Cosmology & Antarctica 🦭 2024

Cosmologica24 – agenda & inclusive discussion

ein Wendepunkt der Geschichte

To view links, download the PDF — do not view in browser.

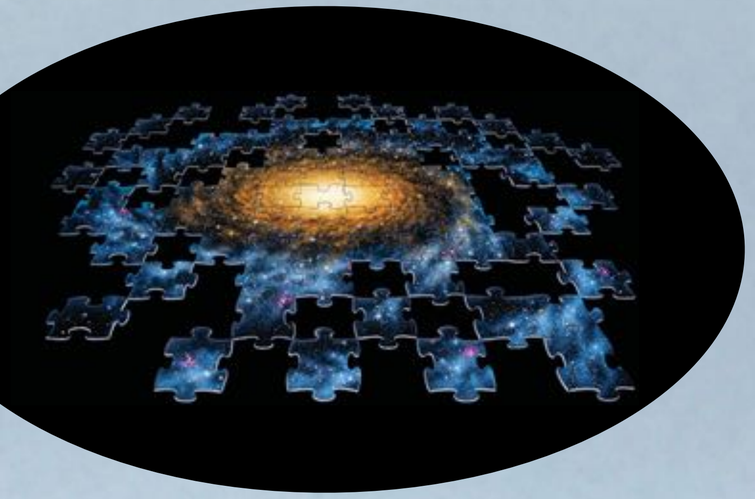

photo credit:
Alexander F Mayer (25 Feb 2024)
Fish Island, Antarctica (66° 01' S , 065° 26' W)
Apple iPhone 15 Pro Max – Telephoto Camera
ISO 50 491 mm ƒ/2.8 1/990 s

Adélie Penguins.

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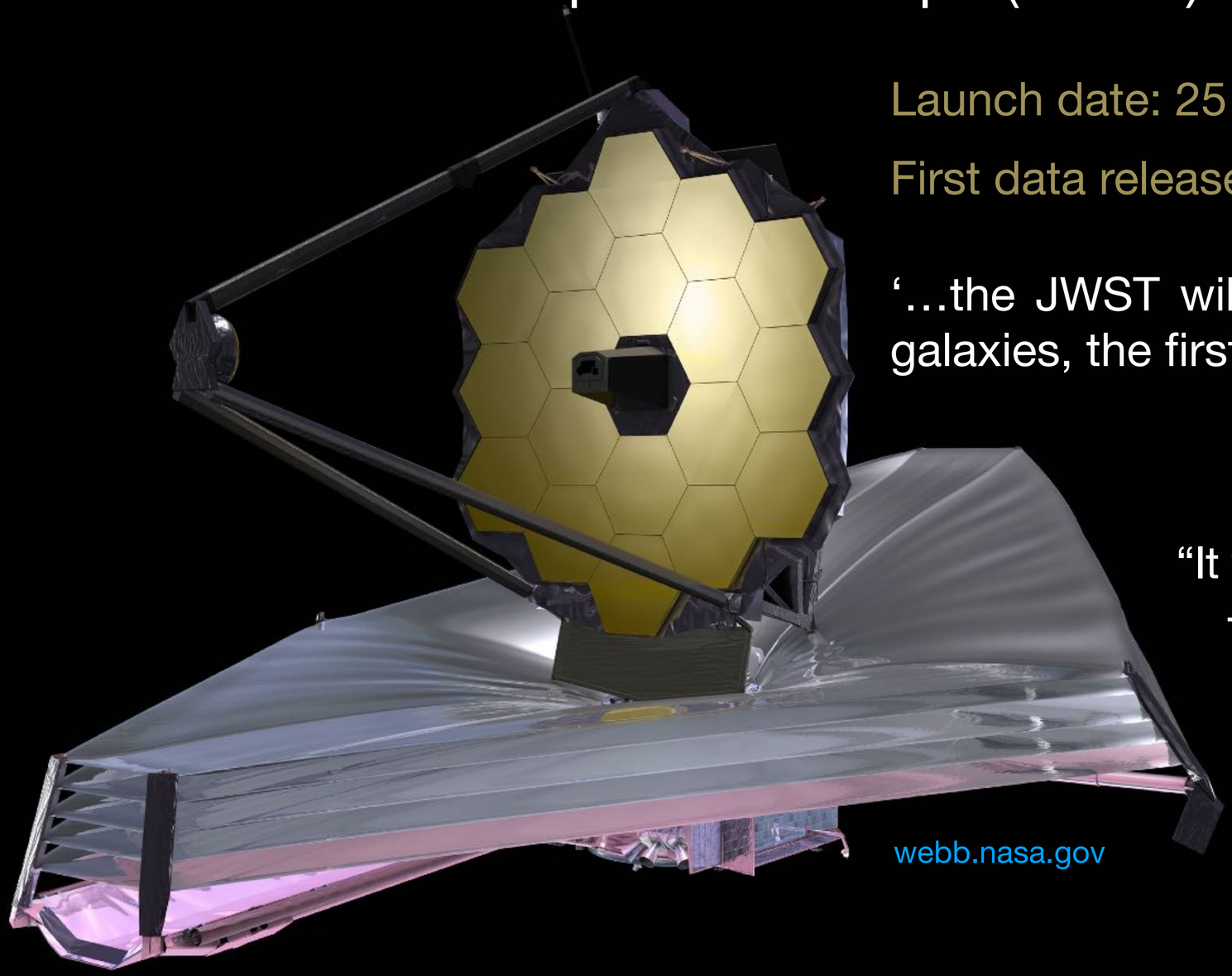
James Webb Space Telescope (*JWST*)



Launch date: 25 Dec 2021

First data release: 2 July 2022

'…the JWST will have the capability to study "baby" galaxies, the first galaxies that formed in the Universe.'
– esa potw1819a (7 May 2018)

"It will be an explosion of new knowledge."
– Prof. Jacob Bean, Univ. of Chicago

webb.nasa.gov

Image credit: NASA (Artist Impression)

Throughout this presentation:

Internet links appear in light blue.

Focal points appear in **magenta.**

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SCIENTIFIC AMERICAN®

ASTRONOMY

JWST Discovers Enormous Distant Galaxies That Should Not Exist

JWST has discovered giant mature galaxies that seem to have filled the universe shortly after the big bang, and astronomers are puzzled

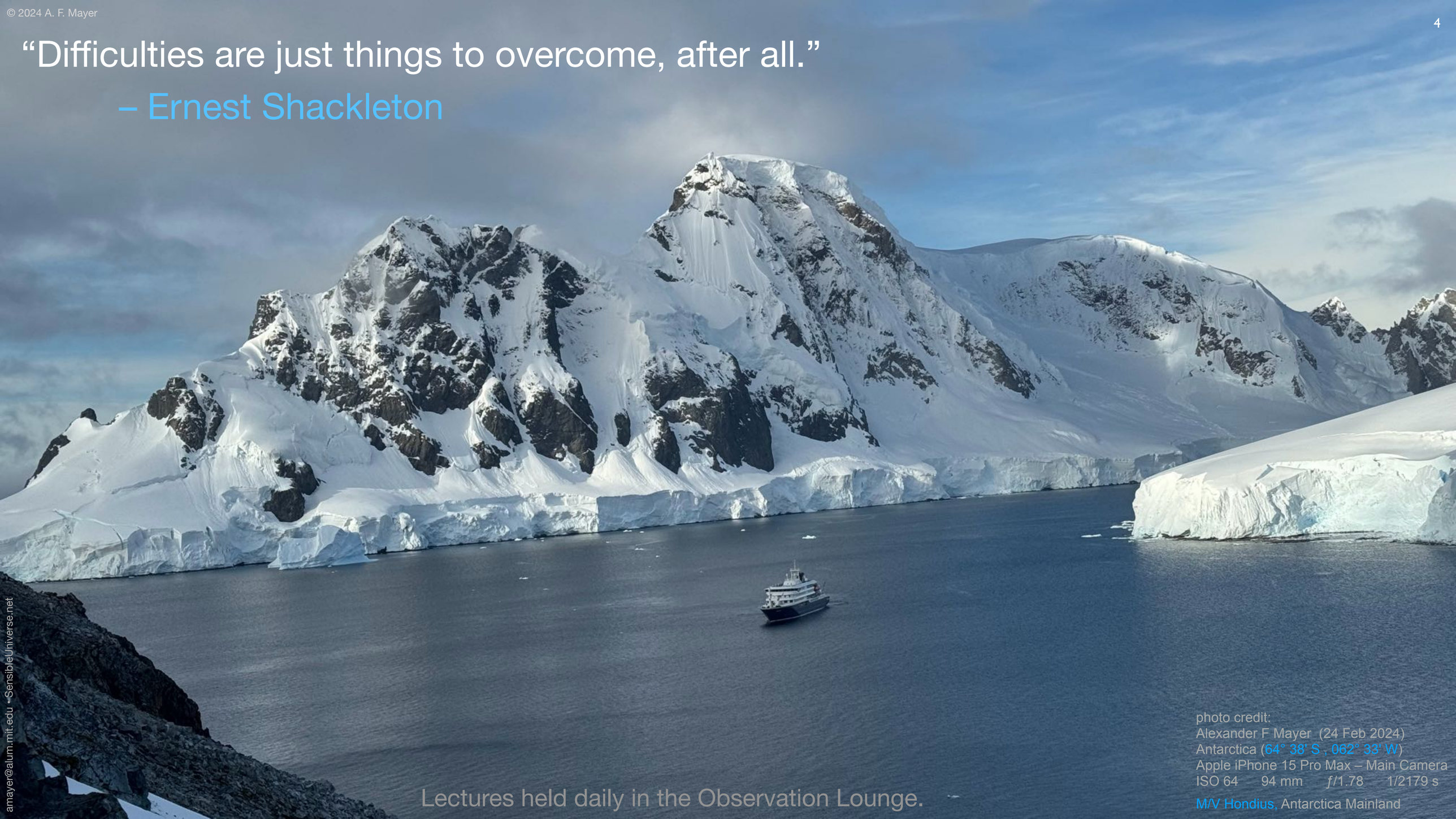
By Tereza Pultarova, SPACE.com on February 23, 2023

Nobody expected them. They were not supposed to be there. And now, nobody can explain how they had formed.

Galaxies nearly as massive as the Milky Way and full of mature red stars seem to be dispersed in deep field images obtained by the James Webb Space Telescope (Webb or JWST) during its early observation campaign, and they are giving astronomers a headache.

“Difficulties are just things to overcome, after all.”

– Ernest Shackleton



Lectures held daily in the Observation Lounge.

photo credit:
Alexander F Mayer (24 Feb 2024)
Antarctica (64° 38' S , 062° 33' W)
Apple iPhone 15 Pro Max – Main Camera
ISO 64 94 mm ƒ/1.78 1/2179 s

M/V Hondius, Antarctica Mainland

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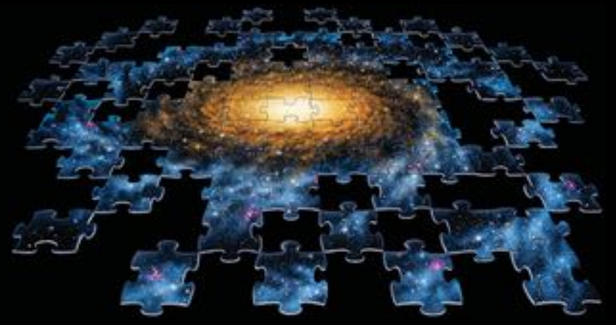
This preliminary talk is aimed at a mixed audience of *topic experts*, as well as a *general technical audience* familiar with interpreting graphs in mathematics, engineering, chemistry, biology, & medicine.
Confronting predictive models with empirical data initiates on p. 31.

It is established beyond doubt that the answer to the following is *YES*:
*New JWST Results: Is the Current Tension in H_0 Signaling New Physics**
– Wendy L Freedman, Univ. Chicago, APS April Meeting (6 April 2024)

* This work is based in part on observations made with the NASA/ESA/CSA James Webb Space Telescope. These observations are associated with JWST program GO-1995.

