

Decolonising science

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2. Correct the false history and bad philosophy of science
- 3: Decolonise the philosophy of math

Concrete examples:
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- ▶ Was part of Multiversity efforts to decolonise education for a decade.

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- ▶ Was part of Multiversity efforts to decolonise education for a decade.
- ▶ Our focus was on curriculum, not fees

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- ▶ Was part of Multiversity efforts to decolonise education for a decade.
- ▶ Our focus was on curriculum, not fees
- ▶ Why? Because fees were traditionally low or absent.

Example 1: Nalanda university



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- ▶ Ancient Nalanda University survived for **over 1000 years**
without fees

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- ▶ Ancient Nalanda University survived for **over 1000 years without fees**
- ▶ until its sack in 1198 CE.

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- ▶ Ancient Nalanda University survived for **over 1000 years without fees**
- ▶ until its sack in 1198 CE.
- ▶ Tax revenue from 10 surrounding villages was granted to it.

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- ▶ Ancient Nalanda University survived for **over 1000 years without fees**
- ▶ until its sack in 1198 CE.
- ▶ Tax revenue from 10 surrounding villages was granted to it.
- ▶ Was an institution of the highest quality: students came from all over the world, including China.

Example 2: a charitable university

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- ▶ AlBukhary International University, Malaysia, charged 0 fees

Example 2: a charitable university

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- ▶ AlBukhary International University, Malaysia, charged 0 fees
- ▶ Gave scholarships to all students instead.



Example 3: Education in India

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- ▶ My own education with low or no fees and scholarships.

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- ▶ My own education with low or no fees and scholarships.
- ▶ Same with children.

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- ▶ My own education with low or no fees and scholarships.
- ▶ Same with children.
- ▶ Their fees in college were **1 ZAR**.

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- ▶ My own education with low or no fees and scholarships.
- ▶ Same with children.
- ▶ Their fees in college were **1 ZAR**.
- ▶ Supposedly the best science college in Delhi and probably India.

Example 3: Education in India

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- ▶ My own education with low or no fees and scholarships.
- ▶ Same with children.
- ▶ Their fees in college were **1 ZAR**.
- ▶ Supposedly the best science college in Delhi and probably India.
- ▶ Quality does not depend on fees.

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- ▶ Some lessons from Multiversity attempts to decolonise.

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- ▶ Some lessons from Multiversity attempts to decolonise.
- ▶ Public debates in Malaysia are being repeated here, e.g. common caricature of decolonisation

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- ▶ Some lessons from Multiversity attempts to decolonise.
- ▶ Public debates in Malaysia are being repeated here, e.g. common caricature of decolonisation
- ▶ “Don’t reject everything Western”

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- ▶ Some lessons from Multiversity attempts to decolonise.
- ▶ Public debates in Malaysia are being repeated here, e.g. common caricature of decolonisation
- ▶ “Don’t reject everything Western”
- ▶ Decolonisation means **critical rejection**.

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- ▶ On ancient Indian rules of debate, misrepresenting or caricaturing the opponent's position

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- ▶ On ancient Indian rules of debate, misrepresenting or caricaturing the opponent's position
- ▶ whether deliberately or due to ignorance

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- ▶ On ancient Indian rules of debate, misrepresenting or caricaturing the opponent's position
- ▶ whether deliberately or due to ignorance
- ▶ is one of the 23 ways of losing an argument.

Colonial education

A colonial ally

- ▶ We need to reject colonial model of education fundamentally.

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- ▶ We need to reject colonial model of education fundamentally.
- ▶ Why?

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A colonial ally

- ▶ We need to reject colonial model of education fundamentally.
- ▶ Why?
- ▶ Because colonial education was church education.

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Western education

Of the church, by the church, for the church

- ▶ All early Western universities were set up by church during the Crusades.

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Western education

Of the church, by the church, for the church

- ▶ All early **Western universities were set up by church during the Crusades.**
- ▶ To produce an army of indoctrinated missionaries

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Western education

Of the church, by the church, for the church

- ▶ All early **Western universities were set up by church during the Crusades.**
- ▶ To produce an army of indoctrinated missionaries
- ▶ to offset Christian military weakness during the Crusades

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Western education

Of the church, by the church, for the church

- ▶ All early **Western universities were set up by church during the Crusades.**
- ▶ To produce an army of indoctrinated missionaries
- ▶ to offset Christian military weakness during the Crusades
- ▶ Western universities were fully controlled by the church till the 20th c.

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Western education

Of the church, by the church, for the church

- ▶ All early **Western universities were set up by church during the Crusades.**
- ▶ To produce an army of indoctrinated missionaries
- ▶ to offset Christian military weakness during the Crusades
- ▶ Western universities were fully controlled by the church till the 20th c.
- ▶ Hence, Western education, **by design**, produces an indoctrinated and enslaved missionary mind subservient to church/Western authority.

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Education for counter-revolution

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- ▶ Hence, Macaulay advocated FREE education for the British poor as the cheapest means to contain revolt,

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- ▶ Hence, Macaulay advocated FREE education for the British poor as **the cheapest means to contain revolt**,
- ▶ (a few months before the *Communist Manifesto*: the spectre of revolt was then haunting Europe.)

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- ▶ Hence, Macaulay advocated FREE education for the **British** poor as **the cheapest means to contain revolt**,
- ▶ (a few months before the *Communist Manifesto*: the spectre of revolt was then haunting Europe.)
- ▶ Google “Education and counter-revolution”.)

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To offset military weakness

- ▶ Macaulay advocated the same remedy for the British colonies

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To offset military weakness

- ▶ Macaulay advocated the same remedy for the British colonies
- ▶ to offset the military weakness of the colonizer.

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Colonial education

To offset military weakness

- ▶ Macaulay advocated the same remedy for the British colonies
- ▶ to offset the military weakness of the colonizer.
- ▶ (First Western universities were set up in India immediately after the revolt of 1857.)

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- ▶ We require a fundamentally different design for education

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- ▶ We require a fundamentally different design for education
- ▶ which aims to free the mind

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- ▶ We require a fundamentally different design for education
- ▶ which aims to free the mind
- ▶ and not enslave it into a missionary/colonised mindset.

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For science?

- ▶ While the aim was control,

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For science?

- ▶ While the aim was control,
- ▶ Macaulay's rhetoric was that Western education benefit the colonised

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For science?

- ▶ While the aim was control,
- ▶ Macaulay's rhetoric was that Western education benefit the colonised
- ▶ by giving them science.

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Colonial education

For science?

- ▶ While the aim was control,
- ▶ Macaulay's rhetoric was that Western education benefit the colonised
- ▶ by giving them science.
- ▶ This is still widely believed: that Western education is needed for science and technology.

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- ▶ Hence, to decolonise education we must first decolonise math and science.

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- ▶ Hence, to decolonise education we must first decolonise math and science.
- ▶ This was my focus in the Multiversity efforts to decolonise the curriculum.

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- ▶ Also necessary to decolonise other aspects of education.

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- ▶ Also necessary to decolonise other aspects of education.
- ▶ But math and science must get priority.

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- ▶ We aimed to decolonise math and science per se.

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- ▶ We aimed to decolonise math and science per se.
- ▶ Not merely the pedagogy, but also **the content**.

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- ▶ Can science be decolonised?

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- ▶ Can science be decolonised?
- ▶ People believe “modern” science is objective and **universal**.

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- ▶ Can science be decolonised?
- ▶ People believe “modern” science is objective and **universal**.
- ▶ This is **NOT** true.

