Impact, Inclusiveness and Outreach: The Latin American case

Luis A. Aguilar
IAUNAM/México
(aguilar@astro.unam.mx)

Where do I come from?

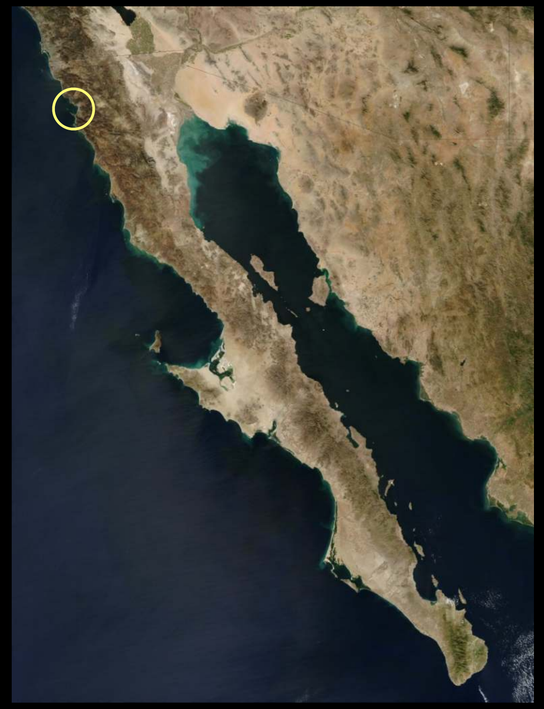
UNAM: National Autonomous University of México.

360,000 enrolled students:
30.9% in high school
60.4% undergraduates
8.7 % graduates.

Largest university in Latin America.
Founded in 1551, re-founded in 1922.

Where do I come from?

Ensenada is a port city in the Pacific ocean,
100 km south of the border with the U.S.



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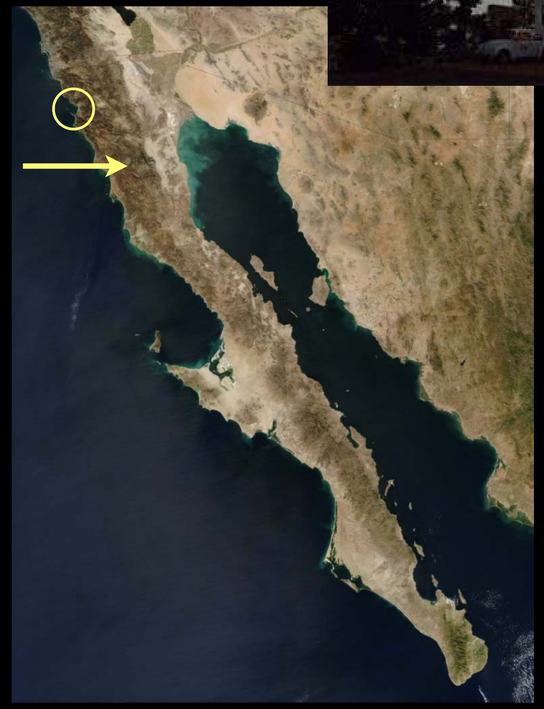

Involvement in teaching and outreach

What exactly I’m supposed to talk about?

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From David:

> “One aspect I would be interested in hearing is how to engage scientists and the public in a project that will not launch until ~2045 and will not have results until ~2050”.

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That is a tall order!

From Anthony:

"One aspect that I think is likely to be important for GaiaNIR is how to engage a more global community in the effort. I think the appreciation for Gaia worldwide can be used to achieve this. Your suggestion ('Engaging minorities with science: A Latin American perspective) fits this".

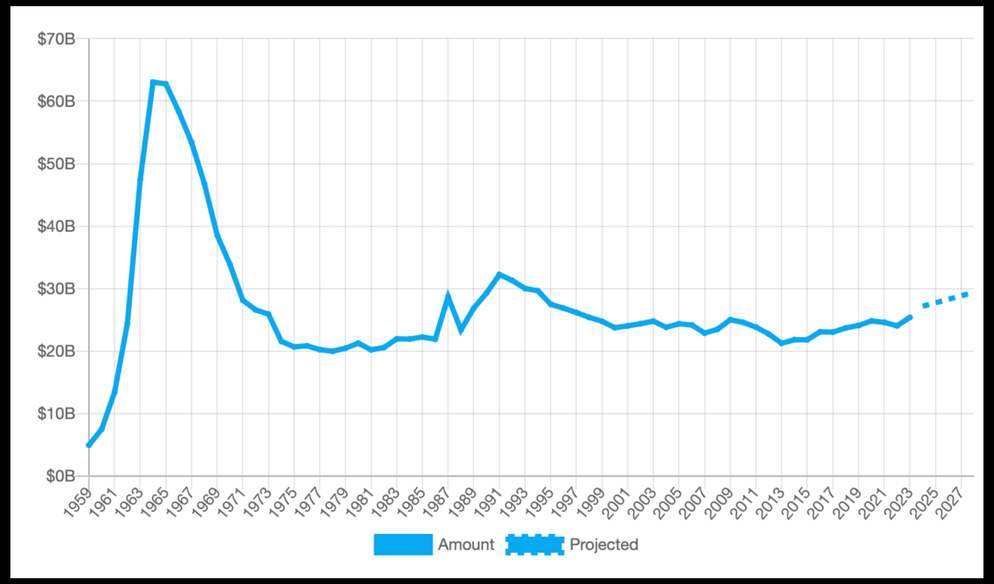
Why to communicate science?

The source of most financial support for science comes ultimately from the public, through their taxes and interest.

An engaged public, supports science.

An example: NASA

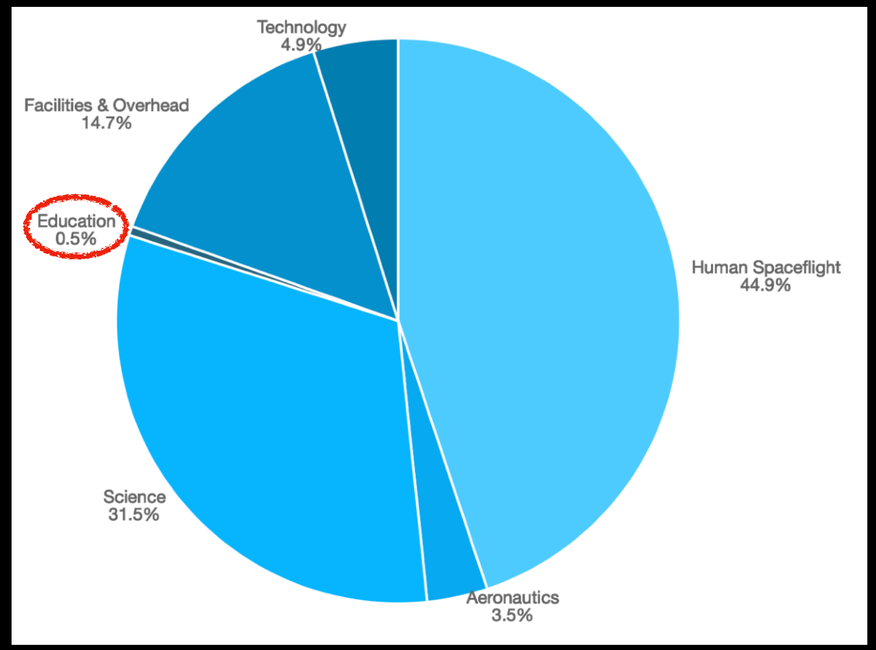
NASA Annual budget adjusted for inflation



Source: https://www.planetary.org/space-policy/nasa-budget

But 0.5% of 24.8 Gdls is 124 Mdls.

