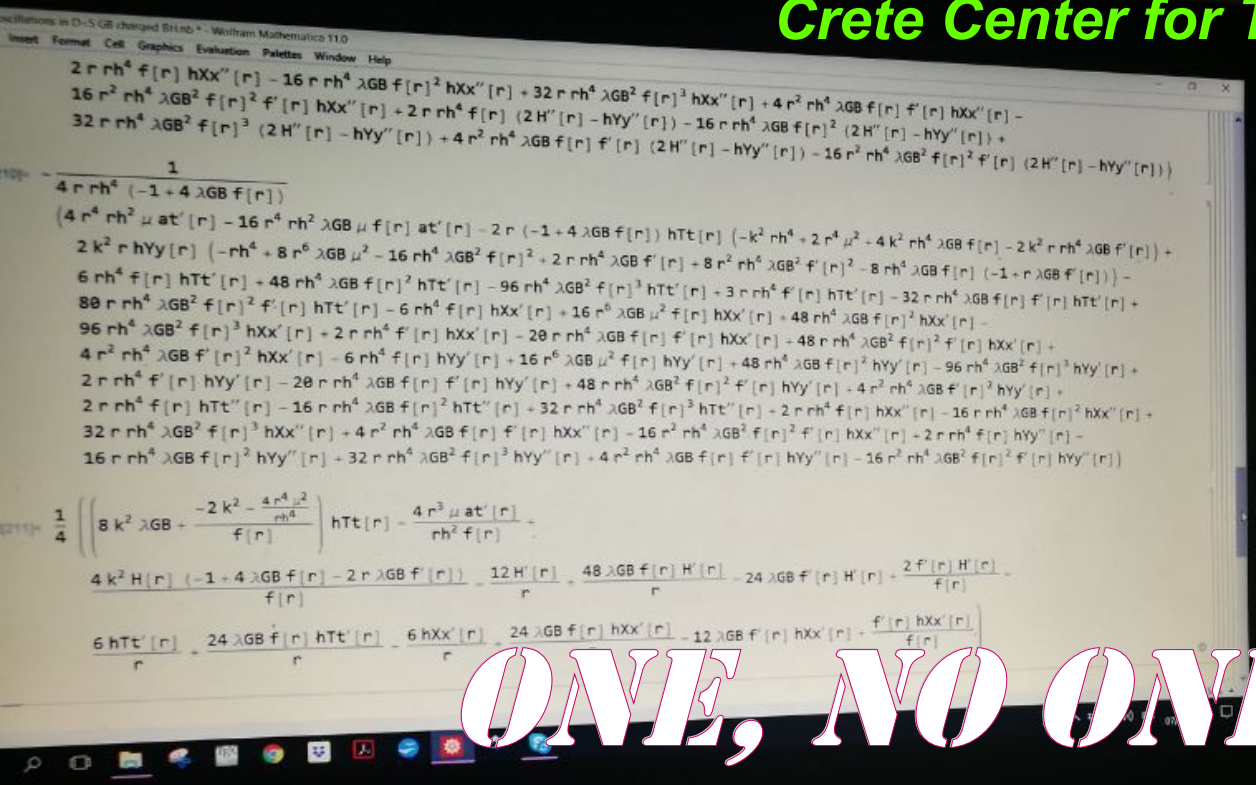
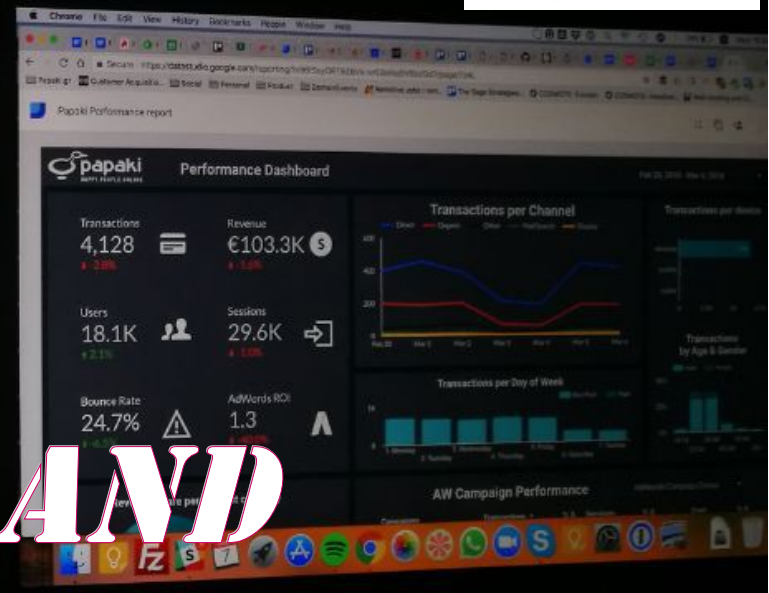
Matteo Baggioli (aka TGS)

Crete Center for Theoretical Physics





ONE, NO ONE AND ONE HUNDRED THOUSAND: YOU KNOW MORE THAN YOU THINK YOU KNOW

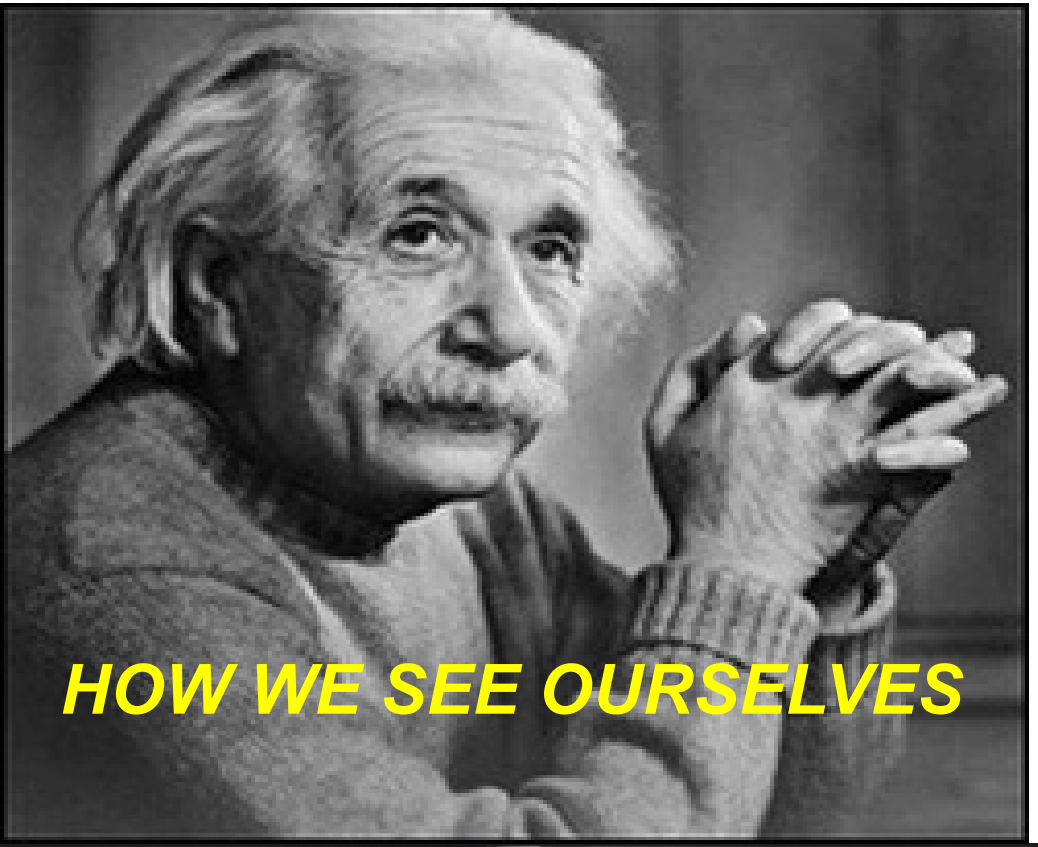
THE GRUMPY SCIENTIST

Thegrumpyscientist.com

thegrumpyscientist

STAY GRUMPY,
STAY SCIENTIST

The grumpy scientist



Theoretical physics

Field of study

Theoretical physics is a branch of physics that employs mathematical models and abstractions of physical objects and systems to rationalize, explain and predict natural phenomena. Wikipedia

Maths, abstraction, rationalize, explain

predict

WE ARE!

