Determining Relations of Power Products of Physical Quantities by Generalized Relational Expression

Yong Bao

Postbox 777, 100 Renmin South Road, Luoding 527200, Guangdong, China
E-mail: baoyong9803@163.com

The relations of power products of physical quantities (PQs) are determined by the generalized relational expression (GRE). Assuming the relations of two, three and four PQs to the GRE separately, we find the corresponding general formulas. Ordering the exponent of physical constants in relations is zero or fit numbers, we gain many famous equations without factors such as Einstein mass-energy relation, formula of event horizon temperature of Schwarzschild black hole (SBH), equation of holographic dark energy (HDE) model, Casimir effect equation, Planck black body radiation formula, Stefan-Boltzmann law, Einstein field equation, Newtonian attraction law, Schrodinger equation, Coulomb law, Newtonian second law, Clapeyron equation, power law of superconducting films, centrifugal force formula, and so on. Some new relations are given including the square of total energy with energy density of HDE, square of energy with its density of SBH, energy density with sextic radii of SBH, pressure in SBH centre and entropy density of SBH center etc. We show that the GRE can determine the relations of power products of two, three and four PQs, it is useful and significant.

1. Introduction

It is the grail that a general theory can be found and deduced other physical equations in theoretical physics. The standard model [1] succeeds in uniting the weak interaction, electromagnetic force and strong interaction. Predictive 62 elementary particles are detected, including the Higgs boson recently [2], but it doesn’t embrace the gravity. Supersymmetry [3], superstring/M theory [4], loop quantum gravity theory [5] and A. Garrett Lisi’s exceptionally simple theory of everything [6] described the four forces, but aren’t detected [7]. Recently N. Wu’s quantum gauge general relativity [8], T. Ma and S.H. Wang produced unified field equations [9], Zh-Y. Shen’s SQS theory [10], and Y-L. Wu’s Quantum Field Theory of Gravity [11], also aren’t detected. Yin Ye, Hu Suhui considered the symmetric approximation [12]; Y. Bao produced the generalized relational expression (GRE) [13]. These are making progress.

This paper is organized as follows. In Sec. 2, we determine the relations of power products of two physical quantities (PQs); find the corresponding general formulas; obtain many famous equations such as Einstein mass-energy relation [14], temperature of event horizon of Schwarzschild black hole (SBH) [15], equation of holographic dark energy (HDE) model [16], Casimir effect equation [17], Planck black body radiation formula [18], Stefan-Boltzmann law [19], Einstein field equation [20], etc. In Sec. 3, we have the relations of power products of three PQs; find the corresponding general formulas also; get Newtonian attraction law [21], Schrodinger equation [22], Coulomb law [23], Newtonian second law [24], Clapeyron equation [24], power law of superconducting films [25] and so on. In Sec. 4, we give the relations of power products of four PQs; gain the centrifugal force formula [21]. We conclude in Sec. 5.

2. Relations of Power products of Two PQs

In this section, we obtain the relations of power products when \( n = 2 \) to the GRE; and find the corresponding general formulas; obtain the Einstein mass-energy relation, temperature of event horizon of SBH, equation of HDE model, Casimir effect equation, Planck black body radiation formula, Stefan-Boltzmann law, Einstein field equation, etc.

2.0 The basic relationship [13] is

\[
A_i - A_\rho = [\hbar (\delta + \varepsilon + \kappa + \eta) \zeta (3\delta - \varepsilon + 5\kappa - 5\eta) - 2\eta \varepsilon]^{1/2} (1)
\]

Where \( A \) is any physical quantity, \( [A] = [L] [M]^0 [T]^0 [Q]^2 \) its dimensions, \( L, M, T \) and \( Q \) are the dimensions of length, mass, time, temperature and electric charge separately (here we use the LMTQ units [13]), \( A_\rho \) the corresponding Planck scale of \( A, \delta, \varepsilon, \kappa, \eta \) and \( \lambda \) the real number, \( h, G, c, \kappa \) and \( \varepsilon \) the reduced Planck constant, gravitational constant, speed of light in vacuum, Boltzmann constant and elementary charge separately.

