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# Fine-structure constant (spiral)

**H atom n-shell energy levels emerge from a gravitational orbit**

If we map the electron transition between energy levels in the H atom semi-classically as a gravitational orbit, we find a hyperbolic spiral appears. This spiral has interesting properties, namely if we measure the transition radius as $r = mr_0$ (m is a function of the fine structure constant alpha, $r_0$ as the Bohr radius), we find periodically $m = n^2$ where n is the principal quantum number, this periodicity occurring as a function of pi (a geometrical periodicity) [1].

In order to map the electron as a gravitational orbit, the electron is treated as an oscillation between an electric state and a mass state; the electric state duration = particle frequency, the mass state duration = 1 unit of Planck time. In the mass state the particle is a point (i.e.: it can be assigned Cartesian co-ordinates). An orbit can then be simulated as a gravitational orbit by plotting these (mass) points.

During transition, the incoming photon is treated likewise, as the sum of oscillations (albeit without a mass state), where *m* corresponds to the number of photon oscillations, as each photon oscillation is added, the radius increases. During this process the electron continues orbiting the proton, a hyperbolic spiral path then emerging. As only the mass state has point co-ordinates, the transition is mapped as a series of steps, each step as 1 oscillation cycle, and so when mapped as a gravitational orbital transition, the path is semi-classical, the total number of steps giving the transition frequency.

The number of oscillation steps required to reach each $m = n^2$ level corresponds to the transition frequencies of the electron, thus we can derive the Bohr model from this spiral (when $m = n^2$, the formulas are the same).

In this context the Bohr model can be considered as a gravitational model (which is what the spiral model is), and so rather than the Schrödinger equation replacing the Bohr model, the actual electron orbit could be a combination of both models; the Schrödinger equation mapping the electron (electric) wave-state and the Bohr model mapping the electron (mass) point-state.

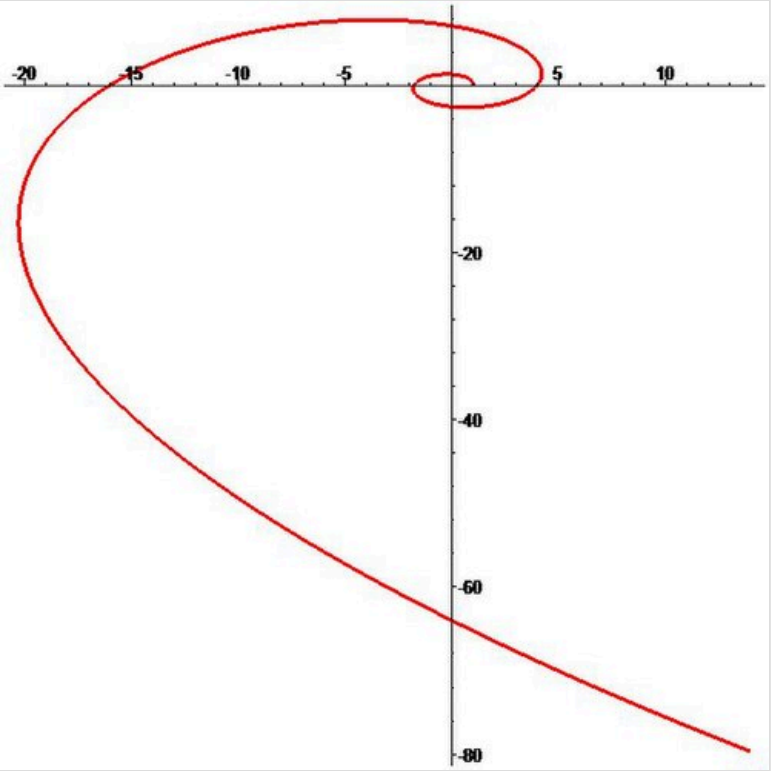
And so although the Bohr model does not include the wave-state, it is not an incorrect description of the atomic orbital, rather it is incomplete, there is a distinction. The same may be said of the Schrödinger equation.