YOU ARE

$$\sum_{m=1}^{M}\int_t\Big\{\Big[-\int_0^{2\pi}\mathbb{I}\mathcal{L}_m(N_{xm}-\bar{N}_{xm})\,a_m\delta u_m+\mathcal{L}_m(Q_{vm}-\bar{Q}_{vm})\,a_m\delta v_m$$
$$-\mathcal{L}_m(Q_{wm}-\bar{Q}_{wm})\,a_m\delta w_m+\mathcal{L}_m(M_{xm}-\bar{M}_{xm})\,a_m\delta\psi_m\mathbb{I}_0^l\,\mathrm{d}\varphi$$
$$+\int_0^l\int_0^{2\pi}\Big\{\Big[\frac{\partial\mathcal{L}_m N_{xm}}{\partial x}+\Big(G\frac{t_m}{a_m^2}(1+k_m^*I_m)\frac{\partial^2}{\partial\varphi^2}-\rho t_m\frac{\partial^2}{\partial t^2}\mathcal{L}_m\Big)u_m$$
$$+G\frac{t_m}{a_m}\frac{\partial^2 v_m}{\partial\varphi\,\partial x}+\Big(G\frac{t_m}{a_m}k_m^*I_m\frac{\partial^2}{\partial\varphi^2}+\rho a_m t_m k_m\frac{\partial^2}{\partial t^2}\mathcal{L}_m\Big)\psi_m+\mathcal{L}_m p_{xm}\Big]a_m\delta u_m$$
$$+\Big[\frac{\partial\mathcal{L}_m Q_{vm}}{\partial x}+\frac{\nu E}{1-\nu^2}\frac{t_m}{a_m}\frac{\partial^2 u_m}{\partial\varphi\,\partial x}+\Big(\frac{E}{1-\nu^2}\frac{t_m}{a_m^2}\frac{\partial^2}{\partial\varphi^2}-\rho t_m(1+3k_m)\frac{\partial^2}{\partial t^2}\mathcal{L}_m\Big)v_m$$
$$+\Big(\frac{E}{1-\nu^2}\frac{t_m}{a_m^2}\frac{\partial}{\partial\varphi}+\rho t_m 2k_m\frac{\partial^3}{\partial\varphi\,\partial t^2}\mathcal{L}_m\Big)w_m-\frac{\nu E t}{1-\nu^2}k_m^*\frac{\partial^2\psi_m}{\partial\varphi\,\partial x}+\mathcal{L}_m p_{\varphi m}\Big]a_m\delta v_m$$
$$-\Big[\frac{\partial\mathcal{L}_m Q_{wm}}{\partial x}+\frac{\nu E}{1-\nu^2}\frac{t_m}{a_m}\frac{\partial u_m}{\partial x}+\Big(\frac{E}{1-\nu^2}\frac{t_m}{a_m^2}\frac{\partial}{\partial\varphi}+\rho t_m 2k_m\frac{\partial^3}{\partial\varphi\,\partial t^2}\mathcal{L}_m\Big)v_m$$
$$+\Big(\frac{E}{1-\nu^2}\frac{t_m}{a_m^2}\Big[1+k_m^*I_m\Big(1+\frac{\partial^2}{\partial\varphi^2}\Big)^2\Big]+\rho t_m\frac{\partial^2}{\partial t^2}\mathcal{L}_m-\rho t_m k_m\frac{\partial^4}{\partial\varphi^2\,\partial t^2}\mathcal{L}_m\Big)w_m$$
$$+\frac{\nu E t}{1-\nu^2}k_m^*\frac{\partial^3\psi_m}{\partial\varphi^2\,\partial x}+\mathcal{L}_m\Big(p_{rm}+p_{rm}^{(\mathrm{vdW})}\Big)+\frac{1}{a_m}\frac{\partial m_{\varphi m}}{\partial\varphi}\Big]a_m\delta w_m\Big\}\mathrm{d}\varphi\,\mathrm{d}x\Big\}\Big\}\mathrm{d}t=0.$$

Container-based Ecosystem

```
<a href="http://www.wordpress.com">Start blogging on WordPress.com</a>
```

Opening tag | URL | Description | Closing tag

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<a href="http://www.wordpress.com">Start blogging on Wordpress.com</a>
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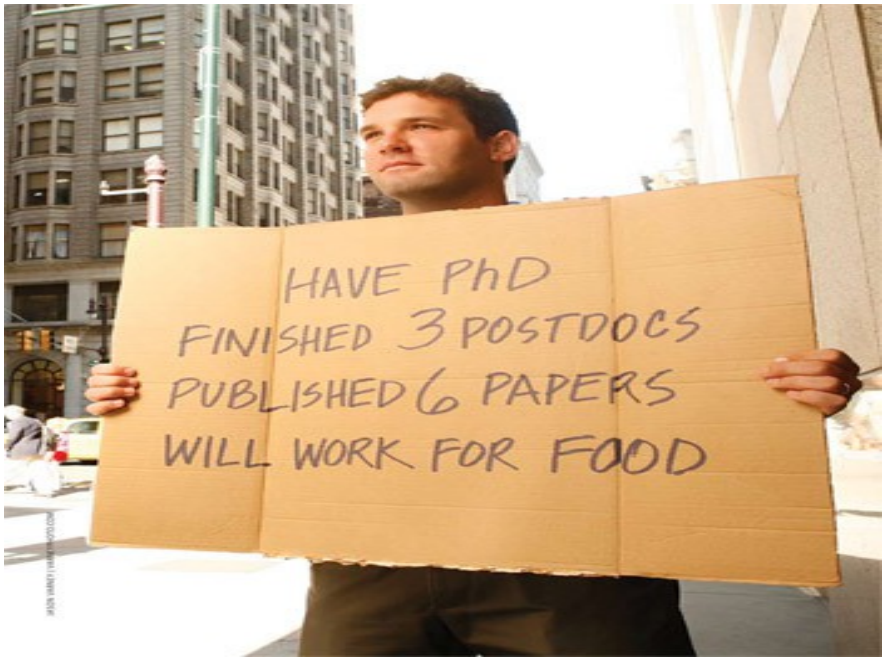
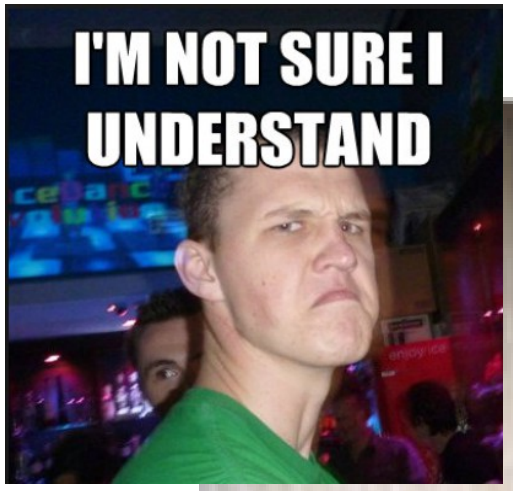
GRUMPY PEOPLE OFFLINE

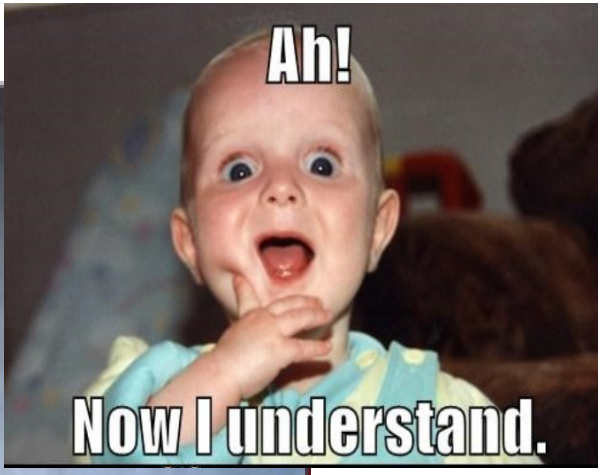
HAPPY.PEOPLE.ONLINE



WHAT WE HAVE IN COMMON …


DUALITY


I'M NOT SURE I
UNDERSTAND


Ah!
Now I understand.

(1)

(2)

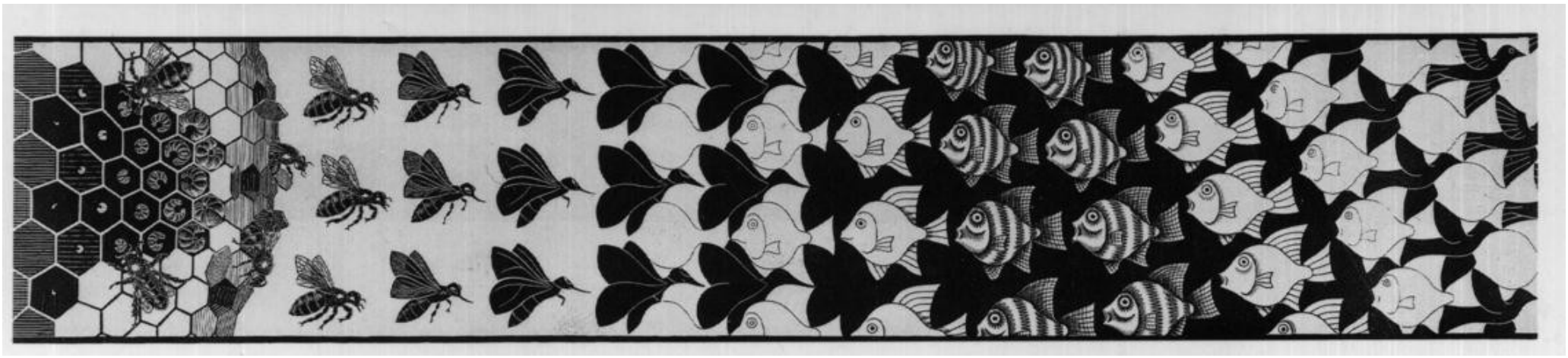

Houston, we have a problem

Slipknot - Duality [OFFICIAL VIDEO] - YouTube

https://www.youtube.com/watch?v=6fVE8kSM43I

Star Wars - Duality - YouTube

YouTube · BlueHalo Task Force



Lessons in Duality and Symmetry from M.C. Escher

Doris Schattschneider
Mathematics Department, Moravian College
1200 Main St., Bethlehem, PA 18018-6650 USA
E-mail: schattdo@moravian.edu

Application of Duality Theory to a Class of Composite Cost Control Problems[1]

Applications of Duality Theory to Agriculture

Applied Lagrange Duality for Constrained Optimization

GROWTH STAGE THEORIES. DUAL ECONOMY MODELS

Game theory, duality, economic growth

Introduction to Game Theory
Matrix Games and Lagrangian Duality

GAMES AND DUALITY

Duality (electrical circuits)

From Wikipedia, the free encyclopedia

Duality in Linear Programming

DUALITY APPROACHES TO MICROECONOMIC THEORY*

THE ZOMBIE ARGUMENT

Philosophers like **DUALISM** as well

"To think is to split the subject and object, to feel is to merge them."
– Mark Mandemaker, Nondualism: Merging Psychology, Spirituality and Philosophy