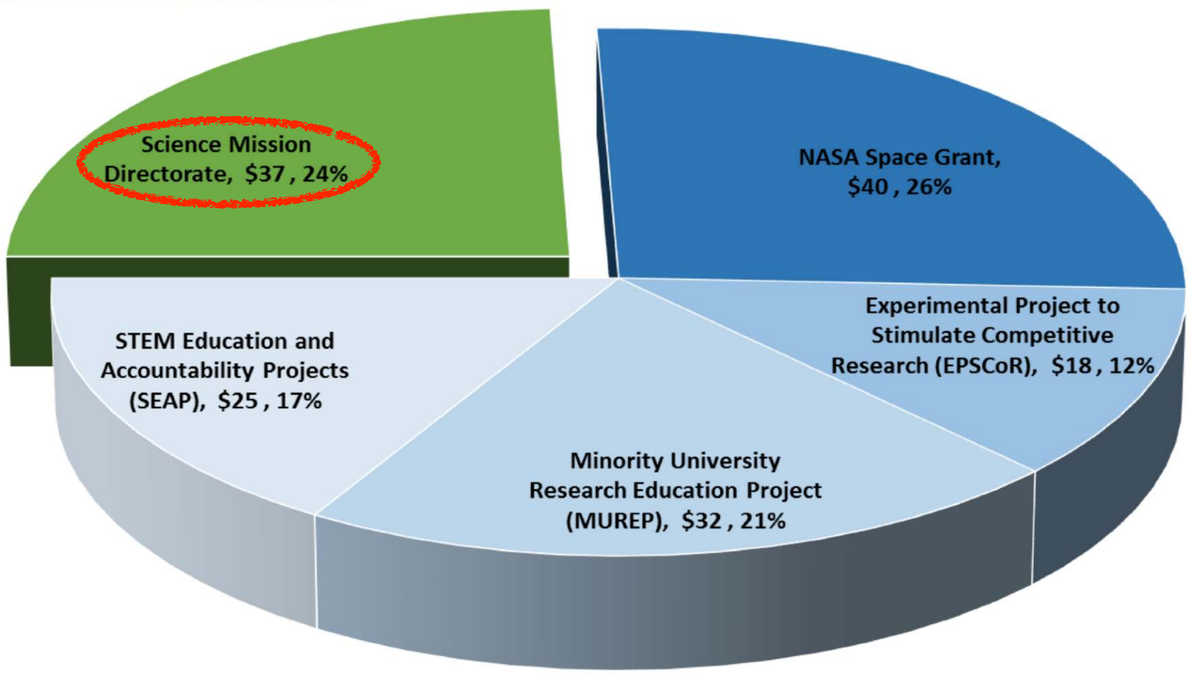
NASA budget split for 2020



An example: NASA

Agency FY16 Total Appropriations - Education

Source: https://www.nasa.gov/sites/



Total Budget = $152M

But obviously, we also drive to contribute to a science literate society

How to communicate science?

Our relation with the media has not always been optimal

IX. *A Determination of the Deflection of Light by the Sun's Gravitational Field, from Observations made at the Total Eclipse of May 29, 1919.*

By Sir F. W. Dyson, *F.R.S., Astronomer Royal, Prof.* A. S. Eddington, *F.R.S., and Mr.* C. Davidson.

(*Communicated by the Joint Permanent Eclipse Committee.*)

Received October 30,—Read November 6, 1919.

[Plate 1.]

Contents.

LIGHTS ALL ASKEW IN THE HEAVENS
Special Cable to THE NEW YORK TIMES.
New York Times (1857-1922); Nov 10, 1919;
ProQuest Historical Newspapers The New York Times (1851 - 2007)
pg. 17

LIGHTS ALL ASKEW IN THE HEAVENS

Men of Science More or Less Agog Over Results of Eclipse Observations.

EINSTEIN THEORY TRIUMPHS

Stars Not Where They Seemed or Were Calculated to be, but Nobody Need Worry.

A BOOK FOR 12 WISE MEN

No More in All the World Could Comprehend It, Said Einstein When His Daring Publishers Accepted It.

Our relation with the media has not always been optimal

The trend continues at present

The Astrophysical Journal Letters, 865:L3 (8pp), 2018 September 20 https://doi.org/10.3847/2041-8213/aadd90

The Cow: Discovery of a Luminous, Hot, and Rapidly Evolving Transient

S. J. Prentice[1], K. Maguire[1], S. J. Smartt[1], M. R. Magee[1], P. Schady[2], S. Sim[1], T.-W. Chen[2], P. Clark[1], C. Colin[1,3], M. Fulton[1], O. McBrien[1], D. O'Neill[1], K. W. Smith[1], C. Ashall[4], K. C. Chambers[5], L. Denneau[5], H. A. Flewelling[5], A. Heinze[5], T. W.-S. Holoien[6], M. E. Huber[5], C. S. Kochanek[7,8], P. A. Mazzali[9,10], J. L. Prieto[11,12], A. Rest[13,14], B. J. Shappee[5], B. Stalder[15], K. Z. Stanek[7], M. D. Stritzinger[16], T. A. Thompson[7,8], and J. L. Tonry[5]
[1] Astrophysics Research Centre, School of Mathematics and Physics, Queen's University Belfast, BT7 1NN, UK; sipren.astro@gmail.com
[2] Max-Planck-Institut für Extraterrestrische Physik, Giessenbachstraße, D-85748, Garching, Germany
[3] Universite de Pierre et Marie Curie (Paris IV), 4 Place Jussieu, F-75252, Paris Cedex 5, France
[4] Department of Physics, Florida State University 77 Chefitan Way, Tallahasee 32304, USA
[5] Institute for Astronomy, University of Hawai'i, 2680 Woodlawn Drive, Honolulu, HI 96822, USA
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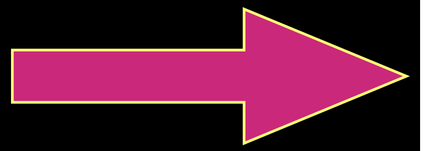
[7] Department of Astronomy, The Ohio State University, 140 W. 18th Avenue, Columbus, OH 43210, USA
[8] Center for Cosmology and AstroParticle Physics, The Ohio State University, 191 W. Woodruff Avenue, Columbus, OH 43210, USA
[9] Astrophysics Research Institute, Liverpool John Moores University, IC2, Liverpool Science Park, 146 Brownlow Hill, Liverpool, L3 5RF, UK
[10] Max-Planck-Institut für Astrophysik, Karl-Schwarzschild-Straße 1, D-85748 Garching, Germany
[11] Núcleo de Astronomía de la Facultad de Ingeniería, Universidad Diego Portales, Av. Ejército 441, Santiago, Chile
[12] Millennium Institute of Astrophysics, Santiago, Chile
[13] Space Telescope Science Institute, 3700 San Martin Drive, Baltimore, MD 21218, USA
[14] Department of Physics and Astronomy, Johns Hopkins University, Baltimore, MD 21218, USA
[15] LSST, 950 N. Cherry Avenue, Tucson, AZ 95719, USA
[16] Department of Physics and Astronomy, Aarhus University, Ny Munkegade 120, DK-8000 Aarhus C, Denmark
Received 2018 July 17; revised 2018 August 27; accepted 2018 August 28; published 2018 September 17



NEWS | 02 November 2018 | Correction 30 November 2018

Holy Cow! Astronomers agog at mysterious new supernova

An event known as 'Cow' that has rocked astronomy since June likely offers a close look at the birth of a neutron star or black hole.

Davide Castelvecchi

For many astronomers, 2018 will be remembered as the Year of the Cow – after the nickname of a spectacular stellar explosion that has kept them busy for months.