Source code H-orbital.c [2]

At these angles on the spiral, the (*x*, *y*) coordinates converge to give exact integer values (4, 9, 16, 25, 36 ...)

$\varphi = (2)\pi,\ r = 4r_0$ (360°)
$\varphi = (8/3)\pi,\ r = 9r_0$ (360+120°)

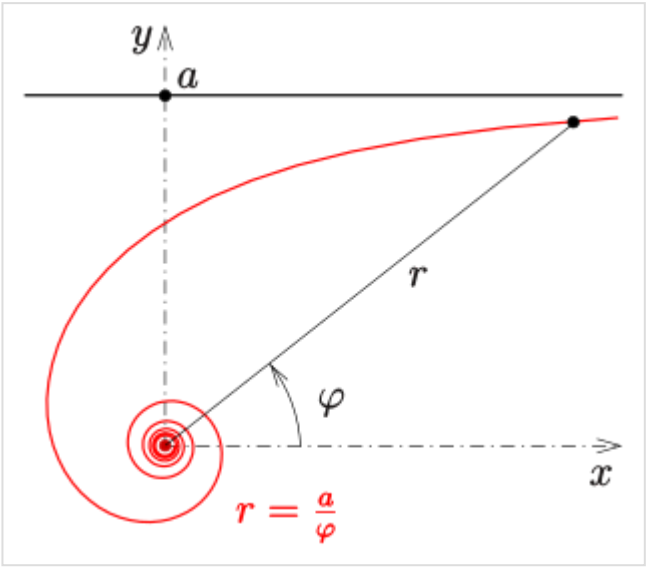
$\varphi = (3)\pi,\ r = 16r_0$
(360+180°)
$\varphi = (16/5)\pi,\ r = 25r_0$
(360+216°)
$\varphi = (10/3)\pi,\ r = 36r_0$
(360+240°)
$\varphi = (7/4)\pi,\ r = 49r_0$
$\varphi = (7/2)\pi,\ r = 64r_0$
(360+270°)



Electron transition path radius *r* (from *n*=1 to *n*=9)

## Hyperbolic spiral

A hyperbolic spiral is a type of spiral with a pitch angle that increases with distance from its center. As this curve widens (radius **r** increases), it approaches an asymptotic line (the **y**-axis) with the limit set by a scaling factor **a** (as **r** approaches infinity, the **y** axis approaches **a**).



Hyperbolic spiral

$$x = a^2 \frac{cos(\varphi)}{\varphi^2},\ y = a^2 \frac{sin(\varphi)}{\varphi^2},\ 0 < \varphi < 4\pi$$

radius = $\sqrt{(x^2 + y^2)}r$

$\varphi = (2)\pi,\ 4r$ (360°)
$\varphi = (4/3)\pi,\ 9r$ (240°)
$\varphi = (1)\pi,\ 16r$ (180°)
$\varphi = (4/5)\pi,\ 25r$ (144°)

$\varphi = (2/3)\pi,\ 36r$ (120°)

### AI spiral rationale

AI was used to condense the derivation (summarize the method and give conclusions)[3]. This presumes familiarity with the Bohr model.

Chat GPT chatgpt.com/share/67ce62fc-8bf8-8012-8622-37a7a4fae6d6 [4]

> Conclusion : the stability of the n orbital shells (with $m = n^2$) arises because at these levels the spiral's radial and angular increments are in perfect resonance. The electron's semi-classical motion then traces a repeating, closed path. This geometrical resonance, which directly involves π and the circular nature of the motion, naturally leads to the quantized orbital shells without invoking the usual quantum-mechanical postulates.