1 kind of substance

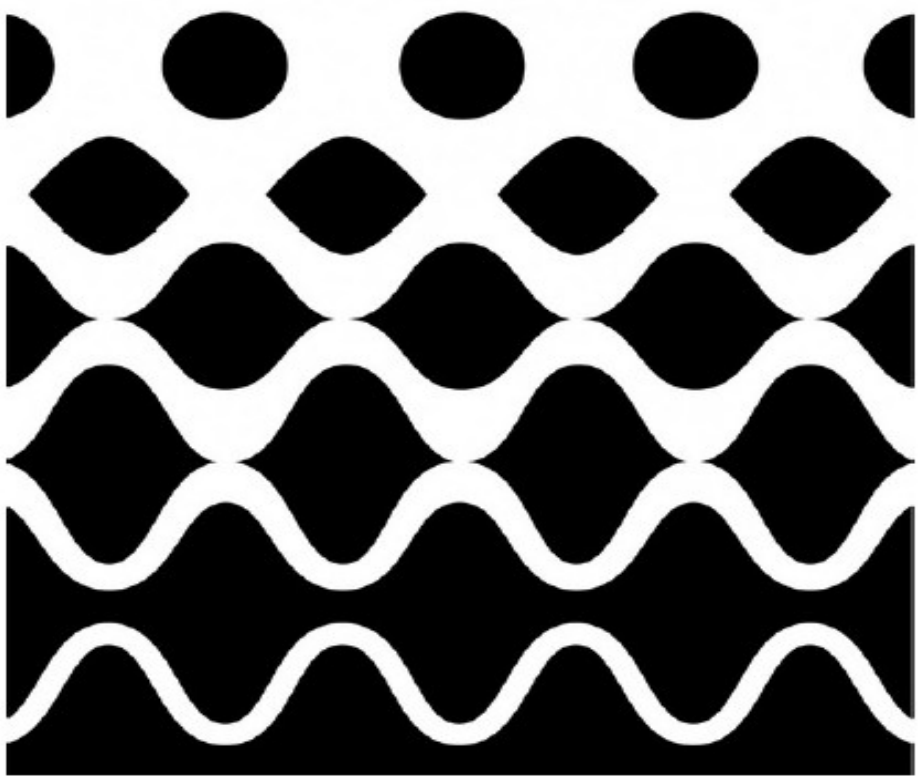
PHYSICAL

2 kinds of property

MENTAL

PHYSICAL

… and we can prove it using ZOMBIES !!!! (isnt that cool ??)



Duality in mathematics is not a theorem, but a "principle"

Michael Atiyah

$$\langle f, g \rangle = \int f(x) g(x) dx.$$

$$\hat{f}(\boldsymbol{\xi}) = \int f(\boldsymbol{x}) \exp(2\pi i \langle \boldsymbol{x}, \boldsymbol{\xi} \rangle) d\boldsymbol{x}.$$

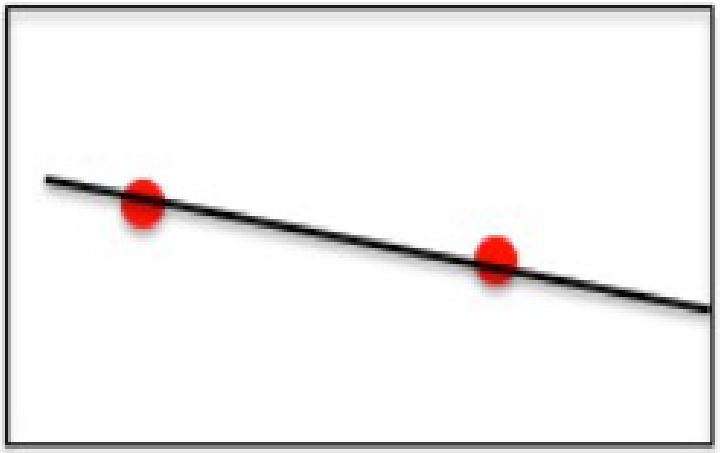
$$\hat{G} = \mathrm{Hom}(G, U(1)).$$

$$dF = 0, \quad d * F = 0.$$

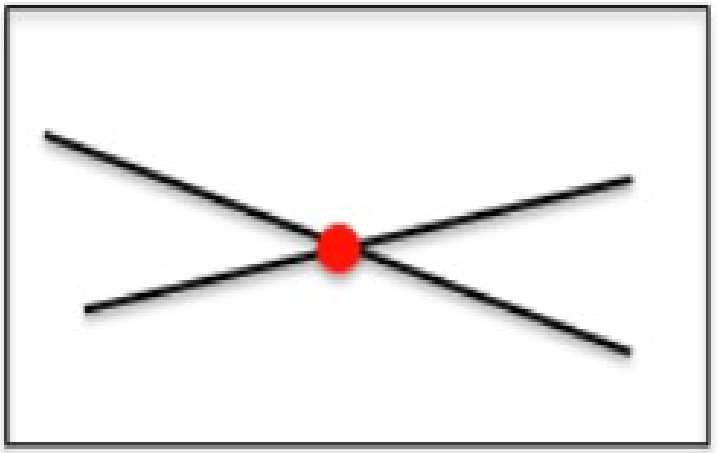
$$(\vec{\boldsymbol{E}}, \vec{\boldsymbol{B}}) \mapsto (\vec{\boldsymbol{B}}, -\vec{\boldsymbol{E}})$$

Line-Point duality

Point and linear are dual in projective space



By 2 points, only one line



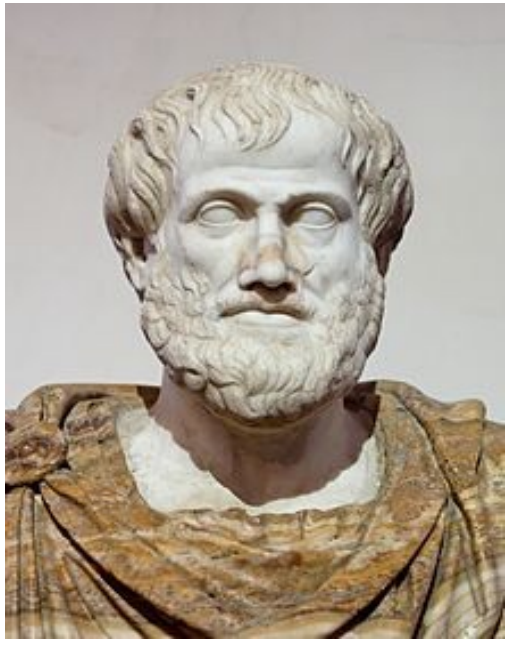
2 lines intersect in 1 point only

Language of points	Language of lines
Point	Lines
Collinear	Coincident
Are joined	Intersect into

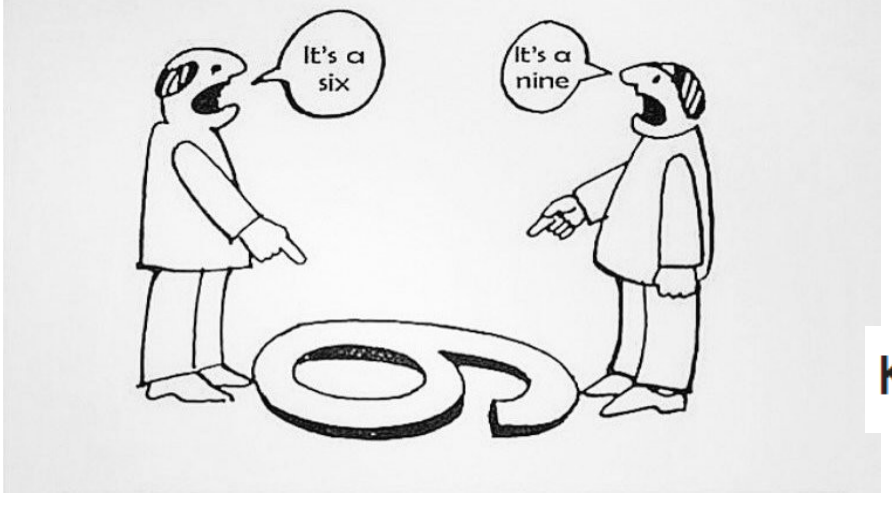
LIGHT IS A WAVE
MALAKA !!

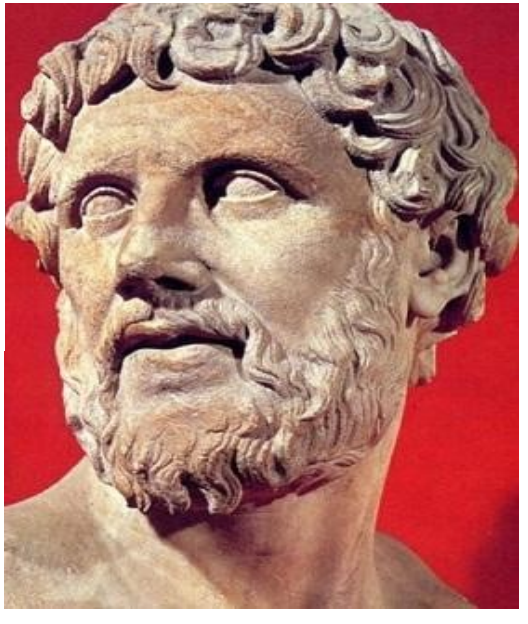
Once upon a time...
Somewhere nearby...
Between a freddo espresso
And a souvlaki...

LIGHT IS A PARTICLE
MALAKA !!



