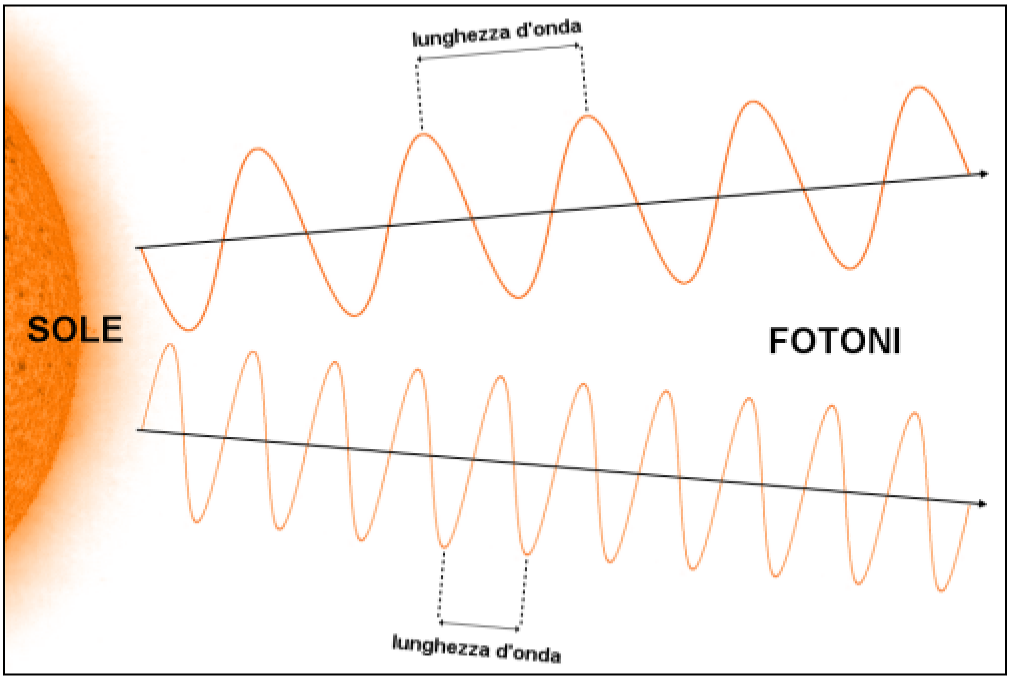


The energy of the photon

For years, reading books that divulged the Theory of Relativity I wondered: how can a **photon** of zero mass have an energy different from zero?

If in Einstein's famous equation you put the mass of the photon: m = 0, since every number multiplied by 0 is equal to zero, the E (energy) of the equation becomes 0, causing me serious psychological problems and long sleepless nights, because I used to think that the photon comes from the Sun and carries a fair share of renewable energy, equal to the square of the speed of light. After all Einstein convinced me that we are all made of energy that goes round and round, and is nothing more than a lot of photons connected together to form matter.

Let's analyze the problem in stages.

We start from the equation of Einstein: $E = mc^2$

This is the equation that determines the equivalence and the conversion factor between the energy and the mass of a physical system. "E" indicates the energy contained or emitted by a body, "m" is its mass and "c" the constant speed of light. According to this equation, all matter is energy, including us. We are made of photons.

If this equation is valid, and I replace it with **m = 0**, I get this result: **E = 0** because **E = 0** X c^2 is zero and I get an energy equal to “nothing “ that cannot exist.

Today driving towards Ragusa and savoring the delights of sitting with the dentist, I opened my mind suddenly, to escape at least mentally, the sad reality that awaited me. Here is the lighting that hit me: "The formula of relativity must also include the gamma correction for the effects of speed on massive bodies." Otherwise the whole edifice built by Einstein would collapse.

Here's the formula that many of us ignore, which that wizard and astute Einstein had proposed to correct the mass of bodies depending on the speed at which they travel. Why do we ignore it? Because we are afraid of the square roots that remind us of those of our teeth and of the square exponents representing the accelerations of the rotating drill. We are terrestrial bipedal beings that travel slowly, without acceleration and we don’t like dentists. (Although mine is a Saint).

But here's the formula for the gamma correction:

$$E = \frac{mc^2}{\sqrt{1 - \frac{v^2}{c^2}}}$$

The formula written above includes a term in the denominator which is called gamma correction and actually should be written like this:

$$E = m \cdot \gamma \cdot c^2$$

And since gamma squared is:

$$\gamma^2 = \frac{1}{\left(1 - \frac{v^2}{c^2}\right)}$$

because of the Pythagorean theorem (gamma is a long story to explain, but the squares are all the fault of Pythagoras and trust me that after a brutal effort, I managed to derive it myself), we must now take the square root of gamma and then we have:

$$E = \gamma mc^2 = \frac{1}{\sqrt{1 - \frac{v^2}{c^2}}} mc^2 = \quad ?$$

This big question is soon resolved. The result varies depending on the speed of the movement and the size of the mass concerned. Now let's see the details of this correction.