Deepseek deepseek-spiral.pdf [5]

> Conclusion : The levels $m = n^2$ are stable because the spiral's geometry enforces a self-consistent synchronization between radial growth and angular displacement. This resonance prevents dispersion, creating discrete orbital shells without invoking quantum mechanics. The quantization of m into squares is a geometric constraint ensuring constructive interference in the spiral's path, much like how integer multiples of wavelengths stabilize standing waves. The stability of $m = n^2$ levels arises from geometric resonance in the spiral, where radial expansion and angular progression harmonize to form closed or self-reinforcing paths. This ensures discrete, stable orbital shells.

Qwen chat.qwen.ai/s/9fe132a6-91d7-4ec6-8c82-ebf2e1b2b422 [6]

> Conclusion : The stability of $m = n^2$ orbits is a geometric necessity . The spiral's radial and angular evolution align to create resonant, non-decaying paths at these specific radii. These orbits are "stable" because they satisfy the minimal condition for periodicity and constructive interference, ensuring the electron's motion remains bounded without invoking quantum theory.

Claude claude.ai/share/355e21e4-d623-4810-962a-fb1892c2ef3f [7][8]

> Conclusion : The stability of orbits at m = n² emerges from the geometric properties of the spiral itself, specifically from resonances in the relationship between angular rotation and radial expansion. This geometric perspective provides a semi-classical explanation for why certain orbital levels are preferred without invoking quantum mechanical principles.

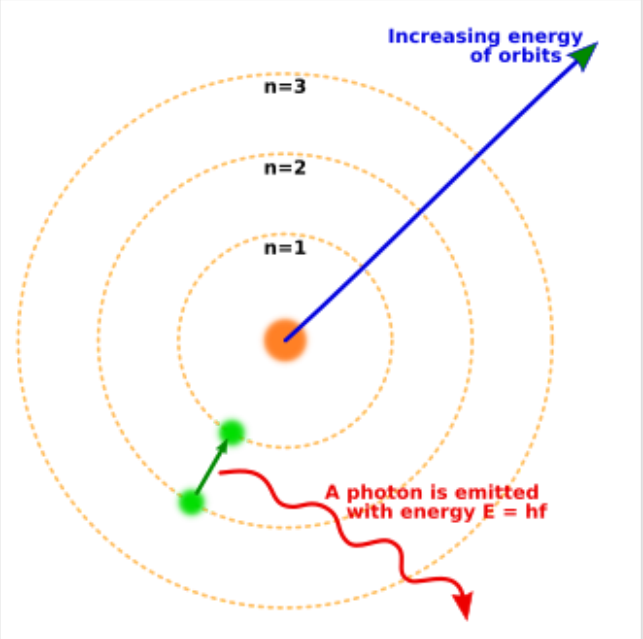
Grok x.com/i/grok/share/2ERWIbPFpB0wlCsaqcGErGVX2 [9][10]

Conclusion : The integer ( n ) introduces a quantization effect, and at these points, the spiral's geometry—through the number of steps and the resulting angular position—creates a resonant or balanced configuration. This allows the electron, moving semi-classically, to occupy stable orbital shells, not because of quantum wavefunctions, but due to the inherent structure and symmetry of the spiral's path at these discrete, integer-squared intervals.

## Theory

### Principal quantum number n

The H atom has 1 proton and 1 electron orbiting the proton, in the Bohr model (which approximates a gravitational orbit), the electron can be found at select radius (the Bohr radius) from the proton (nucleus), these radius represent the permitted energy levels (orbital regions) at which the electron may orbit the proton. Electron transition (to a higher energy level) occurs when an incoming photon provides the required energy (momentum). Conversely emission of a photon will result in electron transition to a lower energy level.



Electron at different *n* level orbitals

The principal quantum number *n* denotes the energy level for each orbital. As *n* increases, the electron is at a higher energy level and is therefore less tightly bound to the nucleus (as *n* increases, the electron orbit is further from the nucleus). Each shell can accommodate up to $n^2$ (1, 4, 9, 16 ... ) electrons. Accounting for two states of spin this becomes $2n^2$ electrons. As these energy levels are fixed according to this integer *n*, the orbitals may be said to be quantized.