"Physics is the law; everything else is a recommendation." – Elon Musk (X)



extrasolar.spaceart.org

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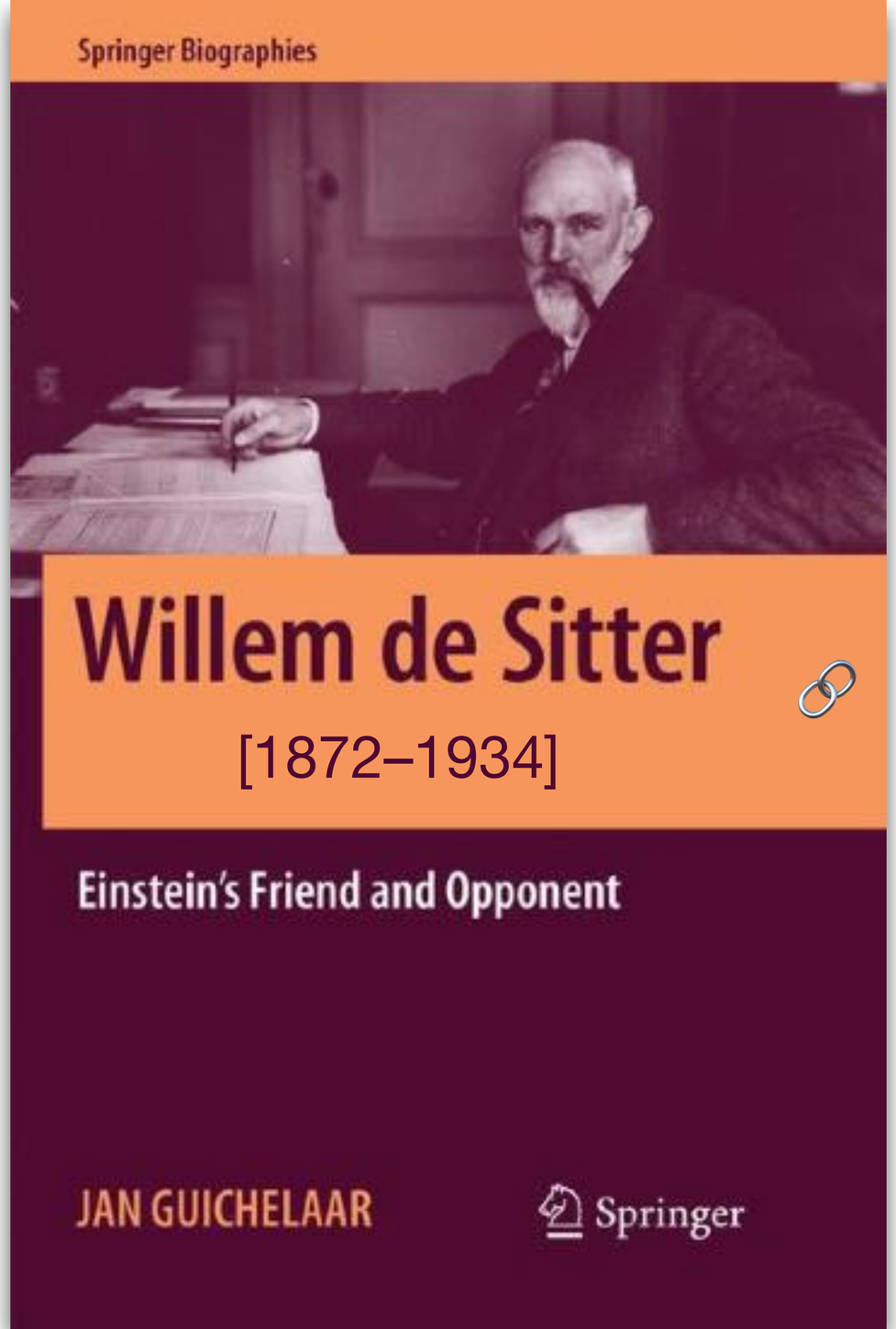
v 2024-10-09-03z

dynamic PDF version check

World-Class Mathematical Physicist
&
Director of the Leiden Observatory

NETHERLANDS

Einstein and Willem de Sitter established the field of cosmology, which was then led astray by *pathological science* for nearly a century. Herein, de Sitter re-emerges as being among the most significant scientific minds in history.



Linked graphic

We will present some equations, so let us be clear how to react to that…

If one is not literate in Chinese, one cannot read this; thanks to Google Translate, we learn that these two characters mean “*Foreign Language*”.

> Pure mathematics is, in its way, the poetry of logical ideas.
>
> – Albert Einstein (1935)

外語

For most people, sophisticated mathematical equations are just as cryptic as these wonderful Chinese characters — *all that is needed is a translation*…

If one is not literate in differential geometry, specifically in the context of Einstein's General Theory of Relativity (GR), one similarly cannot read this; one needs a translation because the maths is a foreign language. Today, no astronomer possesses de Sitter's preeminent proficiency with the mathematics of GR; in practice, they also rely on such translations.

$$G_{\mu\nu} + \Lambda g_{\mu\nu} = \kappa T_{\mu\nu}$$

This is the compact form of the Einstein Field Equations (EFE); translation:
"Spacetime tells matter how to move; matter tells spacetime how to curve."
Basically, this cryptic equation describes **THE GEOMETRY OF GRAVITY**.
It has yielded a number of accurate predictions, and GPS depends on it.

Quote: John Archibald Wheeler, *Geons, Black Holes and Quantum Foam: A Life in Physics*

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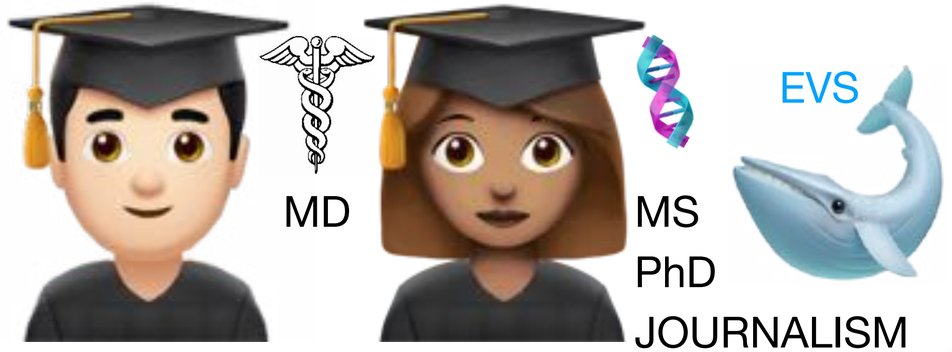
$$\mathrm{d}s^2 = -\,\mathrm{d}t^2 + a^2(t)\left[\frac{\mathrm{d}r^2}{1-kr^2} + r^2\underbrace{\left(\mathrm{d}\theta^2 + \sin^2\theta d\phi^2\right)}_{\theta\text{-}\phi\ \textit{Physics}\ \text{convention}}\right]$$

'Now': $a = 1$

$t \sim 13.7$ Gyr

as per ISO-8000-2-17.3 (2019)

This one is the [Friedmann-Lemaître-]Robertson-Walker metric; translation: **"The Universe is expanding."** Going back in time ($t \to 0$), space containing ~10^{12} galaxies contracts ($a \to 0$), theoretically to smaller than a proton; it is possible for formulas to be *Ptolemaic*, making *illogical* ideas seem credible.



MD

MS
PhD
JOURNALISM
MBA
JD

EVS

Refresher!

For most, such maths were never used in professional life, and for some, equations are like 外語 🙄

.

$$a^2 + b^2 = c^2$$

Euclidean [flat-space] “metric”
(i.e., a *distance* measurement)

$$\sin\theta = \frac{b}{c} \quad \frac{\text{opposite}}{\text{hypotenuse}}$$

For some majors, this is 🍰

MATHEMATICS • PHYSICS • ASTRONOMY • ENGINEERING

$$\cos\theta = \frac{a}{c} \quad \frac{\text{adjacent}}{\text{hypotenuse}}$$

The EFE are not practically useful, per se; it is ***solutions* to the EFE** that are practically useful, meaning that they **produce accurate predictions of measurable physical phenomena**. Here is one exact solution, a metric that calculates a kind of cosmic 'distance' using "spherical coordinates". For many, this is unintelligible mathematics, so we will need a translation…

space part

time part

$$\mathrm{d}s^2 = -\mathrm{d}r^2 - R^2 \sin^2\left(\frac{r}{R}\right)\left[\mathrm{d}\psi^2 + \sin^2(\psi)\,\mathrm{d}\theta^2\right] + c^2\mathrm{d}t^2$$

① ②

③

Note that this is an angle, so in there are **3 angles** in the space coordinates.

ψ-θ *Mathematics* convention, as per de Sitter's papers

Experts, you know the basics; feel free to jump ahead to page 12.

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- First, the d means "differential", an infinitesimal change to sum.

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➤ In physics, c is the symbol for the *speed of light* (~3×10^8 m·s^{-1}).

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First, the d means "differential", an infinitesimal change to sum.

In physics, c is the symbol for the *speed of light* (~3×10^8 m·s^{-1}).

➤ The $\mathrm{d}s$ is a length; in relativity it is called a "spacetime interval".

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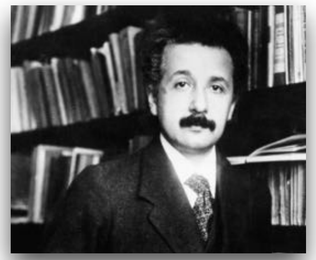

Incidentally, this initial solution was Einstein's, published in a 1917 paper that effectively gave birth to the field of cosmology.

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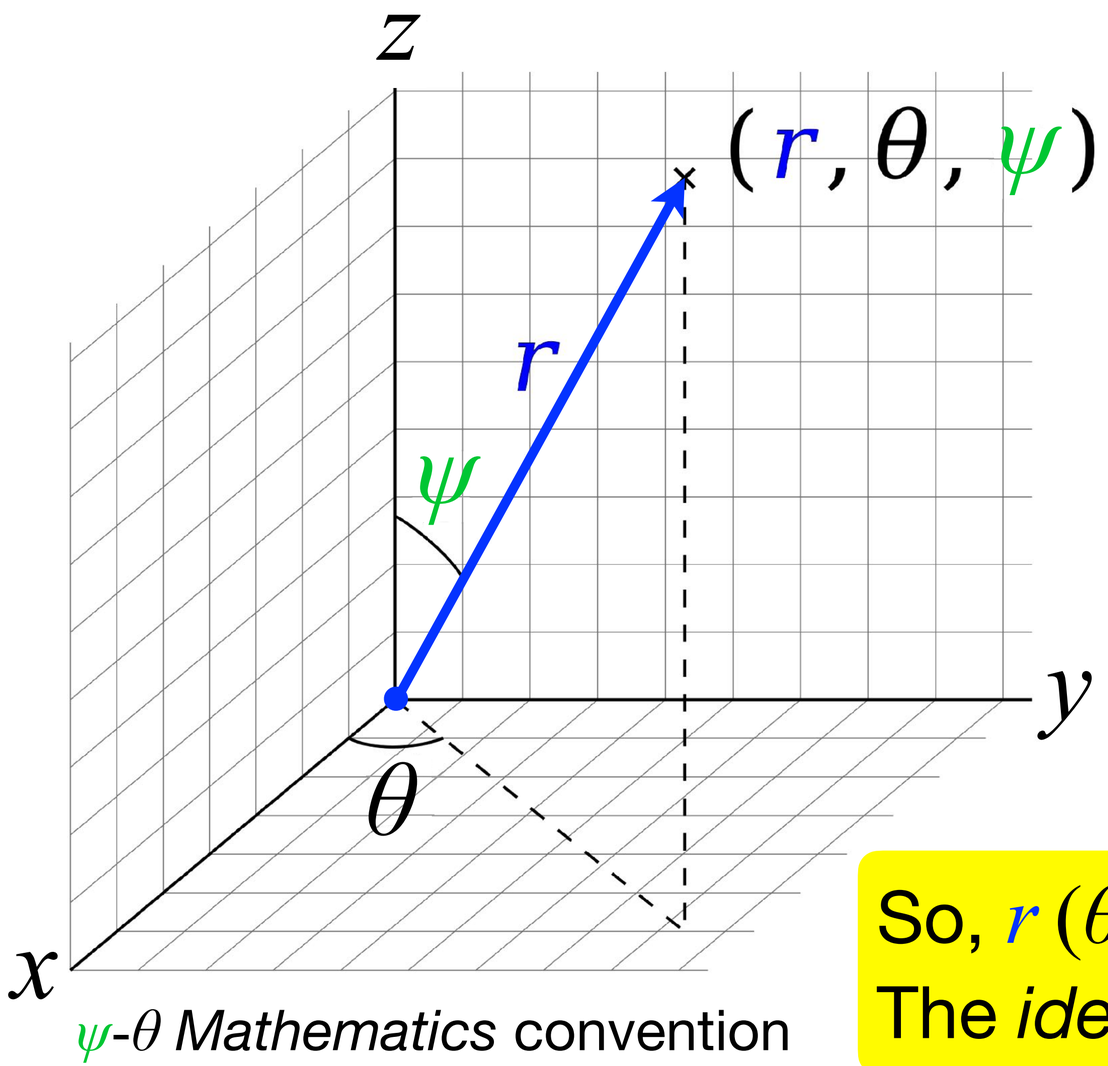
In the above formula, ignore time (just for now): $\mathrm{d}t = 0$

OK, let’s *translate*…

Instead of cartesian coordinates (x, y, z), spherical coordinates—
the r is an arbitrary radius from an origin in 3-dimensional space.