Our relation with the media has not always been optimal


GRAN COMETA Y QUEMAZON,

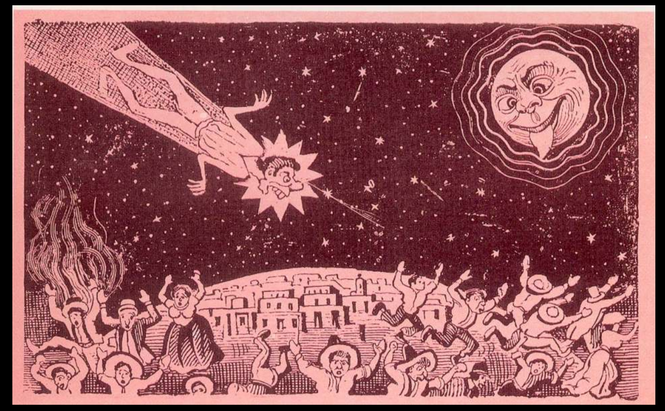
QUE MUY PRONTO SE VA A VER:

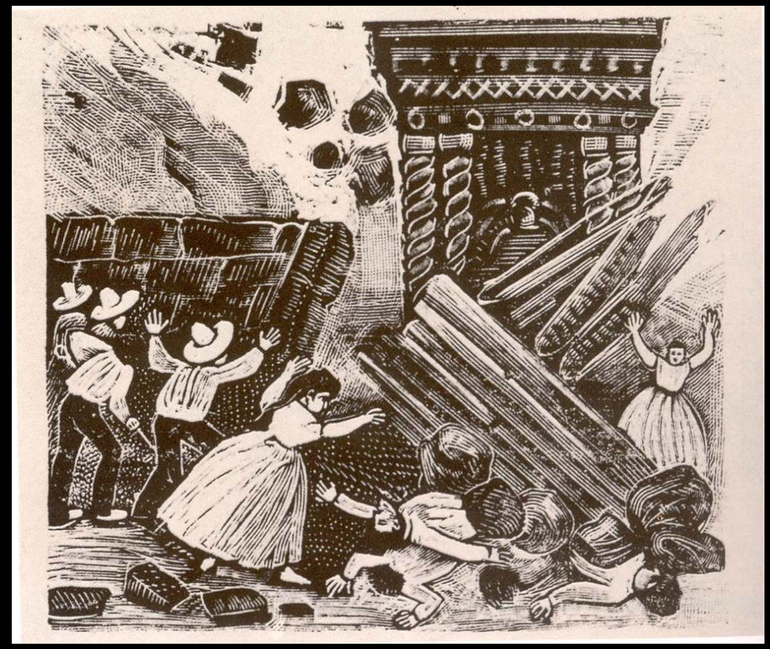
EL MUNDO SE VA A VOLVER
TODITITO CHICHARRON.

¡El mundo se va á acabar! Nos vamos á tostar irremisiblemente! ¡Qué á tostar! Ya quisiéramos! ¡A volvernos ceniza!

Un gran astrónomo de Europa lo ha predicho últimamente; ya no para Noviembre del año de 1899, sino para el mes de Octubre próximo. Esta catástrofe horrorosísima la va á anunciar el cometa gigantesco que aparecerá en estos días; este astro malévolo será el que chocará con la tierra, haciendo mil averías, por

Catastrophes and doom are a favorite topic





Return of Halley's comet in 1910

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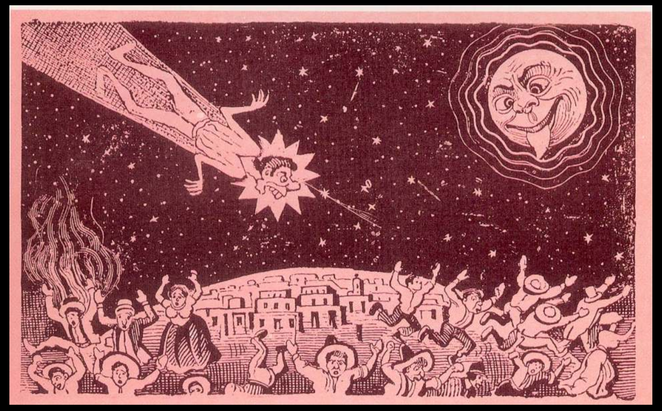

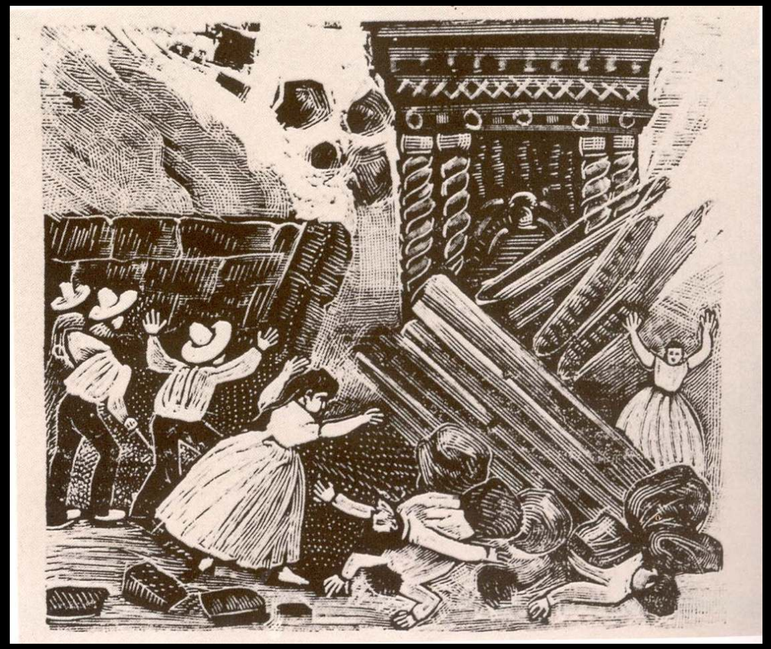

The world is going to end!
We will be roasted irredeemably!
Not roasted, turned into ash!
A great astronomer in Europe has predicted, not for November, but for next October.
This horrible catastrophe will be announced by a giant comet that will appear in those days; this evil star will smash against Earth, blasting us to smithereens, …

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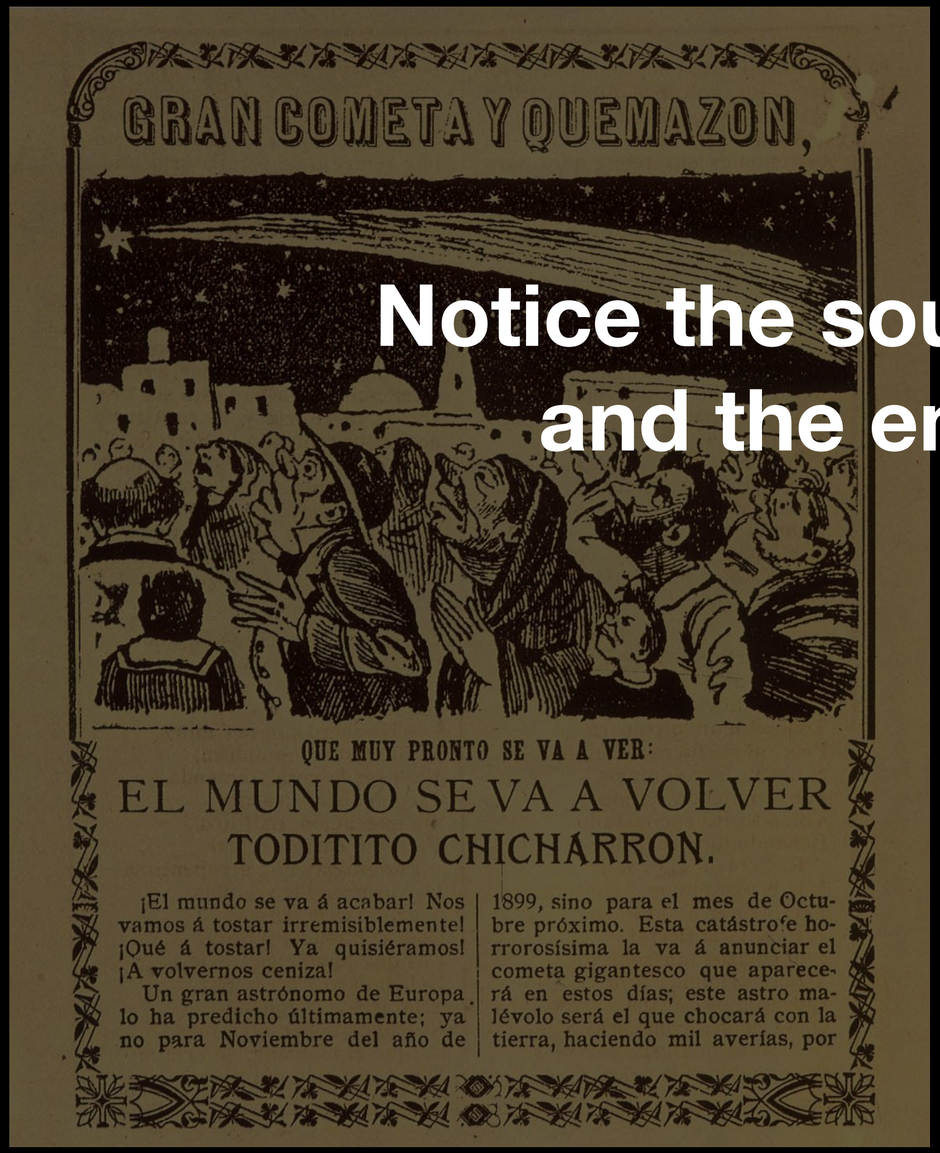