## Oscillating electron Bohr orbital

Note: Here the electron is treated as an oscillation between an electric state and a mass state; the electric state duration = particle frequency, the mass state duration = 1 unit of Planck time. In the mass state the particle is a point (i.e.: it can be assigned Cartesian co-ordinates).

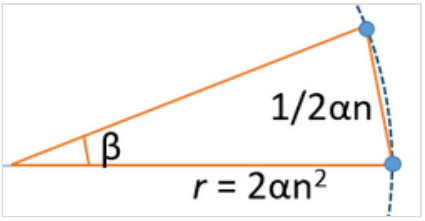
The basic orbital radius has 2 components, dimensionless (the fine structure constant alpha) and dimensioned (electron + proton wavelength);

wavelength $\lambda_H = \lambda_p + \lambda_e$

radius $r_{orbital} = 2\alpha n^2(\lambda_H)$

As a mass point, the electron orbits the proton at a fixed radius (the Bohr radius) in a series of steps (the duration of each step corresponds to the wavelength component). The distance travelled per step (per wave-point oscillation) equates to the distance between mass point states and is the inverse of the radius

length (per step) = $l_{orbital} = \frac{1}{r_{orbital}}$



electron (blue dot) moving 1 step anti-clockwise along the alpha orbital circumference

Duration = 1 step per wavelength and so velocity

velocity = $v_{orbital} = \frac{1}{2\alpha n}$

Giving period of orbit

period = $\frac{2\pi r_{orbital}}{v_{orbital}} = 2\pi 2\alpha 2\alpha n^3 \lambda_H$

As we are not mapping the wavelength component, a base (reference) orbital ($n$=1)

$t_{ref} = 2\pi 4\alpha^2$ = 471964.356...

The angle of rotation derives from the orbital radius

$$\beta = \frac{1}{r_{orbital}\sqrt{r_{orbital}}\sqrt{2\alpha}}$$

### Photon orbital model

The electron can jump between *n* energy levels via the absorption or emission of a photon. In the Photon-orbital model[11], the orbital (Bohr) radius is treated as a 'physical wave' akin to the photon albeit of inverse or reverse phase such that $orbital\ radius + photon = zero$ (cancel).

The photon can be considered as a moving wave, the orbital radius as a standing/rotating wave (trapped between the electron and proton), as such it is the orbital radius that absorbs or emits the photon during transition, in the process the orbital radius is extended or reduced (until the photon is completely absorbed/emitted). The electron itself has a `passive' role in the transition phase. It is the rotation of the orbital radius that pulls the electron, resulting in the electron orbit around the nucleus (orbital momentum comes from the orbital radius), and this rotation continues during the transition phase resulting in the electron following a spiral path.

The photon is actually 2 photons as per the Rydberg formula (denoted initial and final).

$$\lambda_{photon} = R.(\frac{1}{n_i^2} - \frac{1}{n_f^2}) = \frac{R}{n_i^2} - \frac{R}{n_f^2}$$

$$\lambda_{photon} = (+\lambda_i) - (+\lambda_f)$$

The wavelength of the ($\lambda_i$) photon corresponds to the wavelength of the orbital radius. The ($+\lambda_i$) will then delete the orbital radius as described above (*orbital* + *photon* = *zero*), however the ($-\lambda_f$), because of the Rydberg minus term, will have the same phase as the orbital radius and so conversely will increase the orbital radius. And so for the duration of the ($+\lambda_i$) photon wavelength, the orbital radius does not change as the 2 photons cancel each other;

$$r_{orbital} = r_{orbital} + (\lambda_i - \lambda_f)$$

However, the ($\lambda_f$) has the longer wavelength, and so after the ($\lambda_i$) photon has been absorbed, and for the remaining duration of this ($\lambda_f$) photon wavelength, the orbital radius will be extended until the ($\lambda_f$) is also absorbed. For example, the electron is at the *n* = 1 orbital. To jump from an initial $n_i = 1$ orbital to a final $n_f = 2$ orbital, first the ($\lambda_i$) photon is absorbed ($\lambda_i + \lambda_{orbital} = zero$ which corresponds to 1 complete *n* = 1 orbit by the electron, the **orbital phase**), then the remaining ($\lambda_f$) photon continues until it too is absorbed (the **transition phase**).