The GRE [13] is

\[
\sum_{i=1}^{n} A_i^{a_i} \sim \sum_{i=1}^{n} A_{\rho i}^{a_i}; \ i = 1, 2, 3...n (2)
\]

where \( A_i \) is the physical quantity, \( a_i \) the real number, and \( A_{\rho i} \) the corresponding Planck scale. When \( n = 2 \), we obtain
Determining Relations of Power Products of Phyical Quantities by Generalized Relational Expression  Y. Bao  viXra: 1502.0106

\[ A_{11} A_{22} \sim A_{12}^{A_1} A_{21}^{A_2} \]  

2.2.3 Instructing frequency quasi

\[ E = \frac{M \rho^G}{G} \]

2.2.2 Ordering 1

\[ E = \frac{M \rho^G}{\sqrt{G}} \]

Especially when \( a = 1 \), we obtain

\[ AB \sim A_1 B \]

When \( a = -1 \), we gain

\[ A \sim A_1 B / B \]

Therefore we can determine the relations of power products of two PQs. For example

2.1 Assuming that energy \( E \) has relations with mass \( M \) only, we find

\[ EM^a \sim E \rho^G M^\rho \]

\[ = \frac{\hbar^{(1+a)/2} G^{-(1+a)/2}}{c^{(5+a)/2}} \]  

where \( E_p = \frac{\hbar}{c} \) is the Planck energy and \( M_p = \frac{\hbar}{c} \) the Planck mass (From basic relationship (1)). It is the general formula for energy and mass.

2.1.1 Ordering 1

\[ E \sim Mc^2 \]

This is the Einstein mass-energy relation.

2.1.2 Instructing 5

\[ E \sim \frac{G^2 M^5}{\hbar^5} \]

2.1.3 Ordering \( \alpha = 1 \), we gain

\[ EM \sim \frac{hc^3}{G} \]

Substituting \( E \sim kT \) into above formula, we obtain

\[ T \sim \frac{hc^3}{\kappa GM} \]

where \( T \) is the temperature. It is the temperature of event horizon of SBH, but it hasn’t \( 1 / 8\pi \).

2.2 Supposing that energy \( E \) has relations with frequency \( \omega \) merely, we find

\[ E_{\omega^a} \sim E_{\omega^P} \]

\[ = \frac{\hbar^{(1-a)/2} G^{-(1-a)/2}}{c^{(5-a)/2}} \]  

(8)

where \( \omega_p = \sqrt{\frac{\hbar}{G}} \) is the Planck frequency. This is the general formula for energy and frequency.

2.2.1 Instructing 1

\[ \sim h \omega \]

It is the light quantum relation [26].

2.2.2 Ordering 1

\[ \sim c^5 / G \]

Substituting \( E \sim MC^2 \) into above formula, we gain

\[ \omega \sim \frac{c^3}{GM} \]

where \( \omega \sim \omega_G \). This is the inverse correlation between high-frequency quasi-periodic oscillation and black hole mass [27].

2.2.3 Instructing \( a = -3 \), we have

\[ E \sim \frac{h^3 G \omega}{c^5} \]

2.3 Assuming that energy \( E \) has relations with energy density \( \rho \) only, we find

\[ E_{\rho^a} \sim E_{\rho^P} \]

\[ = \frac{\hbar^{(1-2a)/2} G^{-(1+4a)/2}}{c^{(5+14a)/2}} \]  

(9)

where \( \rho_p = \frac{c^7}{\hbar c^2} \) is the Planck energy density. It is the general formula for energy and energy density.

2.3.1 Ordering 1

\[ -2a = 0, \quad a = 1 / 2, \quad \text{we obtain} \]

\[ E^2 \sim c^{12} / G^3 \rho \]

From D. Li et al HDE model [16], \( \rho_{de} = 3c^3 \rho M^2 L^{-2}, \quad E = \rho V \) and \( V \sim L^3 \), we gain

\[ E_{de}^2 \sim 27c^6 \rho L^3 / 512 \pi^3 \]

2.3.2 Instructing 1

\[ + 4a = 0, \quad \rightarrow a = -1 / 4, \quad \text{we obtain} \]

\[ E^4 \sim c^3 \rho \]

This is the relationship between biquadratic quanta energy and its density [19].

