Pi is a Rational Number in Physics

(Version 2)

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Abstract

It has been mathematically proved that pi is an irrational number, Mathematics has infinitesimal but there is a minimum in physics. The Planck length is the smallest length that can be measured, and a size smaller than it doesn't make sense. By comparing the circumference of a circle with the Planck length, the significant decimal places of the circumference of the circle are determined, with formula: Pi = circumference / diameter, calculate the number of significant decimal places for pi. Therefore, pi is a finite decimal and is a rational number, according to this, set up the physical pi table. In the same way we get: The square root of 2 is a finite decimal and is a rational number, resolved the square root crisis of 2. Finally think that, Mathematics and physics are different, Irrational numbers are all rational numbers in physics. There is infinity ($n\rightarrow\pm\infty$, $n\rightarrow\pm 1/\infty$) in mathematics, but not in physics; Length, quality and time all have definite values. Our universe is certain and limited.

Key words: Circumference, Pi, Planck length, √2, Rational Number, Dimension

It has been mathematically proved that pi is an irrational number, calculating pi by split regular polygons, can be divided infinitely; use the infinite series formula to calculate the pi, can be calculated indefinitely, infinitely increasing decimal places. As of June 8, 2022, it has been calculated to 100 trillion digits [1].

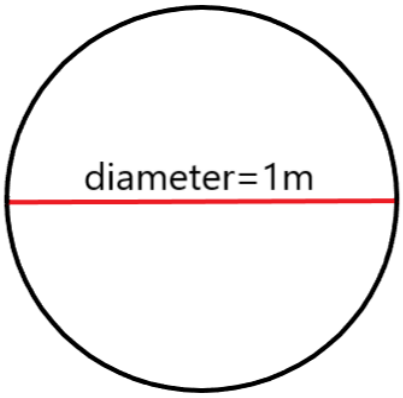
1 Pi in physics

Mathematics has infinitesimal but there is a minimum in physics. The Planck length is the smallest length that can be measured, and a size smaller than it doesn't make sense[2].

Calculate the pi, you can't go down exceed the Planck length, the decimal places of pi stop here and no longer grow.

1.1 A circle with a diameter of 1 meter (Fig.1)

Fig.1



circumference
=3.14159265358979323846264338327950 28m

Circumference of circle =π d = 3.1415926……m.

We compare the circumference of a circle with Planck length.

Circumference of circle: **3.14159265358979323846264338327950**84197……m

Planck length: **0.00000000000000000000000000000000000**16162……m

Because the Planck length is the smallest length that can be measured，less than the Planck length is meaningless. We take 3.14159265358979323846264338327950 28, that is, 34 decimal places can satisfy the value valid.

The effective value of the circumference of a circle with a diameter of 1 meter is 3.14159265358979323846264338327950288m, it is a finite decimal and is a rational number.

According to the formula:

Pi= circumference/ diameter=3.14159265358979323846264338327950288

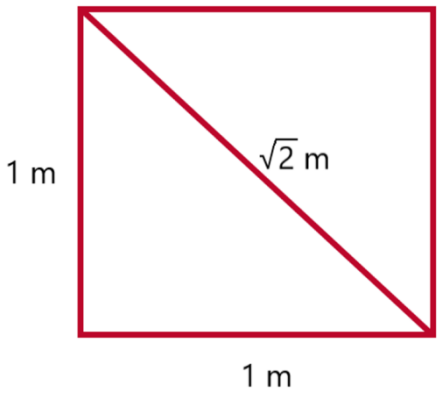
That is, the pi of 1 meter diameter is 3.14159265358979323846264338327950288, take 34 digits after the decimal point of pi.

At this time, pi is a finite decimal and is a rational number.

The same, the effective value of the circumference of a circle of 10 meters in diameter is 31.41592653589793238462643383279502888m, its corresponding pi is 3.14159265358979323846264338327950288, take pi 35 places after the decimal point.

2 The square root of 2(Fig.2)

Fig.2



Geometrically, the square root of 2 is the length of a diagonal across a square with sides of one unit of length.