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- ▶ Can science be decolonised?
- ▶ People believe “modern” science is objective and **universal**.
- ▶ This is **NOT** true.
- ▶ Will explain why not

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- ▶ Can science be decolonised?
- ▶ People believe “modern” science is objective and **universal**.
- ▶ This is **NOT** true.
- ▶ Will explain why not
- ▶ and provide concrete examples of decolonised science.

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- ▶ Can science be decolonised?
- ▶ People believe “modern” science is objective and **universal**.
- ▶ This is **NOT** true.
- ▶ Will explain why not
- ▶ and provide concrete examples of decolonised science.
- ▶ Full details (with references) posted at <http://ckraju.net/papers/uct-panel-decolonising-science-ckr-summary.pdf>

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Gist of summary

The paradox

- ▶ Science is empirical,

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The paradox

- ▶ Science is empirical,
- ▶ it uses math, **but**

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Gist of summary

The paradox

- ▶ Science is empirical,
- ▶ it uses math, **but**
- ▶ Western (formal) math (as taught in schools and universities) is **anti-empirical**.

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Gist of summary

The paradox

- ▶ Science is empirical,
- ▶ it uses math, **but**
- ▶ Western (formal) math (as taught in schools and universities) is **anti-empirical**.
 - ▶ E.g. a geometric point is declared to be invisible (cannot also infer its existence from empirical data).

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The paradox

- ▶ Science is empirical,
- ▶ it uses math, **but**
- ▶ Western (formal) math (as taught in schools and universities) is **anti-empirical**.
 - ▶ E.g. a geometric point is declared to be invisible (cannot also infer its existence from empirical data).
 - ▶ Everything in formal math (from $1+1=2$) requires a metaphysics of infinity.

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Gist of summary

The paradox

- ▶ Science is empirical,
- ▶ it uses math, **but**
- ▶ Western (formal) math (as taught in schools and universities) is **anti-empirical**.
 - ▶ E.g. a geometric point is declared to be invisible (cannot also infer its existence from empirical data).
 - ▶ Everything in formal math (from $1+1=2$) requires a metaphysics of infinity.
 - ▶ This metaphysics not universal or objective (tied to church dogmas of eternity).

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Resolving the paradox

- ▶ To decolonise science

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- ▶ To decolonise science
- ▶ we propose to discard formal math

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Resolving the paradox

- ▶ To decolonise science
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- ▶ and revert to **normal** math

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- ▶ To decolonise science
- ▶ we propose to discard formal math
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- ▶ which admits the empirical (including empirical proofs)

Resolving the paradox

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- ▶ To decolonise science
- ▶ we propose to discard formal math
- ▶ and revert to **normal** math
- ▶ which admits the empirical (including empirical proofs)
- ▶ and prevailed for thousands of years before the birth of formal math.

Advantages

- ▶ Reverting to normal math

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- ▶ Reverting to normal math
- ▶ makes math easy
- ▶ and science better.

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A doubt

“it works”

- ▶ A common doubt (about existing math): “it works”.

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- ▶ All engineering applications involve **approximate calculations**, not “eternal truth”.

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- ▶ A computer **cannot** handle the metaphysics of infinity.
- ▶ All engineering applications involve **approximate calculations**, not “eternal truth”.
- ▶ Normal math **works better**, try it.

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- ▶ Normal math (arithmetic, algebra, trigonometry, probability, calculus) historically imported by the West from the non-West for its practical value.

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- ▶ Normal math (arithmetic, algebra, trigonometry, probability, calculus) historically imported by the West from the non-West for its practical value.
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- ▶ a redundant ideological wrapper.

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- ▶ Mystery geometry imported from Egypt, since Plato

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- ▶ West added the metaphysics of formal math
- ▶ a redundant ideological wrapper.
- ▶ Mystery geometry imported from Egypt, since Plato
- ▶ was twisted (“reinterpreted”) to suit post-Crusade rational theology.

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- ▶ Repeat: issue not merely *some* metaphysics,

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- ▶ Repeat: issue not merely *some* metaphysics,
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- ▶ Repeat: issue not merely *some* metaphysics,
- ▶ but the particular metaphysics of **infinity** in formal math which is NOT universal, but
- ▶ is tied to church dogmas about **eternity**.
- ▶ **Eliminating these superstitions results in a better science.**

The Blackhouse Collective invites you to a conversation with

PROFESSOR C.K. RAJU

"Every conquest is, in the first instance, a conquest of knowledge"



WESTERN SUPERSTITION PACKAGED AS SCIENCE: DECOLONIZING MATHS & SCIENCE

Due to the colonial experience, all ideas, philosophies and theories - generally all systems of learning and knowing in the education curriculum - have a Eurocentric historical and cultural base.

As such, subjects like Mathematics and Science are usually assumed to be inherently European. Afrikan contributions to these subjects remain excluded.

Join us in conversation with Professor C.K. Raju as we explore the origins Maths and Science under the theme:

"Western Superstition Packaged As Science: Decolonizing Maths & Science".

DATE: SUNDAY, 22 JANUARY 2017

TIME: 11.30 FOR 12.00

**VENUE: BLACKHOUSE COLLECTIVE, 10493 DR MATSEKE DRIVE
DOBSONVILLE, EXT.3, SOWETO**

For more information please contact Sista Nehanda on 078 243 8830 or via email blackhousecollective1@gmail.com

**"THE MOST POTENT WEAPON IN THE HANDS OF
THE OPPRESSOR IS THE MIND OF THE OPPRESSED"**
- BANTU BIKO



**BLACKHOUSE
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- ▶ 1. Decolonise the method of validating science:

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 - ▶ Use refutability NOT reputability

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 - ▶ Use refutability NOT reputability
 - ▶ Judge valid science by experiment, not publication in “reputable” journals.

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 - ▶ and the associated dogmas (“universal laws of nature” etc.).

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 - ▶ Reject church/racist/colonial history of the Western origin of science
 - ▶ and the associated dogmas (“universal laws of nature” etc.).
- ▶ 3. Eliminate the bad metaphysics of (formal) math:
 - ▶ Bad metaphysics creeps into science through formal math.

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Experiment: the right way

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- ▶ Right way to validate science (or any knowledge) is by experiment.

Experiment: the right way

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- ▶ (**All** systems of Indian philosophy accept the empirically manifest as the first means of proof.)

Experiment: the right way

- ▶ Right way to validate science (or any knowledge) is by experiment.
- ▶ (All systems of Indian philosophy accept the empirically manifest as the first means of proof.)
- ▶ In India, experimental method was applied also to religious beliefs, such as the soul.

Payāsi's experiments

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- ▶ The sceptic Payasi performed **30 odd controlled experiments** in India 2500 years ago

Payāsi's experiments

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- ▶ to test the existence of the soul and life after death.

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- ▶ The sceptic Payasi performed **30 odd controlled experiments** in India 2500 years ago
- ▶ to test the existence of the soul and life after death.
- ▶ Recorded in the *Dīgha Nikāya* (= *Long discourses of the Buddha*).

Western innovation!?

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- ▶ The Western innovation was this:

Western innovation!?

- ▶ The Western innovation was this:
- ▶ Don't apply experimental method to religious beliefs.

Western innovation!?

- ▶ The Western innovation was this:
- ▶ Don't apply experimental method to religious beliefs.
- ▶ Get authoritative approval (“publish it in an authoritative outlet”)

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- ▶ I critiqued Popper's criterion of refutability (over a quarter century ago).