ψ-θ *Mathematics* convention

$$0 \le \theta \le 2\pi$$

$$0 \le \psi \le \pi$$

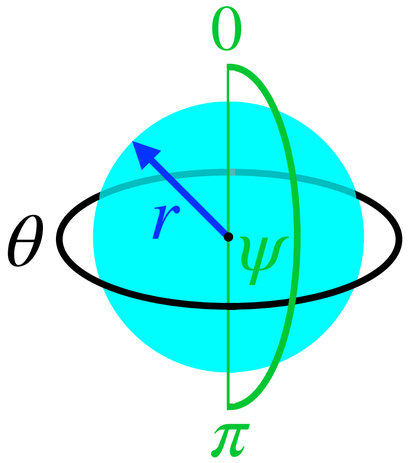
radians

$2\pi = 360°$

2pi

theta ~ longitude

psi ~ latitude



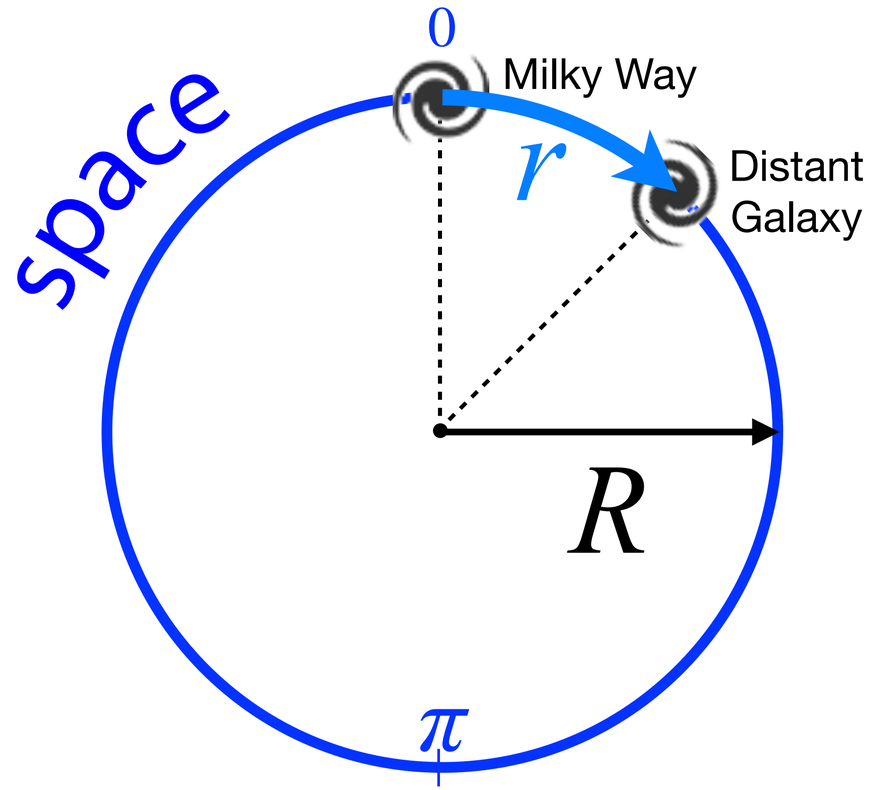
So, $r\ (\theta, 0)$ points *straight* in the z direction.
The *identical* r is shown on the next page…

Recall that there is also a big R in the equation; so, what does that mean?

It means that r is measured on the *surface* of a cosmic "3-sphere" (S^3) such that, regardless the direction in 3-dimensional (3D) space, progress in a '*straight line*' results in traversing a full circle of radius R, the effectual cosmic radius.

$$\angle\left(\frac{r}{R}\right)$$

The interpretation of the metric's 3rd *angle* is unambiguous.



▶ S^3 designates a *volumetric surface* of a 4D manifold.

The EFE tell us that cosmological space *must be* finite without boundary.

In topology, this is also known as a "compact manifold".

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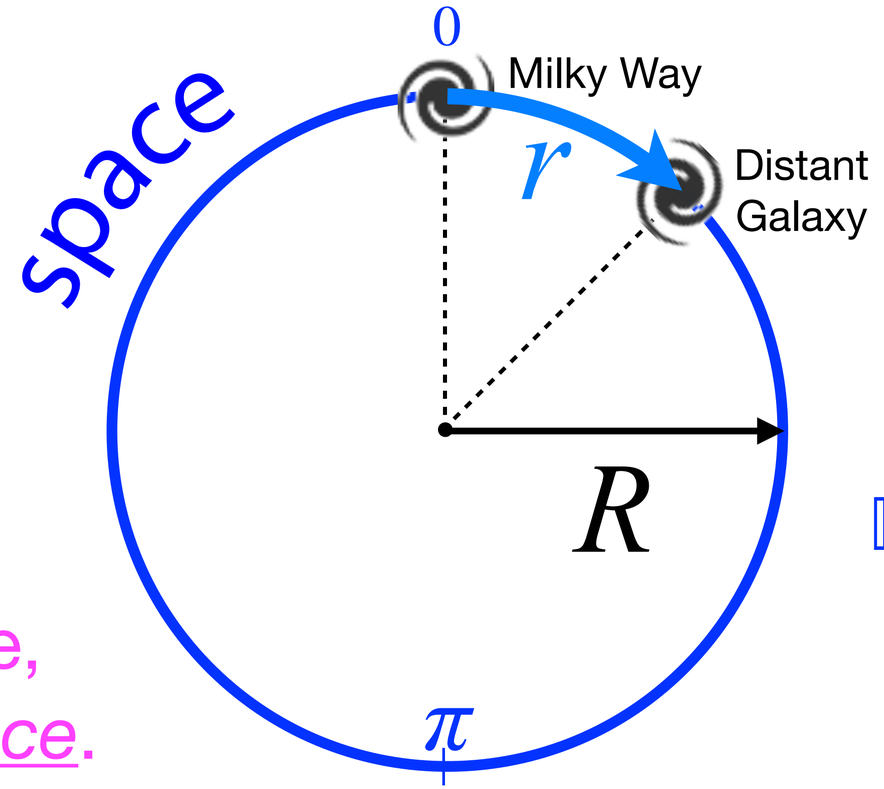
$$d\psi = d\theta = 0 :$$

2 space dimensions are not depicted; the circle solely denotes $\mathbb{R}^1$ of $\mathbb{R}^3$ dimensions.

$R \notin \mathbb{R}^3 ; R \perp \mathbb{R}^3 ; R \in \mathbb{R}^4$

R is not *physical* space, yet it has an *equivalence*.



► S^3 designates a *volumetric surface* of a 4D manifold.

$\mathbb{R}^3 \equiv$ 3D *physical* space (*measurable* in meters)

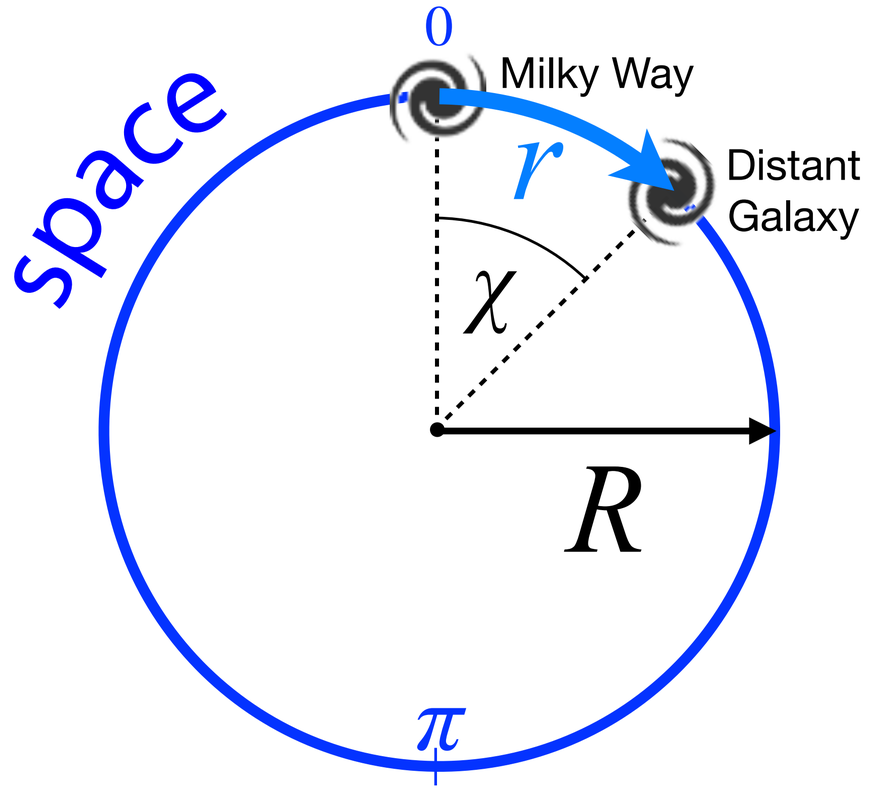
The EFE tell us that cosmological space *must be* finite without boundary.

In topology, this is also known as a "compact manifold".

Relative to the Milky Way galaxy, which is an arbitrary cosmic origin, every other galaxy has some *COSMIC ANGULAR COORDINATE*, χ.
This is similar to measuring distance in nautical miles (nm) because a 1-degree geodesic* (60′ great arc) in latitude is precisely 60 nm. ⚓

$$\underset{chi}{\chi} \equiv \left(\frac{r}{R}\right)$$

$$r = \chi R$$



A geodesic in $\mathbb{R}^3$ (r) is *defined* by the path of light in vacuum.

* A *geodesic* is a minimum-distance route, typically on a curved surface.

Model ("System") A

Einstein's metric —an exact solution of the Einstein field equations

A. Einstein, "Cosmological Considerations in the General Theory of Relativity", *SPAW*, 142 (1917).

$$\mathrm{d}s^2 = -\,\mathrm{d}r^2 - R^2 \sin^2\left(\frac{r}{R}\right)\left[\mathrm{d}\psi^2 + \sin^2(\psi)\,\mathrm{d}\theta^2\right] + c^2\mathrm{d}t^2$$

coordinate time

$c \equiv$ speed of light (~2.998×10^8 m·s^{-1})

$$\frac{\mathrm{m}^2}{\cancel{\mathrm{s}^2}} \cdot \cancel{\mathrm{s}^2} = \mathrm{m}^2$$

units of measure

As consistent units are required, coefficient c expresses time in meters; accordingly, 1m of time is equivalent to ~3.34ns (nanoseconds; 10^{-9} s).

Model ("System") A

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A. Einstein, "Cosmological Considerations in the General Theory of Relativity", *SPAW*, 142 (1917).

$d\psi = d\theta = 0$ simplifies to 1D space ($\mathbb{R}^1$).

$$ds^2 = -dr^2 \underbrace{- R^2 \sin^2\left(\frac{r}{R}\right)\left[d\psi^2 + \sin^2(\psi)\, d\theta^2\right]}_{\text{This equals } \textit{zero}.} + c^2 dt^2$$

coordinate time

$c \equiv$ speed of light (~2.998×10^8 m·s^{-1})

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units of measure

As consistent units are required, coefficient c expresses time in meters; accordingly, 1m of time is equivalent to ~3.34ns (nanoseconds; 10^{-9} s).

Scientists and mathematicians seek to eliminate weakness or inadequacy in an argument, similar to how predators thin populations of prey species…

Leopard seal, Antarctica

up to 3.5 m and 600 kg

photo credit:
Alexander F Mayer (27 Feb 2024)
Pleneau Island, Antarctica (65° 06' S , 064° 02' W)
GoPro 7 video frame (cropped)

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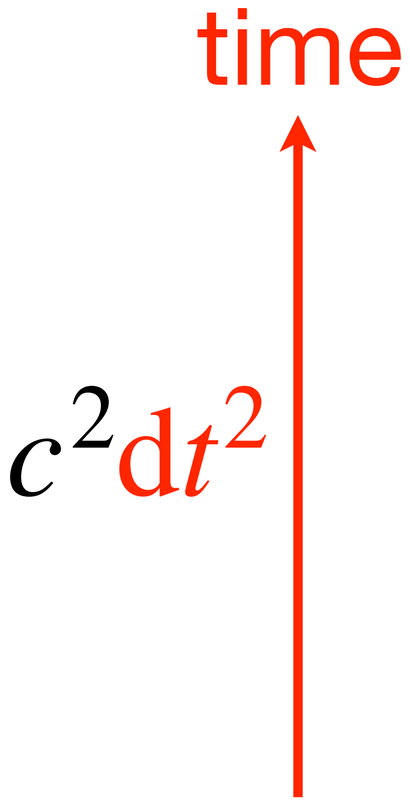
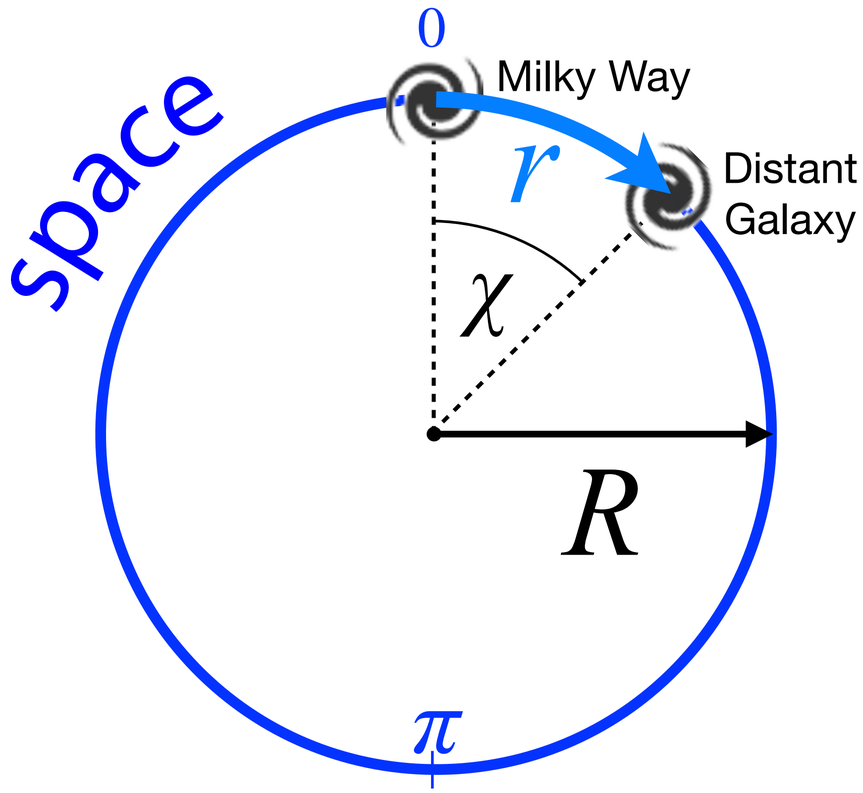
In Einstein's solution of the EFE, which produced a cosmological metric, the time coordinate (dimension) is *independent* of the space coordinates.