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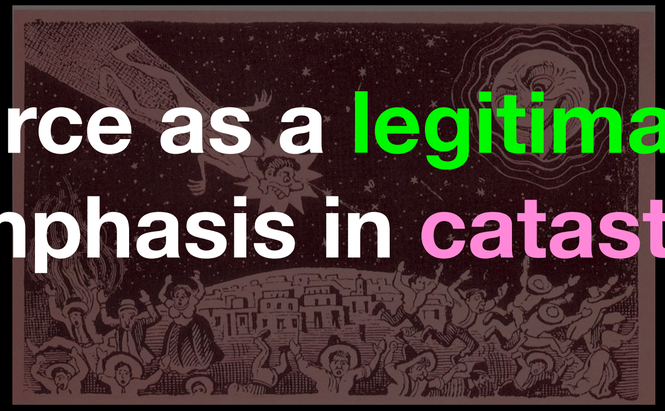
Notice the source as a legitimate authority and the emphasis in catastrophes.



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SCIENCE

Collider Triggers End-of-World Fears

By EBEN HARRELL

Thursday, Sep. 04, 2008

A press photographer takes a picture of the magnet core of the world's largest superconducting solenoid magnet at the European Organization for Nuclear Research's Large Hadron Collider particle accelerator in Geneva, Switzerland.

MARTIAL TREZZINI / EPA

From the flagellants of the Middle Ages to the doomsayers of Y2K, humanity has always been prone to good old-fashioned the-end-is-nigh hysteria. The latest cause for concern: that the earth will be destroyed and the galaxy gobbled up by an ever-increasing black hole next week.

ARTICLE TOOLS

Print

PHOTOS

The Large Hadron Particle

On Sept. 10, scientists at the European Organization for Nuclear Research (CERN) laboratory in Geneva, Switzerland, will switch on the Larg Collider (LHC) — a $6 billion particle accele send beams of protons careening around a

This continues to recent times.

We are partly to blame

Our relation with the media has not always been optimal

Astronomers spot largest cosmic explosion ever witnessed

By Ashley Strickland, CNN
Published 7:23 AM EDT, Fri May 12, 2023

A. Paice

The largest black hole ever discovered can fit 30 billion suns. We found it with gravity and bent light

By Tereza Pultarova published March 29, 2023

The ultramassive black hole in the galaxy cluster Abell 1201 packs a mass of 30 billion suns.

Comments (5)

Astronomers discovered the largest black hole ever seen thanks to its ability to bend light. (Image credit: ESA/Hubble, Digitized Sky Survey, Nick Risinger (skysurvey.org), N. Bartmann)

Universe's oldest known quasar discovered 13 billion light-years away

News By Tim Childers published March 09, 2021

Astronomers have found the farthest known source of radio emissions in the universe: a galaxy-swallowing supermassive black hole.

An artist's illustration of the most distant single source of radio emissions in the universe, a quasar known as P172+18. (Image credit: ESO/M. Kornmesser)

There is an emphasis in largest, biggest, newest, farthest, etc.

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But, for how long can we keep pushing this? After a while, the public won't believe us, or worse, won't care.

The traditional main channel has been the printed media.


UNIVERSIDAD DE GUADALAJARA

MURAL

Incentiva CUCEI gusto a niños con alguna discapacidad

Disfrutan ciencia con sus sentidos

Invitan a estudiantes de Instituto del Niño Ciego y Sordo para participar en talleres


The New York Times

LATE CITY EDITION

MEN WALK ON MOON

ASTRONAUTS LAND ON PLAIN; COLLECT ROCKS, PLANT FLAG

Voice From Moon: 'Eagle Has Landed'

A Powdery Surface Is Closely Explored


TIME

VISIONS OF SPACE & SCIENCE

IN THE FUTURE, Will We...

- Live on Mars?
- Discover Another Universe?
- Control the Weather?
- Travel Back in Time?
- Clone a Dinosaur?

PLUS: The latest chapter of Caleb Carr's novella


Why Humans Live So Long

The Data-Driven Society

Russian Reactors for Sale

SCIENTIFIC AMERICAN

OCTOBER 2013

Gravity Waves

The search for the beginning of time

SPECIAL REPORT

2013 State of the World's Science


BBC NATURA GLI INCREDIBILI ANIMALI TRASPARENTI

SCIENZE

RICERCA • TECNOLOGIA • ATTUALITÀ • FUTURO

LE ULTIME RISPOSTE DELLA SCIENZA

SIAMO SOLI?

DOVE E COME GLI SCIENZIATI CERCANO LA VITA EXTRATERRESTRE NEL SISTEMA SOLARE


CHIP WISSEN

CHIP

1/2021

WISSEN

DAS JUNGE SCIENCE-MAGAZIN

Faszination Wissenschaft

WILLKOMMEN AUF DEM MOND!

Beim zweiten Wettlauf zum Mond geht es vor allem um Bodenschätze

Gesund bleiben trotz Corona-Lockdown

Alles über das Netz der Unterseekabel

Die Risiken der Energy Drinks


SCIENCE VIE

SCIENCE&VIE

NOUVEAU

+ ÉTONNANT
+ ILLUSTRÉ
+ PRATIQUE

FUSION

L'EAU POURRA-T-ELLE REMPLACER LE PÉTROLE ?

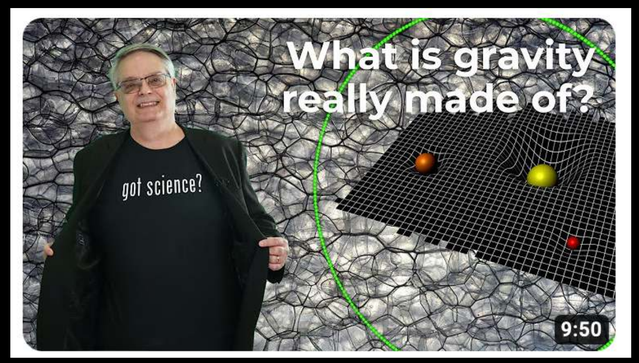
+ EXCLUSIF SCIENCE&VIE

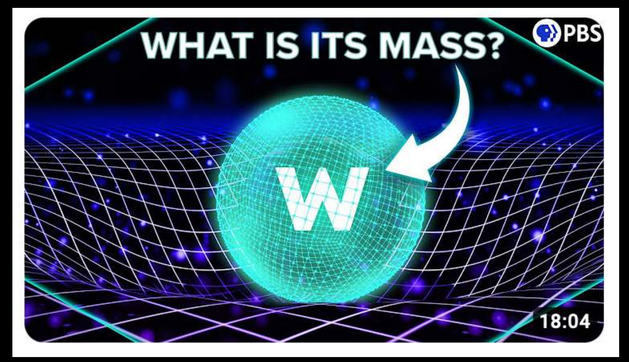
LES 13 MÉDICAMENTS À BANNIR

INSECTES LEUR CERVEAU DÉFIE LE NÔTRE

But at present the social media platforms have exploded.