2.3.3 Ordering \( a = -1 / 2 \), we gain

\[ E^2 \sim c \rho \]

From \( M_{de} V_{H} \sim \frac{h}{c^3} \) [13], \( E = \rho V \) and \( E = MC^2 \), where \( M_H \) is the mass of SBH, and \( V_H \) its volume, we obtain the above formula with square of energy and its density of SBH.

2.4 Supposing that distance \( R \) has relations with mass \( M \) merely, we find

\[ RM^a \sim \frac{L_0 \rho^G}{M} \]

\[ = \frac{\hbar^{(1+a)/2} G^{-(1-a)/2}}{c^{(3-a)/2}} \]  

(10)

where \( L_0 = \sqrt{G / c^3} \) is the Planck length. This is the general formula for distance and mass.

2.4.1 Instructing 1

\[ \sim a = 1 \], we obtain

\[ R \sim \frac{GM}{c^2} \]

It is the radius of event horizon of stationary black holes [28].

2.4.2 Ordering 1

\[ a = 0, \quad R \sim \frac{h}{M c} \]

This is the A.H. Compton wavelength formula [29].

2.4.3 Instructing 3

\[ \sim a = 0, \quad a = 3 \], we have

\[ R \sim \frac{h^2}{GM^3} \]

2.4.4 Ordering \( a = -3 \), we obtain

\[ R \sim \frac{G^2 M^3}{h^4} \]

Substituting \( R = \pi \) into above formula, we gain

\[ \sim t \sim \frac{G^2 M^3}{h c^4} \]

It is the age of SBH [15].

From \( R \sim \frac{GM}{c^2} \), we obtain \( V \sim R^3 \sim \frac{G^3 M^3}{c^6}, \) substituting \( t \sim \frac{G^2 M^3}{h c^4} \), we gain

\[ V \sim \frac{h G t}{c^2} \]

That is the relation between the volume of event horizon of stationary black holes and its age. For the SBH, \( R = 2GM / c^2 \), \( V \approx 32 \pi G M^3 / 3 c^6 \) and \( t \approx 15360 \pi G^2 M^3 / h c^4 \), we have \( V \approx \frac{h G t}{1440 c^2} \).

2.5 Assuming that energy density \( \rho \) has relations with distance \( R \)
only, we find
\[ \rho R^a \sim \rho_R L^6 = \hbar^{-2(a-2)}G^{-4(a-4)}/2c^{(14-3a)/2} \] (11)
This is the general formula for energy density and distance.

2.5.1 Instructing \( 2 - a = 0, \rightarrow a = 2 \), we obtain
\[ \rho c^4 / GR^2 \]
where \( R \sim L \). This is the equation of HDE model \( \rho_{de} = 3c^2 H_0^2 M_0^2 L^{-2} \) [16], hasn't \( 3c^2 \). \( / 8\pi \).

2.5.2 Ordering \( 4 - a = 0, \rightarrow a = 4 \), we gain
\[ \rho c / R^4 \]
where \( R = a \) is the scale factor. It is radiation formula for early universe [30].

2.5.3 Instructing \( 14 - 3a = 0, \rightarrow a = 14 / 3 \), we have
\[ \rho^3 c^4 / R^{14} \]
This is H. Casimir effect formula, hasn't \( \pi^2 / 2940 \).

2.5.4 Ordering \( a = 6 \), we obtain
\[ \rho c^2 G / c^2 R^6 \]
where \( M = G \) is the Planck force, and \( M_0^2 = h P / c^3 \). From \( \rho_{de} = 3c^2 H_0^2 M_0^2 L^{-2} \) and \( p = \alpha P \), we gain
\[ \rho_{de} = 3w_{de} c^2 H_0^2 M_0^2 L^{-2} = 3w_{de} c^2 H_0^2 R^2 / L^{-2} \]
where \( w_{de} \) is the coefficient of state, \( F_{sh} = F_{pl} / 8\pi \) the reduced Planck force. So it is the negative pressure \( \rho_{de} \) of HDE [16], hasn't \( 3w_{de} \).