1-minute VIDEO



Diplomatically, Willem de Sitter found this to be "somewhat contradictory", actually pointing out a salient logical inconsistency requiring rectification…

Referencing Einstein's metric on p. 14, expressed using $x_4 \equiv t$

"We thus find that in the System A the time has a separate position. That this must be so, is evident a priori. For speaking of *the* three-dimensional world, if not equivalent to introducing an absolute time, at least implies the hypothesis that at each point of the four-dimensional space there is one absolute coordinate x_4 which is preferable to all others to be used as "time", and that at all points and always this one coordinate is actually chosen as time. Such a fundamental difference between the time and the space-coordinates seems to be somewhat contradictory to the complete symmetry of the field-equations…"

– Willem de Sitter (31 March 1917)

Note: modern notation uses $x_0 \equiv t$, where $(x_1 , x_2 , x_3) \equiv (x , y , z)$.

W. de Sitter, "On the relativity of inertia. Remarks concerning Einstein's latest hypothesis", *KNAW Proceedings* **19**(2), 1217 (1917).

Model B

Willem de Sitter's metric — a different exact solution of the EFE

W. de Sitter, "Einstein's theory of gravitation and its astronomical consequences. Third paper", *MNRAS* **78**, 3 (1917).

$$\mathrm{d}s^2 = -\,\mathrm{d}r^2 - R^2 \sin^2\left(\frac{r}{R}\right)\left[\mathrm{d}\psi^2 + \sin^2(\psi)\,\mathrm{d}\theta^2\right] + \cos^2\left(\frac{r}{R}\right) c^2 \mathrm{d}t^2$$

same angle, χ

Model B

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proper time @ r

$$\chi \equiv \frac{r}{R} \qquad \mathrm{d}\tau^2 = \cos^2(\chi)\,\mathrm{d}t^2 \qquad c^2\mathrm{d}\tau^2$$

There is now a distinction between the local-reference "*coordinate* time" ($\mathrm{d}t$) and the "*proper* time" ($\mathrm{d}\tau$) of a clock at a distance r from the observer.

Adapted from the French: "Mon propre temps" meaning "my own time".

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Pedantic controversy aside, Eqs. (1) and (2) can be interpreted to impose local orthogonality of the time coordinate with respect to space for any inertial reference frame. Rather than a mere mathematical abstraction, that is a *physical* interpretation, which is also consistent with the physical interpretation of de Sitter's metric (p. 20), having the *cosine* function in the temporal component.

$$(1)\ \mathrm{d}s^2 = -\,\mathrm{d}r^2 + c^2\mathrm{d}\tau^2 \qquad \left(\mathrm{d}\psi = \mathrm{d}\theta = 0\right)$$

Click me…

$$(2)\quad e^{i\phi} = \cos\phi + i\sin\phi$$
$$e^{i\frac{\pi}{2}} = i \quad , \quad e^{i\pi} = -1$$

This maths is intended for topic experts; if this is unfamiliar, don't worry about it.

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Click me…

$$(2)\quad e^{i\phi} = \cos\phi + i\sin\phi$$
$$e^{i\frac{\pi}{2}} = i \quad , \quad e^{i\pi} = -1$$

According to the principle of relativity, no absolute *physical interpretation* is permitted for the four distinct coordinates of $\mathbb{R}^4$ spacetime: Frame A is the spacial neighbourhood V of a point p in $\mathbb{R}^3$; the *time coordinate* $\mathbf{t}$ in A is the *local vertical to* V at p in $\mathbb{R}^4$. However, the *geometric object* $\mathbf{t}$ represents some abstract *geometric mixure of space and time* for a different frame B.

Similarly, $\bar{g}$ is a local distinction in $\mathbb{R}^3$ that is geometrically distinct for discrete points on Earth's S^2 surface.

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The time coordinate is *dependent* on the space coordinate; a distant clock ticks slower than a local ideal reference clock *exclusively* as a function of r.

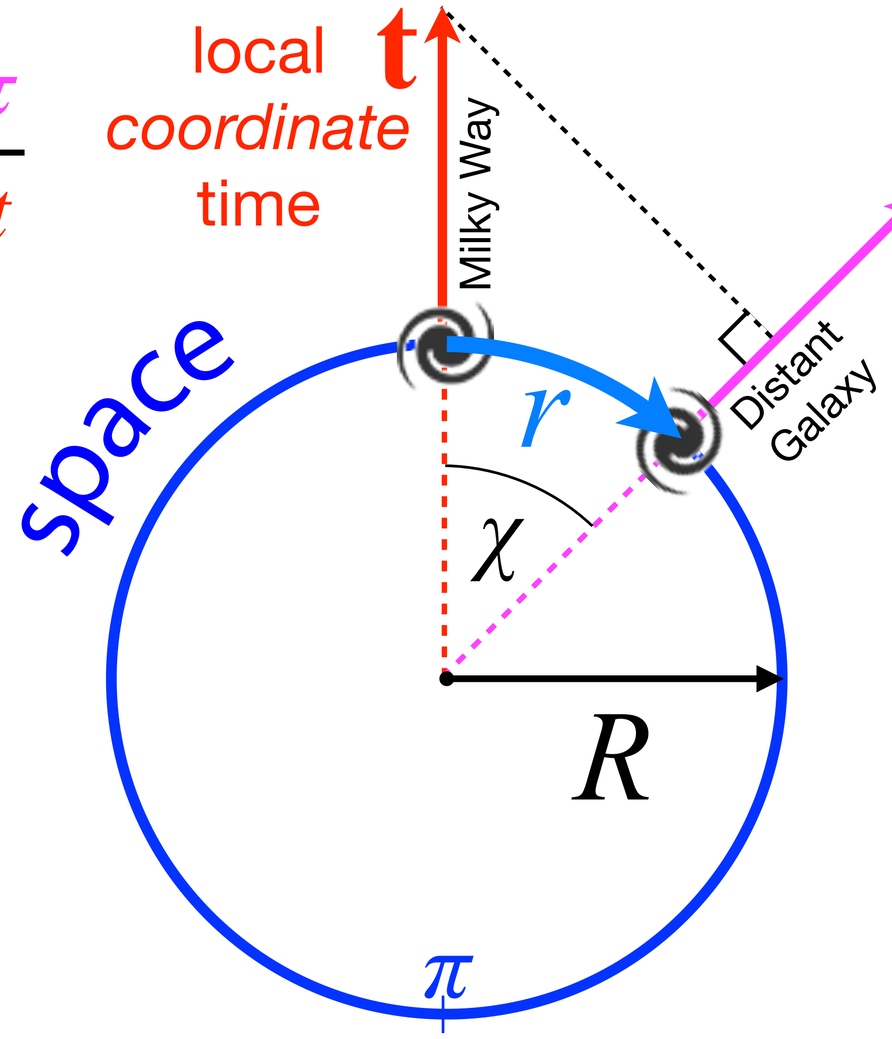
A distance-induced time dilation is modeled, absent cosmic expansion ($\dot{R}$).

$$\cos\left(\frac{r}{R}\right) = \cos\chi = \frac{\mathrm{d}\tau}{\mathrm{d}t}$$

$$\mathrm{d}\tau = \cos\chi\,\mathrm{d}t$$

$$\sec\chi \equiv \frac{1}{\cos\chi}$$

$$\sec\chi = \frac{\mathrm{d}t}{\mathrm{d}\tau}$$



$$\dot{R} \equiv \frac{\mathrm{d}R}{\mathrm{d}t} = 0$$

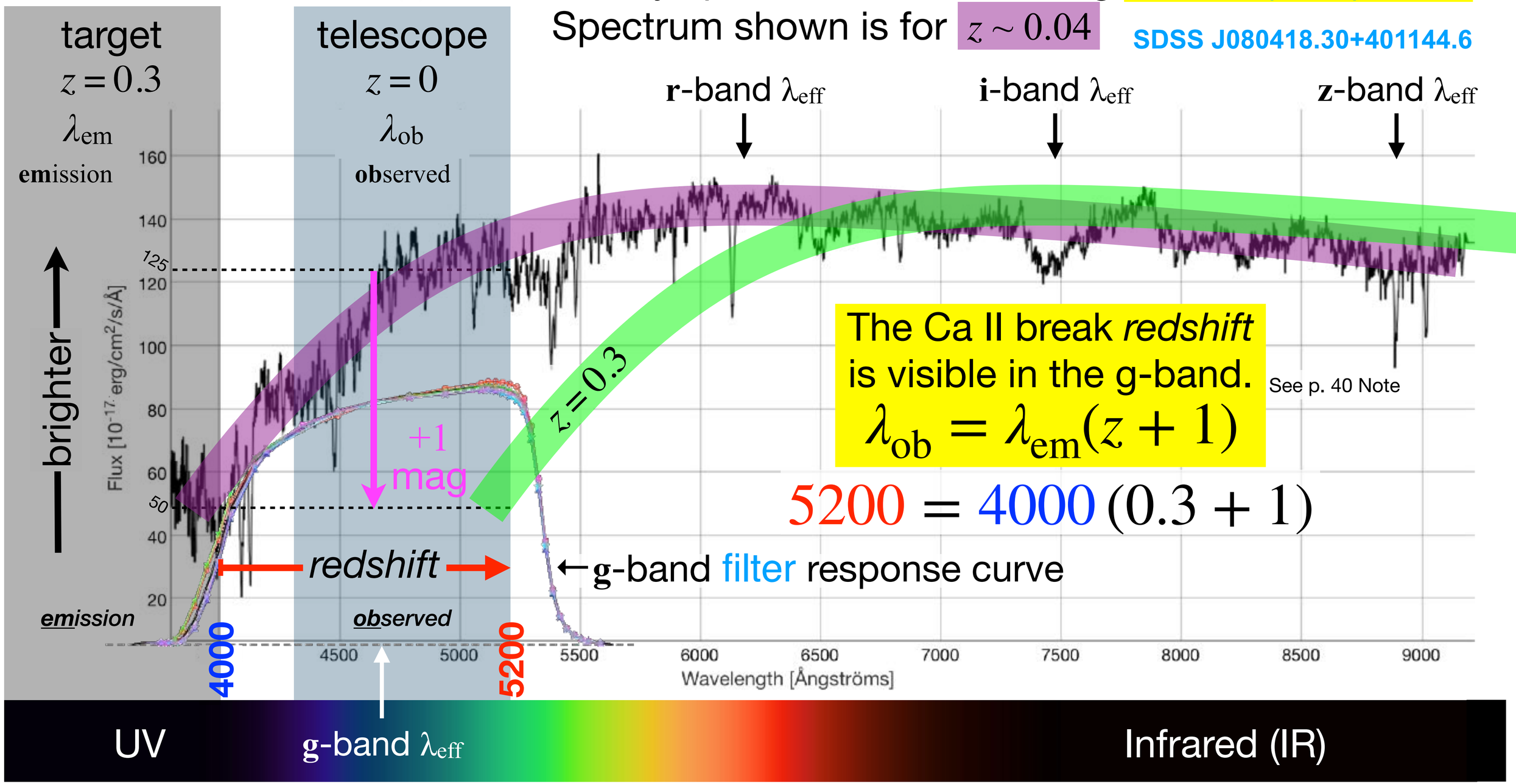
(i.e., “steady state”)

REDSHIFT (z)

Galaxy spectrum demonstrating 4000-Å (Ca II) break

Spectrum shown is for $z \sim 0.04$

SDSS J080418.30+401144.6



The Ca II break *redshift* is visible in the g-band.