Refutability

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- ▶ (Popper wrote, "your arguments are strong, I will reply." but died!)

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- ▶ I critiqued Popper's criterion of refutability (over a quarter century ago).
- ▶ (Popper wrote, "your arguments are strong, I will reply." but died!)
- ▶ So, those arguments stand, but finer points not needed for present debate.
- ▶ Hence, I am willing to pragmatically accept his (actually Poincaré's) weaker criterion of **refutability**.

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- ▶ However, today we use **reputability** as the test of valid science.

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- ▶ However, today we use **reputability** as the test of valid science.
- ▶ It is valid science if it is authoritatively approved, i.e.,
- ▶ published in a **reputable** journal.

- ▶ High-impact journals are mostly controlled by the West/Whites.

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- ▶ So, this is **political control** of truth masquerading as quality control,
- ▶ Somewhat like apartheid where whites were ranked higher
- ▶ than blacks who were declared inferior.

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- ▶ Hence, **secrecy** an essential aspect of such “science”.

Secrecy

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- ▶ Secrecy and blind trust in the West/Whites is **NOT** science.

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- ▶ “Peer” review done by reviewers **secretly** appointed by editors.
- ▶ Secrecy and blind trust in the West/Whites is **NOT** science.
- ▶ (Actually secretive pre-censorship just a church method of thought control designed to preserve bad dogmas.)

Example 1

Controlling dissent

- ▶ Political control prevents articulation of dissent,

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- ▶ E.g. my article “To decolonise math stand up to its false history and bad philosophy”
- ▶ was published by the *Conversation* last year.
- ▶ It went viral (17K hits), and was then censored.
- ▶ (Still survives in some locations online: Google “math and censorship” for details.)

- ▶ If there was some error in the article, the *Conversation* should have pointed it out.

¹“Black thoughts matter: decolonized math, academic censorship. . .”, *Journal of Black Studies* **48**(3) April 2017, pp. 256-278. 



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- ▶ If there was some error in the article, the *Conversation* should have pointed it out.
- ▶ But it could not.
- ▶ Article now published in full in a peer-reviewed academic journal.¹

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- ▶ The *Conversation* article attacked key Western myths about math.

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- ▶ Hence, the article was censored.

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- ▶ Must first eliminate this Western political thought control

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- ▶ Must first eliminate this Western political thought control
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- ▶ Must first eliminate this Western political thought control
- ▶ to allow the debates necessary for decolonisation.
- ▶ Present panel would have been impossible in the days of apartheid.

Trusting reputation

A second example

- ▶ Criterion of reputability fails even for the most reputed

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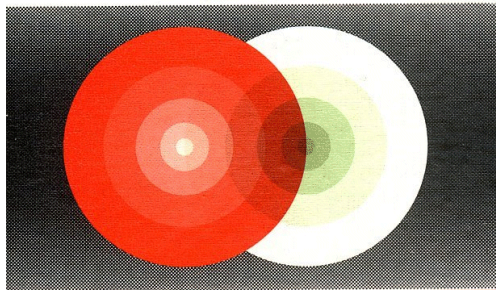
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- ▶ Shamelessly plagiarised my published work twice.
- ▶ The second time after he was personally informed.

Time: Towards a Consistent Theory

by

C. K. Raju

Kluwer Academic Publishers



Fundamental Theories of Physics

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- ▶ The book published by Kluwer/Springer in 1994.

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- ▶ The book published by Kluwer/Springer in 1994.
- ▶ A second book published by Sage, 2003.

The Eleven Pictures of Time

*The Physics, Philosophy, and
Politics of Time Beliefs*



C. K. Raju

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- ▶ Books were well-known because of my critique of Einstein.

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- ▶ Books were well-known because of my critique of Einstein.
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- ▶ “Don’t forget that I suggested it”.

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- ▶ connived with two people to get an article on his speech published in *Notices of the American Mathematical Society*
- ▶ which again quoted him saying “Don’t forget that I suggested it”
- ▶ and also named the idea as “Atiyah’s hypothesis”

- ▶ The editor of the *Notices of AMS*, Andy Magid said

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- ▶ Won't publish your remarks about a conceptual error in the term “Atiyah's hypothesis”. Won't even remove that error. [“Reputation is more important than truth.”]

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Letters to the Editor

Retarded Differential Equations and Quantum Mechanics

G. W. Johnson and I wish to draw attention to the work of C. K. Raju that is related to some of the ideas discussed by Sir Michael Atiyah in his talk “The Nature of Space”, which we reported on in the June/July 2006 issue of the *Notices*. Ideas suggesting a link between retarded differential equations and quantum mechanics were put forward some years ago by Raju, and we, along with Atiyah, believe they deserve attention. Interested readers are encouraged to read, in particular, the following papers written by Raju:

1. *Time: Towards a Consistent Theory*, Kluwer Academic, Dordrecht, 1994 (Fundamental Theories of Physics, vol. 65), ch. 5b “Electromagnetic time” (pp. 116–122), and ch. 6b “Quantum mechanical time” (pp. 161–189).
2. *The Eleven Pictures of Time*, Sage, 2003, pp. 298–302.
3. “The electrodynamic 2-body problem and the origin of quantum mechanics”, *Foundations of Physics*, **34**, (June 2004), 937–962.

—Mark E. Walker
University of Nebraska
mwalker5@math.unl.edu

(Received December 29, 2006)

Moral of the story

- ▶ Reputation a poor guide.

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Moral of the story

- ▶ Reputation a poor guide.
- ▶ Editors of the most widely-read journal in math cannot be trusted.

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Moral of the story

- ▶ Reputation a poor guide.
- ▶ Editors of the most widely-read journal in math cannot be trusted.
- ▶ Nor can the most reputed mathematicians.

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- ▶ To decolonise, we must first reject this Western hegemony over academics.

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- ▶ The rhetorical justification for colonial education was

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- ▶ The rhetorical justification for colonial education was
- ▶ that it was needed for science.

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- ▶ The rhetorical justification for colonial education was
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- ▶ A key argument here was the Western creation myth:
- ▶ that (“modern”) science is a Western creation.

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- ▶ First began with Greeks,

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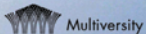
Concrete
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- ▶ First began with Greeks,
- ▶ and then developed after the renaissance (actually Crusades).

- ▶ This thesis of the Western origin of science is completely false.

Is Science Western in Origin?

C K Raju



Multiversity



Citizens International

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- ▶ The book debunks four glorified figures: two “Greeks” and two post-Crusade

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- ▶ The book debunks four glorified figures: two “Greeks” and two post-Crusade
- ▶ “Euclid” (math) and “Claudius Ptolemy” (astronomy)

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- ▶ “Euclid” (math) and “Claudius Ptolemy” (astronomy)
- ▶ and “Copernican” and “Newtonian” revolution.
- ▶ (Copernicus copied from Ibn Shatir of Damascus, Newton got calculus from India).

- ▶ This creation myth of the Western origins of science originated during the Crusades.

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- ▶ The Crusades were military failures after the first,

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- ▶ just because Christian Europe lagged behind Muslim Europe and the Muslim world in knowledge.

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- ▶ The Crusades were military failures after the first,
- ▶ just because Christian Europe lagged behind Muslim Europe and the Muslim world in knowledge.
- ▶ So, the church tried to acquire that knowledge.
- ▶ When Toledo fell its vast library of Arabic books came under Christian control,
- ▶ and was mass translated to Latin starting 1125 CE.

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- ▶ But, learning from books was contrary to the earlier church policy of burning books.