Some of it is good,
very good!





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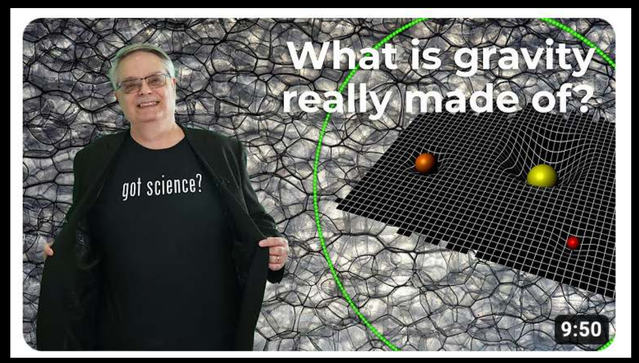
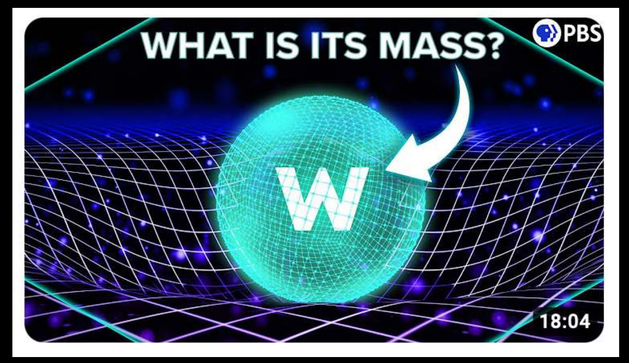
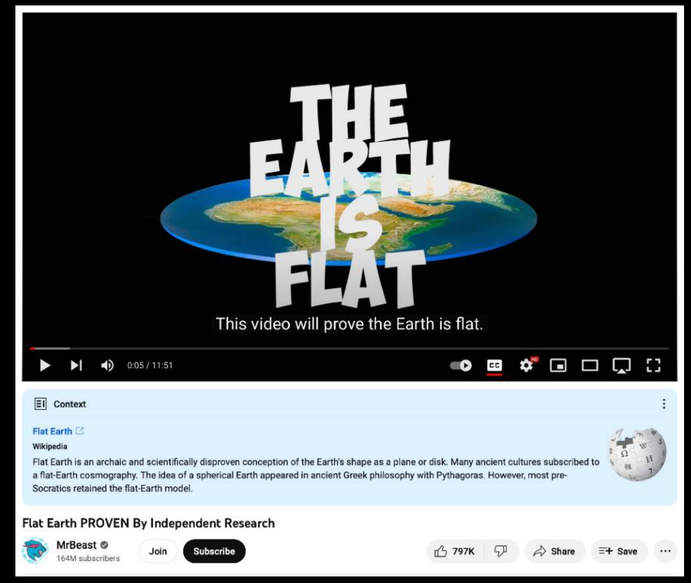
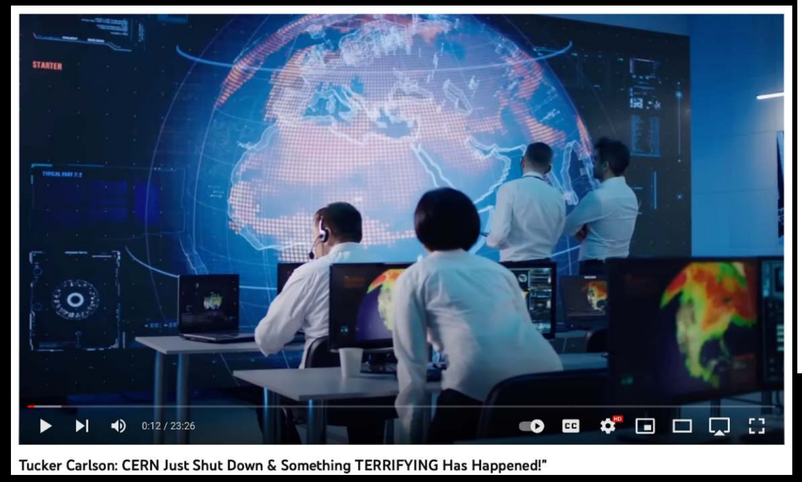
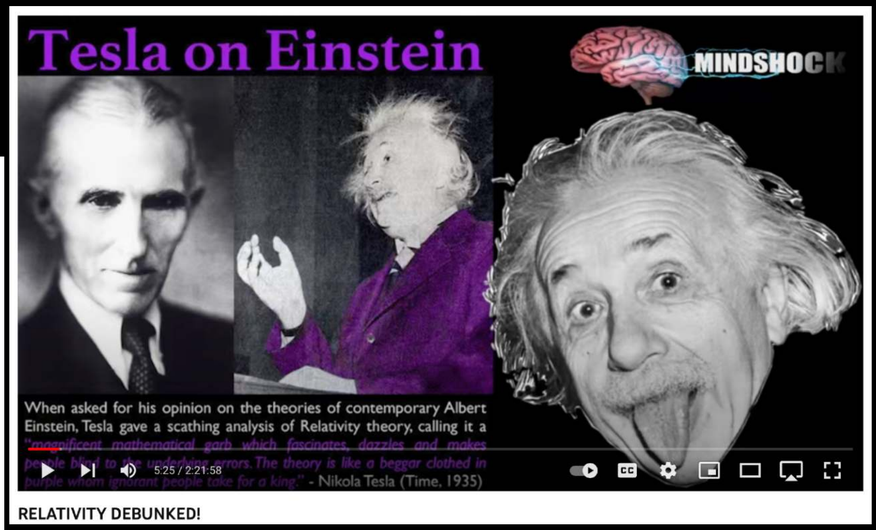






Some of it is bad,
very bad!



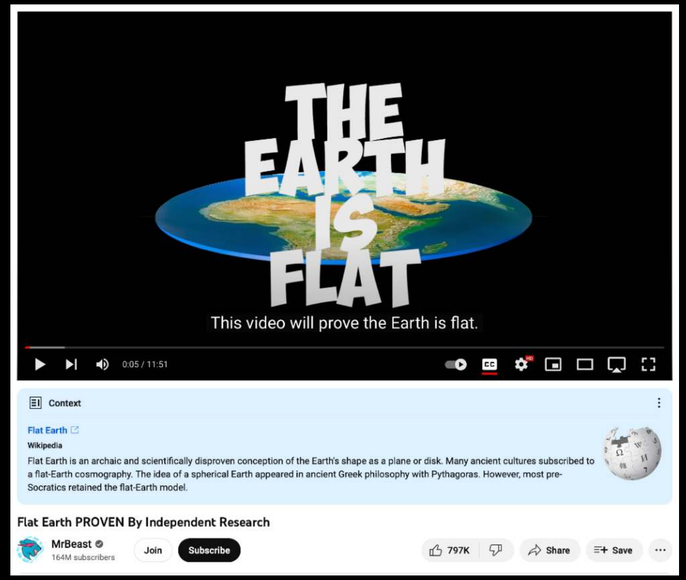


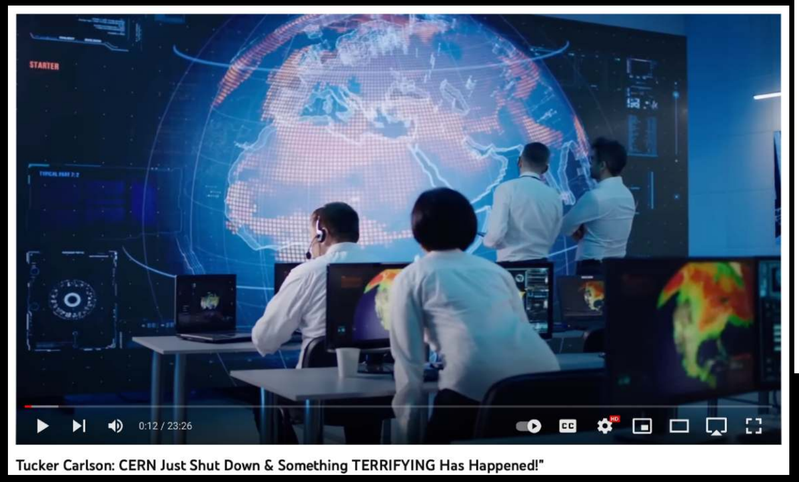
But at present the social media platforms have exploded.