$$\lambda_{ob} = \lambda_{em}(z + 1)$$

See p. 40 Note

$$5200 = 4000\,(0.3 + 1)$$

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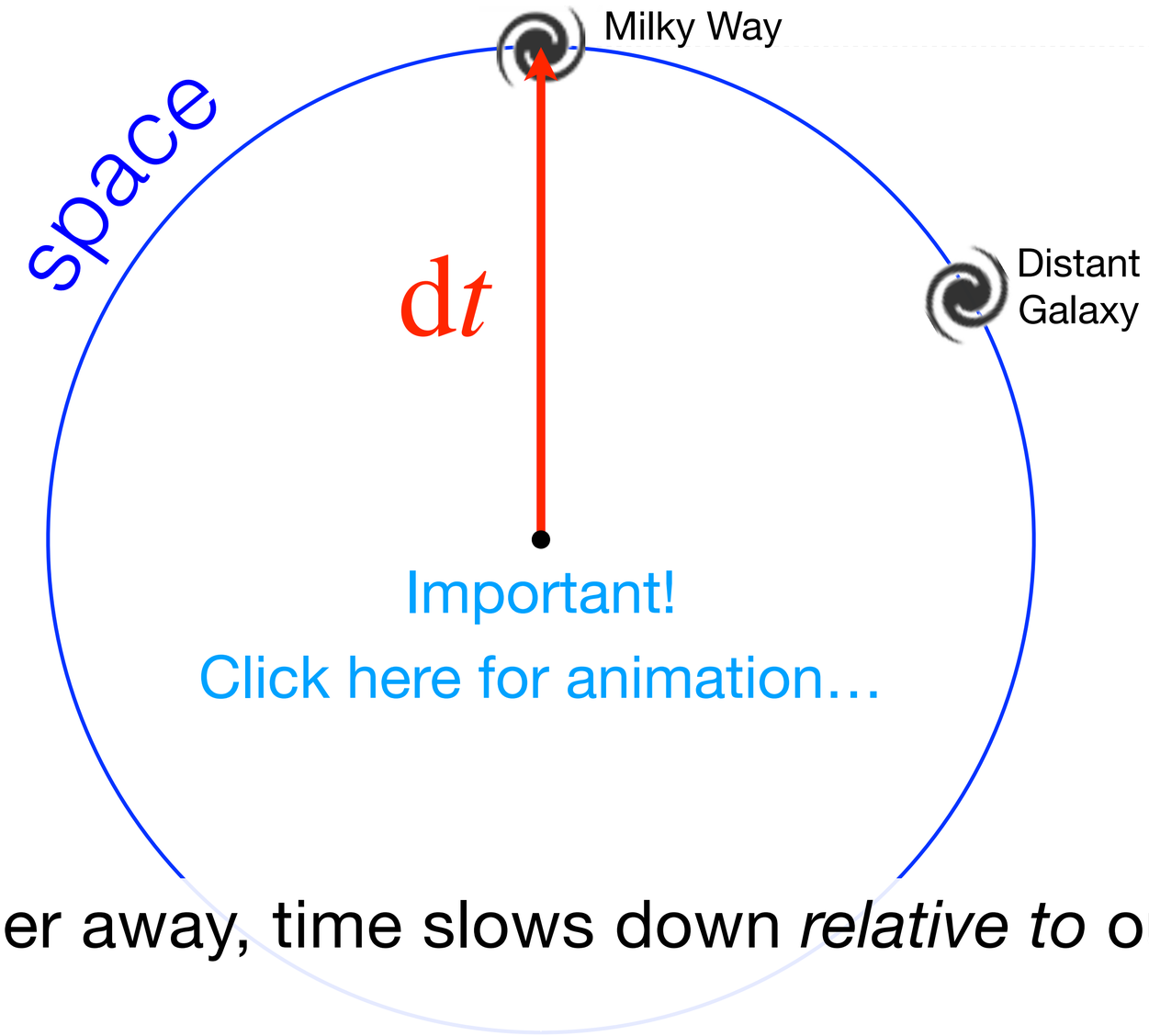
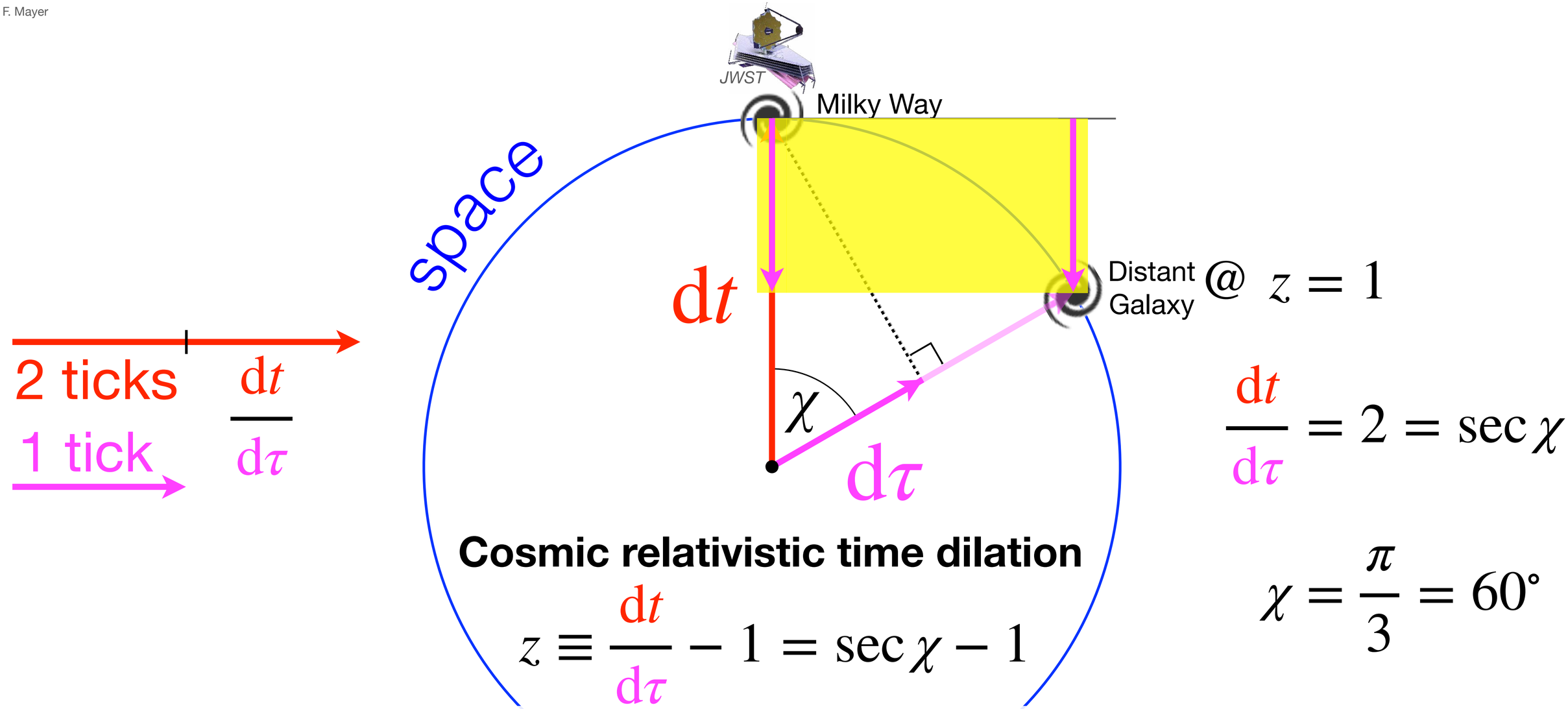
The meaning of de Sitter's solution to the Einstein Field Equations



As we look farther away, time slows down *relative to* our local clock…



Cosmic relativistic time dilation

$$z \equiv \frac{\mathrm{d}t}{\mathrm{d}\tau} - 1 = \sec\chi - 1$$

As we look farther away, time slows down *relative to* our local clock…

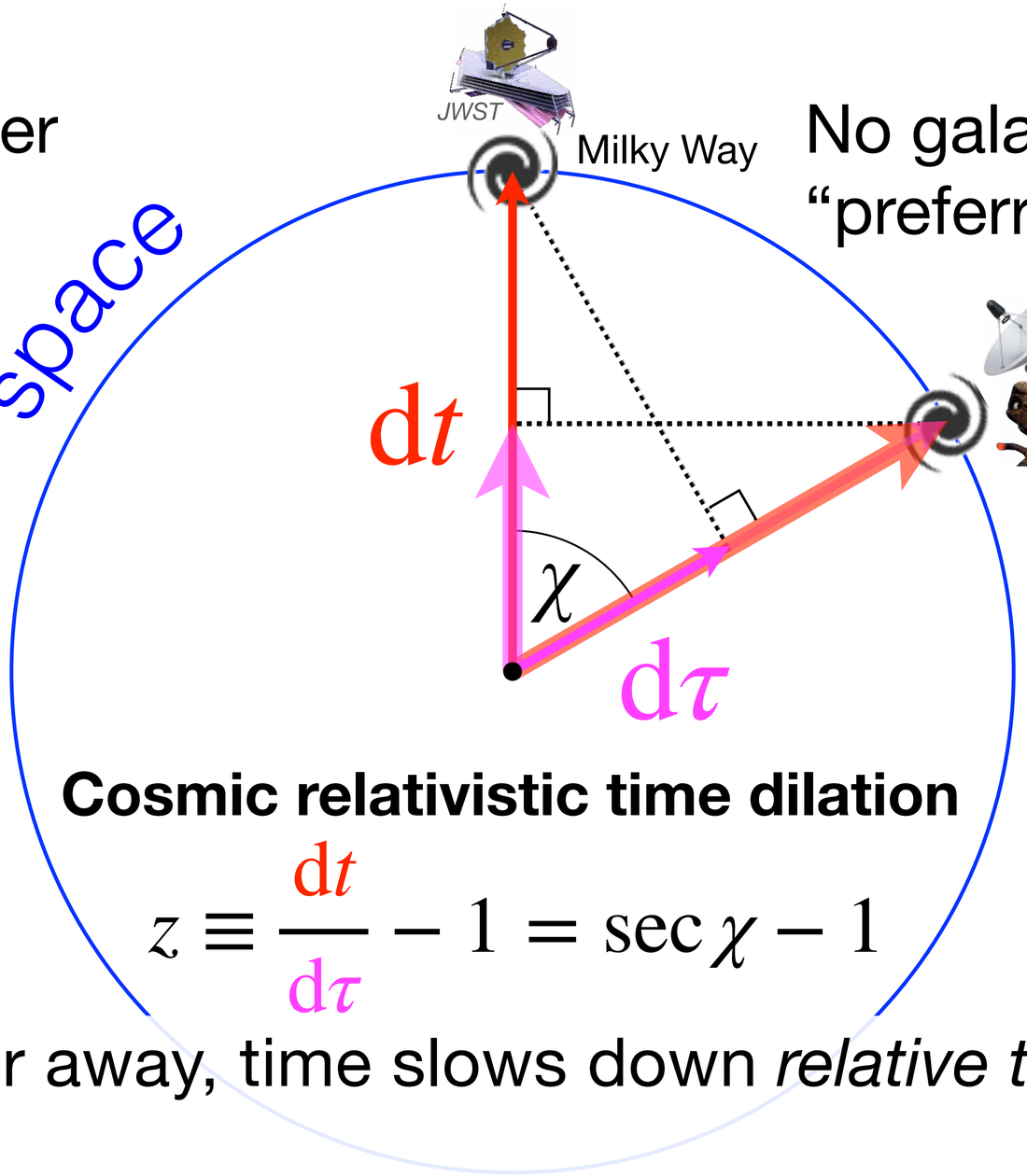
@$z = 1$, the distant clock ticks once for 2 ticks of the observer's clock,

so, *relative to* the local clock, the remote clock is *falling behind* in time.

Any cosmic observer may use the *local* clock as *reference coordinate* time.

2 ticks $\quad \dfrac{\mathrm{d}t}{\mathrm{d}\tau}$

1 tick



No galaxy constitutes some "preferred" reference frame.