Figure 3 is a square with a side length of 1 meter, the length of the diagonal is √2 meters, the length of the diagonal line in the figure is fixed, but √2 is an infinite non-repeating decimal and not a fixed value. The crisis came into being.

Now let's compare the square root of 2 with the Planck length:

The square root of 2: **1.41421356237309504880168872420969807**8569……m

Planck length: **0.00000000000000000000000000000000000**16162……m

We take 1.41421356237309504880168872420969807m as the diagonal value, it is a finite decimal, a fixed value. The length of the line segment is consistent with the numerical value, the crisis is lifted.

3 Why physics

When we draw geometric, it naturally has a length dimension and have physical properties, although no units of length or just letters are marked, but it has a length value and we can measure with tools.

All matter and space-time in the universe have dimensions and have physical properties, we need to explain them with physical rules.

3.1 A square with side length 1, two adjacent sides are on the x-axis and y-axis, respectively. Draw a circular arc with the origin O as the center and the diagonal length as the radius, intersection on the x-axis, then the length from the origin O to the intersection is the square root of 2, the irrational number $\sqrt{2}$ has a position on the X axis(Fig.3).

The conclusion that irrational numbers can be represented on axes is false. When we conduct thought experiments, or describe with text, it is in the realm of philosophy and mathematics, the square root of 2 is an irrational number, ability to find corresponding points on virtual axes. But when we implement it, it has a dimension and physical properties, $\sqrt{2}$ is a rational number in physics, can be marked on the axes.

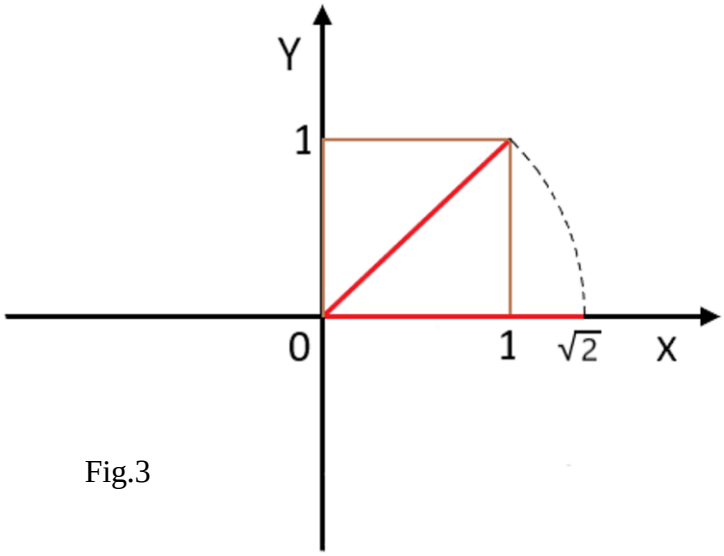


Fig.3

Figure 3 does not indicate the unit of length, but we can measure with tools, theoretically, the measurement accuracy can only reach Planck length and can no longer go down.

4 Significance

Thought experiments do not represent physics, "the cat" is dead or alive to do the experiment (insects are recommended). Mathematics and physics are different, Irrational numbers are all rational numbers in physics. There is infinity ($n\rightarrow\pm\infty$, $n\rightarrow\pm 1/\infty$) in mathematics, but not in physics; length, quality and time all have definite values, problems like Zeno's paradox can be solved; we take on new meaning in interpreting physical formulas. For example, Einstein's equations contain pi, pi is a finite decimal, so we can understand that the universe is certain and limited.

5 Conclusion

Pi is a rational number in physics, it is necessary for physics circle to define pi as a rational number, in this way, we can explain the physical universe more rationally. To distinguish, we use "π_w" to represent the pi in physics.

$$R_{\mu\nu} - \frac{1}{2} R g_{\mu\nu} + \Lambda g_{\mu\nu} = \frac{8\pi G}{c^4} T_{\mu\nu}$$