2.5.3 Instructing \( 14 - 3a = 0, \rightarrow a = 14 / 3 \), we have
\[ f c^4 / R^{14} \]

2.6.1 Instructing \( 4 - a = 0, \rightarrow a = 4 \), we gain
\[ f c / R^4 \]
This is the general formula for entropy density and temperature.

2.7 Assuming that radiation density \( \rho_r \) has relations with frequency \( \gamma \) only, we find
\[ \rho_r \gamma^a \sim \rho_{r\gamma} \gamma^a = \hbar^{-2(a-2)}G^{-4(a-4)}/2c^{(14-3a)/2} \] (13)
where \( \rho_{r\gamma} = \sqrt{c/HG} \) is the Planck radiation density, and \( \gamma_r \) the Planck frequency. It is the general formula for radiation density and frequency.

2.7.1 Instructing \( 3 + a = 0, \rightarrow a = -3 \), we obtain
\[ \rho_r \gamma^3 / c^3 \]
Comparing M. Planck black body radiation formula, it hasn't \( 8\pi \).

2.7.2 Ordering \( 1 + a = 0, \rightarrow a = -1 \), we gain
\[ \rho_r \gamma / G \]

2.7.3 Instructing \( 9 + 5a = 0, \rightarrow a = -9 / 5 \), we have
\[ \rho_r^9 \gamma^9 / G^9 \]
2.7.4 Ordering \( a = -5 \), we get
\[ \rho_r \gamma^5 / c^5 \]
2.8 Supposing that radiation density \( \rho_r \) has relations with temperature \( T \) merely, we find
\[ \rho_r T^a \sim \rho_{rT} T^a = \hbar^{-2(a-2)}G^{-4(a-4)}/2c^{(14+5a)/2}\kappa^{-a} \] (14)
It is the general formula for radiation density and temperature.

2.8.1 Instructing \( 4 + a = 0, \rightarrow a = -4 \), we obtain
\[ \rho_r \sim \kappa^4 T^4 / h^3 c^3 \]
This is Stefan-Boltzmann law, hasn't \( \pi^2 / 15 \).

2.8.2 Ordering \( 2 - a = 0, \rightarrow a = 2 \), we gain
\[ \rho_r \sim \kappa^2 T^2 / h^2 G \]
2.8.3 Instructing \( 14 + 5a = 0, \rightarrow a = -14 / 5 \), we obtain
\[ \rho_r^5 \sim \kappa^{10} T^{14} / h^2 G^3 \]
2.8.4 Ordering \( a = -2 \), we get
\[ \rho_r \sim c^2 T^2 / h^2 G \]
2.9 Assuming that acceleration \( a \) has relations with temperature \( T \) merely, we find
\[ aT^a \sim aTP \gamma^a = \hbar^{-2(a-2)}G^{-4(a-4)}/2c^{(7+5a)/2}\kappa^{-a} \] (15)
where \( a_p = \sqrt{c^2 / hG} \) is the Planck acceleration. It is the general formula for acceleration and temperature.

2.9.1 Instructing \( 1 + a = 0, \rightarrow a = -1 \), we gain
\[ a \sim c \kappa T / h \]
This is Unruh formula [31], hasn't \( 1 / 2\pi \).

2.9.2 Ordering \( 1 - a = 0, \rightarrow a = 1 \), we obtain
\[ aT \sim c^2 G / h^3 \]
2.9.3 Instructing \( 7 + 5a = 0, \rightarrow a = -7 / 5 \), we have
\[ a^5 \sim \kappa^2 G^{7/3} / h^6 \]
2.9.4 Ordering \( a = -3 \), we obtain
\[ a \sim \kappa^3 G^{3/2} / h^4 c^4 \]
2.10 Supposing that entropy density \( s \) has relations with temperature \( T \) merely, we find
\[ sT^a \sim sT \gamma^a = \hbar^{-2(a-2)}G^{-4(a-4)}/2c^{(9+5a)/2}\kappa^{-a} \] (16)
where \( s_p = \sqrt{\kappa^2 c^3 / h^3 G^3} \) is the Planck entropy density. It is the general formula for entropy density and temperature.

