or equation of one-way variable speed of light) for the constancy of the two-way velocity of light (or constancy of the two-way speed of light), experimental criterion equation for the closed strings model of the photon (general refraction equation of the photon with one same rotation plane), superluminal (also faster-than-light or FTL) velocity, medium action equation of particle fractal motion for the wave-particle duality, and quantum fractal are studied deeply. As a result, it shows that a tentative theoretical frame which includes not only the superluminal-velocity motion but consists with Einstein special relativity and quantum theory can be established.

Keywords equation of one-way velocity of light, general refraction equation, medium action equation, superluminal velocity, quantum fractal, energy exchange, particle fractal motion

Yan Kun. Energy-exchange descriptions on the superluminal velocity and quantum fractal[J]. Basic Science Journal of Textile Universities(in Chinese), 2004, 17(3):223～227. DOI:10.3969/j.issn.1006-8341.2004.03.010.
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Introductions on the medium shell and discrete orbits of celestial bodies motion

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Abstract By using phenomenological method for the medium shell curve, an energy equation on three dimensions regular space and an energy-gravitation form about gravitational interaction between bodies are given. Further more, two condition solutions of the gravitational expression is close by with the results of Newton's gravitational theory and Einstein's general relativity respectively. The localizations in the functions of the fractal dimension calculus compared with the fractional-order calculus at present are discussed, and similar expanded equation is given. Subsequently，by discussing the expanded baseline property on the celestial motion orbit, discrete orbital equations of the celestial bodies motion are given. And referring to the related orbital data of planets and some satellites in the Solar System, the concrete expression on the discrete orbit of the celestial bodies motion are given too.

Keywords medium shell curve, discrete orbital equation of celestial bodies motion, energy equation, localization of fractal dimension calculus, similar expanded equation, fractal dimension expanded

Yan Kun. Introductions on the medium shell and discrete orbits of celestial bodies motion[J]. Progress in Geophysics(in Chinese), 2004, 19(4): 984～995. DOI:10.3969/j.issn.1004-2903.2004.04.046.
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The general expression of Binet equation about celestial bodies motion orbits

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Abstract By discussing the existent equations of mass-velocity relation, an equivalent polar coordinate equation and its Binet equation of the mass-velocity relation are given, and expressions of the mass-velocity relation and mass-energy relation are given too, which include forms of superluminal (also faster-than-light or FTL) motion. Subsequently, using the mass-energy relation, the general expression of the solution of the energy equation on the medium shell curve method is discussed, and general expression of Binet equation and its approximate solutions about orbits of the celestial bodies motion in weak and strong gravitational field are given. Further more, analysis solutions of the advance of the perihelion of planets and bending of light for the gravitational force are given.

Keywords orbit of the celestial bodies motion, equations of mass-velocity relation, Binet equation, superluminal motion, advance of the perihelion of planets, bending of light, gravitational frequency shift

Yan Kun. The general expression of Binet equation about celestial bodies motion orbits[J]. Progress in Geophysics(in Chinese with abstract in English), 2005, 20(2): 534～539. DOI:10.3969/j.issn.1004-2903.2005.02.052.

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The tendency analytical equations of stable nuclides and the superluminal velocity motion laws of matter in geospace

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Abstract In this paper, by discussing the existent distribution trend of relation for the proton number and the neutron number to be included by the stable nuclides in geospace, tendency analytical method and it's periodic distribution equation forms of the stable nuclides are expressed at first. Then a comparison result between the curve of the theoretical equation analysis and the points of the experimental distribution data of the stable nuclides in geospace are given. Further more, stable nuclide limit and chemical element limit for the chemical element periodic table are given, and possible corresponding relation equation with the positron-particle annihilation is expressed, which includes estimation of order of the static mass to be situated nearby at the electron neutrino structural dimension and a tendency distribution equation (with the characteristics of dense distribution in the partial closed intervals and sparse distribution in the few open intervals) of the particles mass. Subsequently, by forming two hypotheses about energy state of vacuum matter, and basing on an equivalent Binet's equation, mass equations and energy equations of the partial moving with light-velocity or superluminal (also faster-than-light or FTL) velocity motion fusing with the results of Einstein special relativity are expressed. As inference, possible corresponding relations between the mass equations and energy equations with the dark matter and dark energy are discussed tentatively.

