Pi is a Rational Number in Physics

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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

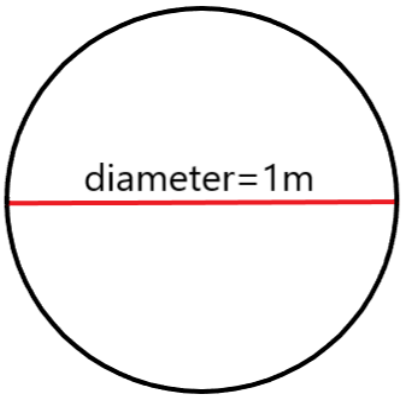
It has been mathematically proved that pi is an irrational number, calculating pi by split regular polygons, can be divided infinitely; use the infinite series formula to calculate the pi, can be calculated indefinitely, infinitely increasing decimal places. As of June 8, 2022, it has been calculated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

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 (Carr et al. 2005; Hossenfelder 2012). 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 3.14159265358979323846264338327950 28m, it is a finite decimal and is a rational number.

According to the formula:

Pi= circumference/ diameter=3.14159265358979323846264338327950 28

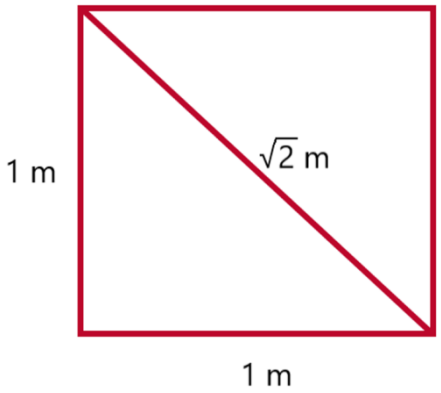
That is, the pi of 1 meter diameter is 3.14159265358979323846264338327950288, take 34 digits after the decimal point of pi.

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 31.415926535897932384626433832795028 8m, its corresponding pi is 3.14159265358979323846264338327950288, take Pi 35 places after the decimal point.

2 The square root of 2(Fig.2)

Fig.2



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

The square root of 2: **1.414213562373095048801688724209698078569**……m

Planck length: **0.00000000000000000000000000000000000016162**……m

We take 1.41421356237309504880168872420969 80m 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 √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.

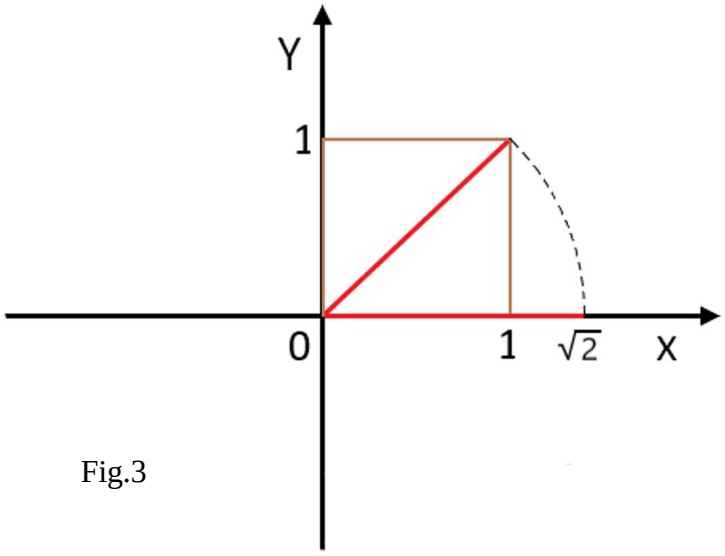


Fig.3

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

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.