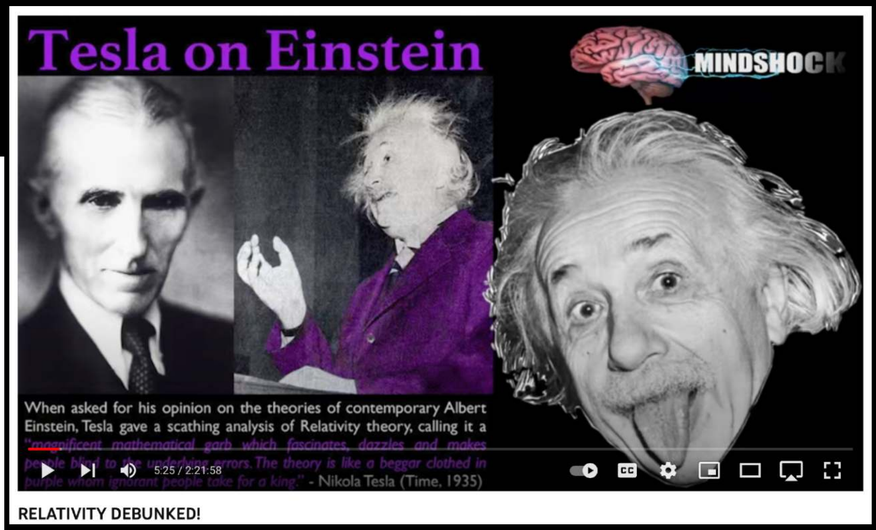
Many of the misleading videos use bona fide animations and interviews with respected scientists, or communicators, but edit the content to spin a totally different story.

They repurpose our material.

And have multitude of followers.







How can a science communicator distinguish the good from the bad?

Is going to “official” sources good?

RNAAS RESEARCH NOTES OF THE AAS

OPEN ACCESS

Intergalactic Travel with MOND Rockets

Abraham Loeb[1]

Published May 2022 • © 2022. The Author(s). Published by the American Astronomical Society.

Research Notes of the AAS, Volume 6, Number 5

Citation Abraham Loeb 2022 *Res. Notes AAS* **6** 101

DOI 10.3847/2515-5172/ac713a

References

+ Article and author information

Abstract

An attractive interpretation of MOdified Newtonian Dynamics as an alternative to dark matter, changes the inertia of matter at accelerations $a \lesssim a_0 \approx 1.2 \times 10^{-8}\,\mathrm{cm\,s^{-2}}$. I show that if inertia is modified at low accelerations, this suppresses the exponential factor for the required fuel mass in low acceleration journeys. Rockets operating at $a \ll a_0$ might allow intergalactic travel with a modest fuel-to-payload mass ratio.

NOTE ON THE THERMOKINETICS OF DOLICHODERINE ANTS

By Harlow Shapley

Harvard College Observatory, Cambridge, Mass.

Communicated, August 28, 1924

In an earlier communication I reported on the relation of speed to temperature for ants of the species *Liometopum apiculatum* Mayr. The observations were made on Mount Wilson, California, where this and closely related species are conspicuous features of the ant fauna.[1] The observations showed that meteorological conditions other than temperature had little effect on the field activities of the *Liometopa*. But the

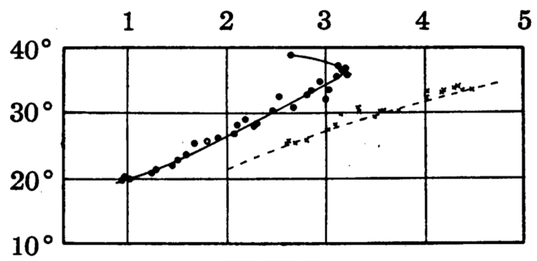


FIGURE 1

Speed curves for *Tapinoma sessile* and *Iridomyrmex humilis*.

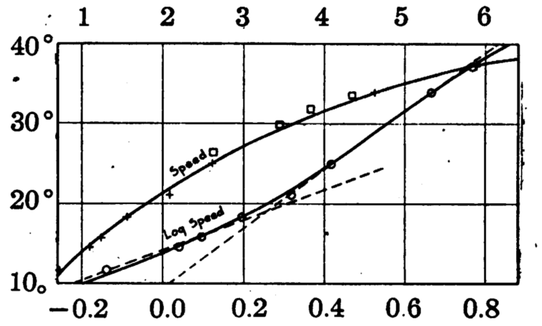


FIGURE 2

Speed curves for *Liometopum apiculatum*.

Is going to “official” sources good?

Progress in Biophysics and Molecular Biology 136 (2018) 3–23

Contents lists available at ScienceDirect

Progress in Biophysics and Molecular Biology

journal homepage: www.elsevier.com/locate/pbiomolbio

Cause of Cambrian Explosion - Terrestrial or Cosmic?

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Thus the possibility that cryopreserved Squid and/or Octopus eggs, arrived in icy bolides several hundred million years ago should not be discounted (below) as that would be a parsimonious cosmic explanation for the Octopus' sudden emergence on Earth ca. 270 million years ago. Indeed this principle applies to the sudden appearance in the fossil record of pretty well all major life forms, covered in the prescient concept of “punctuated equilibrium” by Eldridge and Gould advanced in the early 1970s (1972, 1977); and see the conceptual cartoon of Fig. 6. Therefore, similar living features like this “as if the genes were derived from some type of pre-existence" (Hoyle and Wickramasinghe, 1981) apply to many other biological ensembles when closely examined. One little known yet

structures
UV radia-
etrate the
tive factor

Earth may be readily understood in this wider perspective.

Given that the complex sets of new genes in the Octopus may have not come solely from horizontal gene transfers or simple random mutations of existing genes or by simple duplicative expansions, it is then logical to surmise, given our current knowledge of the biology of comets and their debris, the new genes and their viral drivers most likely came from space. However, it is also clear that to accept such a proposition also requires that we diminish the role for highly localised Darwinian evolution on Earth which is likely to be strongly resisted by traditional biologists. That should not, of course, be of concern as the focus of our attention, for general evolutionary molecular processes, now shifts to the Cosmos and beyond our immediate solar system. This evidence provides for, and allows the study of, *Cosmic Gene Pools* — and these are capable of driving, and, dare we say, controlling and thus steering biological evolution here on Earth (via Darwinian and non-

SUPERSTRING THEORY AND ASTROLOGY

[Astrology's] claims can at least be tested, while those of the superstring theorists cannot. It appears that if we define “science” as something that can be subjected to experimental test, then astrology is scientific, while superstring theory is not.

Clearly, something is wrong here. We must at least admit that the distinction between science and pseudoscience isn't as simple as we like to think.

Richard Morris, in *Doing Science: The Reality Club, 2,* edited by John Brockman (Prentice-Hall, New York, 1991), p. 158.

of genes inserted by extraterrestrial viruses. An alternative extraterrestrial scenario discuused is that a space 275 million years ago.

s -Author: Jeanne Le Roux & L. Joubin URL (http://www.archive.org/stream/rsultatsdescam17albe#page/

nmons Author: Pseudopanax at English Wikipedia
Tarlton%27s.jpg

Virus image from: https://www.dreamstime.com/royalty-free-stock-photo-h1n1-viruses-image11898035.

It is not easy for a non-specialist to distinguish the seed from the chaff.

We should all get involved in this struggle.

Outreach is VERY important!

How to reach the general public?

How to reach the general public?

- The first and most important thing, is to start from the mind frame of the intended audience.

We can laugh and/or disapprove of the methods used by some politicians, but they are quite effective in achieving their intended goal.

I don't mean that we act in inappropriate ways, just that we make a link to the public, and from there build our intended message.

Source: Periódico Reforma, June 2023.