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- ▶ How to learn from the books of the religious enemy? That too during a religious war?

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- ▶ How to learn from the books of the religious enemy? That too during a religious war?
- ▶ An easy lie was invented: all secular knowledge in Arabic books was declared to be of Greek origin
- ▶ hence a Christian inheritance.

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- ▶ The myth developed during the Inquisition

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- ▶ when Europeans (e.g. Copernicus, Mercator, Tycho Brahe, Kepler) trembled to acknowledge their “heretical” sources.

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- ▶ Later this false history was picked up by racist historians

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- ▶ (Greeks from Alexandria in Africa were painted White),

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- ▶ Later this false history was picked up by racist historians
- ▶ (Greeks from Alexandria in Africa were painted White),
- ▶ and then colonial historians
- ▶ (Greeks were declared West)
- ▶ to glorify themselves.

No evidence

- ▶ No serious evidence for Greek science: “Euclid”, “Claudius Ptolemy”, Archimedes

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- ▶ All the “evidence” comes from stray remarks in excessively late texts (from 1000-1800 years later)
- ▶ from another place, in another language.
- ▶ Exactly like saying that a present-day text in aerodynamics in English, from London, is a carbon copy of an ancient African text.

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- ▶ Contrary to commonsense: scientific texts are accretive,

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- ▶ Contrary to commonsense: scientific texts are accretive,
- ▶ so a 16th c. text attributed to Archimedes reflects 16th c. knowledge

Much counter-evidence

- ▶ Robust non-textual evidence against Greek science: e.g. numerals and calendar.

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- ▶ Early Greeks and Romans were arithmetically challenged: no systematic notation for fractions.

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Much counter-evidence

- ▶ Robust non-textual evidence against Greek science: e.g. numerals and calendar.
- ▶ Early Greeks and Romans were arithmetically challenged: no systematic notation for fractions.
- ▶ Hence, couldn't do astronomy.
- ▶ Look at the inferior calendar, manifestly inferior even after the Julian reform (copied from Egypt) and the Gregorian reform (copied from India).

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Much counter-evidence

- ▶ Robust non-textual evidence against Greek science: e.g. numerals and calendar.
- ▶ Early Greeks and Romans were arithmetically challenged: no systematic notation for fractions.
- ▶ Hence, couldn't do astronomy.
- ▶ Look at the inferior calendar, manifestly inferior even after the Julian reform (copied from Egypt) and the Gregorian reform (copied from India).
- ▶ (See, e.g. video of my MIT talk or video: "A tale of two calendars".)

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- ▶ Nevertheless, the bunkum Crusading/racist/colonial myth of “Euclid”

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- ▶ Nevertheless, the bunkum Crusading/racist/colonial myth of “Euclid”
- ▶ used by Indian school texts

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- ▶ Nevertheless, the bunkum Crusading/racist/colonial myth of “Euclid”
- ▶ used by Indian school texts
- ▶ to motivate the teaching of anti-empirical (formal) math.

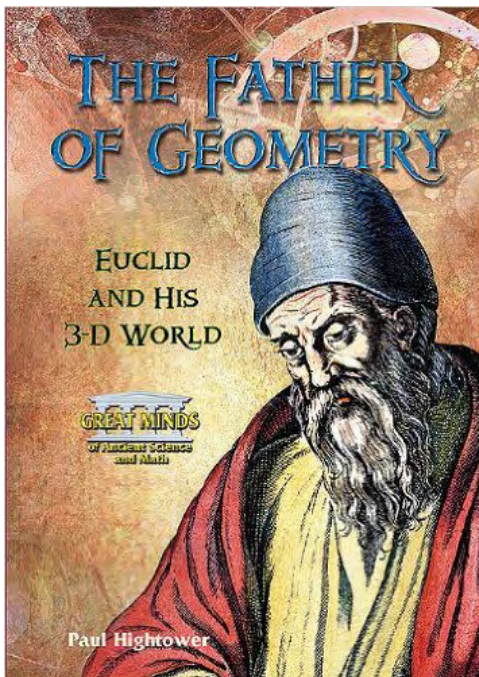
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- ▶ Nevertheless, the bunkum Crusading/racist/colonial myth of “Euclid”
- ▶ used by Indian school texts
- ▶ to motivate the teaching of anti-empirical (formal) math.
- ▶ All Indian school math texts show an image of Euclid, and depict him a white man.



Decolonising
science

C. K. Raju

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- ▶ My censored *Conversation* article stated

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- ▶ My censored *Conversation* article stated
- ▶ that “Euclid” was most probably a black woman (as argued in my book *Euclid and Jesus*).

- ▶ My censored *Conversation* article stated
- ▶ that “Euclid” was most probably a black woman (as argued in my book *Euclid and Jesus*).
- ▶ This caused considerable outrage.

Euclid and Jesus



C. K. Raju



Multiversity



Citizens International

- ▶ Why a woman?

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- ▶ Why a woman?
- ▶ The texts state that they are based on the lectures of Theon, so probably Theon's daughter.

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- ▶ Why a woman?
- ▶ The texts state that they are based on the lectures of Theon, so probably Theon's daughter.
- ▶ Also because commentators speak anonymously of the "author of the Elements" (though they name everyone else).

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- ▶ Why a woman?
- ▶ The texts state that they are based on the lectures of Theon, so probably Theon's daughter.
- ▶ Also because commentators speak anonymously of the "author of the Elements" (though they name everyone else).
- ▶ Why black?

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- ▶ Also because commentators speak anonymously of the "author of the Elements" (though they name everyone else).
- ▶ Why black?
- ▶ Since from Alexandria in Africa where the default is black.

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- ▶ Why a woman?
- ▶ The texts state that they are based on the lectures of Theon, so probably Theon's daughter.
- ▶ Also because commentators speak anonymously of the "author of the Elements" (though they name everyone else).
- ▶ Why black?
- ▶ Since from Alexandria in Africa where the default is black.
- ▶ (Show me better evidence and I will change my opinion.)

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- ▶ What difference does it make?

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- ▶ What difference does it make?
- ▶ Changing the author and her time, changes the understanding of the *Elements*.

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- ▶ It is clearly a book in the (“Platonic”/“Neoplatonic”) tradition of Egyptian mystery geometry

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- ▶ It is clearly a book in the (“Platonic”/“Neoplatonic”) tradition of Egyptian mystery geometry
- ▶ which links geometry to the soul as in Plato’s Meno.

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- ▶ It is clearly a book in the (“Platonic”/“Neoplatonic”) tradition of Egyptian mystery geometry
- ▶ which links geometry to the soul as in Plato’s Meno.
- ▶ That involves a notion of the soul cursed by the church in the 6th c.

- ▶ It is clearly a book in the (“Platonic”/“Neoplatonic”) tradition of Egyptian mystery geometry
- ▶ which links geometry to the soul as in Plato’s Meno.
- ▶ That involves a notion of the soul cursed by the church in the 6th c.
- ▶ Hence, the “author of the Elements”, Hypatia, was raped on the altar of a church and then lynched most brutally.

- ▶ The *Elements* is certainly **NOT** a book about deductive proofs,

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- ▶ The *Elements* is certainly **NOT** a book about deductive proofs,
- ▶ as the Western/church myth about it makes out.