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

6 Physical pi table

Serial number	Diameter (m)	Pi decimal places[1]	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
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, geosynchro-nous orbit, Saturn, Jupiter
25	1.00E+09	43	3.19E+08 ～ 3.18E+09	Moon orbit, Sun

Serial number	Diameter (m)	Pi decimal places	Applicable diameter range(m)	Example
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, Androm-eda
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 (Wang 2022)

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

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在物理学中圆周率是有理数

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摘要

圆周率是无理数已经被数学证明，数学有无穷小，但是进入物理学就有最小值了。普朗克长度是能够测量的最小长度，比其更短的长度是没有意义的。通过圆周长与普朗克长度比较，确定了圆周长的有效小数位，再用公式：圆周率=周长/直径，计算出圆周率的有效小数位。因此，圆周率是有限小数，是有理数，据此制定了物理圆周率表。用同样的方法得出：2 的平方根是有限小数，是有理数，解除了 2 的平方根危机。最后认为，数学与物理是不同的，数学里的无穷(∞、1/∞)在物理中没有，长度、质量、时间都有确定值。我们的宇宙是确定的有限的。

关键词：圆周长、圆周率、普朗克长度、2 的平方根、有理数、量纲

圆周率是无理数已经被数学证明，用分割正多边形的方法计算圆周率，可以无穷地进行分割；无穷级数公式计算圆周率，可以无穷地计算下去，小数位无穷地增加。至 2022 年 6 月 8 日，已经计算到 100 万亿位(Emma 2022)。

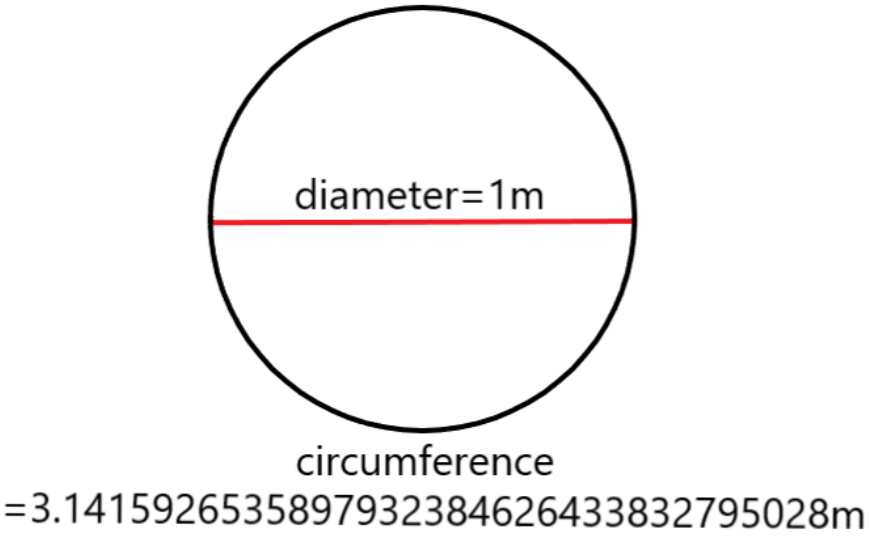
1. 物理中的圆周率

数学有无穷小，但是进入物理学就有最小值了。普朗克长度是能够测量的最小长度，比其更短的长度没有意义(Carr et al. 2005; Hossenfelder 2012)。

计算圆周率，到普朗克长度就不能往下了，圆周率小数位到此停止，不再增长。

1.1 直径 1 米的圆(图 1)

图 1



圆周长 C=π d=3.1415926……m。

我们将圆周长与普朗克长度进行比较。

圆周长：　**3.14159265358979323846264338327950284**4197……m

普朗克长度：　**0.00000000000000000000000000000000000**16162……m

因为普朗克长度是能够测量的最小长度，小于普朗克长度没有意义。我们就取 3.14159265358979323846264338327950288，即 34 位小数能满足数值有效。

1 米直径的圆周长有效数值是 3.14159265358979323846264338327950288m，是一个有限小数，有理数。

根据公式, 圆周率=圆周长/直径=3.14159265358979323846264338327950288

即，1 米直径的圆周率是 3.14159265358979323846264338327950288，取圆周率小数点后 34 位。

此时，圆周率是一个有限小数，是有理数。

同样可以得出：

10 米直径的圆周长有效数值是 31.41592653589793238462643383279502888m，

其对应的圆周率为 3.14159265358979323846264338327950288，取圆周率小数点后 35 位。

2. 二的平方根(图 2)