2.10.1 Instructing \( 3 + a = 0, \rightarrow a = -3 \), we obtain
\[ s \sim \kappa^s T^3 / h^3 c^3 \]
This is entropy density with cube of temperature [30] [32].

2.10.2 Ordering \( 3 - a = 0, \rightarrow a = 3 \), we have
3. Relations of Power products of Three PQs

In this section, we obtain the relations of power products when \( n = 3 \) to the GRE; find the corresponding general formulas also; and obtain the Newtonian attraction law, Schrodinger equation, Coulomb law, Newtonian second law, Clapeyron equation, power law of superconducting films, etc.

3.1 Similarly when \( n = 3 \), we obtain

\[
A_1^3 A_2^3 A_3^3 \sim A_1^2 A_2^2 A_3^2 A_1^1 A_2^1 A_3^1 A_1^1 A_2^1 A_3^1
\]  

(19)

Ordering \( \alpha_1 = 1, \alpha_2 = 3, \alpha_3 = \beta, A_1 = A, A_2 = B, \) and \( A_3 = C, \) we give

\[
AB^\alpha C^\beta \sim A_0 B_0^\beta C_0^\beta
\]  

(20)

when \( \beta = 0 \), (4) is recovered. Thus we can determine the relations of power products of three PQs. For example

3.1.1 Assuming that energy \( E \) has relations with mass \( M \) and distance \( r \), we find

\[
EM^\alpha\beta \sim \hbar^{(1+\alpha+\beta)/2}G_{-1(1-\alpha-\beta)/2}e^{(5+\alpha-3\beta)/2}
\]  

(21)

This is the general formula for energy, mass and distance.

3.1.2 Ordering \( 1 + \alpha - \beta = 0 \), and \( 5 + \alpha - 3\beta = 0 \rightarrow \alpha = -2 \) and \( \beta = 1 \), we obtain

\[
E \sim GM^2 / r \sim GMn / r
\]

It is Newtonian attraction law, hasn’t \(-1\).

3.1.3 Ordering \( 1 + \alpha + \beta = 0 \), and \( 1 + \alpha - \beta = 0 \rightarrow \alpha = -1 \) and \( \beta = 0 \), we obtain

\[
E \sim \hbar^2 / M r^2
\]

Substituting \( E \rightarrow \hbar \partial / \partial t \) and \( 1 / r^2 \rightarrow \nabla^2 \) into above formula, we obtain

\[
\hbar \partial \psi / \partial t \sim \hbar^2 \nabla^2 \psi / M
\]

where \( \psi \) is wave function. This is Schrodinger equation, hasn’t \(-1 / 2\).

3.1.4 Ordering \( \alpha = -1 \) and \( \beta = 2 \), we gain

\[
E \sim hGM / c r^2
\]

From Unruh formula \( T = 2\pi a / c, \alpha \sim g \) and \( g = GM / r^2 \), we have

\[
T = 2\pi h G / c k r^2
\]

so it is the temperature \( T \sim E / k \) in Newtonian attraction, hasn’t \(-2\pi\).

3.2 Supposing that energy \( E \) has relations with electric charge \( Q \) and distance \( r \), we find

\[
EQ^\alpha\beta \sim \hbar^{(1+\alpha+\beta)/2}G_{-1(1-\alpha-\beta)/2}e^{(5+\alpha-3\beta)/2}
\]  

(22)

It is the general formula for energy, electric charge and distance.

3.2.1 Ordering \( 1 + \alpha + \beta = 0 \), and \( 1 - \beta = 0 \rightarrow \alpha = -2 \) and \( \beta = 1 \), also \( 5 + \alpha - 3\beta = 0 \), we gain only

\[
E \sim Q^2 / r \sim Q_1Q_2 / r
\]

This is Coulomb law.

3.3 Assuming that acceleration \( a \) has relations with force \( F \) and mass \( M \), we find

\[
aF^\alpha M^\beta \sim \hbar^{(1+\beta)/2}Q_{-1(1-\alpha-\beta)/2}e^{(5+\alpha-3\beta)/2}
\]  

(23)

It is the general formula for acceleration, force and mass.