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- ▶ The *Elements* is certainly **NOT** a book about deductive proofs,
- ▶ as the Western/church myth about it makes out.
- ▶ **It does NOT contain a single pure deductive proof from its first proposition to the last**

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- ▶ The *Elements* is certainly **NOT** a book about deductive proofs,
- ▶ as the Western/church myth about it makes out.
- ▶ **It does NOT contain a single pure deductive proof from its first proposition to the last**
- ▶ as was finally admitted at the beginning of the 20th c.

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- ▶ The *Elements* is certainly **NOT** a book about deductive proofs,
- ▶ as the Western/church myth about it makes out.
- ▶ **It does NOT contain a single pure deductive proof from its first proposition to the last**
- ▶ as was finally admitted at the beginning of the 20th c.
- ▶ So, for centuries (since 1125 CE), the book was wrongly interpreted by ALL Western scholars.

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- ▶ To decolonise: don't let the West ever forget this foolish mistake it made for centuries

- ▶ To decolonise: don't let the West ever forget this foolish mistake it made for centuries
- ▶ Keep reminding them of the worthlessness of their authoritative truth.

- ▶ To save the absurd myth of “Euclid” and his deductive proofs

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- ▶ To save the absurd myth of “Euclid” and his deductive proofs
- ▶ Western scholars now authoritatively asserted that the mythical intention of the mythical Euclid was to give deductive proofs.

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- ▶ To save the absurd myth of “Euclid” and his deductive proofs
- ▶ Western scholars now authoritatively asserted that the mythical intention of the mythical Euclid was to give deductive proofs.
- ▶ All myth-and-magic Harry Potter stuff: very popular in the West.

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- ▶ To save the absurd myth of “Euclid” and his deductive proofs
- ▶ Western scholars now authoritatively asserted that the mythical intention of the mythical Euclid was to give deductive proofs.
- ▶ All myth-and-magic Harry Potter stuff: very popular in the West.
- ▶ Formal math started with attempts to “correct” “Euclid” and do what “he” “intended” to do:

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- ▶ To save the absurd myth of “Euclid” and his deductive proofs
- ▶ Western scholars now authoritatively asserted that the mythical intention of the mythical Euclid was to give deductive proofs.
- ▶ All myth-and-magic Harry Potter stuff: very popular in the West.
- ▶ Formal math started with attempts to “correct” “Euclid” and do what “he” “intended” to do:
- ▶ both Hilbert and Russell wrote (separate) tracts on the Foundations of Geometry.

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- ▶ Principle: Any nonsense theory can be saved

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- ▶ Principle: Any nonsense theory can be saved
- ▶ for any length of time

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- ▶ Principle: Any nonsense theory can be saved
- ▶ for any length of time
- ▶ against all facts

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- ▶ Principle: Any nonsense theory can be saved
- ▶ for any length of time
- ▶ against all facts
- ▶ by piling on the hypotheses.

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- ▶ Principle: Any nonsense theory can be saved
- ▶ for any length of time
- ▶ against all facts
- ▶ by piling on the hypotheses.
- ▶ That is why refutability is important, and one must reject reputability.

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- ▶ All right, so the book was written by someone else for a different reason.

- ▶ All right, so the book was written by someone else for a different reason.
- ▶ What difference does it make now to the present-day philosophy of formal math?

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- ▶ It tells us that **deductive proofs are terribly fallible.**

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- ▶ Invalid deductive proofs were mistaken for valid deductive proofs for centuries, unanimously by ALL Western scholars.

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- ▶ Empirical proofs are fallible, but not so fallible:

- ▶ It tells us that **deductive proofs are terribly fallible**.
- ▶ Invalid deductive proofs were mistaken for valid deductive proofs for centuries, unanimously by ALL Western scholars.
- ▶ Empirical proofs are fallible, but not so fallible:
- ▶ easier to deceive the mind than the senses.

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- ▶ Philosophy of formal math just naively assumed that deductive proofs are infallible.

- ▶ Philosophy of formal math just naively assumed that deductive proofs are infallible.
- ▶ Failure of the myth of Euclid is a strong counter-argument.

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- ▶ To understand the whole trick, we need one more step.

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- ▶ To understand the whole trick, we need one more step.
- ▶ Adelard of Bath was the first to translate the Elements from Arabic to Latin around 1125 CE (almost the same time as Gerhard of Cremona).

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- ▶ To understand the whole trick, we need one more step.
- ▶ Adelard of Bath was the first to translate the Elements from Arabic to Latin around 1125 CE (almost the same time as Gerhard of Cremona).
- ▶ He was a Crusading spy who travelled in Muslim lands disguised as a Muslim student.

- ▶ Adelard wrote: “From my Arab teachers I have learnt one thing,

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- ▶ Adelard wrote: “From my Arab teachers I have learnt one thing,
- ▶ to have reason as my guide,

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- ▶ Adelard wrote: “From my Arab teachers I have learnt one thing,
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- ▶ while you are dazzled by the show of authority and led by a halter.

- ▶ Adelard wrote: “From my Arab teachers I have learnt one thing,
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- ▶ For what is authority to be called, but a halter?

- ▶ Adelard wrote: “From my Arab teachers I have learnt one thing,
- ▶ to have reason as my guide,
- ▶ while you are dazzled by the show of authority and led by a halter.
- ▶ For what is authority to be called, but a halter?
- ▶ As the brute beasts, indeed, are led by the halter, and have no idea by what they are led or why, but only follow the rope that holds them”

- ▶ The better to persuade Muslims

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- ▶ The better to persuade Muslims
- ▶ the post-Crusade church switched to the theology of reason,

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- ▶ The better to persuade Muslims
- ▶ the post-Crusade church switched to the theology of reason,
- ▶ and endlessly glorified reason.

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- ▶ The better to persuade Muslims
- ▶ the post-Crusade church switched to the theology of reason,
- ▶ and endlessly glorified reason.
- ▶ But there was a trick.

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- ▶ The better to persuade Muslims
- ▶ the post-Crusade church switched to the theology of reason,
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- ▶ But there was a trick.
- ▶ The starting point: the assumptions had to be approved by authority.

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- ▶ This way the church retained authority while boasting reason.

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- ▶ The better to persuade Muslims
- ▶ the post-Crusade church switched to the theology of reason,
- ▶ and endlessly glorified reason.
- ▶ But there was a trick.
- ▶ The starting point: the assumptions had to be approved by authority.
- ▶ This way the church retained authority while boasting reason.
- ▶ FYI: **Any nonsense proposition whatsoever can be proved by deductive reasoning applied to metaphysics.**

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- ▶ Reason, at best, leads to **relative** truth: relative to the hypotheses.

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- ▶ Reason, at best, leads to **relative** truth: relative to the hypotheses.
- ▶ A deductive proved theorem, which starts from faulty assumptions, will result in a false conclusion.

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- ▶ Reason, at best, leads to **relative** truth: relative to the hypotheses.
- ▶ A deductive proved theorem, which starts from faulty assumptions, will result in a false conclusion.
- ▶ Indian Lokayat (people's philosophers) hence rejected deductive inference as a poor guide to truth.

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- ▶ Famous examples of wolf's footprints.

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- ▶ Famous examples of wolf's footprints.
- ▶ To convince his girlfriend, at night a man makes a wolf's footprints on the ground

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- ▶ Famous examples of wolf's footprints.
- ▶ To convince his girlfriend, at night a man makes a wolf's footprints on the ground
- ▶ from the gate of the city to its central square.

- ▶ Famous examples of wolf's footprints.
- ▶ To convince his girlfriend, at night a man makes a wolf's footprints on the ground
- ▶ from the gate of the city to its central square.
- ▶ In the morning, a crowd assembles and wise people infer that a wolf was around.