$$t_{ref} \sim 2\pi 4\alpha^2$$

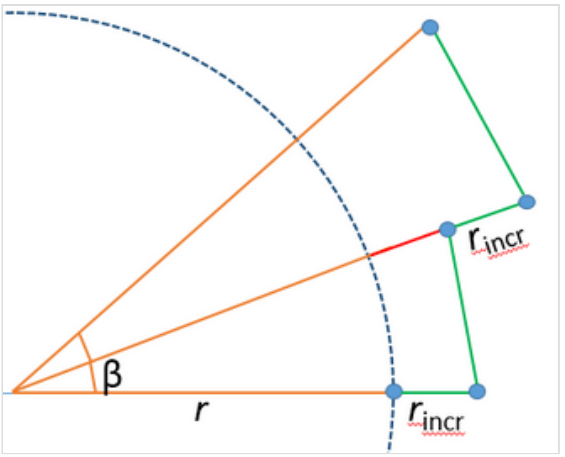
$$\lambda_i = 1t_{ref}$$

$$\lambda_f = 4t_{ref}\ (n = 2)$$

After the ($\lambda_i$) photon is absorbed, the ($\lambda_f$) photon still has $\lambda_f = (n_f^2 - n_i^2)t_{ref} = 3t_{ref}$ steps remaining until it too is absorbed.

This process does not occur as a single `jump' between energy levels by the electron, but rather absorption/emission of the photon takes place in discrete steps, each step corresponds to a unit of $r_{incr}$ (both photon and orbital radius may be considered as constructs from multiple units of this geometry);

$$r_{incr} = -\frac{1}{2\pi 2\alpha r_{wavelength}}$$



orbital transition during orbital rotation

In summary; the ($\lambda_i$) photon, which has the same wavelength as the orbital radius, deletes the orbital radius in steps $r = r_{orbital}$

$r = r + r_{incr}$
//$\lambda_i$ photon

Conversely, because of its minus term, the ($\lambda_f$) photon will simultaneously extend the orbital radius accordingly;

WHILE ($r < 4r_{orbital}$)

$r = r - r_{incr}$
//$\lambda_f$ photon

The model assumes orbits also follow along a timeline *z*-axis

$$t_{orbital} = t_{ref}\sqrt{1 - \frac{1}{(v_{orbital})^2}}$$

The orbital phase has a fixed radius, however at the transition phase this needs to be calculated for each discrete step as the orbital velocity depends on the radius;

$$t_{transition} = t_{ref}\sqrt{1 - \frac{1}{(v_{transition})^2}}$$

## Electron transition

*Further information: Quantum_gravity_(Planck) § Atomic_orbitals*

The following refers to an idealized Rydberg atom (a nucleus of point size, infinite mass and disregarding wavelength). Derivations are summarized in the AI spiral rationale section.

In this example the electron transition starts at the initial ($n_i$ = 1) orbital

$$\varphi = 0,\ r_{orbital} = 2\alpha$$

For each step during transition;

$$\beta = \frac{1}{r_{orbital}\sqrt{r_{orbital}}\sqrt{2\alpha}}$$

$$\varphi = \varphi + \beta$$

Setting t = step number (FOR t = 1 TO ...), we can calculate the radius *r* and $m$ at each step.