The first thing to analyze is what happens if the body is stationary. The velocity **v** under the square root becomes 0 and the ratio between the speed of the body and that of light becomes **v / c = 0** because a zero divided by any number always gives zero. For this reason, the denominator is the square root of **1** which is **1** and the gamma correction becomes **1 / 1 = 1** multiplied by mc^2 and the equation only in this case remains: $E = mc^2$ which means that the body is stationary.

If instead the mass is traveling at the speed of light, the ratio **v / c = 1** because **v = c** and the term in the denominator becomes the square root of **1 - 1 = 0**, and then the gamma correction becomes **1 / 0** that is one divided by zero and gives infinity, (as we shall see later studying the equations Brahmagupta) then it would take an infinite energy to move the mass at the speed of light. This of course is impossible. That's why our friend **photon** (of which we are made) must have zero mass. In that case the mass zero divided by zero becomes the famous (unacceptable) equation: 0/0 = 1, exactly as 1 / 1 = 1 and 2 / 2 = 1 etc. ... because any number divided by itself must be equal to 1. And zero is a number, let's us stick it in our head! In the case of the photon the equation becomes: : $E = c^2$, and the photon must travel at the same speed of light to exist.

The gamma correction corrects all problems, if only you accept a simple concept of mathematical logic that I had proposed some time ago in the Talmud of Scicli and that many mathematicians are reluctant to accept, namely that a zero divided by itself would result in the unit, namely:

0/0 = 1

For many mathematicians the division by zero gives an indeterminate result, but they are not people who have read the Kabbalah and the Talmud. They are atheists who don't understand who God is.

For those of you who, despite everything, don't want to believe it, I repeat here the demonstration of this truth that seems logical to me.

Demonstration

We have seen that 0 is the accumulation point of the series 1 / n as n goes to infinity.

i.e.:

Lim 1 / n for n tending to infinity = 0 then we can write

$1 / \infty = 0$

And its reciprocal

$$\frac{1}{0} = \infty.$$

These are the equations of Brahmagupta.

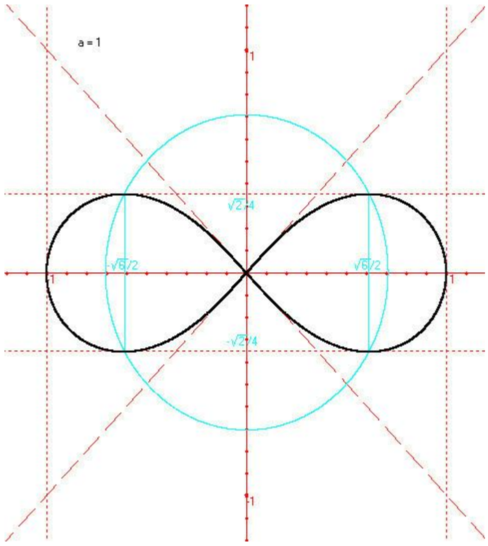
We also said (in the Talmud of Scicli) that mathematical logic implies that 0/0 = 1, and then we can give the value 0 to $1 / \infty$ and then write:

$1 / \infty$ divided $1 / \infty = 1$

and since the two infinities cancel each other out we would have 1 = 1, which is the proof that 0/0 = 1

Q.E.D.

Now I feel better and I can sleep peacefully tonight. And you, dear friends of the Academy of Kabbalists, if you have trouble sleeping, drink some grappa before bed.



The drawing shows the existence of infinitely many points between + 1 and - 1

Series of numbers and their strange sum

To add a finite number of real numbers is undoubtedly a task that cannot hold many surprises. But what happens if you add an infinite number? Before giving precise definitions let's do some little experiment.

If we add up the infinite positive integers, we get:

$1 + 2 + 3 + 4 + 5 + 6 + \cdots \rightarrow +\infty$

What's the use of it and what does this show? We can use it to add up all the infinite quantized points of space-time, since the distance between them is always equal to 1.

If 1 = h (Planck's constant) this sum is used to add up all the space-time that is quantized to obtain $+\infty$. In this case, however, we leave *holes* in the space-time because between each number and its subsequent number we can put an infinity of rational numbers such as 1/2, 1/3, 1/4 or 2/3, 2/5 etc .. We'll see how It can be done to avoid the terrible *horror vacui*. You have to find the numbers that leave no gap between them and the next number following them. The only number that is optimal for this purpose is *zero*. To tell the truth, there would also be the ∞, which is always equal to itself and to its next, so it does not leave empty spaces between itself and its next, but it would be too much to go up to ∞ the get zero. The zero can be built in endless ways.

If we modify the set of natural numbers in the following way:

1-2 + 3-4 + 5-6 + · · · what will be the result of this sum? The answer is less trivial than the last one. To find it we need to observe the behavior of the partial sums:

1 = 1

−1 = 1 − 2

2 = 1 − 2 + 3

−2 = 1 − 2 + 3 − 4

3 = 1 − 2 + 3 − 4 + 5

−3 = 1 − 2 + 3 − 4 + 5 – 6

……………. Etc..

