Circle fractaloids and Pi constant screening method in quantum mechanics

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Abstract

The Dirac constant, also known as the reduced Planck constant, is the Planck constant divided by 2π. This constant is utilized in the quantization of angular momentum and spin in quantum mechanics. Although it has not been directly measured as the regular Planck constant *h*, which was first used by Max Planck in [1] and [2] to explain the quantization of direct motion and the radiation of a black body, it is believed that circular motion can be accurately described by this constant.

In this study, a new method was developed for multi-nucleus electron systems with non-zero inter-electron integrals, where the Dirac constant is squared and the influence of the π value is not entirely eliminated from the description of the system's energy, electron energy levels and wavefunctions.

This method involves using alternative π constant values for circle fractaloids instead of the regular circle π for highly precise quantum chemistry computations, with the goal of determining the most accurate π value. The π values for circle fractaloids are found to be greater than the regular circle π, and the results suggest that particles may be moving in a fractal space-time for inner movements.

Introduction

The circle π constant is used in quantum mechanics in various physical equations for the Borh radius:

$$a=\left(\varepsilon_0 h^2\right)/\left(\pi m_e e^2\right), \tag{1}$$

where a is Bohr radius, ε_0 is permittivity of vacuum, π is a circle constant, m_e is mass of electron and e is the elementary charge, for nucleus-nucleus potential energy

$$V=-\frac{e^2 Z_1 Z_2}{4\pi\epsilon_0 R}, \tag{2}$$

where Z_1 and Z_2 are charges of the nucleuses and R is inter-nucleuses distance in Borh radiuses,

for electron-nucleus potential energy

$$V=-\frac{e^2 Z}{4\pi\epsilon_0}\left\langle\psi_i\left|\frac{1}{R}\right|\psi_i\right\rangle, \tag{3}$$

where ψ_i is wavefunction of i-th electron and R is electron-nucleus distance in Bohr radiuses, for electron-electron potential energy:

$$V=\frac{e^2}{4\pi\epsilon_0}\left\langle \psi_i\psi_i\left|\frac{1}{R}\right|\psi_j\psi_j\right\rangle, \tag{4}$$

where ψ_j is wavefunction of j-th electron, R is inter-electron distance in Bohr radiuses, for electron-electron resonance integrals

$$V=\frac{e^2}{4\pi\epsilon_0}\left\langle \psi_i\psi_j\left|\frac{1}{R}\right|\psi_i\psi_j\right\rangle, \tag{5}$$

and for electron-electron kinetic energy (nucleuses with electrons-electron kinetic energies are described from a virial theorem as negatively taken one half of electron-nucleus potential energy in equilibrium)

$$T=\frac{h^2}{8\pi^2 m_e} * \psi_i\nabla^2\psi_j, \tag{6}$$

where ∇^2 is Laplace operator.

Thus, the π constant is entirely eliminated, including for inter-electron kinetic energy integrals, which depend on the second power of the Bohr radius via wavefunctions.

The screened values of the π constant for fractaloids and their impact on the precision of quantum chemistry computations can be preferably studied in molecules with a strong spin-orbit coupling effect.

$$\Delta E=Z^4\frac{\mu_0}{4\pi}g_s\mu_B^2\frac{1}{a_0^3 l(l+1/2)(l+1)}j(j+1)l(l+1)s(s+1), \tag{7}$$

where μ_0 is permeability of vacuum, g_s is g-factor, μ_B is the Bohr magnetron, a_0 is Bohr radius, j is total angular momentum quantum number, l is magnetic quantum number ans s is spin quantum number and this quantum numbers are quantified by reduced Planck constant – Dirac constant.