κύριε Αριστοτέλη





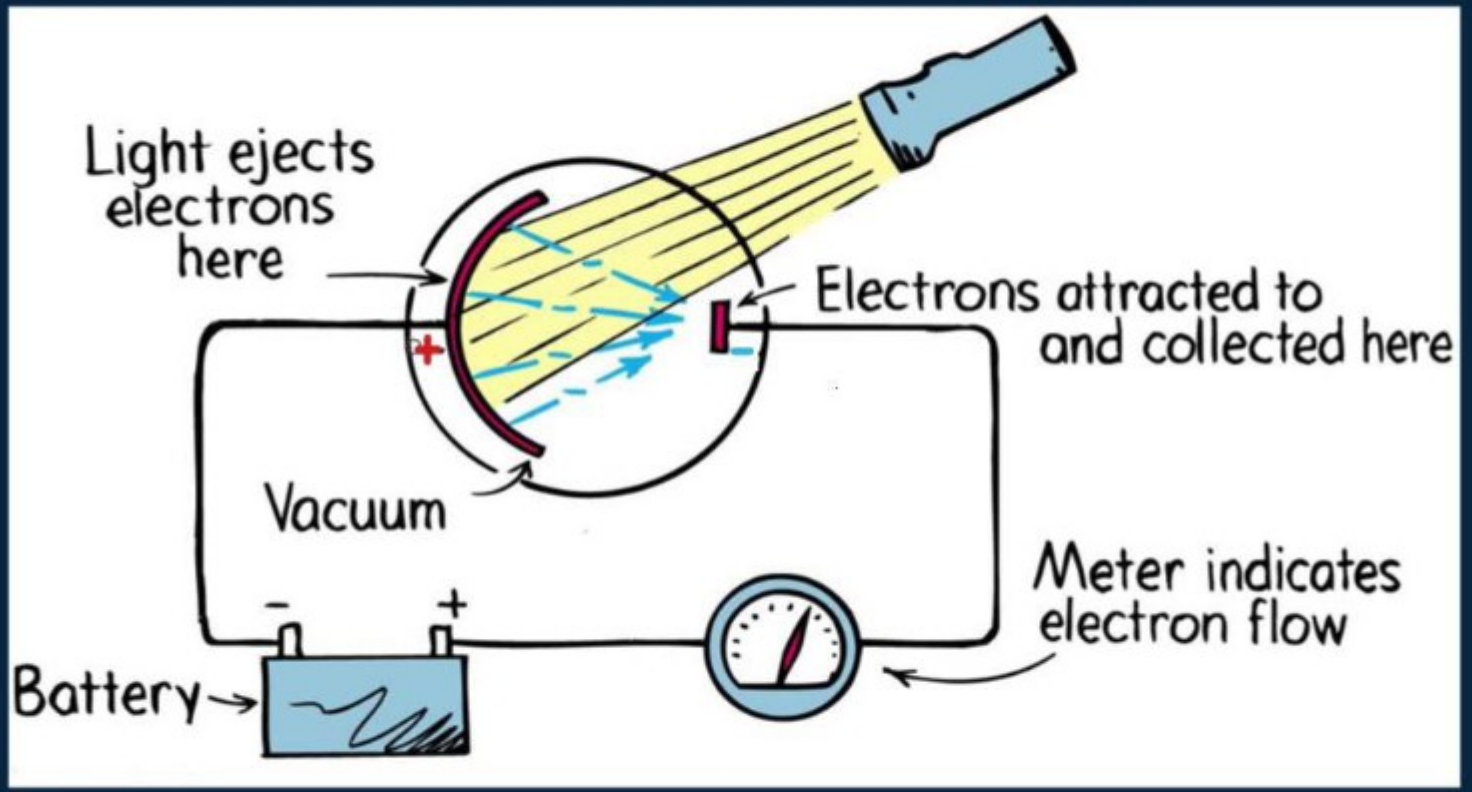
κύριε Δημόκριτος

- h = the Plank constant 6.63 x 10^{-34} J s
- f = the frequency of the incident light in hertz (Hz)
- &phi = the work function in joules (J)
- E_k = the maximum kinetic energy of the emitted electrons in joules (J)