- ▶ Famous examples of wolf's footprints.
- ▶ To convince his girlfriend, at night a man makes a wolf's footprints on the ground
- ▶ from the gate of the city to its central square.
- ▶ In the morning, a crowd assembles and wise people infer that a wolf was around.
- ▶ The man laughs: see how deceptive inference can be?

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- ▶ I made this example a bit easier in my censored article

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- ▶ I made this example a bit easier in my censored article
- ▶ 1. All animals have two horns.

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- ▶ I made this example a bit easier in my censored article
- ▶ 1. All animals have two horns.
- ▶ 2. A rabbit is an animal.

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- ▶ I made this example a bit easier in my censored article
- ▶ 1. All animals have two horns.
- ▶ 2. A rabbit is an animal.
- ▶ 3. Therefore, a rabbit has to horns.

- ▶ I made this example a bit easier in my censored article
- ▶ 1. All animals have two horns.
- ▶ 2. A rabbit is an animal.
- ▶ 3. Therefore, a rabbit has two horns.
- ▶ This is a valid example of logical reasoning, but the conclusion is false.

- ▶ We know that the starting point is false: there are animals who don't have two horns, for instance, a rabbit.

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- ▶ We know that the starting point is false: there are animals who don't have two horns, for instance, a rabbit.
- ▶ But there is no way to know this in anti-empirical formal math,

- ▶ We know that the starting point is false: there are animals who don't have two horns, for instance, a rabbit.
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- ▶ just as there is no way to know way school students can know the properties of an invisible geometric point.

- ▶ We know that the starting point is false: there are animals who don't have two horns, for instance, a rabbit.
- ▶ But there is no way to know this in anti-empirical formal math,
- ▶ just as there is no way to know way school students can know the properties of an invisible geometric point.
- ▶ Since formal math starts with a metaphysics of infinity (set theory) which assumptions cannot be empirically tested.

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Concrete examples: calculus and Newtonian physics

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**Concrete
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- ▶ Today we hear that Newton and Leibniz invented calculus

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examples:
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- ▶ Today we hear that Newton and Leibniz invented calculus
- ▶ and teach that formal real numbers are needed to do calculus.

- ▶ Today we hear that Newton and Leibniz invented calculus
- ▶ and teach that formal real numbers are needed to do calculus.
- ▶ Both propositions are false.

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- ▶ Formal real numbers involve a metaphysics of infinity.

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examples:
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- ▶ Formal real numbers involve a metaphysics of infinity.
- ▶ No one can write down even a single formal real number such as $\sqrt{2}$ **exactly**,

- ▶ Formal real numbers involve a metaphysics of infinity.
- ▶ No one can write down even a single formal real number such as $\sqrt{2}$ **exactly**,
- ▶ because it involves a non-repeating, non-terminating (infinite) series.

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- ▶ In India calculus arose as normal math (*gaṇita*) in 5th c. for the numerical solution of difference equations

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- ▶ to calculate precise trigonometric values.

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- ▶ In India calculus arose as normal math (*gaṇita*) in 5th c. for the numerical solution of difference equations
- ▶ to calculate precise trigonometric values.
- ▶ Developed over a thousand year period.

Madhava's sine table

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श्रेष्ठं नाम वरिष्ठानां हिमाद्रिर्वेदभावनः ।

तपनो भानुसूक्तज्ञो मध्यमं विद्धि दोहनम् ॥

धिगाज्यो नाशनं कष्टं छन्नभोगाशयाम्बिका ।

म्रिगाहारो नरेशोऽयं वीरो रणजयोत्सुकः ॥

...

छायालयो गजो नीलो निर्मलो नास्ति सत्कुले ।

रात्रौ दर्पणमभ्राङ्गं नागस्तुङ्गनखो बली ॥

धीरो युवा कथालोलः पूज्यो नारीजनैर्भगः ।

कन्यागारे नागवल्ली देवो विश्वस्थली भृगुः ॥

तत्परादिकलान्तास्तु महाज्या माधवोदिताः ।

स्वस्वपूर्वविशुद्धे तु शिष्टास्तत्खण्डमौर्विकाः ॥ २.९.५ ॥

Table: Mādhava's sine values

No.	Kaṭapayādi	kalā (')	vikalā('')	tatparā('''')
1	श्रेष्ठं नाम वरिष्ठानां	224	50	22
2	हिमाद्रिर्वेदभावनः	448	42	58
3	तपनो भानुसूक्तज्ञो	670	40	16
4	मध्यमं विद्धि दोहनम्	889	45	15
...
21	धीरो युवा कथालोलः	3371	41	29
22	पूज्यो नारीजनैर्भगः	3408	20	11
23	कन्यागारे नागवल्ली	3430	23	11
24	देवो विश्वस्थली भृगुः	3437	44	48

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Accuracy of Madhava's sine values

Table: Accuracy of Mādhava's sine table.

No.	Mādhava's sine value	Difference
1	0.0654031452	0.0000000160
2	0.1305262297	0.0000000375
3	0.1950903240	0.0000000020
4	0.2588190035	-0.0000000416
...
...
21	0.9807852980	0.0000000176
22	0.9914448967	0.0000000353
23	0.9978589819	0.0000000587
24	1.0000000000	0.0000000000

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- ▶ Precise trigonometric values were badly needed to solve the European navigational problem

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- ▶ Precise trigonometric values were badly needed to solve the European navigational problem
- ▶ to determine latitude, longitude, and loxodromes.

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Concrete
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- ▶ European dreams of wealth depended on overseas “trade” (piracy)

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- ▶ Precise trigonometric values were badly needed to solve the European navigational problem
- ▶ to determine latitude, longitude, and loxodromes.
- ▶ European dreams of wealth depended on overseas “trade” (piracy)
- ▶ So, this was the biggest scientific challenge in Europe
- ▶ and one for which European governments offered large rewards from 1530 to 1760 CE.

- ▶ Jesuits based in their Cochin college translated and stole these texts in the 16th c.

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- ▶ Jesuits based in their Cochin college translated and stole these texts in the 16th c.
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- ▶ (Such theft followed by self-glorification a cultural characteristic of the West.)
- ▶ Eventually, calculus was credited to Newton and Leibniz, on the doctrine of Christian discovery.

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Redundant metaphysics

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- ▶ Practical applications of calculus (sending a rocket to moon) still involve the numerical solution of differential equations as done by Āryabhaṭa.

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Concrete
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- ▶ Today done on a computer, which **cannot** use formal real numbers.

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- ▶ Practical applications of calculus (sending a rocket to moon) still involve the numerical solution of differential equations as done by Āryabhaṭa.
- ▶ Today done on a computer, which **cannot** use formal real numbers.
- ▶ Uses floating point numbers, for which even the associative law for addition fails.

Sum of infinite geometric series

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- ▶ Sum of infinite geometric series Given by 15th c. Nīlakanṭha in his commentary on *Āryabhaṭīya* (Ganita 22)

एवं यस्तुल्यच्छेदपरभागपरम्पराया अनन्ताया अपि संयोगः
तस्यानन्तानामपि कल्प्यमानस्य योगस्याद्यावयविनः
परम्परांशच्छेदादेकोनच्छेदांशसाम्यं सर्वत्रापि समानमेव ।

which may be translated:⁷⁵

The sum of an infinite [*anantya*] series, whose later terms (after the first) are got by dividing the preceding one by the same divisor everywhere, is equal to the first term divided by one less than the common divisor.