@ $z = 1$

$$\frac{\mathrm{d}t}{\mathrm{d}\tau} = 2 = \sec\chi$$

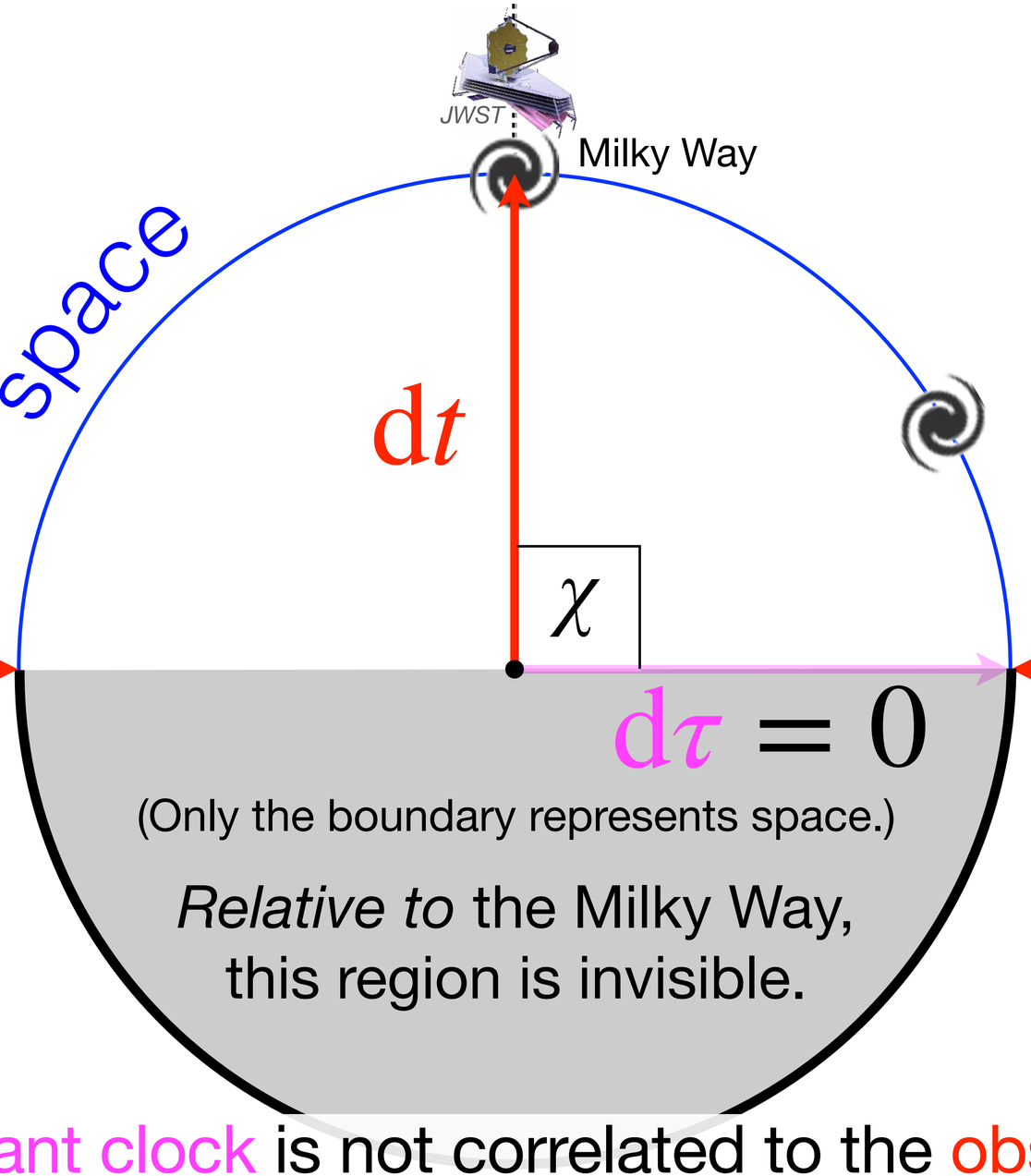
$$\chi = \frac{\pi}{3} = 60^\circ$$

Cosmic relativistic time dilation

$$z \equiv \frac{\mathrm{d}t}{\mathrm{d}\tau} - 1 = \sec\chi - 1$$

As we look farther away, time slows down *relative to* our local clock…

Effect is bilateral; the remote observer perceives our clock to be slow.



$$\frac{dt}{d\tau} = z + 1 = \sec\chi$$

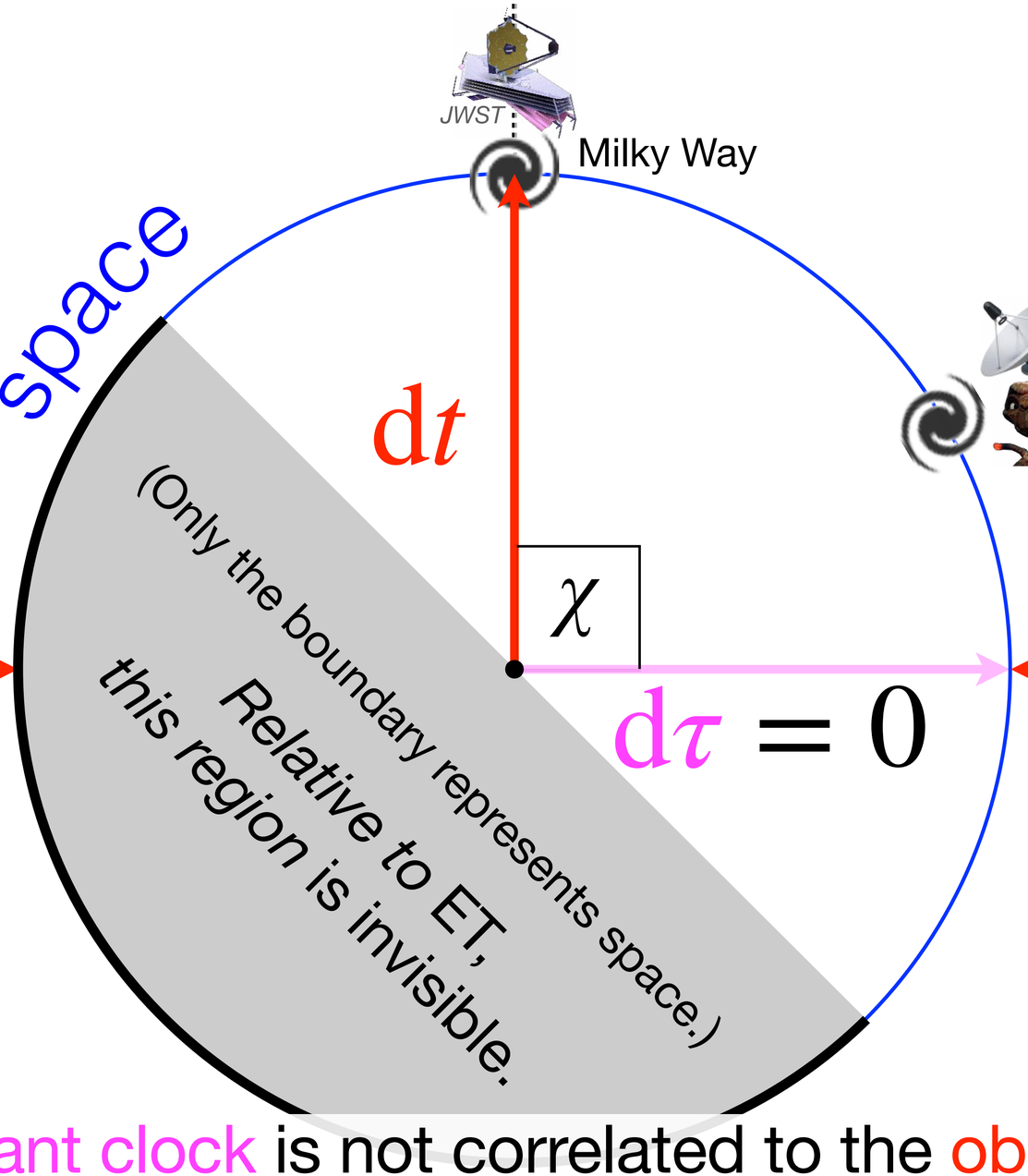
$$\frac{dt}{d\tau} = \infty$$

90°: Milky Way
redshift horizon
$z = \infty\ @D = \pi R/2$

$@\ z = \infty$

$$\chi = \frac{\pi}{2} = 90^\circ$$

$@z = \infty$, the distant clock is not correlated to the observer's clock, and the antipodal cosmic half is not visible; it is beyond the redshift horizon.



$$\frac{\mathrm{d}t}{\mathrm{d}\tau} = z + 1 = \sec\chi$$

$$\frac{\mathrm{d}t}{\mathrm{d}\tau} = \infty$$

$$@\ z = \infty$$

$$\chi = \frac{\pi}{2} = 90^\circ$$

90°: Milky Way
redshift horizon
$z = \infty\ @D = \pi R/2$

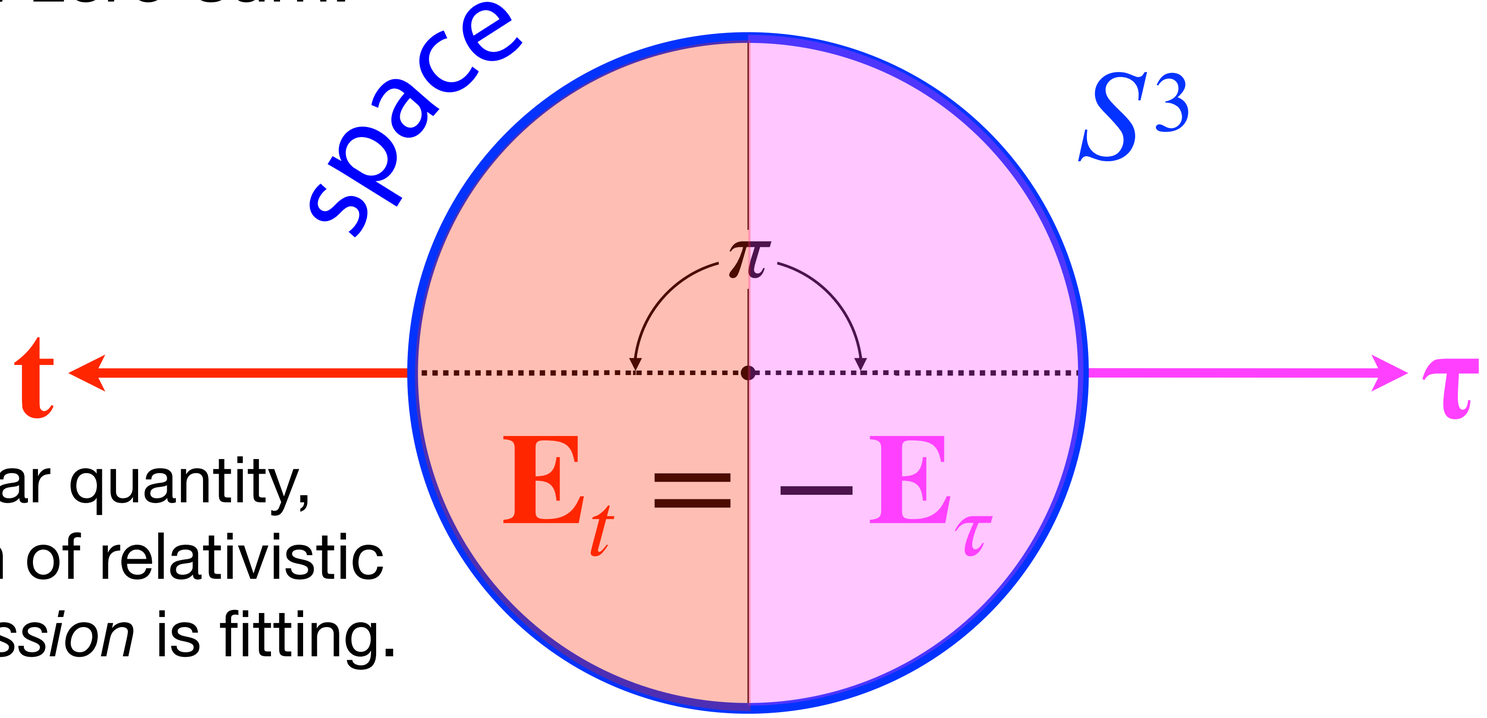
$@z = \infty$, the distant clock is not correlated to the observer's clock, and the antipodal cosmic half is not visible; it is beyond the redshift horizon.

A unique peculiarity of de Sitter's solution to the EFE is that it requires the total energy density of the Universe to be *zero*,* which *seemed* unphysical. With his solution newly interpreted in the context of *temporal geometry*, that feature proves to be a physically-rational mathematical *necessity*. As per the cosmological principle, antipodal cosmic 'hemispheres' (S^3) encompass identical mass-energy, E. Relativistic time reversal, imparting negative energy, yields a *net-zero* sum:

$$E + (-E) = 0 \;\; \therefore \;\; \rho_0 = 0$$

* "ρ_0 is the average density of the world-matter."

See de Sitter (11/1917), Eqs. (6, 9B)



Conventionally, energy is a scalar quantity, yet in the atypical consideration of relativistic time reversal, this **vector** *expression* is fitting.

Things you didn't know about the Hubble Diagram

In 1921, a young Belgian mathematics postdoc and seminarian by the name of Georges Henri Lemaître wrote an essay entitled *God's First Three Declarations*.* The author stated that this 1921 essay was "an attempt to describe scientifically the first verses of Genesis." That formative hermeneutic essay, discovered in the archives of the Catholic University of Leuven in the late 20th century, is the actual root of the Big-Bang theory. Lemaître (July 1894 – June 1966) was ordained as a Catholic priest in 1923.