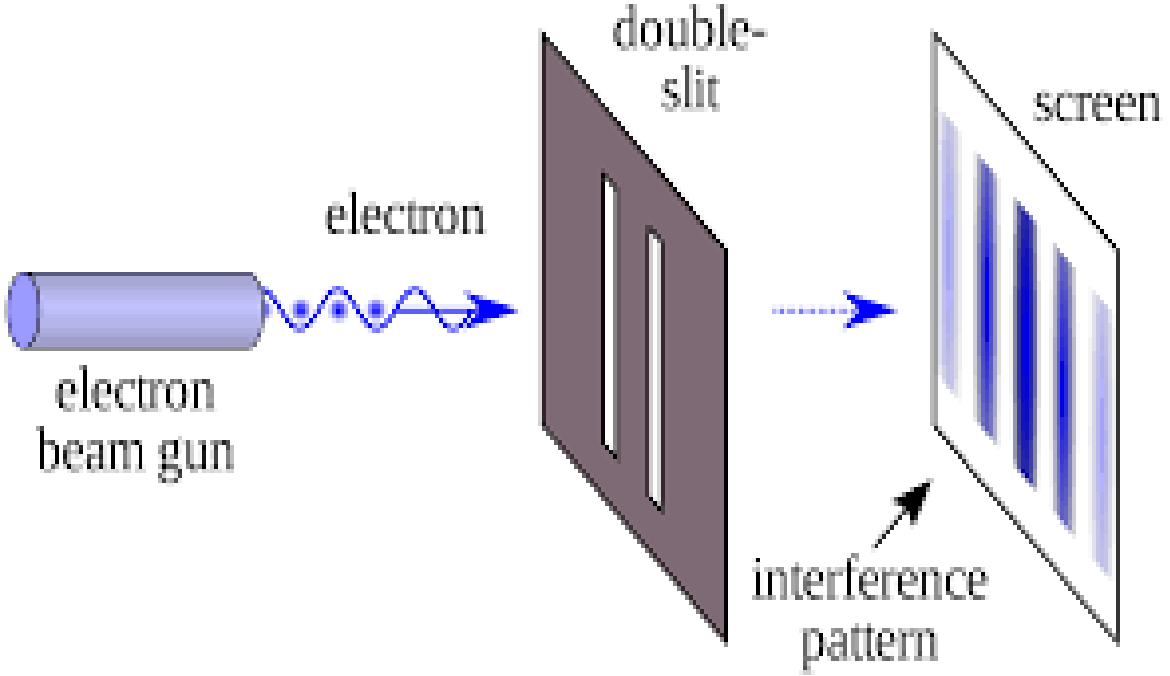
$$hf = \phi + E_k$$

IT IS A PARTICLE

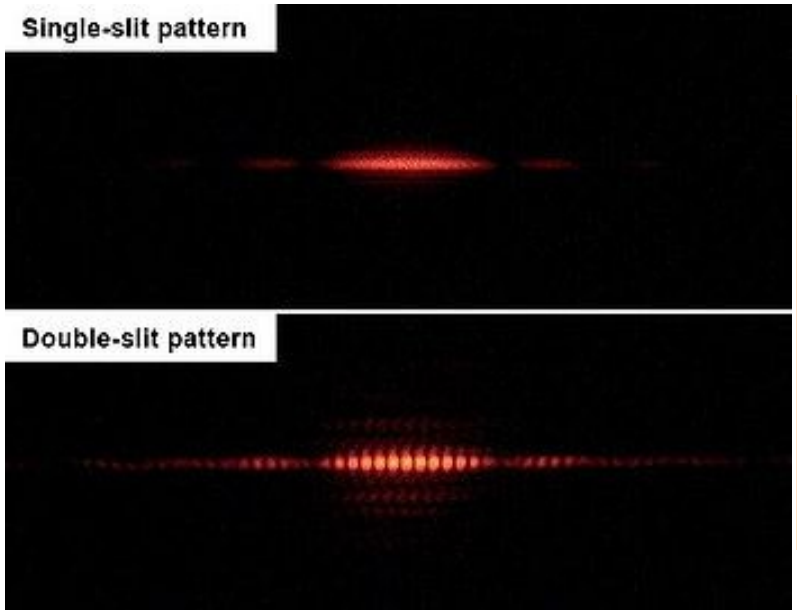
PHOTOELECTRIC EFFECT

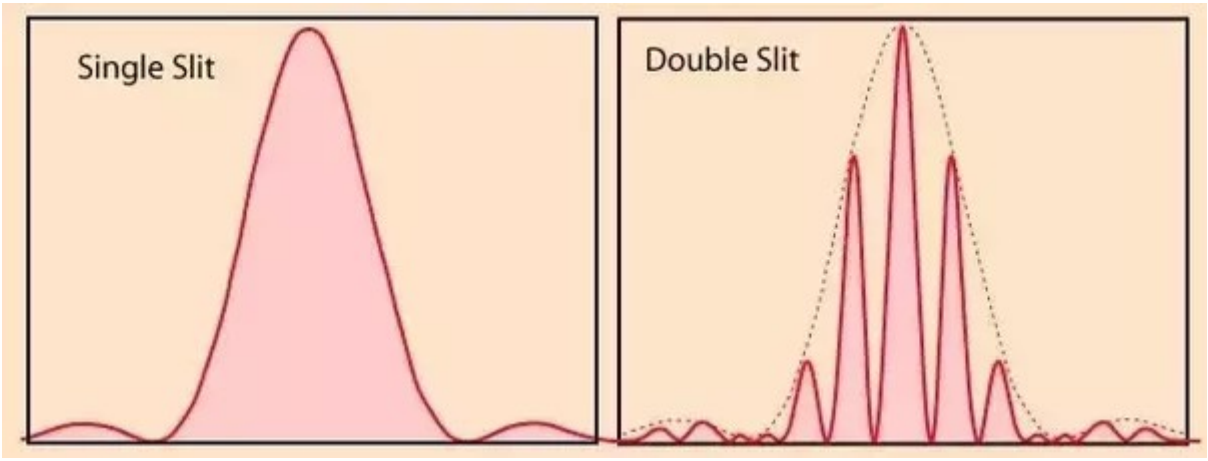


The double slit experiment

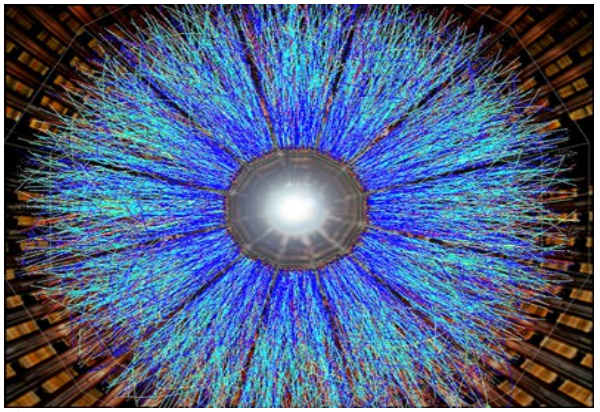


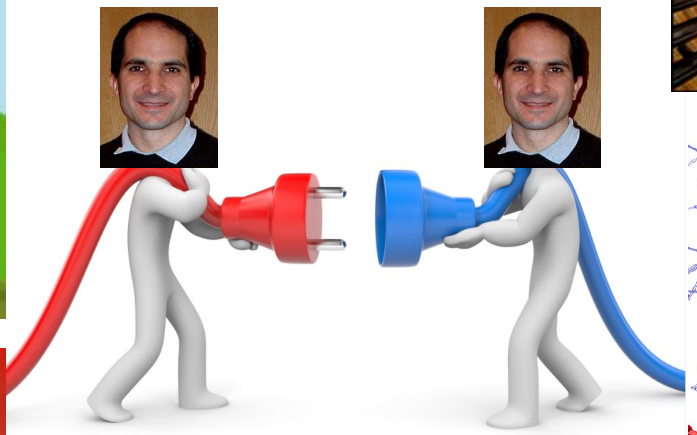
IT IS A WAVE

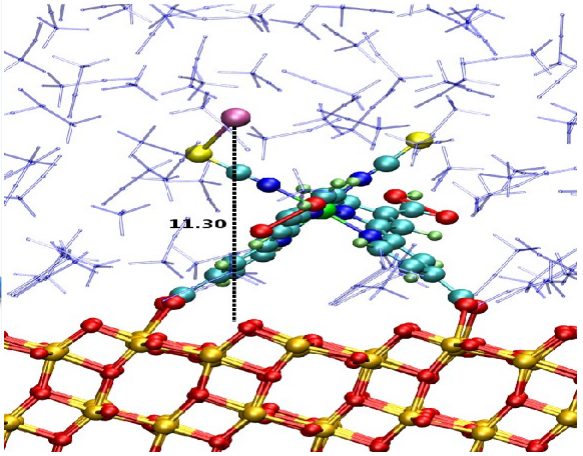


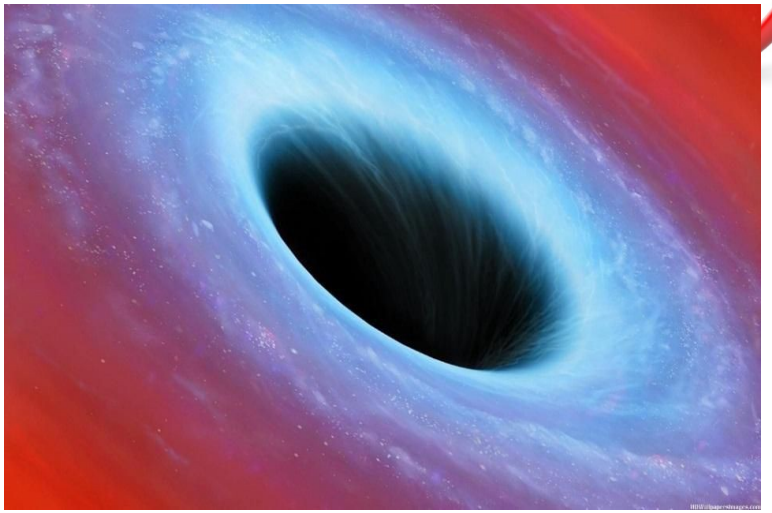


AdS-CFT duality

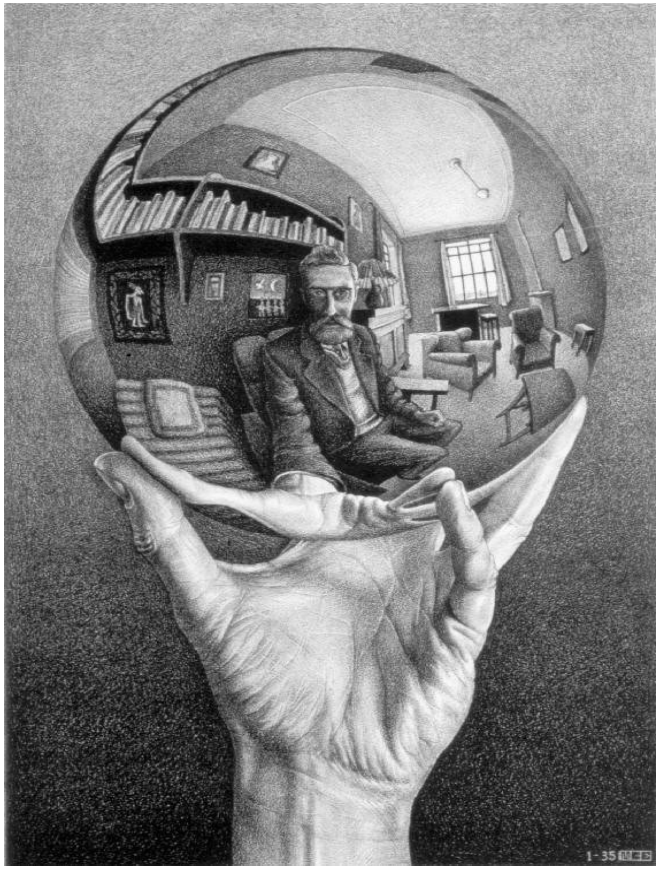




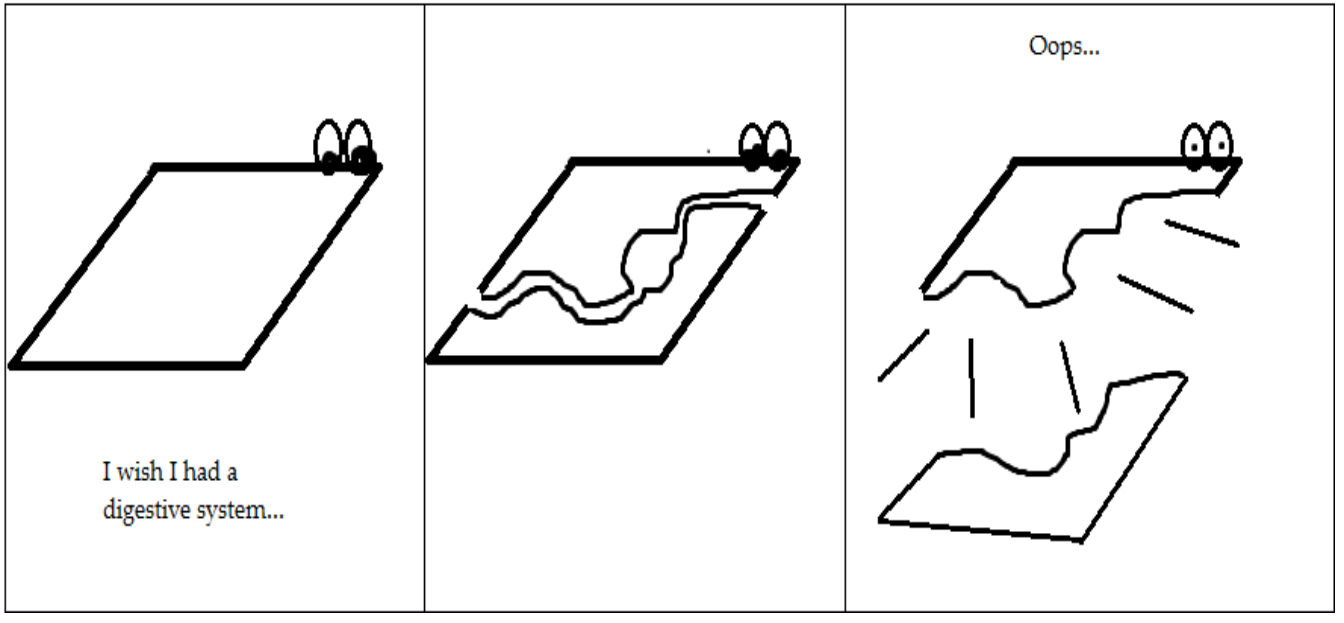




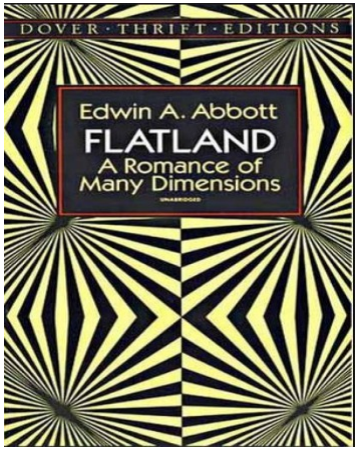
Holographic duality



The gravity picture lives in one dimension more !!!