3.3.1.1 Ordering \( -\beta = 0 \), and \( 1 + 2\alpha + \beta = 0 \rightarrow \alpha = -1 \) and \( \beta = 1 \), also \( 7 + 8\alpha + \beta = 0 \), we obtain merely

\[
a \sim F / M
\]

This is Newtonian second law [21].

3.4 Supposing that acceleration \( a \) has relations with mass \( M \) and distance \( r \), we find
We gain

\( aM^2 \alpha^\beta \sim h^{-{(1-\alpha-\beta)/2}G^{-2}}(1-\alpha+\beta)/2_\gamma(c^{-3+3\gamma})^{\beta/2} \) \hfill (24)

It is the general formula for acceleration, mass and distance.

3.4.1 Ordering \( 1-\alpha-\beta = 0 \), and \( 7+\alpha-3\beta = 0 \), we gain 
\( a \sim GM/r^2 \)  

This is Newtonian gravitational acceleration [21].

3.4.2 Instructing 1 + \( \alpha = 0 \), and \( 7+\alpha-3\beta = 0 \), we gain \( a = 2 \) and \( \beta = 3 \), we have

\( a \sim \frac{h^2}{M^2 r^3} \rightarrow r \sim \frac{\sqrt{h^2}}{aM^2} \)

It is \( \frac{h}{n} = \frac{3}{8}(\frac{1}{g} mH/2m) / 2g \) \hfill (35), where \( h \sim r \) is the height of the \( n \)th energy level, \( m \sim M \) the neutron mass and \( g \sim a \) the Earth's gravitational acceleration.

3.4.3 Ordering 1 - \( \alpha-\beta = 0 \), and 1 + \( \alpha = 0 \), we gain 1 and \( \beta = 1 \), we obtain

\( a \sim \frac{c^2}{r} \)

From \( p_{de} = 3eC^3M^2l^{-2} \), \( p = op \), and \( F = pl^2 \), \( a \sim F/M \), \( M c^2 = \rho V \) and \( V = l^3 \), we gain

\( a \sim 3w_{de}c^2 / 8\pi L \)

where \( r \sim L \). It is the acceleration of HDE, hasn't \( 3w_{de} / 8\pi \).

3.5 Assuming that pressure \( p \) has relations with volume \( V \) and temperature \( T \), we find

\[ pV^2 \alpha^\beta \sim p \rho \gamma^2 \alpha^\beta \]

\[ = h^{-{(2-3\alpha-\beta)/2}G^{-2}}(1-\alpha+\beta)/2_\gamma(14-9\alpha+5\beta)/2_\gamma \] \hfill (25)

where \( \rho = c^2 / hG^2 \) is the Planck pressure. This is the general formula for pressure, volume and temperature.

3.5.1 Instructing 2 - \( 3\alpha-\beta = 0 \), and \( 4 + 3\alpha+\beta = 0 \), \( a = 1 \) and \( \beta = -1 \), also \( 14-9\alpha+5\beta = 0 \), we obtain only

\( pV \sim \gamma T \)

This is Clapeyron equation, hasn't \( WN \) / \( M \), where \( W \) is the gaseous mass, \( N_A \) the Avogadro constant and \( M \) is the mass of gaseous mole molecule.

3.6 Assuming that thickness \( d \) has relations with temperature \( T \) and resistance \( R \), we find

\[ dT^2 R^\beta = L_p T_p^2 R_p^\beta \]

\[ = h^{-{(1+\alpha+\beta)/2}G^{-2}}(1-\alpha)/2_\gamma(-3-5\alpha)/2_\gamma - e^{-2\beta} \] \hfill (26)

where \( R_p = h / e^2 \) is the Planck resistance. This is the general formula for thickness, temperature and resistance.

3.6.1 Ordering 1 - \( \alpha = 0 \), we gain 1, we obtain

\[ dT \sim \frac{h^2}{c} \kappa^{-1}e^{-2\beta} R \]

It is the power law of superconducting films \( d T_c = AR_{S}^\beta \) \hfill (25), where \( T_c \) is critical temperature, \( R_S \) sheet resistance, \( A \) and \( B \) are fitting parameters. When \( \beta = 1 \), we get \( dT \sim h^2 \kappa^{-1}e^{-2} R^{-1} \).