Keywords stable nuclide, tendency analytical equation, periodic law, chemical element limit, tendency distribution of the particles mass, energy state of vacuum matter, equations of superluminal velocity motion

YAN Kun. The tendency analytical equations of stable nuclides and the superluminal velocity motion laws of matter in geospace[J]. Progress in Geophysics(in Chinese with abstract in English), 2006, 21(1): 38～47.
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Introduction on background medium theory about celestial body motion orbit and foundation of fractional-dimension calculus about self-similar fractal measure calculation

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Abstract In this paper, by discussing the basic hypotheses about the continuous orbit and discrete orbit in two research directions of background medium theory for celestial body motion, concrete equation forms and their summary of the theoretic frame of celestial body motion are introduced. Future more, by discussing the general form

of Binet's equation of celestial body motion orbit and it's solution of the advance of the perihelion of planets, some relations and differences between the continuous orbit theory and Newton's gravitational theory and Einstein's general relativity are given. And by discussing fractional-dimension expanded equation for the celestial body motion orbits, the concrete equations and the prophesy data of discrete orbit or stable orbits of celestial bodies which included the planets in the Solar System, satellites in the Uranian System, satellites in the Earth System and satellites obtaining the Moon obtaining from discrete orbit theory are given too. Especially, as preliminary exploration and inference to the gravitational curve of celestial bodies in broadly range, the concept for the ideal black hole with trend to infinite in mass density difficult to be formed by gravitation only is explored. By discussing the position hypothesis of fractional-dimension derivative about function and formula form the hypothesis of fractional-dimension derivative about power function, concrete equation formulas of fractional-dimension derivative, differential and integral are described distinctly further, and difference between the fractional-dimension derivative and the fractional-order derivative are given too. The difference equations description of the self-similar fractal extension and fractional-dimension extension are discussed. Subsequently, the concrete forms of measure tendency calculus equations of self-similar fractal obtaining by based on the definition of form in non-integral order calculus about general fractal measure are discussed again, and differences with Hausdorff measure method or the covering method at present are given. By applying the measure calculation equations, measure of self-similar fractals which include middle-third Cantor set, Koch curve, Sierpinski gasket and orthogonal cross star are calculated and analyzed. At the end, the calculating equations of dimension and measure of an ideal points set are explored.

Keywords orbit of celestial body motion, background medium theory, continuous orbit, discrete orbit, self-similar fractal measure, non-integral order calculus, fractional-order calculus, fractional-dimension calculus

YAN Kun. Introduction on background medium theory about celestial body motion orbit and foundation of fractional-dimension calculus about self-similar fractal measure calculation[J]. Progress in Geophysics(in Chinese with abstract in English), 2007, 22(2): 451～462. DOI:10.3969/j.issn.1004-2903.2007.02.018.
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http://www.nature.ac.cn/report/paper-pdf/celestialandmaths-pdf.pdf

Primary annotation of symbol basing on imaginary form about infinity

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Abstract In this paper, primary annotation of symbol basing on imaginary form about infinity is given.
Keywords infinity, zero, imaginary form, symbol, annotation, Euler's formula

YAN Kun. Primary annotation of symbol basing on imaginary form about infinity[R]. Xi'an Modern Nonlinear Science Applying Institute, 18 March 2009.
http://www.nature.ac.cn/papers/paper-pdf/spirit-pdf.pdf

Research on tendency equation about the concentration data of carbon dioxide in the atmosphere over the past 60 years

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Abstract In this paper, by discussing the existing distribution of the CO_2 concentration data in the atmosphere over the past 60 years, and adopting the tendency analytical method, concrete tendency equation forms of the CO_2 concentration are presented at first. Further more, comparison result between the curve of the theoretical equation and the data curve of CO_2 concentration from the ice cores analysis or the observation is given. The result shows that the tendency equation curve agree well with the existing data. Subsequently, predictive data of the CO_2 concentration in the atmosphere during the year from 2010 to 2016 are suggested tentatively, and the coupling model of the relationship among the rotation, rotation and the global plate motion of the earth is briefly discussed.