We note that a part of the sums grows towards + ∞ while the other decreases towards -∞ and thus their overall behavior is zero, because the two infinities cancel each other.

Some may argue that any negative number in this series is always larger than 1 than the positive number that precedes it, and it's evident the fact that at infinity the number - ∞ (+ 1) is greater than +∞. Relax. Fortunately to infinity we can add or remove any number and it's always infinite.

What is the use of this amount of numbers that are alternately positive and negative, and whose follower differ from the preceding by 1? It could serve to sum a vibration that expands in space increasing by the same amount of 1 = h (Planck's constant) and that cancels out becoming zero at infinity. It's a good thing that it should cancel out, because a vibration can not grow beyond infinity!

To add the "*continuum space-time*" in which there are no gaps between one point and the next, we have to resort to the sum of infinite zeros.

If we add up infinite zeros, their sum should be zero:

0 + 0 + 0 + 0 → · · · 0

instead we have seen that if we use the old trick of dividing each number of the infinite series of natural numbers by ∞, we solve the problem of reducing to zero all the natural numbers, since any number divided by ∞ is equal to 0.

Then we write:

1 / ∞ + 2 / ∞ + 3 / ∞ + 4 / ∞+ .... ∞ / ∞ = 1

Note that at the numerator of this series we have the sum of positive integers that is ∞, and that by reducing to the lowest common denominator this infinite sum we have:

∞ / ∞ = 1 and as a mathematical entity divided by itself should always give 1, the result is 1. The ∞ cancel out without a trace!

The unit 1 can be achieved in other ways.

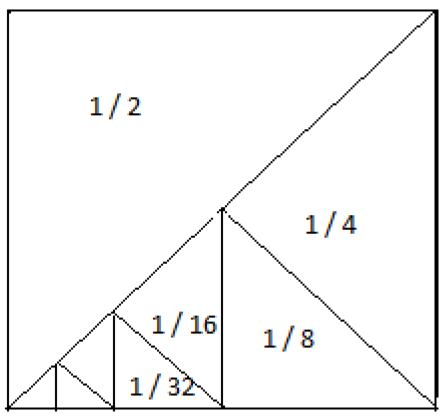
Consider now the sum of the positive powers of 1/2:

1/2 + 1/4 + 1/8 + 1/16 + · · ·.

Is there a limit to this sum, and if there is, can we calculate it? We can give an answer in this particular case using a geometric reasoning. In a square of side 1 , are gradually "cut out" rectangle triangles whose areas correspond exactly to the terms of the sum that we are examining. We proceed as follows: we fold the square following the diagonal, dividing it into 2 parts each of which is equal to 1/2 of the original square, then we divide each triangle in half and continue to divide into two each triangle to infinity.

The sum of positive powers of 1/2 will therefore be 1.

So in addition to the sum of infinite zeros, 1 is also obtained by adding up the endless positive powers of 1 / 2. See the geometric explanation below.



Let's see now another infinite sum that could serve some purpose.

The infinite sum 1 - 1 + 1 - 1 + ..., also called the *series of Grandi*, discovered by Guido Grandi in 1703, is a series similar to the series 1 - 2 + 3 - 4 + · · · only that in this case its swings back and forth, or above and below, of an amount that is always of the same amplitude 1 = h, Planck's constant. What would be its use? It can serve to calculate the sum of the movements of a particle vibrating in the same way, up and down, in space-time.

It can be represented by the formula:

$$\sum_{n=0}^{\infty}(-1)^n$$

The series of Grandi is irregular, in the sense that the sequence of its partial sums does not possess a certain limit; in a sense, however, it can be said that its sum is 1/2, or 0. In fact, this series can be rewritten either as:

$$(1-1)+(1-1)+(1-1)+...$$

where the result of the summation is obviously 0 (the sum of infinite zeros without Kabbalistic tricks). Or it can be written as:

$$1-(1-1)-(1-1)-...$$

where the result is 1.

However, there is a third way to write the series: from which it is apparent that:

$$S=1-(1-1+1-1+...)=1-S$$

From which it’s evident that the result is :

$$S=\frac{1}{2}$$

The result of this sum for the mathematicians (and not for the Kabbalists) is therefore threefold: it is either 0, or is ½ or 1.

The result is ambiguous and reminds of Schrödinger's cat (0 or 1) or of the uncertainty principle for which a distance between particles moving and vibrating in space-time can never be less than: ħ = h / 2π (note the half integer 1/2).

I explained to you how you get to the most important numbers that are used to describe the positive reality: 0, 1, ∞ and 1/2. Do not forget, however, that there is also a negative reality, in which these numbers are multiplied by - 1.

That's enough for today. I will try to find other strange mathematical results in the future, but for now I've had enough, I drink a grappa and read a funny book, the famous: *Post Office* by Charles Bukowski.