$r = r_{orbital} + \frac{t}{2\pi 2\alpha}$ (number of increments *t* of $r_{incr}$)

$m = 1 + \frac{t}{2\pi 4\alpha^2}$ ($m$ as a function of *t*)

$\varphi = 4\pi\frac{(m - \sqrt{m})}{m}$ ($\varphi$ at any $m$)

We can then re-write ($m$ is only an integer at prescribed spiral angles);

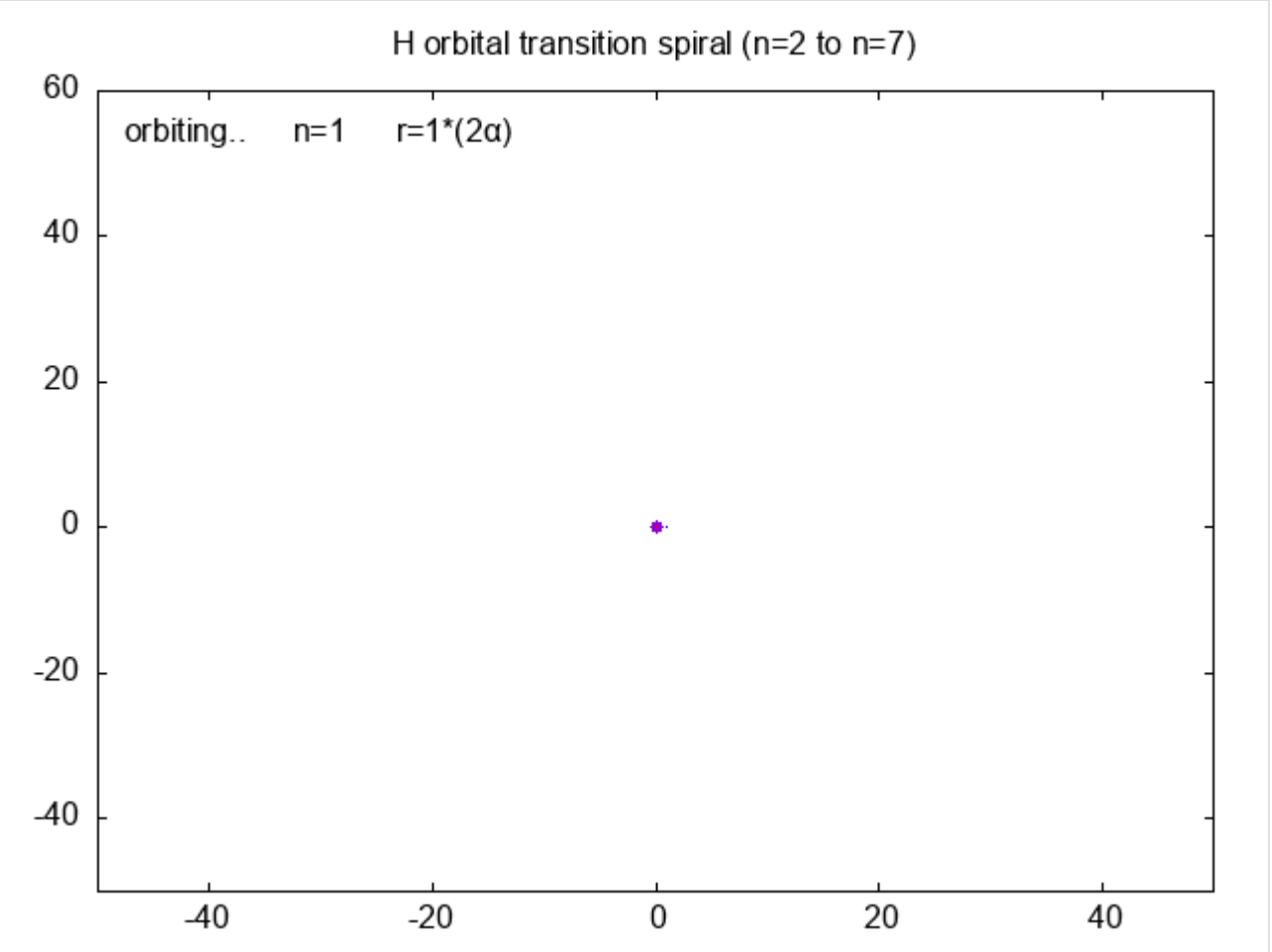
$$\beta = \frac{1}{{r_{orbital}}^2 m^{(3/2)}}$$