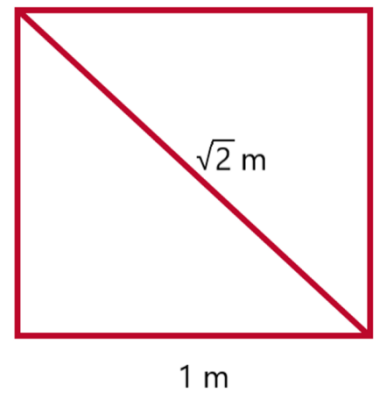


图2

在几何上，2 的平方根是一个边长为一个单位的正方形的对角线的长度。

图 2 是一个边长为 1 米的正方形，对角线的长度是√2 米，图中对角线的长度是固定的，但是 √2 是无限不循环小数，不是固定值。危机产生了。

现在我们用 √2 与普朗克长度比较：

2 的平方根:　　**1.414213562373095048801688724209698078569**……m

普朗克长度:　　**0.00000000000000000000000000000000016162**……m

我们取 1.41421356237309504880168872420969 80m 为对角线的值，它是一个有限小数，是一个固定值。线段的长度与数值是一致的，危机解除。

3. 为什么是物理

当我们把线条、图形画出来，它自然具有了长度单位，具有了物理性质，虽然没有标注长度单位或只是标注了字母，不改变它有一个长度值，我们可以用工具测量出来。

宇宙中的所有物质和时空都具有量纲，都具有物理性质,要用物理规则解释它们。

3.1 一个边长为 1 的正方形，两临边分别在 x 轴和 y 轴上。以原点 0 为圆心，对角线长为半径画园弧，交点于 x 轴，则原点到交点的长度为 √2。无理数 √2 在数轴上有了位置（图 3）。

无理数能在坐标轴上表示，这个结论是错误的。当我们进行思想实验，设想、用文字表述时，它在哲学、数学范畴内，√2 是无理数，能够在虚拟的坐标轴上找到对应点。但是当我们把它实施出来，它就具有了量纲，具有物理性，√2 在物理上是有理数，能在数轴上标示。