Georges Lemaître

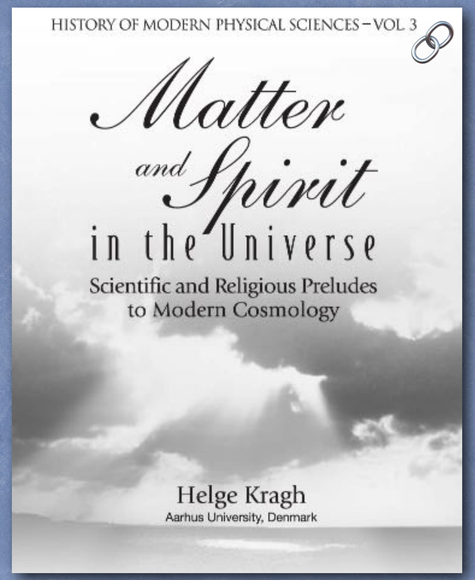
Professor
Université Catholique
de Louvain
(1925 – 1966)

Pontifical Academy
of Sciences
(1936 – 1966)

PAS President
(1960 – 1966)

* Footnotes: "Les trois premières paroles de Dieu."
The manuscript is reproduced in Stoffel (1996), pp. 107–111.
Lemaître's religious views are discussed in Lambert (1997).

Source: Helge Kragh, Matter and Spirit in the Universe
PDF | (Imperial College Press, London, 2004), p. 141.



Click the cover for a book review by E. McMullin
in *Journal for the History of Astronomy* (2005).

In June1925, Lemaître met with Hubble at Mt. Wilson.[1,2]

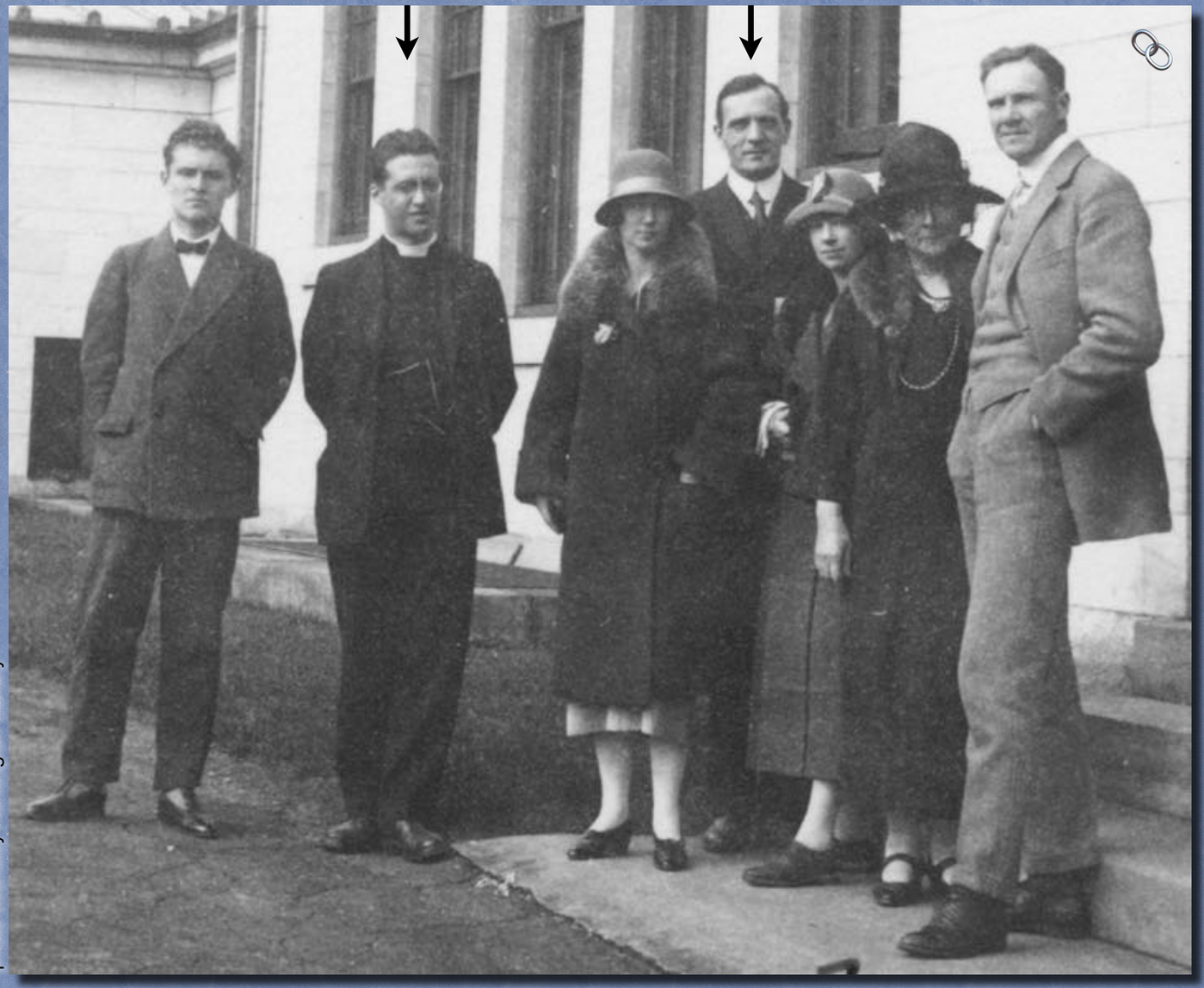


photo courtesy Huntington Library

1. references Mt. Wilson (a)
2. references Caltech (b)

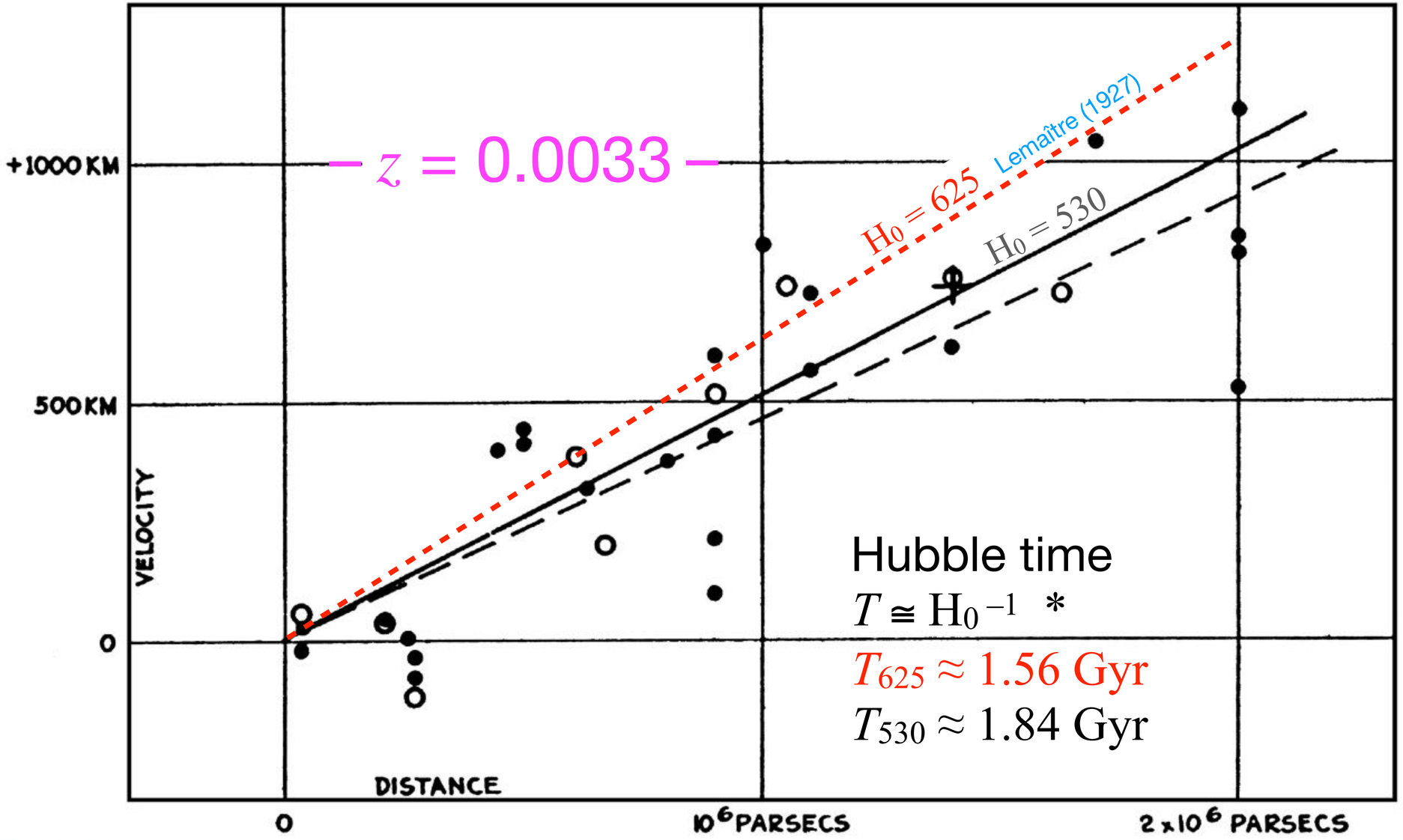
They also met at the 1928 IAU conference in Holland.[3]

Edwin Hubble's biographies all note that he was idiosyncratic: he was a pathological liar and inclined to self-aggrandizement based on fictional exploits.

1. John Farrell, *The Day Without Yesterday: Lemaître, Einstein, and the Birth of Modern Cosmology*, New York: Thunder's Mouth Press, 2005, p. 78.
2. Jeremiah P. Ostriker & Simon Mitton, *Heart of Darkness: Unraveling the Mysteries of the Invisible Universe*, Princeton: Princeton Univ. Press, 2013, p. 68.

Hubble diagram (1929) — annotated

The historical foundation of the ‘expanding-universe’ paradigm



Hubble time

$T \cong H_0^{-1}$ *

$T_{625} \approx 1.56$ Gyr

$T_{530} \approx 1.84$ Gyr

Hubble constant H_0 units:

km s^{-1} Mpc $^{-1}$

* Modeled age of Universe ($\Omega = 0$)

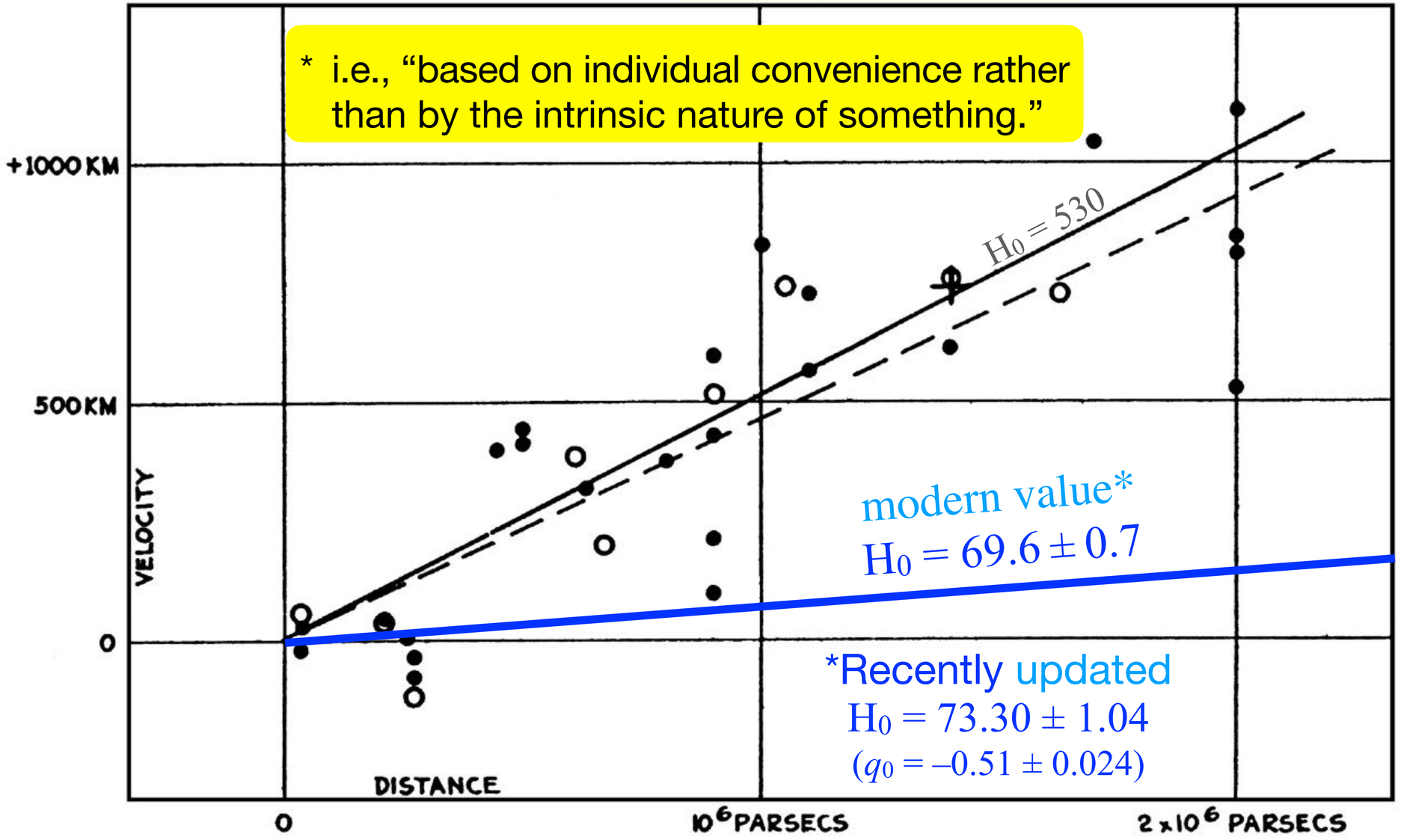
E. Hubble,

“A Relation between Distance and Radial Velocity among Extra-Galactic Nebulae”, *PNAS* **15**, 168 (1929).