How to reach the general public?

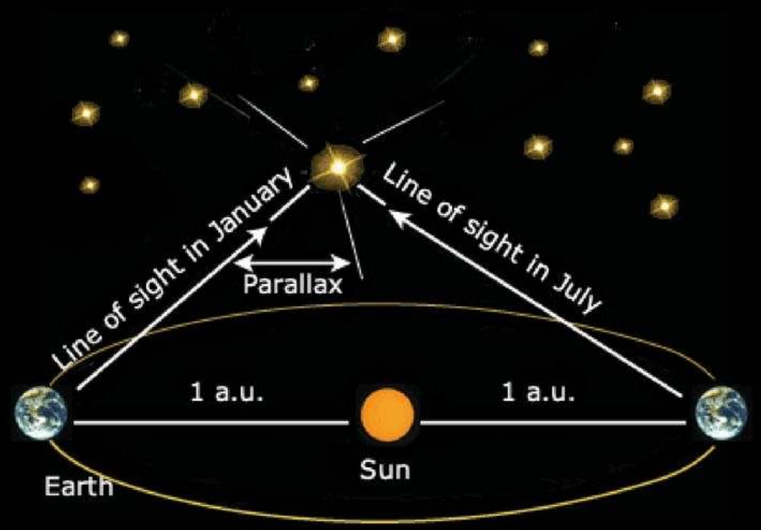
Source: Periódico Reforma, June 2023.

Example:
Activity in a volcano.

How to reach the general public?

- Use analogies that connect something familiar to what you want to communicate.

Example: Parallax.



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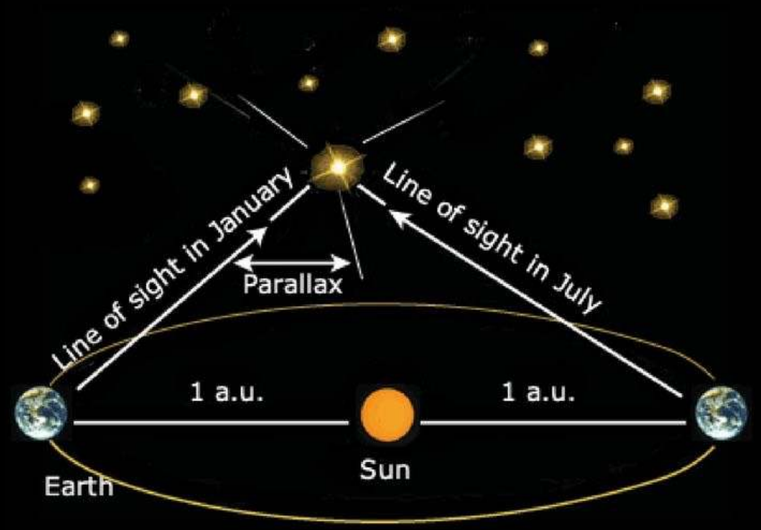


2-D

3-D

Why do they look different?

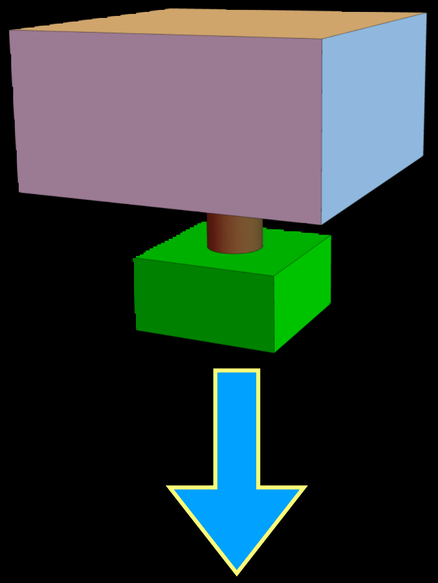
How to reach the general public?

- If possible, design experiments your public can do by themselves.

How to reach the general public?

- If possible, design experiments your public can do by themselves.

Example:
All bodies accelerate equally under gravity.



How to reach the general public?

- No matter how obtuse the concept you want to transmite, there’s always a way.

- I work in Galactic Dynamics.
- I use the positions and velocities of stars to trace the gravitational forces acting on them.
- From this, we infer the potential of the Galaxy.
- And from this, the mass distribution of it.

- What is Galactic dynamics?
- How can you get the gravitational forces from the positions and motions?
- What is a potential?
- How do you go from the potential to the mass distribution?

How to reach the general public?

- No matter how obtuse the concept you want to transmite, there’s always a way.

- Concepts of acceleration and mass.
- Newton’s laws of motion.
- Universal law of gravitation.
- Concept of slope: potential →force.

But this is a bit too much to ask ...

How to reach the general public?

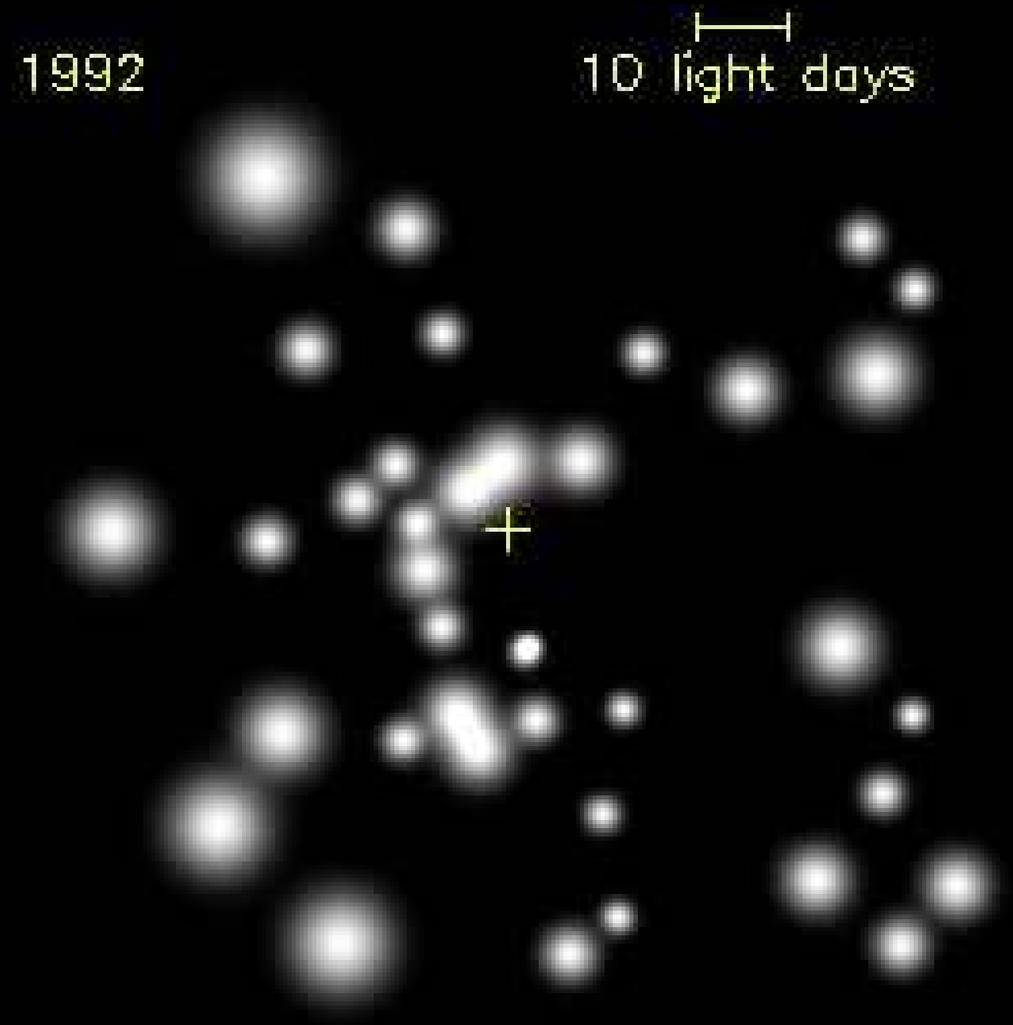
- No matter how obtuse the concept you want to transmite, there’s always a way.