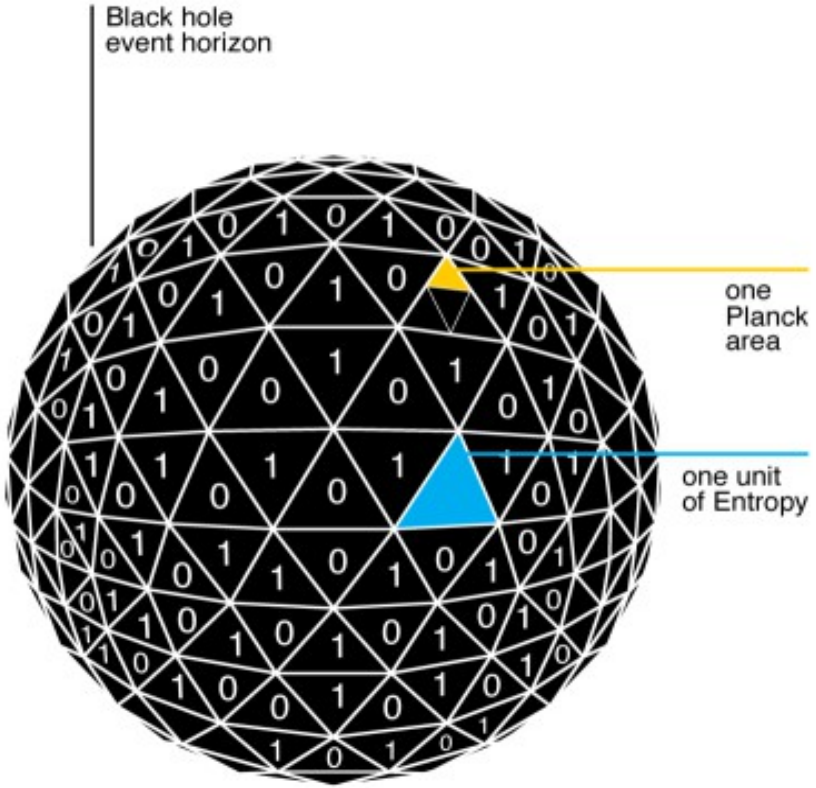
What is really a dimension ???



In how many dimensions do we live ???

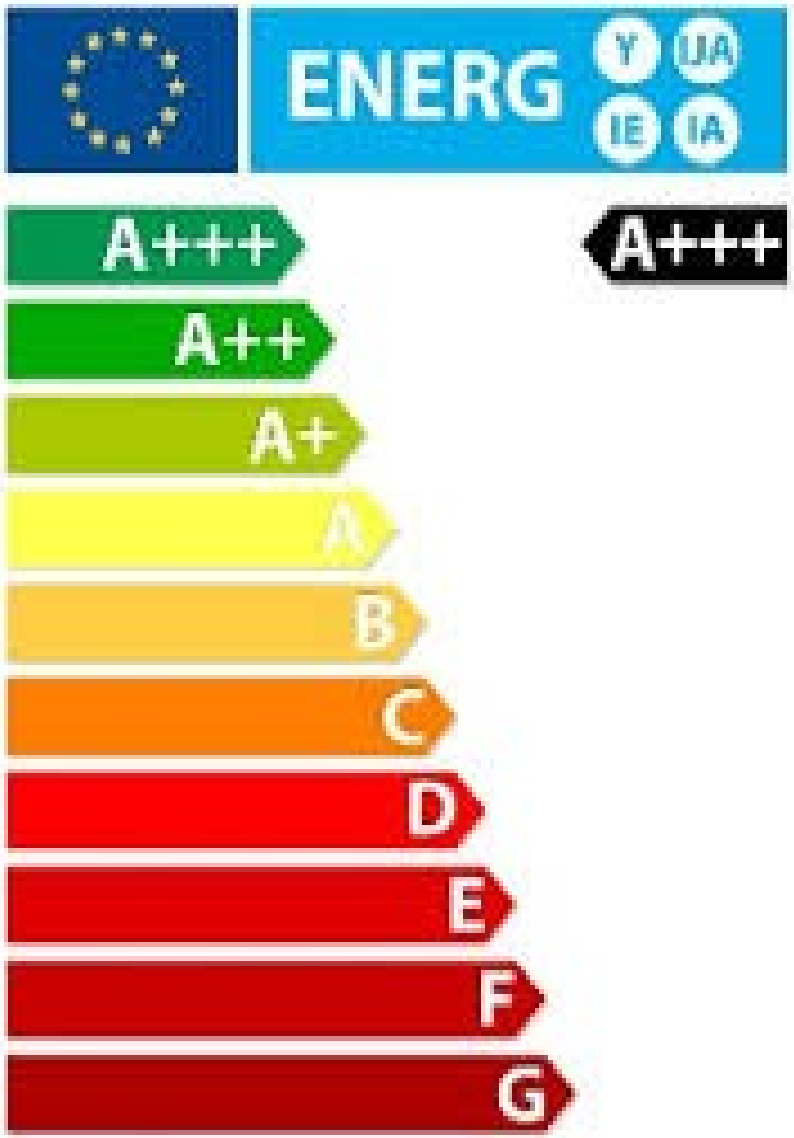
YOUR FAVORITE HOLOGRAM

STAR WARS



~~YOUR FAVORITE HOLOGRAM~~

BLACK HOLES



What if energy is actually a dimension like time and space ?

WHY IT IS USEFUL ….

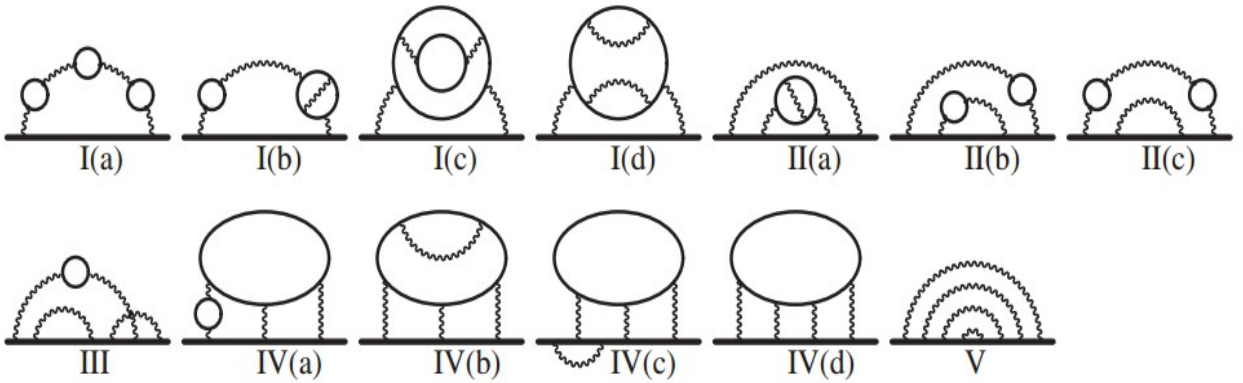
We are <u>very good</u> at computing

$$\blacksquare(g) = \mathcal{O}(g^0) + \mathcal{O}(g) + \mathcal{O}(g^2) + \dots$$

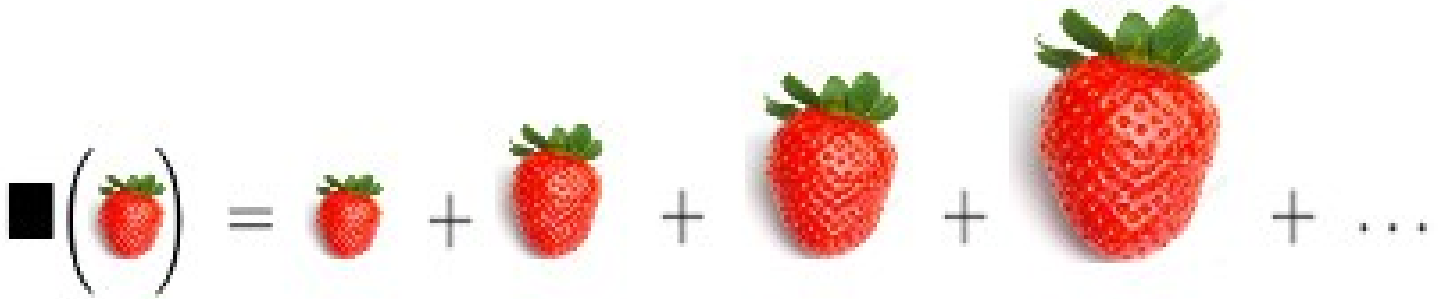
Best example

$$g_e = 2(1 + \frac{\alpha}{2\pi} + \cdots),$$

$$g_e = 2.00231930436 17(15).$$



But what if the coupling is not small ??



$g \not< 1$

STRONG COUPLING

Standard (usually very efficient) methods are not useful anymore !!

ESCAPE ROOM

Theme : theoretical physics

$$S = \frac{1}{16\pi G_N}\int_{\mathcal{M}_5} d^5x\sqrt{-g}\Big[R + 12 - \frac{1}{2}(\partial\phi)^2 - \frac{1}{4}(1+\gamma\phi^2)\ F^2 + \frac{\Delta(4-\Delta)}{2}\ \phi^2 - \frac{1}{2}\phi^2\ \sum_{I=1}^{3}\Big\{\lambda_1(\partial\psi_I)^2 + \lambda_2\left((\partial\psi_I)^2\right)^2\Big\}\Big]$$

This is a **BLACK HOLE** with electric CHARGE
(Yes...the one of **INTERSTELLAR**...)

$$\phi = 0\,, \qquad \Sigma = \frac{a(t)}{x}\,, \qquad a_0 = \frac{Q(x_h^2 a(t)^2 - x^2)}{a(t)^3}\,,$$

$$A = \frac{1}{2x^2} - \frac{\dot{a}(t)}{xa(t)} + \frac{x^4Q^2}{6a(t)^6} - \frac{x^2}{a(t)^4}\left(\frac{1}{6}x_h^2Q^2 + \frac{1}{2x_h^4}\right)$$

IF YOU ARE STILL IN THE ROOM

There is not coffee outside yet …. sorry !
And the door is locked (thanks to the organizers)

Examples of what we have to solve.....