6 Physical pi table

Serial number	Diameter (m)	Pi decimal places#	Applicable diameter range(m)	Example
1	1.00E-15	19	3.19E-16 ～ 3.18E-15	electron
2	1.00E-14	20	3.19E-15 ～ 3.18E-14	
3	1.00E-13	21	3.19E-14 ～ 3.18E-13	
4	1.00E-12	22	3.19E-13 ～ 3.18E-12	hydrogen atom
5	1.00E-11	23	3.19E-12 ～ 3.18E-11	
6	1.00E-10	24	3.19E-11 ～ 3.18E-10	atom
7	1.00E-09	25	3.19E-10 ～ 3.18E-09	base pair
8	1.00E-08	26	3.19E-09 ～ 3.18E-08	flagellum
9	1.00E-07	27	3.19E-08 ～ 3.18E-07	virus
10	1.00E-06	28	3.19E-07 ～ 3.18E-06	bacteria
11	1.00E-05	29	3.19E-06 ～ 3.18E-05	red blood cell
12	1.00E-04	30	3.19E-05 ～ 3.18E-04	the steel ball in ballpoint pen
13	0.001	31	3.19E-04 ～ 3.18E-03	rapeseed, yarn
14	0.01	32	3.19E-03 ～ 3.18E-02	coins and buttons

Serial number	Diameter (m)	Pi decimal places[#]	Applicable diameter range(m)	Example
15	0.1	33	3.19E-02 ～ 3.18E-01	table tennis, football
16	1	34	3.19E-01 ～ 3.18E+00	manhole cover, round pipe
17	10	35	3.19E+00 ～ 3.18E+01	shield machine, hot air balloon
18	100	36	3.19E+01 ～ 3.18E+02	stadium
19	1000	37	3.19E+02 ～ 3.18E+03	crater
20	1.00E+04	38	3.19E+03 ～ 3.18E+04	Large Hadron Collider
21	1.00E+05	39	3.19E+04 ～ 3.18E+05	rainbow
22	1.00E+06	40	3.19E+05 ～ 3.18E+06	Moon, Pluto, Triton
23	1.00E+07	41	3.19E+06 ～ 3.18E+07	Mercury, Mar, Venu, Earth
24	1.00E+08	42	3.19E+07 ～ 3.18E+08	Neptune, Uranu, geo-synchronous orbit, Saturn, Jupiter
25	1.00E+09	43	3.19E+08 ～ 3.18E+09	Moon orbit, Sun
26	1.00E+10	44	3.19E+09 ～ 3.18E+10	Callisto orbit
27	1.00E+11	45	3.19E+10 ～ 3.18E+11	Earth orbit
28	1.00E+12	46	3.19E+11 ～ 3.18E+12	Jupiter orbit
29	1.00E+13	47	3.19E+12 ～ 3.18E+13	Neptune orbit, Kuiper belt
30	1.00E+14	48	3.19E+13 ～ 3.18E+14	
31	1.00E+15	49	3.19E+14 ～ 3.18E+15	
32	1.00E+16	50	3.19E+15 ～ 3.18E+16	
33	1.00E+17	51	3.19E+16 ～ 3.18E+17	
34	1.00E+18	52	3.19E+17 ～ 3.18E+18	
35	1.00E+19	53	3.19E+18 ～ 3.18E+19	
36	1.00E+20	54	3.19E+19 ～ 3.18E+20	Small Magellanic Cloud, Large Magellanic Cloud
37	1.00E+21	55	3.19E+20 ～ 3.18E+21	Hoag's Object, The Sombrero Galaxy, Milky Way, Andromeda

Serial number	Diameter (m)	Pi decimal places[#]	Applicable diameter range(m)	Example
38	1.00E+22	56	3.19E+21 ～ 3.18E+22	IC 1100
39	1.00E+23	57	3.19E+22 ～ 3.18E+23	Alcyoneus
40	1.00E+24	58	3.19E+23 ～ 3.18E+24	
41	1.00E+25	59	3.19E+24 ～ 3.18E+25	Laniakea Supercluster
42	1.00E+26	60	3.19E+25 ～ 3.18E+26	Hercules-Corona Borealis Great Wall
43	1.00E+27	61	3.19E+26 ～ 3.18E+27	Hubble Volume
44	6.19E+34	69	3.19E+34 ～ 3.18E+35	Maximum universe[3]

#Significant decimal places of pi corresponding to the circumference of the circle, It doesn't make sense to exceed it.

References

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