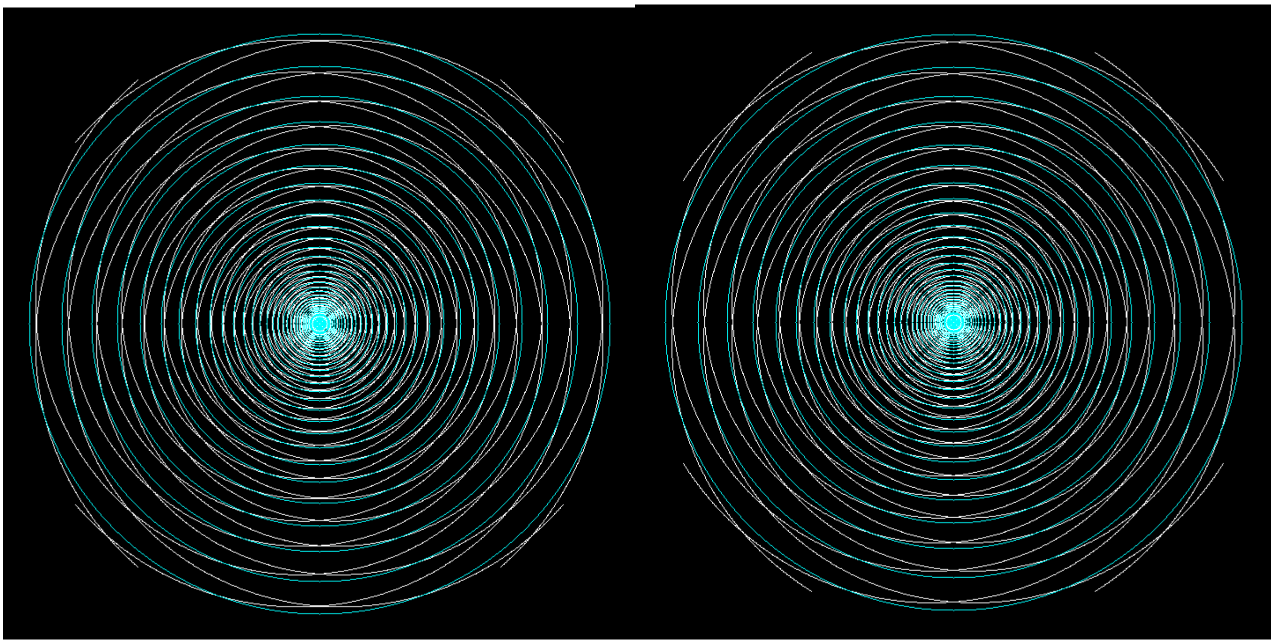

Fig. 1: Spiral fractaloid for 8 Golden spirals (left) and spiral fractaloid for spirals increased by 1.66 for each level (right). The approximated circles are shown by cyan.

In recent years, a constant π value has been developed or discovered for fractal-like circle structures composed of spirals. This study investigates the fractal-spiral motion in quantum mechanics, focusing on two types of spiral circle fractaloids. These fractaloids consist of 8 spirals with phases at 0°, 90°, 180°, and 270° starting angles, and both clockwise and counterclockwise directions.

The two types of spiral circle fractaloids examined are:

1. Spiral fractaloids formed from Golden spirals, where the ratio of distances between neighboring levels is $\phi=\left(\sqrt{(5)}+1\right)/2$, corresponding to $\pi = of\ 4/\sqrt{(\phi)}$, (See Fig. 1 left.).
2. Spiral fractaloids formed from spirals with half-circles between edge of circumscribed squares and circumference of a circle, corresponding to $\pi=\left(14-\sqrt{(2)}\right)/4$, (See Fig. 1 right).

Mathematic proofing for both values of Pi are available from [3] and [4].

Derivation of the value 4/√Φ

- Recently, in 11-dimensional string theories, it is possible to have balls of eight strings with the same center and the particles, which are too composed from strings.
- These strings vibrate at a set of harmonic frequencies, which are mutually harmonic.
- The frequencies of oscillations on the strings are mutually added and subtracted, resulting in a distribution that follows the Fibonacci sequence (where each number is the sum of the two preceding numbers).
- The limit of the Fibonacci sequence for the difference between two neighboring numbers in the sequence is the Golden ratio, and thus these strings are in a Golden spiral conformation.
- The optimized shape of this unit is a fractaloid consisting of 8 spirals with phases at 0°, 90°, 180°, and 270° starting angles, and both clockwise and counterclockwise directions.
- In this fractaloid, there are circle levels with $\pi = of\ 4/\sqrt{(\phi)}$, as mentioned in Fig. 1.
- The particles in M-theory with 8 supersymetries are a vibrating string circles and from this fractaloid can be folded a deformed circle levels and inter-levels of vibrating strings vibrating on tones with Fibonacci sequence distribution ($AdS_4 \times S^7$ correspondence) [5].

This is a base model for a string loop effects for anomalous magnetic moments in spin-orbit coupling. The true model for multi-loop effect is more complex and probably not impressionable only by simple fractal structure.

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