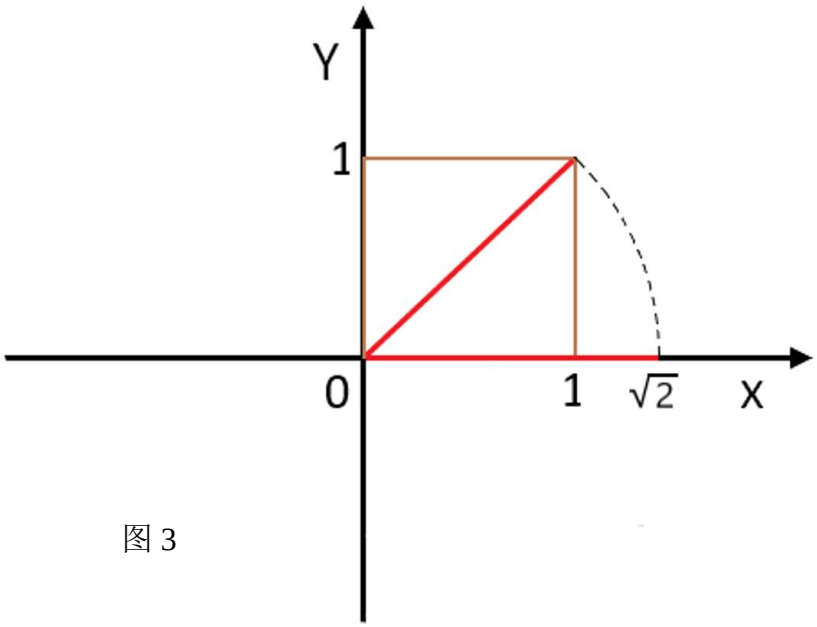


图 3

图 3 没有标注长度的单位，但我们可以用工具测量，理论上测量精确度到普朗克长度为止，不能再向下。

4. 意义

数学与物理是不同的，无理数在物理中都是有理数，数学里的无穷(∞、1/∞)在物理中没有，长度、质量、时间都有确定值，芝诺悖论之类的问题都可以解决；我们在解释物理公式时具有新的意义。比如，爱因斯坦方程含有π，π 是一个有限小数，因此我们可以理解宇宙是确定的有限的。

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

5．结论：圆周率在物理学里是有理数，物理界有必要把圆周率定义为有理数，这样我们能更合理的解释物质宇宙。为了区分，我用“π_w”表示物理中的圆周率。

6.物理圆周率表

序号	直接(m)	圆周率小数位[1]	适用直径范围(m)	举 例
1	1.00E-15	19	3.19E-16 ～ 3.18E-15	电子
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	氢原子
5	1.00E-11	23	3.19E-12 ～ 3.18E-11	
6	1.00E-10	24	3.19E-11 ～ 3.18E-10	原子
7	1.00E-09	25	3.19E-10 ～ 3.18E-09	碱基对
8	1.00E-08	26	3.19E-09 ～ 3.18E-08	鞭毛
9	1.00E-07	27	3.19E-08 ～ 3.18E-07	病毒
10	1.00E-06	28	3.19E-07 ～ 3.18E-06	细菌
11	1.00E-05	29	3.19E-06 ～ 3.18E-05	红血球细胞
12	1.00E-04	30	3.19E-05 ～ 3.18E-04	圆珠笔钢珠
13	0.001	31	3.19E-04 ～ 3.18E-03	菜籽、纺线
14	0.01	32	3.19E-03 ～ 3.18E-02	硬币、纽扣
15	0.1	33	3.19E-02 ～ 3.18E-01	乒乓球，足球
16	1	34	3.19E-01 ～ 3.18E+00	井盖、圆管
17	10	35	3.19E+00 ～ 3.18E+01	盾构机、热气球
18	100	36	3.19E+01 ～ 3.18E+02	体育场
19	1000	37	3.19E+02 ～ 3.18E+03	火山口
20	1.00E+04	38	3.19E+03 ～ 3.18E+04	大型强子对撞机
21	1.00E+05	39	3.19E+04 ～ 3.18E+05	彩虹
22	1.00E+06	40	3.19E+05 ～ 3.18E+06	月球，冥王星，海卫一
23	1.00E+07	41	3.19E+06 ～ 3.18E+07	水星，火星，金星，地球
24	1.00E+08	42	3.19E+07 ～ 3.18E+08	海王星，天王星，地球同步轨道，土星，木星
25	1.00E+09	43	3.19E+08 ～ 3.18E+09	月球轨道，太阳

序号	直接(m)	圆周率小数位	适用直径范围(m)	举 例
26	1.00E+10	44	3.19E+09 ～ 3.18E+10	木卫四轨道
27	1.00E+11	45	3.19E+10 ～ 3.18E+11	地球轨道
28	1.00E+12	46	3.19E+11 ～ 3.18E+12	木星轨道
29	1.00E+13	47	3.19E+12 ～ 3.18E+13	海王星轨道，柯伊伯带
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	小麦哲伦星云，大麦哲伦星系
37	1.00E+21	55	3.19E+20 ～ 3.18E+21	哈氏天体,草帽星系,银河系， 仙女座
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	拉尼亚凯亚超星系团
42	1.00E+26	60	3.19E+25 ～ 3.18E+26	武仙－北冕座长城
43	1.00E+27	61	3.19E+26 ～ 3.18E+27	可观测宇宙
44	6.19E+34	69	3.19E+34 ～ 3.18E+35	最大宇宙(Wang 2022)

1. 圆周长对应的圆周率的有效小数位,超过它没有意义。

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