

## 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.

[http://en.cnki.com.cn/Article\\_en/CJFDTOTAL-DQWJ200403036.htm](http://en.cnki.com.cn/Article_en/CJFDTOTAL-DQWJ200403036.htm)

<http://www.nature.ac.cn/report/paper-pdf/cosmosandmaths-pdf.pdf>

## 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, by exploring the constancy of light velocity in the vacuum, the energy-exchange equation and the vortex shedding wavelength equation in Karman vortex-street, the 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), the experimental criterion equation for the closed strings mode of the photon (the general refraction equation of the photon with a 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.

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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<http://www.nature.ac.cn/papers/paper-pdf/physics-pdf.pdf>

## 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 the 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 at present are discussed, and the similar expanded equation is given. Subsequently, by discussing the expanded baseline property on the celestial motion orbit, the discrete orbital equation 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.

**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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<http://www.nature.ac.cn/papers/paper-pdf/celestial-pdf.pdf>

## 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, the equivalent polar coordinate equation and its Binet equation of the mass-velocity relation are given, and the expressions of the mass-velocity relation and mass-energy relation are given too, which include the 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 the general expression of Binet equation and its approximate solutions about orbits of the celestial bodies motion in the weak and strong gravitational field are given. Further more, the analysis solutions of the advance of the perihelion of planets and bending of light for the gravitational force are given too.

**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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<http://www.nature.ac.cn/papers/paper-pdf/celestialBinet-pdf.pdf>

## 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, the tendency analytical method and its periodic distribution equation forms of the stable nuclides are expressed at first. Then the 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, the stable nuclide limit and the chemical element limit for the chemical element periodic table are given, and the possible corresponding relation equation with the positron-particle annihilation is expressed, which includes the estimation of the order of the static mass to be situated nearby at the electron neutrino structural dimension. Subsequently, by forming two hypotheses about the energy state of vacuum matter, and basing on the equivalent Binet's equation, the mass equations and the 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, the 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, 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.

DOI:10.3969/j.issn.1004-2903.2006.01.007.

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<http://www.nature.ac.cn/papers/paper-pdf/vacuumenergy-pdf.pdf>

## 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 the background medium theory for celestial body motion, the 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, the relations and differences between the continuous orbit theory and Newton's gravitational theory and Einstein's general relativity are given. And by discussing the 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 the 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 the formula form the hypothesis of fractional-dimension derivative about power function, the concrete equation formulas of fractional-dimension derivative, differential and integral are described distinctly further, and the difference between the fractional-dimension derivative and the fractional-order derivative are given too. 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 the differences with Hausdorff measure method or the covering method at present are given. By applying the measure calculation equations, the measure of self-similar fractals which include middle-third Cantor set, Koch curve, Sierpinski gasket and orthogonal cross star are calculated and analyzed.

**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, the 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<sub>2</sub> concentration data in the atmosphere over the past 60 years, and adopting the tendency analytical method, the concrete tendency equation forms of the CO<sub>2</sub> concentration are presented at first. Further more, the comparison result between the curve of the theoretical equation and the data curve of CO<sub>2</sub> 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, the predictive data of the CO<sub>2</sub> concentration in the atmosphere during the year from 2010 to 2016 are suggested tentatively.

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

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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<http://www.nature.ac.cn/papers/paper-pdf/co2concentration-pdf.pdf>

## Research on adaptive connection equation in discontinuous area of data curve

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**Abstract** In this paper, by discussing the approximate equivalent analytical solution of the nonlinear dynamics equation and the properties in discontinuous area of data curve, a general constructing form of adaptive connection equation and the preset iteration method determining parameters in the discontinuous area are given. And then, the connecting method of the mapping equations for the discontinuous areas of general curves is also given. Subsequently, the computing examples which included the discontinuous areas with the dislocation and the 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 the step discontinuous area of slowly varying data curve, its form of the adaptive connection equation can be obtained by automatic calculating. In this paper, the 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 data curve or the partial continuous functions, the equations of magnetic hysteresis loop for magnetic material, the extended form of average energy equation and the tendency differential equation of the average particle number for the statistical distributions of the particles, the equation of average binding energy per nucleon in stable nuclide, the curvilinear equation of potential energy function (such as curvilinear equation of potential energy function of diatomic molecule, etc), the equation of natural saturation process (such as tree growth and physical reaction or chemical reaction process, the equation of fracture toughness for steel material, etc) and the 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, 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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### Brief annotation of the connection equation

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**Abstract** In this paper, the brief annotation of a constructing procedure and the applications of the connection equation are given. An analytical method of the connection equation as an approximate equivalent analytical solution of the nonlinear dynamics equations is discussed, the equation of the transformation of the phenomena between the states in evolutionary process is presented, that it follows a natural shortcut principle or natural shortpath principle of the equation form of the shortest smooth curve in general. An approximate expression of extended hyperbolic tangent series for the data curve or the partial continuous functions is constructed. According to the approximate form of the nonlinear dynamics equation of the connection equation, two new electronic circuit elements (nonlinstor and geomsentor) with the deepening charge-controlled capacitor properties based on the form of the nonlinear differential equation is predicted, and the nonlinear differential equation for a RLCNG series circuit is also analyzed, the tendency equation and its conditional solutions of the statistical distributions of the particles are given, the nonlinear differential equation expressions with the solution of approximate linear frequency conversion and the characteristics of the curve shapes of frequency conversion wave equations at the negative frequency are discussed, a concise model of the database theoretical framework (this framework to be made up of the foundation database, the tendency equation, and the analytic database) is explored, the equation of relationship between the total annual energy consumption with the annual GDP in the United States, and the equation of relationship between the annual population with the annual GDP in the United Kingdom are established, and the

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, the tendency fitting equations of the 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, the 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 the phenomenological and tendency levels, the research directions of similar property of creep curves of materials with the flow curves of polymer melt, and the 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, the limitations of the connection equation in the data fitting and long-range forecasting are discussed.

**Keywords** connection equation, shape of curve, nonlinear dynamics equation, approximate equivalent analytical solution, states transforming equation, natural shortcut principle

YAN Kun. Brief annotation of the connection equation[Report]. Xi'an Modern Nonlinear Science Applying Institute, 18 March 2011.

<http://www.nature.ac.cn/papers/paper-pdf/ConnectionEquation-pdf.pdf>

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