$$0 = H_0'' + \frac{1}{2} H_0' \left(\ln \frac{AC^3}{B} \right)'$$

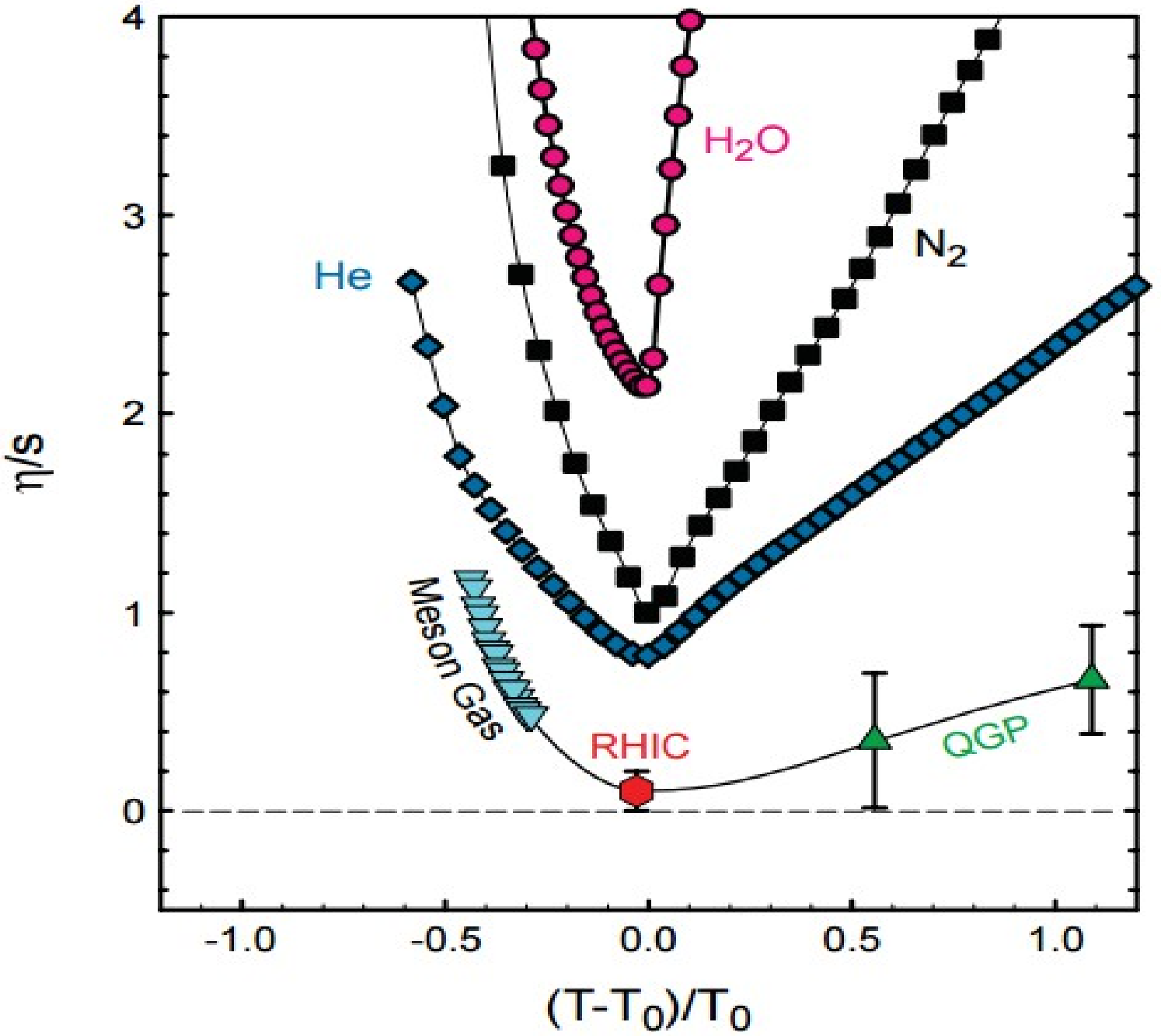
$$0 = H_1'' + \frac{1}{2} H_1' \left(\ln \frac{AC^3}{B} \right)' + H_0 \left(-\frac{B\phi^2 k^2}{C^2} \left(2k^2 \lambda_2 + C\lambda_1 \right) \right)$$

Examples of solutions

$$16\pi G_N \, G = \int_0^{x_h} dx \, \sqrt{\frac{A_{\mathbb{Z}_2} B_{\mathbb{Z}_2}}{C_{\mathbb{Z}_2}}} (\lambda_1 k^2 C_{\mathbb{Z}_2} + 2k^4 \lambda_2) \phi^2$$

$$\frac{\eta}{\mathcal{S}} = \frac{1}{4\pi} \left(1 - \int_0^{x_h} dx \, \sqrt{\frac{A_{\mathbb{Z}_2} B_{\mathbb{Z}_2}}{C_{\mathbb{Z}_2}}} (\lambda_1 k^2 C_{\mathbb{Z}_2} + 2k^4 \lambda_2) \phi^2 \left\{ \int_0^x dy \, \sqrt{\frac{A_{\mathbb{Z}_2} B_{\mathbb{Z}_2}}{C_{\mathbb{Z}_2}^3}} \right\} \right)$$

NATURE WRITTEN IN MATH LANGUAGE



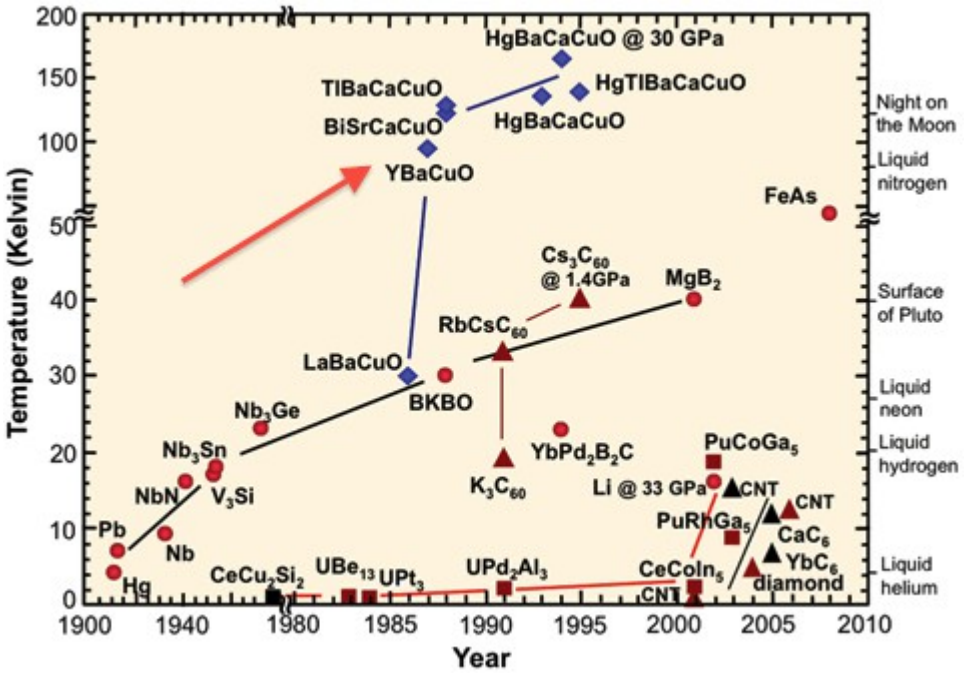
Cit. Galileo Galilei

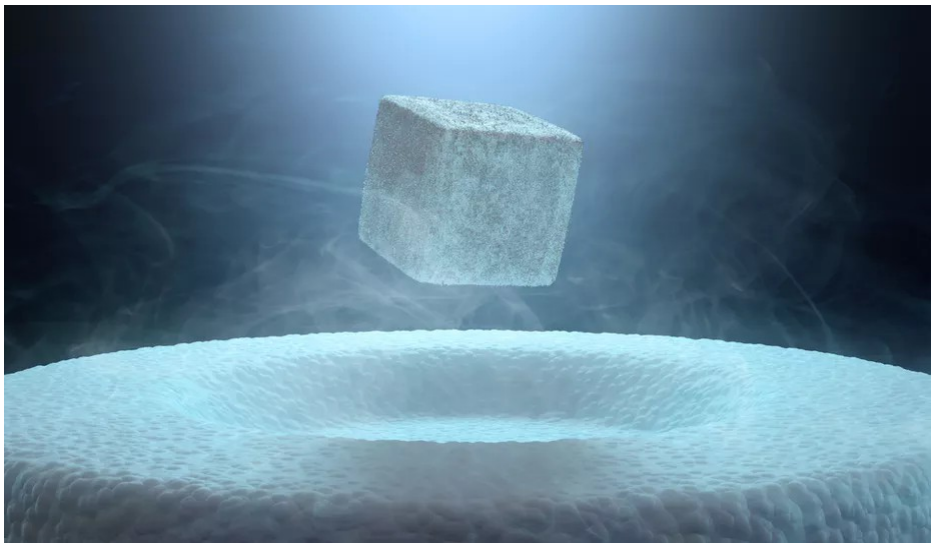
From a Black Hole
In extra dimensions
To the water in our
Potiria !!