3.6.2 Instructing 1 + \( \alpha+2\beta = 0 \), and \( -\alpha = 0 \), \( a = 1 \) and \( \beta = -1 \), we gain

\[ dT \sim \frac{c^2}{R} \]

3.6.3 Ordering 1 + \( \alpha+2\beta = 0 \), and \( 3-5\alpha = 0 \), \( a = 3 / 5 \) and \( \beta = -4 / 5 \), we have

\[ dT^3 \sim \gamma \kappa^{-3}e^{R} \]

3.7 Supposing that temperature \( T \) has relations with superfluid density \( \rho_s \) and mass \( m \), we find

\[ T \rho_s \sim 3M \]

\[ = \frac{h^{-{(1+3\alpha+\beta)/2}G^{-2}}(1-3\alpha+3\beta)/2_\gamma(5+3\alpha+3\beta)/2_\gamma}{2} \]

\[ \frac{-1}{2} \]

\[ \sim \frac{\sqrt{c^3}}{hG^3} \]

The Planck superfluid density. It is the general formula for temperature and superfluid density.

3.7.1 Ordering 1 + 3\( a +\beta = 0 \), \( \beta = -1 \) - \( 3\alpha \), when \( a = -1 / 2, \beta = 1 / 2 \), we gain

\[ T \sim \frac{h^2}{\kappa^{2}} \rho_s / \gamma m \]

This are the relation of critical temperature of LSCO and its superfluid density \( T_c < \sqrt{p_{s0}} \) and \( T_c < \rho_{s0} \) \hfill [36].

3.7.2 Instructing 1 + 3\( a +\beta = 0 \), \( 5 + 9\alpha +\beta = 0 \), \( a = -2 / 3 \), \( \beta = 1 \), we obtain

\[ T \sim \frac{h^2}{\kappa^{2}} \rho_s / \gamma m \]

3.7.3 Ordering 1 - 3\( a +\beta = 0 \), \( 5 + 9\alpha +\beta = 0 \), \( a = -1 / 3 \), \( \beta = -2 \), we gain

\[ T \sim \frac{h^2}{\kappa^{2}} \rho_s / \gamma m \]

3.8 Supposing that force \( F \) has relations with Hamiltonian function \( H \) and curvature \( k \), we find

\[ FH^\alpha k^\beta \sim \frac{p}{p} \frac{\gamma p}{p} \]

\[ = h^{-{(a-\beta)/2}G^{-2}}(1+\alpha+\beta)/2_\gamma(8+5\alpha+3\beta)/2 \]

where \( p \sqrt{c^2 / \gamma h} \) the Planck curvature. It is the general formula for force, Hamiltonian function and curvature.

3.8.1 Instructing \( a -\beta = 0 \), and \( 2+\alpha +\beta = 0 \), \( a = -1 \) and \( \beta = -1 \), also \( 8+5\alpha+3\beta = 0 \), we obtain merely

\[ F \sim H k \]

That is the generalized CFL \( dP / dt = -2Hk \) \hfill [37], where \( P \) is the momentum, \( n \) the local unit normal vector, and \( F \sim dP / dt \), hasn't \( -2n \).

4. Relations of Power products of Four PQs

In this section, we obtain the relations of power products when \( n = 4 \) to the GRE; obtain the centrifugal force formula.