Non-universal metaphysics

- ▶ The Western metaphysics of formal real numbers is NOT universal.

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Non-universal metaphysics

- ▶ The Western metaphysics of formal real numbers is NOT universal.
- ▶ In India such infinite series were summed with “non-Archimedean” arithmetic

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Non-universal metaphysics

- ▶ The Western metaphysics of formal real numbers is NOT universal.
- ▶ In India such infinite series were summed with “non-Archimedean” arithmetic
- ▶ which arose naturally from 7th c. CE Brahmagupta’s *avyakt gaṇit* (unexpressed numbers, polynomials, algebra)

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- ▶ which naturally led to unexpressed fractions (rational functions)
- ▶ which formally constitute a non-Archimedean field
- ▶ (which has infinitely large and infinitesimally small numbers)

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- ▶ which naturally led to unexpressed fractions (rational functions)
- ▶ which formally constitute a non-Archimedean field
- ▶ (which has infinitely large and infinitesimally small numbers)
- ▶ analogue of limits obtained by discarding infinitesimals.

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- ▶ So, what difference does that make to science?

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- ▶ So, what difference does that make to science?
- ▶ A student who copies does not fully understand what he copies.

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- ▶ So, what difference does that make to science?
- ▶ A student who copies does not fully understand what he copies.
- ▶ Because Europeans stole calculus they did not understand it properly.

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- ▶ Europeans were puzzled by Indian infinite series

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- ▶ such as the “Leibniz” series for π .

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- ▶ So, what difference does that make to science?
- ▶ A student who copies does not fully understand what he copies.
- ▶ Because Europeans stole calculus they did not understand it properly.
- ▶ Europeans were puzzled by Indian infinite series
- ▶ such as the “Leibniz” series for π .
- ▶ Descartes declared it beyond the human mind to carry out an infinite sum (he thought of summing it physically).

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- ▶ Newton's answer was **fluxions**

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- ▶ Newton's answer was **fluxions**
- ▶ which involves a confused concept of time itself flowing.

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- ▶ As made clear by "McTaggart's" paradox

- ▶ Newton's answer was **fluxions**
- ▶ which involves a confused concept of time itself flowing.
- ▶ As made clear by "McTaggart's" paradox
- ▶ which steals the arguments of 9th c. Śrīharṣa's *Khaṇḍanakhaṇḍakhādyā*.

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- ▶ Newton thought he could make calculus “perfect”

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- ▶ Newton thought he could make calculus “perfect”
- ▶ by making time flow with an “even tenor”

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**Concrete
examples:
calculus and
Newtonian
physics**

- ▶ Newton thought he could make calculus “perfect”
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- ▶ In the process he made time metaphysical.

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- ▶ “absolute, true and mathematical time, flows on without regard to anything external”

- ▶ Newton thought he could make calculus “perfect”
- ▶ by making time flow with an “even tenor”
- ▶ In the process he made time metaphysical.
- ▶ “absolute, true and mathematical time, flows on without regard to anything external”
- ▶ Four adjectives to emphasize that time is metaphysical.

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**Concrete
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- ▶ Metaphysical time cannot be measured.

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**Concrete
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- ▶ Metaphysical time cannot be measured.
- ▶ But to do physics we need to measure time.

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- ▶ But to do physics we need to measure time.
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Concrete
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- ▶ Metaphysical time cannot be measured.
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- ▶ Metaphysical time cannot be measured.
- ▶ But to do physics we need to measure time.
- ▶ Poincaré's theory of relativity resolved the problem of time measurement in Newtonian physics
- ▶ by defining the speed of light as a constant.
- ▶ But this changes Newton's laws of motion.

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**Concrete
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- ▶ Newton's laws of motion and law of gravitation come as a package deal.

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**Concrete
examples:
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- ▶ Newton's laws of motion and law of gravitation come as a package deal.
- ▶ Neither is individually refutable.

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Concrete
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- ▶ Newton's laws of motion and law of gravitation come as a package deal.
- ▶ Neither is individually refutable.
- ▶ Therefore, Newtonian gravitation too must be modified.

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Concrete
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- ▶ Newton's laws of motion and law of gravitation come as a package deal.
- ▶ Neither is individually refutable.
- ▶ Therefore, Newtonian gravitation too must be modified.
- ▶ Minimum change is my retarded gravitation theory (RGT) not General Relativity Theory (GRT).

Retarded Gravitation Theory

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**Concrete
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- ▶ We seek an expression for the 4-force F in the simple form

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- ▶ We seek an expression for the 4-force F in the simple form



$$F = aX + bV$$

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- ▶ We seek an expression for the 4-force F in the simple form



$$F = aX + bV$$

- ▶ where a , b , are Lorentz invariants

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- ▶ X = retarded 4-position

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- ▶ where a , b , are Lorentz invariants
- ▶ X = retarded 4-position
- ▶ V = retarded 4-velocity

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- ▶ We seek an expression for the 4-force F in the simple form



$$F = aX + bV$$

- ▶ where a , b , are Lorentz invariants
- ▶ X = retarded 4-position
- ▶ V = retarded 4-velocity
- ▶ of “attracting” body (“attracted” body at origin).

- ▶ A simple calculation shows that the 4-force

$$F = -\frac{kc^3}{(X.V)^3}X + \frac{kc^3}{(X.V)^3} \frac{(X.U)}{(V.U)}V.$$

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- ▶ $k = Gm_1m_2$, m_1 , m_2 = rest masses,
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- ▶ $k = Gm_1m_2$, m_1 , m_2 = rest masses,
- ▶ c = speed of light,
- ▶ X , V as before,
- ▶ U = 4 velocity of “attracted” particle.

Non-relativistic approximation

- ▶ In the non-relativistic approximation

$$F \approx \frac{Gm_1m_2}{r^2} \left(\frac{X}{r} + \frac{V}{c} \right),$$

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Non-relativistic approximation

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$$F \approx \frac{Gm_1m_2}{r^2} \left(\frac{X}{r} + \frac{V}{c} \right),$$

- ▶ Thus, the RGT gravitational force

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Non-relativistic approximation

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 - ▶ depends on **retarded position** (not instantaneous position)

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Concrete examples: calculus and Newtonian physics

Non-relativistic approximation

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 - ▶ is **velocity dependent** (not pure position dependent inverse square law)

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Non-relativistic approximation

- ▶ In the non-relativistic approximation

$$F \approx \frac{Gm_1m_2}{r^2} \left(\frac{X}{r} + \frac{V}{c} \right),$$

- ▶ Thus, the RGT gravitational force
 - ▶ depends on **retarded position** (not instantaneous position)
 - ▶ is **velocity dependent** (not pure position dependent inverse square law)
- ▶ Lorentz covariance needed to measure time. A Lorentz covariant force cannot be purely position dependent.

NASA flyby anomaly

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**Concrete
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- ▶ Because of velocity dependence of RGT force, we expect

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**Concrete
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- ▶ Because of velocity dependence of RGT force, we expect
- ▶ rotation of earth will affect spacecraft trajectories as a $\frac{v}{c}$ effect.

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Concrete
examples:
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- ▶ Because of velocity dependence of RGT force, we expect
- ▶ rotation of earth will affect spacecraft trajectories as a $\frac{v}{c}$ effect.
- ▶ On Newtonian gravitation, earth rotation does not affect gravitational force.