Giving integer values at these spiral angles

$\varphi = (2)\pi,\ r = 4r_{orbital}$ (360°)
$\varphi = (8/3)\pi,\ r = 9r_{orbital}$ (360+120°)
$\varphi = (3)\pi,\ r = 16r_{orbital}$ (360+180°)
$\varphi = (16/5)\pi,\ r = 25r_{orbital}$ (360+216°)
$\varphi = (10/3)\pi,\ r = 36r_{orbital}$ (360+240°)
$\varphi = (7/4)\pi,\ r = 49r_{orbital}$
$\varphi = (7/2)\pi,\ r = 64r_{orbital}$ (360+270°)

The wavelength of the H atom

$$\lambda_H = \lambda_p + \lambda_e$$




Bohr radius during ionization, as the H atom electron reaches each *n* level, it completes 1 orbit (for illustration) then continues outward (actual velocity will become slower as radius increases according to angle β)

$$H = \frac{2c}{\lambda_H}$$

Frequency (Hz)

$$f_H = \frac{(n^2 - 1)}{n^2} \frac{H}{2\pi r_0^2}$$

We can replace wavelength with the Rydberg constant R and the proton-electron mass ratio μ

$$H = \frac{2c}{\lambda_H} = 8\pi c\alpha^2 R \frac{\mu}{\mu + 1}$$

This gives the Bohr model when $m = n^2$

$$f_H = \frac{(n^2 - 1)}{n^2} Rc \frac{\mu}{\mu + 1}$$

## Geometrical universe links

A universe model that uses dimensionless geometrical forms:

- Electron_(mathematical): Mathematical electron from Planck units
- Planck_units_(geometrical): Planck units as geometrical forms
- Physical_constant_(anomaly): Anomalies in the physical constants
- Quantum_gravity_(Planck): Gravity at the Planck scale
- Relativity_(Planck): 4-axis hypersphere as origin of motion
- Black-hole_(Planck): CMB and Planck units
- Sqrt_Planck_momentum: Link between charge and mass
- God_(programmer): Simulation Hypothesis

## External links

- Simulation hypothesis modelling at the Planck scale using geometrical objects (https://codingthecosmos.com/)

## References


1. Macleod, Malcolm J.; "Simulating gravitational and atomic orbits via rotating particle-particle orbital pairs". *RG*. Dec 2024. doi:10.13140/RG.2.2.11378.00961.
2. https://codingthecosmos.com/files/H-atomic-orbital-03-2025.c code H-atomic-orbital-03-2025.c
3. https://codingthecosmos.com/ AI model analysis
4. https://chatgpt.com/share/67ce62fc-8bf8-8012-8622-37a7a4fae6d6 Chat GPT derivation
5. https://codingthecosmos.com/ai_pdf/Deepseek-spiral-03-2025.pdf Deepseek derivation pdf
6. https://chat.qwen.ai/s/9fe132a6-91d7-4ec6-8c82-ebf2e1b2b422 Qwen derivation
7. https://claude.ai/share/355e21e4-d623-4810-962a-fb1892c2ef3f Claude derivation
8. https://codingthecosmos.com/ai_pdf/Claude-spiral-03-2025.pdf Claude derivation pdf
9. https://x.com/i/grok/share/2ERWIbPFpB0wlCsaqcGErGVX2 Grok derivation
10. https://codingthecosmos.com/ai_pdf/Grok-spiral-03-2025.pdf Grok derivation pdf

11. Macleod, Malcolm J.; "Simulating gravitational and atomic orbits via rotating particle-particle orbital pairs". *RG*. Dec 2024. doi:10.13140/RG.2.2.11378.00961.

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