4.0 Similarly when \( n = 4 \), we obtain

\[ A^2 A_2 \bar{A}_2 A_3 \bar{A}_3 \sim \frac{A_1^2 A_2 \bar{A}_2 A_3 \bar{A}_3 A_4 \bar{A}_4}{D_p} \]

Instructing \( a_1 = 1 \), \( a_2 = a \), \( a_3 = \beta \), \( a_4 = \gamma \), \( A_1 = A \), \( A_2 = B \), \( A_3 = C \) and \( A_4 = D \), we gain

\[ A^2 c^\beta \beta \gamma \sim \frac{A_2 B_2 \bar{A}_2 A_3 \bar{A}_3 / A_4}{D_p} \]

when \( \gamma = 0 \), \( (20) \) is recovered. Therefore we can determine the
relations of power products of four PQs. For example
4.1 Supposing that force $F$ has relations with mass $M$, speed $v$ and distance $r$, we find
\[ F M^{\alpha} v^{\beta} r^{\gamma} \sim \left(\frac{\alpha + \gamma}{\beta} - 2\alpha r - \gamma \right) \frac{(8 + a + 2\beta - 3\gamma)^2}{\beta} \quad (31) \]
This is the general formula for force, mass, speed and distance.
4.1.1 Ordering $\alpha + \gamma = 0$, $2 + a = 0$ and $8 + a + 2\beta - 3\gamma = 0$
\[ \alpha = -1, \beta = -2 \text{ and } \gamma = 1, \]
we obtain
\[ F = M v^2 / r \]
It is the centripetal force formula. And so on.

5. Conclusion

In this paper we determine the relations of power products of PQs by the GRE. We find the following results:

1) The relations of power products of two PQs are determined when $n = 2$ to the GRE. Specially two PQs have direct proportion or inverse relation when their exponents are equal to $-1$ or $1$.

2) The corresponding general formulas are found by Assumimg the relation between energy and mass, energy and frequency, energy and energy density, distance and mass, energy density and distance, per area force and distance, radiation density and frequency, radiation density and temperature, acceleration and temperature, entropy density and temperature, curvature tensor and energy-momentum tensor, Lagrange density function and electromagnetic field tensor respectively etc.

3) Many famous equations without corresponding factors are obtained including Einstein mass-energy relation [14], temperature of event horizon of SBH [15], light quantum relation [26], inverse correlation between high-frequency quasi-periodic oscillation and black hole mass [27], biquadratic quanta energy with its density [19], radius of event horizon of stationary black holes [28], A.H. Compton wavelength formula [29], age of SBH [15], equation of HDE model [16], radiation formula for early universe [30], Casimir effect equation [17], negative pressure of HDE [16], Planck black body radiation formula [18], Stefan-Boltzmann law [19], Unruh formula [31], entropy density with cube of temperature [30] [32], relation of critical temperature of LSCO and its superfluid density [36], Einstein field equation [20], electromagnetic Lagrange density function under Lorentz gauge [34], and so on.

4) Some new relations are found including square of total energy with energy density of HDE, square of energy with its density of SBH, energy density with sextic radii of SBH, pressure in SBH centre, entropy density of SBH [33] center, etc.

5) The relation of power products of three and four PQs are determined when $n = 3$ and $4$ to the GRE.

6) The corresponding general formulas are found also by Assuming the relation between energy, mass and distance; energy, electric charge and distance; acceleration, force and mass; acceleration, mass and distance; pressure, volume and temperature; thickness, temperature and resistance; force, mass, speed and distance respectively and so on.

7) Also some famous equations without factors are gained including Newtonian attraction law [21], Schrödinger equation [22], Coulomb law [23], Newtonian second law [21], Newtonian gravitational acceleration [21], height of the nth energy level of neutrons in the Earth’s gravitational field [35], acceleration of HDE, Clapeyron equation [24], power law of superconducting films [25], generalized CFL [37], and centrifugal force formula [21] etc.

8) Some relations which are given can’t be understood.

9) The GRE can determine the relations of power products of two, three and four PQs, but can’t give the corresponding factors. It is useful and significant.

References

Determining Relations of Power Products of Physical Quantities by Generalized Relational Expression

Y. Bao

viXra: 1502.0106


[23] C.A.de Coulomb, J. de Phys., 27 (1785), 116; Mém. Acad. Sci., 1785 (1788), 569, 578, 612; 1786 (1788), 67; 1787 (1791), 617; 1789 (1799), 455.


[33] Y. Bao, vixra: 1409.0159.

[34] C-F. Qiao, “Introduction to Quantum Field Theory”, College of Physical Sciences, Graduate University, Chinese Academy of Science, 2008.