A tree in the wind …

How to reach the general public?

- No matter how obtuse the concept you want to transmite, there’s always a way.

Stars moving under gravity …



How to reach the general public?

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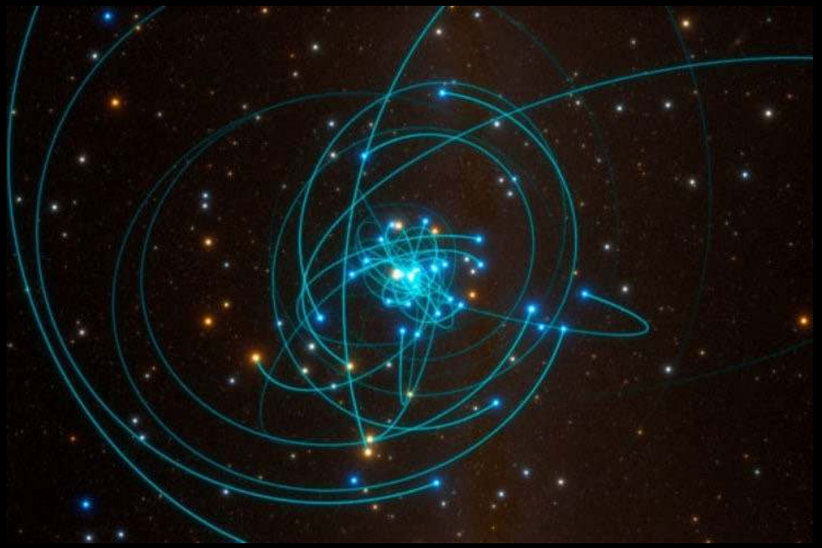
Tree Galaxy

Leaves Stars

Wind Force of gravity

(direction and magnitude)

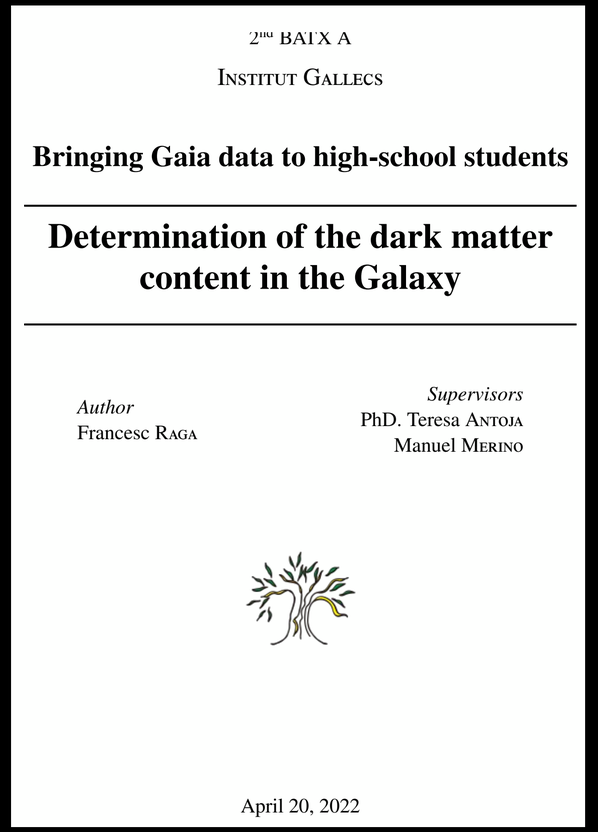


- Invisible “things” exist.
- Invisible “things” can have an effect on visible objects.
- Concept of vector: direction and magnitude.
- A familiar analogy everybody understands.

How to communicate with the public?

- Start from the mind frame of the intended audience.
- Use analogies.
- Design experiments your public can do by themselves.
- There’s always a way.

Although these lessons arose from a particular country, they apply in other places.



2ⁿᵘ BATX A

INSTITUT GALLECS

Bringing Gaia data to high-school students

Determination of the dark matter content in the Galaxy

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Manuel MERINO

April 20, 2022

Outreach is very important!
We should get involved,
but think out of the “ivory tower”.

But with GaiaNIR the task is more difficult

JWST

Credit: NASA/ESA

An astrometric mission doesn't give images, just a bunch of numbers.

solution_id	designation	source_id	random_index	ref_epoch	ra	ra_error	dec	dec_error	parallax	parallax_error	parallax_over_error	pm	pmra	pmra_error	pmdec	pmdec_error	ra_dec_corr	ra_parallax_corr	ra_pmra_corr
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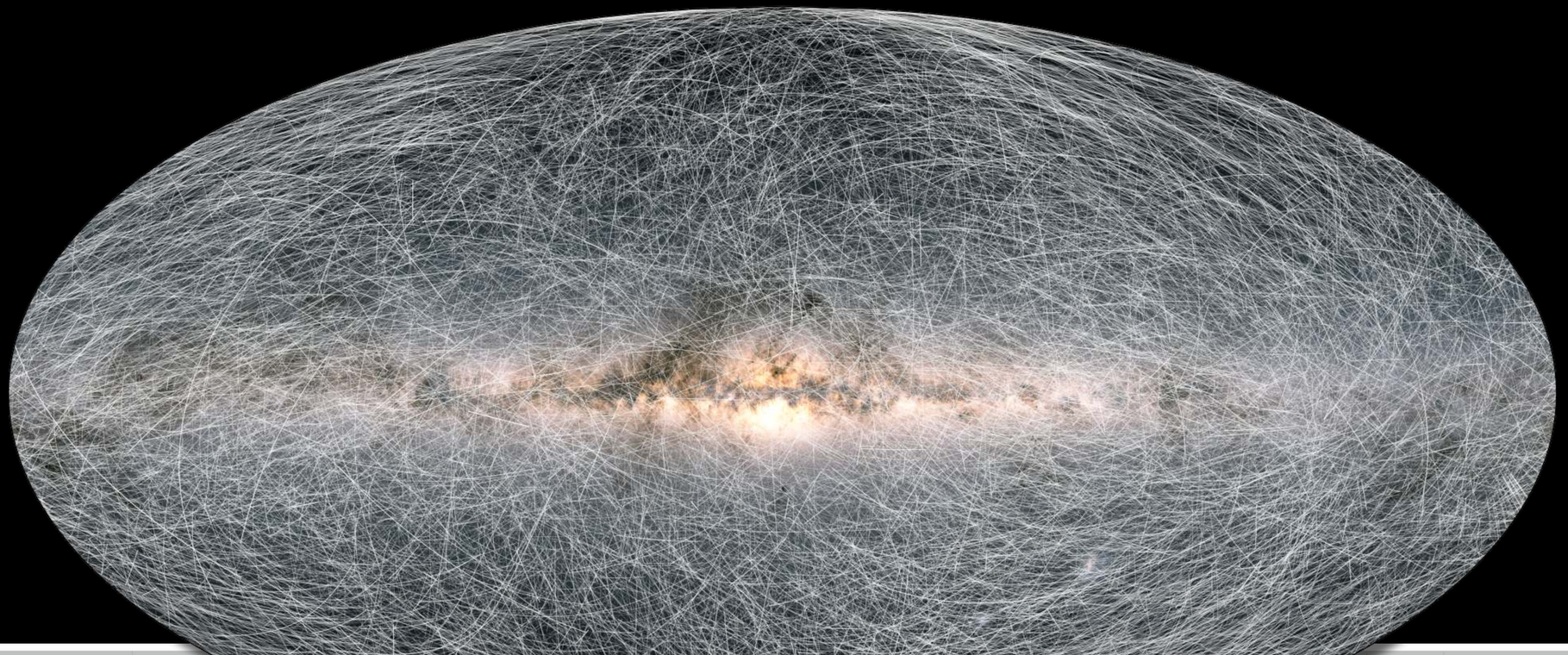
But with GaiaNIR the task is more difficult



But we can turn those numbers into appealing images and sims!

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Thanks for the invitation!