Keywords concentration of carbon dioxide, atmosphere, tendency equation, curve fitting, predictive data, data analysis, coupling model

YAN Kun. Research on tendency equation about the concentration data of carbon dioxide in the atmosphere over the past 60 years[J]. Progress in Geophys. (in Chinese with abstract in English), 2009, 24(5):1665～1670. DOI:10.3969/j.issn.1004-2903.2009.05.016.
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Research on adaptive connection equation in discontinuous area of data curve

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Abstract In this paper, by discussing approximate equivalent analytical solution of nonlinear dynamics equation and some properties in discontinuous area of data curve, a general constructing form of adaptive connection equation and preset iteration method determining parameters in discontinuous area are given. And then, a connecting method of the mapping equations for the discontinuous areas of general curves is also given. Subsequently, computing examples which included the discontinuous areas with dislocation and turn-back are given too. This adaptive connection equation can be applied as a general form of expansion (extended hyperbolic tangent function) of the classical S-curve (sigmoid curve) equation or Logistic function, and for step discontinuous area of slowly varying data curve, its form of the adaptive connection equation can be obtained by automatic calculating. In this paper, compatibility of the nonlinear equation in classical Newton dynamic equation and the charge equation of the RLC series circuit is analyzed. Basing on the form of the adaptive connection equation, an approximate expression of extended hyperbolic tangent series for the characteristic function of the series phases transition of the evolution of phenomena, equations of magnetic hysteresis loop for magnetic material, extended form of average energy equation (or Einstein-Stern equation) and tendency differential equation of the average particle number for the statistical distributions of the particles, equation of average binding energy per nucleon (or specific binding energy) of stable nuclide, a theoretical maximum of the nuclear binding energy and its corresponding proton number, abundances equation of elements in the Solar System, curvilinear equation of potential energy function (such as curvilinear equation of potential energy function of diatomic molecule, etc), equation of natural saturation process (such as tree growth and physical reaction or chemical reaction process, equation of fracture toughness for steel material, etc) and equation of typical creep process for metal or rock material are explored and analyzed tentatively.

Keywords nonlinear dynamics equation, discontinuous area of data curve, adaptive connection equation, connecting method of the mapping equations, equations of magnetic hysteresis loop, equation of statistical distributions of the particles, equation of average binding energy per nucleon, abundances equation of elements in Solar System, curvilinear equation of potential energy function, equation of natural saturation process, equation of creep process

YAN Kun. Research on adaptive connection equation in discontinuous area of data curve[J]. Progress in Geophys(in Chinese with abstract in English), 2011,26(1): 162～171. DOI:10.3969/j.issn.1004-2903.2011.01.018.
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http://www.nature.ac.cn/papers/paper-pdf/curveandequation-pdf.pdf

Brief annotation of the connection equation

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Abstract In this paper, brief annotation of a constructing procedure and the applications of connection equation are given. An analytical method of the connection equation as an approximate equivalent analytical solution of nonlinear dynamics equations is discussed. The expressions of the basic analytical solution of a class of simple nonlinear differential equations are analyzed. Research direction of Jiansics or Dimennics about spectrum(spectrum array) formed by series of laws and their connections in evolution processes of natural phenomena are explored, an equation of the transformation of the phenomena between the states in evolutionary process is presented, that it follows a natural optimum principle or a natural conciseness principle in general, which having an equation form of the smooth curve with the optimal path or the most concise path, simple constructing forms of forward partial-symmetrical equation(or weak-symmetrical equation) and backward partial-symmetrical equation are given, an approximate expression of extended hyperbolic tangent series for the characteristic function of the series phases transition of the evolution of phenomena is constructed, then natural evolution-balance rule is presented, and tendency equation of biological growth process is given too. According to approximate form of the nonlinear dynamics equation of the connection equation, two new electronic circuit elements(nonlinstor and geomsentor) with deepening charge-controlled capacitor properties based on form of the nonlinear differential equation is predicted, and the nonlinear differential equation for a RLCNG series circuit is also analyzed, extended direction of the general distribution function and the general distribution density function, tendency equation and its conditional solutions of the statistical distributions of the particles are given, properties of the frequency interval of Planck's quantum equation are explored, nonlinear differential equation expressions with solution of approximate linear frequency