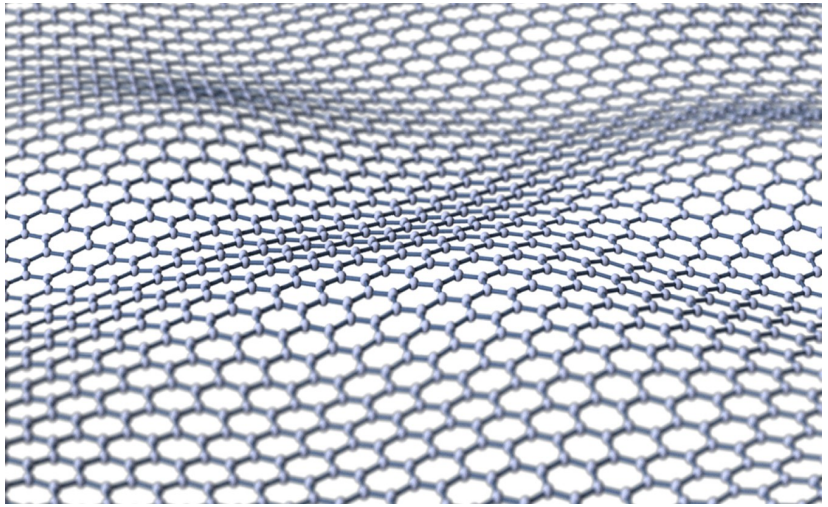
$$\frac{\eta}{s} \geq \frac{1}{4\pi}\frac{\hbar}{k_B}$$

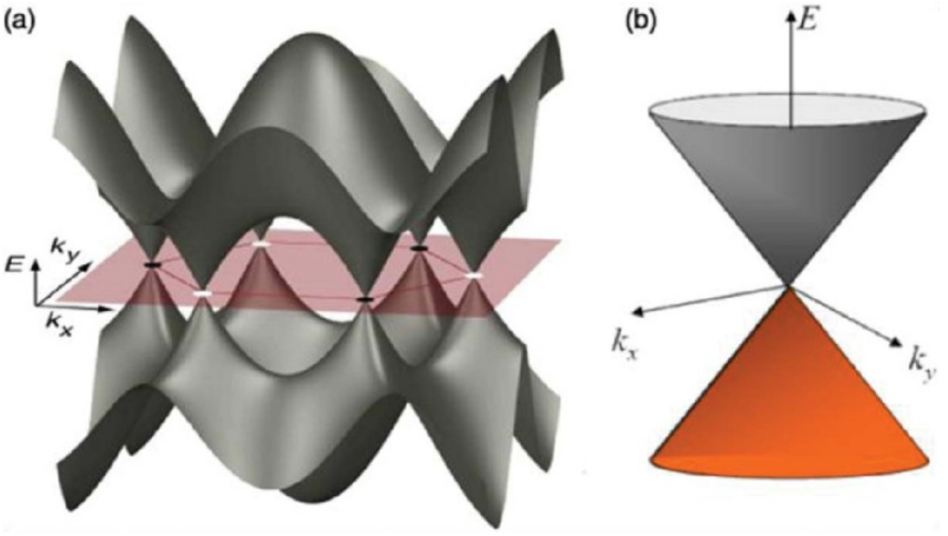
KSS BOUND

E-XAMPLES


Temperature (Kelvin)
Year
HgBaCaCuO @ 30 GPa
TlBaCaCuO
HgTlBaCaCuO
BiSrCaCuO
HgBaCaCuO
YBaCuO
FeAs
Cs_3C_{60} @ 1.4GPa
MgB_2
$RbCsC_{60}$
LaBaCuO
BKBO
Nb_3Ge
Nb_3Sn
NbN
V_3Si
Pb
Nb
Hg
$YbPd_2B_2C$
K_3C_{60}
$PuCoGa_5$
Li @ 33 GPa
CNT
$PuRhGa_5$
CaC_6
YbC_6
diamond
$CeCu_2Si_2$
UBe_{13}
UPt_3
UPd_2Al_3
$CeCoIn_5$
Night on the Moon
Liquid nitrogen
Surface of Pluto
Liquid neon
Liquid hydrogen
Liquid helium






(a)
(b)
E
k_y
k_x
k_x
k_y

LOT OF SOLUTIONS FOR TECHNOLOGY

Superconducting quantum computing

From Wikipedia, the free encyclopedia

Superconducting quantum computing is an implementation of a quantum computer in superconducting electronic circuits. Research in superconducting quantum computing is conducted by Google[1], Microsoft[2], IBM[3] and Intel.[4] Up to nine fully controllable qubits are demonstrated in a 1D array,[5] up to sixteen in a 2D architecture.[3]

EMERGING TECH

A material supreme: How graphene will shape the world of tomorrow

30 ways graphene is about to change your life

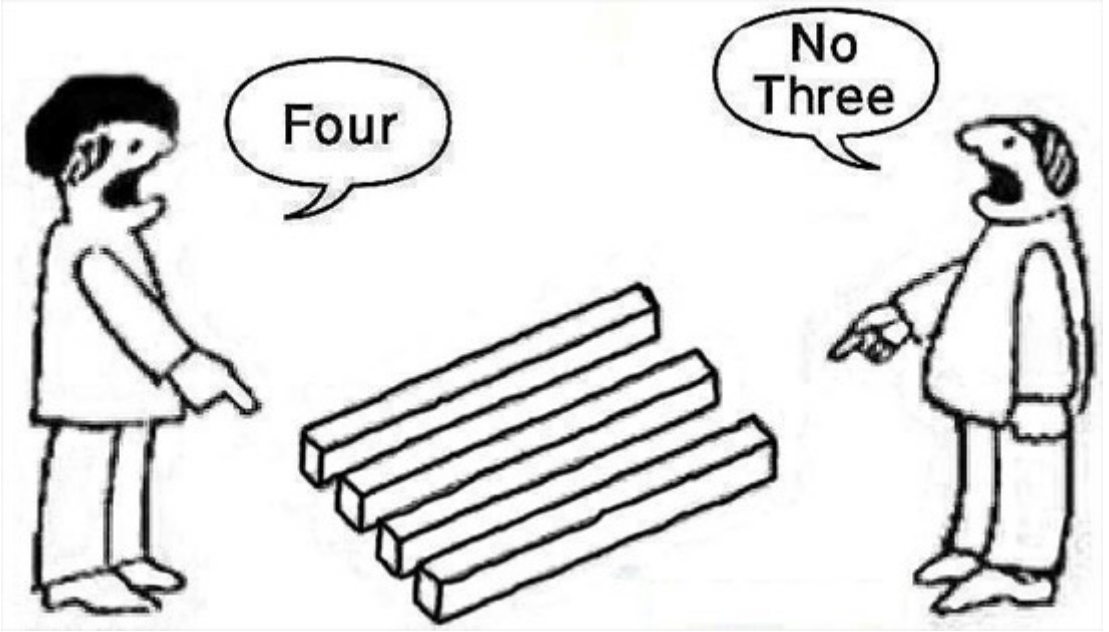
WORLDS FASTEST TRAINS - MAGLEV "capable" of 3,500 km/h ...

Busta Rhymes & Mariah Carey - Baby If You Give It To Me - YouTube

https://www.youtube.com/watch?v=BY5CUTjLC70

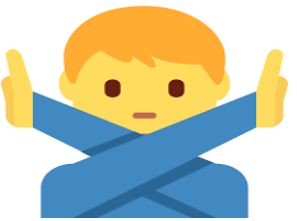
Baby if you give it to me
I'll give it to you
I know what you want
You know I got it
Baby if you give it to me
I'll give it to you
I know what you want
You know I got it

Baby if you give it to me
I'll give it to you
I know what you want
You know I got it
Baby if you give it to me
I'll give it to you
I know what you want
You know I got it



"PEOPLE WHO THINK DIFFERENTLY SOLVE PROBLEMS SMARTER THAN PEOPLE WHO THINK ALIKE."

No!



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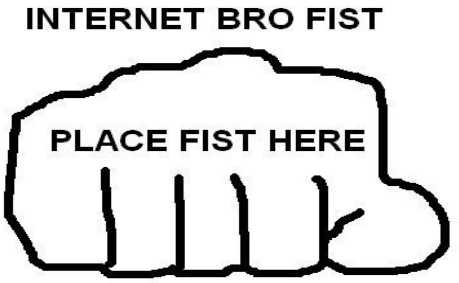
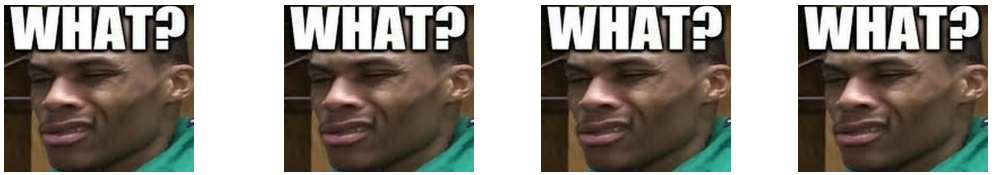


Emotion. 2015 Feb;15(1):1-5. doi: 10.1037/emo0000017. Epub 2014 Aug 11.

Warm thanks: gratitude expression facilitates social affiliation in new relationships via perceived warmth.



Williams LA[1], Bartlett MY[2].

Author information

Abstract

Recent theorizing on the nature and function of gratitude (the find-remind-and-bind theory; Algoe, 2012) stipulates that expressing gratitude should serve to alert previously unacquainted peers to the potential for a high-quality social bond (i.e., a find function). Although the logic of this premise is supported by extant research, it has not, as yet, been tested empirically. In the current study, participants received a note from a previously unacquainted peer that contained an expression of gratitude (or did not) with regard to prior benefits provided by the participant. After providing ratings of the peer and ostensibly completing the study, participants were given an opportunity to spontaneously give their contact information to the peer, which served as a behavioral measure of affiliation. In line with the proposed find function of gratitude expressions, recipients of expressions of gratitude were more likely to extend the effort to continue the relationship with the novel peer by providing that peer with a means to contact them. This experiment also provided evidence that perceptions of interpersonal warmth (e.g., friendliness, thoughtfulness) serve as the mechanism via which gratitude expressions facilitate affiliation: insofar as gratitude expressions signaled interpersonal warmth of the expresser, they prompted investment in the burgeoning social bond. As such, these findings provide the first empirical evidence regarding 1 of the 3 central premises of the find-remind-and-bind theory of gratitude (Algoe, 2012) in the context of novel relationships.

PMID: 25111881 DOI: 10.1037/emo0000017

[Indexed for MEDLINE]

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