NASA flyby anomaly

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Concrete
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- ▶ Because of velocity dependence of RGT force, we expect
- ▶ rotation of earth will affect spacecraft trajectories as a $\frac{v}{c}$ effect.
- ▶ On Newtonian gravitation, earth rotation does not affect gravitational force.
- ▶ This effect observed. Called NASA flyby anomaly.

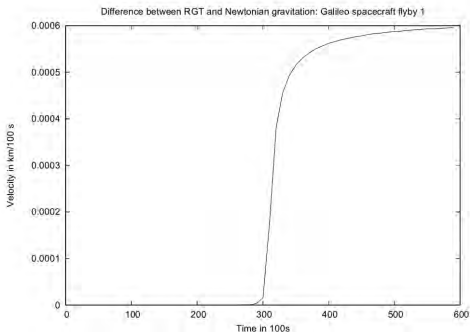


Figure: Galileo. The difference in the velocity between the solutions obtained using the new velocity-dependent RGT force and the Newtonian force, for the first flyby of the Galileo spacecraft. The x -axis is time (in units of 100 s) and the y -axis is difference of (scalar) velocity in units of km per 100 s.

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Concrete examples: calculus and Newtonian physics

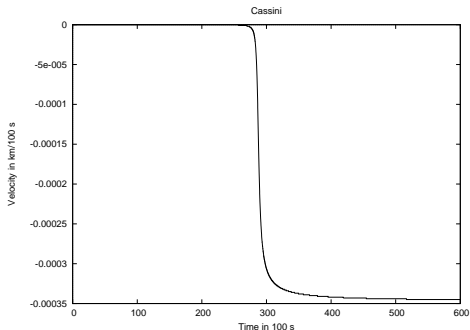


Figure: Cassini. The difference in the velocity between the solutions obtained using the new velocity-dependent RGT force and the Newtonian force for the earth flyby of the Cassini spacecraft. Same units as before. The calculated change in velocity is -3.4 mm/s compared to the reported change of -2 mm/s.

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Further tests

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- ▶ Theory can be further tested by using two satellites

Further tests

- ▶ Theory can be further tested by using two satellites
- ▶ one co-rotating with earth, and the other counter-rotating.

Further tests

- ▶ Newton's "universal" law of gravitation fails beyond the solar system

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Further tests

- ▶ Newton's "universal" law of gravitation fails beyond the solar system
- ▶ for the galaxy (ours and others)

Galactic rotation curves

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**Concrete
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- ▶ If v_r is the velocity of a star at distance r from the galactic centre then

Galactic rotation curves

- ▶ If v_r is the velocity of a star at distance r from the galactic centre then
- ▶ on Newtonian gravitation $v_r \propto \frac{1}{\sqrt{r}}$

Galactic rotation curves

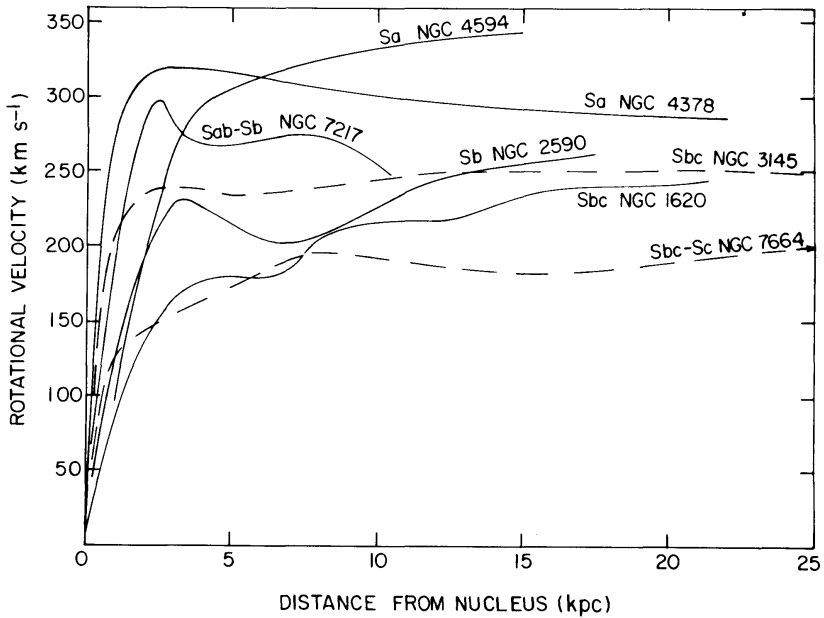
- ▶ If v_r is the velocity of a star at distance r from the galactic centre then
- ▶ on Newtonian gravitation $v_r \propto \frac{1}{\sqrt{r}}$
- ▶ accurately holds for solar system.

Galactic rotation curves

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- ▶ But in spiral galaxies v_r **increases** with r

Galactic rotation curves

- ▶ If v_r is the velocity of a star at distance r from the galactic centre then
- ▶ on Newtonian gravitation $v_r \propto \frac{1}{\sqrt{r}}$
- ▶ accurately holds for solar system.
- ▶ But in spiral galaxies v_r **increases** with r
- ▶ then becomes **approximately constant**.



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**Concrete
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- ▶ This failure attributed to “dark matter”

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**Concrete
examples:
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- ▶ This failure attributed to “dark matter”
- ▶ distributed like a halo around the galaxy

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**Concrete
examples:
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- ▶ This failure attributed to “dark matter”
- ▶ distributed like a halo around the galaxy
- ▶ not found in 50 years.

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**Concrete
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physics**

- ▶ This failure attributed to “dark matter”
- ▶ distributed like a halo around the galaxy
- ▶ not found in 50 years.
- ▶ Typical piling on of hypotheses.

Universality?

- ▶ As this example shows

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Universality?

- ▶ As this example shows
- ▶ the claim of the “universality” of science

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Universality?

- ▶ As this example shows
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- ▶ is pompous and bogus.

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Universality?

- ▶ As this example shows
- ▶ the claim of the “universality” of science
- ▶ is pompous and bogus.
- ▶ The universe is vast, only a tiny part is open to our observation.

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Universality?

- ▶ As this example shows
- ▶ the claim of the “universality” of science
- ▶ is pompous and bogus.
- ▶ The universe is vast, only a tiny part is open to our observation.
- ▶ At best we can build fallible models.

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Laws of nature

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Concrete
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- ▶ This pompous belief in universality originates with the church dogma ²

²Aquinas, *Summa Theologica*, first part of the second part, 91, 1 

Laws of nature

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Concrete
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- ▶ This pompous belief in universality originates with the church dogma ²
- ▶ that God rules the world with eternal laws of nature.

²Aquinas, *Summa Theologica*, first part of the second part, 91, 1 


Laws of nature

- ▶ This pompous belief in universality originates with the church dogma ²
- ▶ that God rules the world with eternal laws of nature.
- ▶ Hence, we teach Newton's "laws" as the first lesson in science,

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Laws of nature

- ▶ This pompous belief in universality originates with the church dogma ²
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Laws of nature

- ▶ This pompous belief in universality originates with the church dogma ²
- ▶ that God rules the world with eternal laws of nature.
- ▶ Hence, we teach Newton's "laws" as the first lesson in science,
- ▶ though they failed a century ago,
- ▶ due to conceptual confusion about calculus.

²Aquinas, *Summa Theologica*, first part of the second part, 91, 1 

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- ▶ This has important political repercussions.

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- ▶ This has important political repercussions.
- ▶ Muslims are accused of being anti-science

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**Concrete
examples:
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- ▶ This has important political repercussions.
- ▶ Muslims are accused of being anti-science
- ▶ on the grounds that they don't believe in "laws of nature"