conversion and their characteristics of curve shapes of frequency conversion wave equations at negative frequency are discussed, a concise model of database theoretical framework (this framework to be made up of foundation database, tendency equation, and analytic database) is explored, an equation of relationship between the total annual energy consumption with the annual GDP in the United States, and an equation of relationship between the annual population with the annual GDP in the United Kingdom are established, and limit values of the total annual energy consumption in the United States and the annual population in the United Kingdom are calculated and predicted. Subsequently, tendency fitting equations of curves are explored, which included the creep process curve of the rock and the single-crystal superalloy, the Volt-Ampere characteristic curve of the discrete semiconductor device, the resistance (or resistivity)-absolute temperature curve of the superconducting material, the direct current *I-U* characteristic curve of the bicrystal Josephson junction, and the current step amplitude of Shapiro steps, the friction-speed characteristic curve (that included the stages of Coulomb friction, Stribeck friction, viscous friction, friction hysteresis, and anomalous friction hysteresis effect) in mechanical system or servo system, an expanded equation form of the Newton's law of cooling, the shear stress-shear rate in the flow curve (that included the sections of first Newtonian fluid-flow, pseudoplastic flow, second Newtonian fluid-flow, dilatant flow, turbulent flow, and anomalous shearing effect) of the polymer melts, etc. On phenomenological and tendency levels, research directions of similar property of creep curves of materials with the flow curves of polymer melt, and similarity in the fractal measure of the evolutions of fracture cracks growth structure and fluid turbulent eddies nested structure are pointed out. At the end, limitations of the connection equation in data fitting and long-range forecasting are discussed.

Keywords connection equation, nonlinear dynamics equation, spectrum array of laws, Jiansics or Dimennics, states transforming equation, natural conciseness principle, natural evolution-balance rule

YAN Kun. Brief annotation of the connection equation[Report]. Xi'an Modern Nonlinear Science Applying Institute, 18 March 2011.
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Analysis method of PSSIR model equations and its tendency prediction for the infection data of the novel coronavirus pneumonia(NCP) in China

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Abstract In this paper, by discussing the cumulative number of people of confirmed SARS(severe acute respiratory syndrome) virus infection in Beijing and Hongkong in 2003, and basing on the data of the number of novel coronavirus pneumonia(called NCP or 2019-nCOV(2019-new coronavirus)) confirmed infection in China between 11 January and 21 February 2020, using the simple analysis method of the general saturation process, corresponding partial-symmetrical equations(or weak-symmetrical equations) are given. Then by using the partial-symmetrical equations, the SIR model equations with the small sample data volume are discussed, PSSIR model equations and its approximate solutions are given preliminarily, and the accumulated data of the novel coronavirus pneumonia infection in China and in China except for Hubei Province are analyzed and calculated tentatively. At the same time, corresponding inflection point position and stage limit value of tendency prediction are given too. The results of this paper provide a reference for the description of multivariable nonlinear dynamic equations in the development of viral infection.

Keywords novel coronavirus pneumonia, SARS virus, infection data, partial-symmetrical equations, PSSIR model equations, approximate solutions, tendency prediction

YAN Kun. Analysis method of PSSIR model equations and its tendency prediction for the infection data of the novel coronavirus pneumonia(NCP) in China[Report]. Xi'an Modern Nonlinear Science Applying Institute, 22 February 2020.
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