Hubble diagram (1929) — annotated

The modern legacy of an *arbitrary** correlation 95 years ago

* i.e., "based on individual convenience rather than by the intrinsic nature of something."



Hubble constant H_0 units:
$\mathrm{km\ s^{-1}\ Mpc^{-1}}$

* Both H_0 values fit the thick blue line.

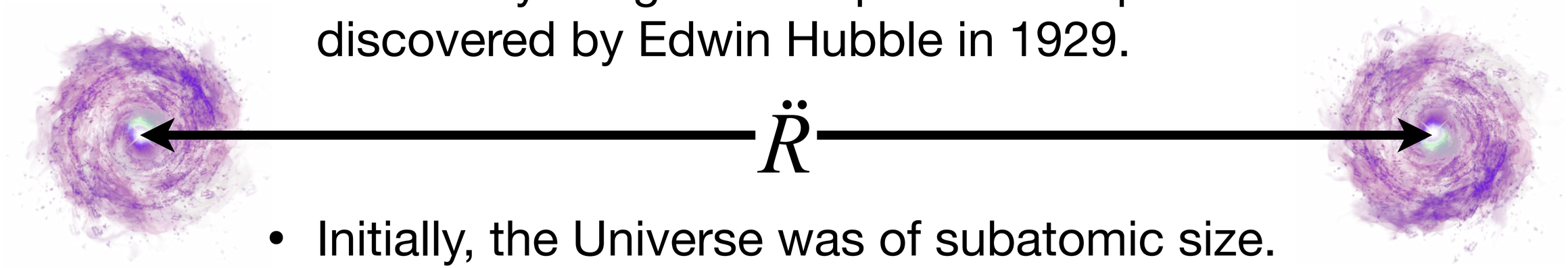
$T_{73.3} \approx 13.0$ Gyr $T_{69.6} \approx 13.7$ Gyr $(\Omega = 1)$

Modern Conventional Textbook Cosmology

(Big-Bang "ΛCDM" Expanding-Universe Model)

"**Lambda C**old **D**ark **M**atter"

- Observed galaxy redshifts are definitively caused by the general expansion of space discovered by Edwin Hubble in 1929.



- Initially, the Universe was of subatomic size.
- Cosmic expansion started with $v \gg c$ 'inflation'.
- That expansion is now inexplicably accelerating.
- Most of the Universe is *undetectable* 'dark stuff'.
- Galaxy superclusters formed over about 10 Gyr.
- Anomalous JWST observations are annoying…

Es ist immer angenehm, über strenge Lösungen einfacher Form zu verfügen.

"It is always pleasant to have exact solutions in simple form at your disposal."

– Karl Schwarzschild, "On the Gravitational Field of a Mass Point According to Einstein's Theory"; In: Proceedings of the Royal Prussian Academy of Sciences Meeting (Berlin), 1916, p. 189.

English translation: arXiv:physics/9905030 [physics.hist-ph]

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The Complete Set of Empirically-Accurate Cosmological Predictive Equations

Relativistic Temporal Geometry (RTG) model

A logically consistent set:
(1 ⇔ 2 ⇔ 3)
1 iff 2 iff 3

(1) Theta-z

to be shown...

$$\theta(z) = C_R \left(1 - \frac{1}{(z+1)^2} \right)^{-\frac{1}{2}} \quad \text{radians}$$

C_R, C_V, C_M are empirically-related constants of proportionality; they are not "free parameters".

(2) Redshift-volume

to be shown...

$$S^3(z) = C_V \cdot \left[\cos^{-1}\left(\frac{1}{z+1} \right) - \left(\frac{1}{(z+1)^2} - \frac{1}{(z+1)^4} \right)^{\frac{1}{2}} \right] \quad \text{arbitrary units}$$

These equations rest on first principles and Riemann.
Later, as an excercise, consider deriving them on your own.

(3) Redshift-magnitude

to be shown...

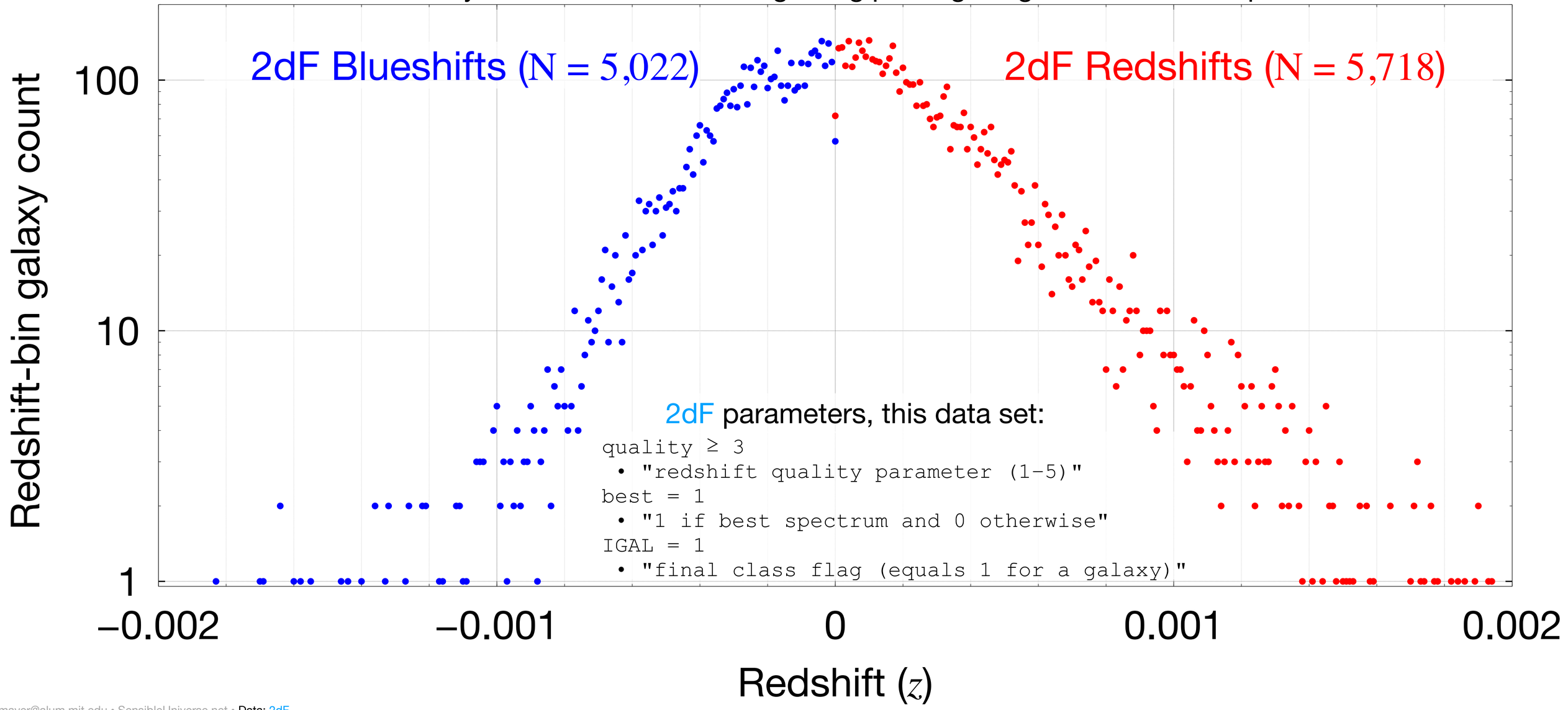
$$m(z) = C_M - 2.5 \cdot \log\left(\frac{1}{4\pi \left[(z+1)^4 - (z+1)^2 \right]} \right) + \underbrace{\epsilon_\lambda \cos^{-1}\left(\frac{1}{z+1} \right)}_{\text{IGM extinction*}} \quad \text{mags}$$

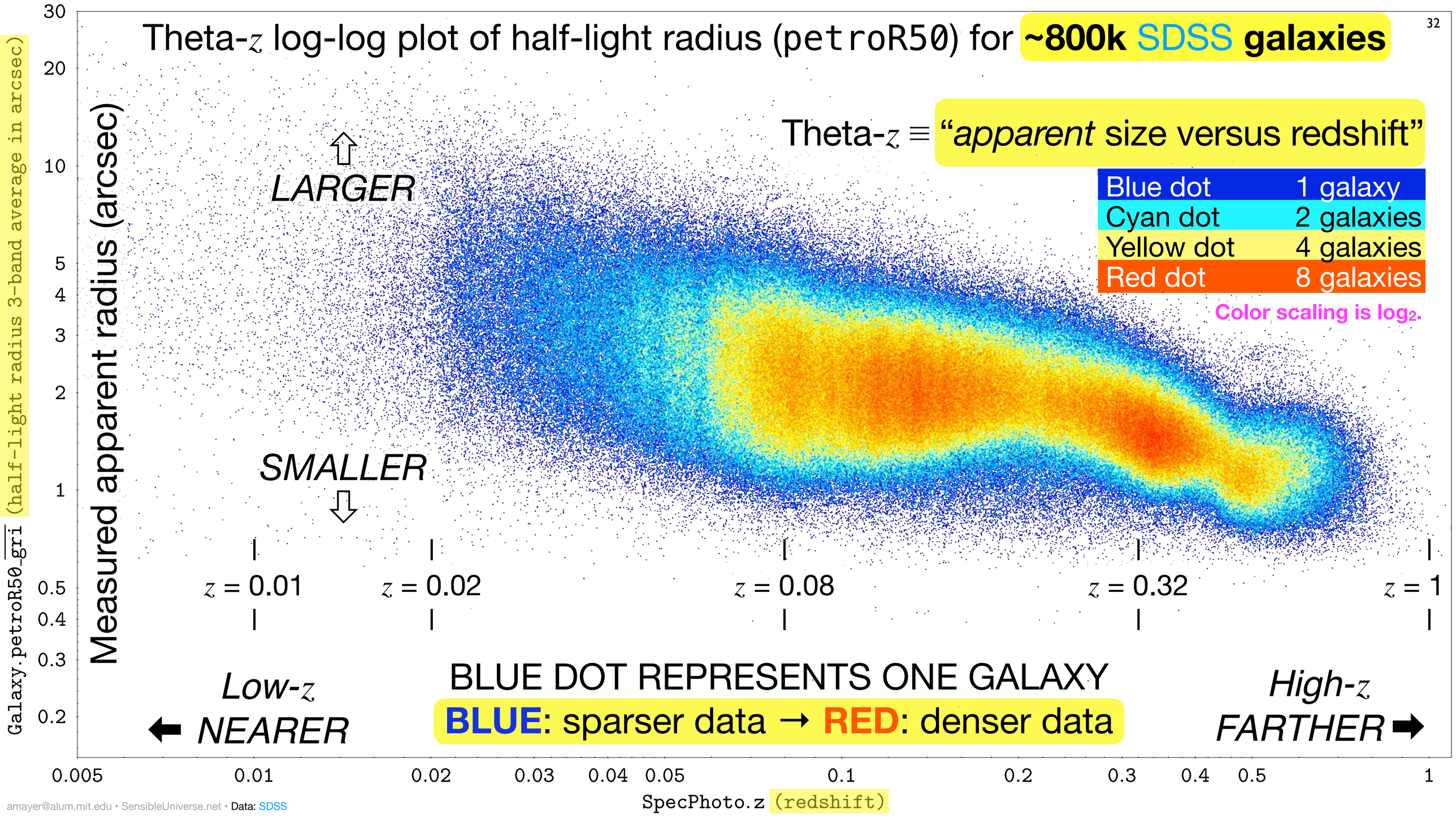
* $\frac{d\epsilon_\lambda}{dz} = 0$ yields a linear approximation.

Approximately-equal numbers of galaxy redshifts and blueshifts

The rough symmetry between redshifts and blueshifts within a sample population of >10k galaxies in the nearby Universe $\left(|z| \leq 0.002\right)$ is indicative of random galactic velocities.

This data is obviously inconsistent with the Big-Bang paradigm's general cosmic expansion.





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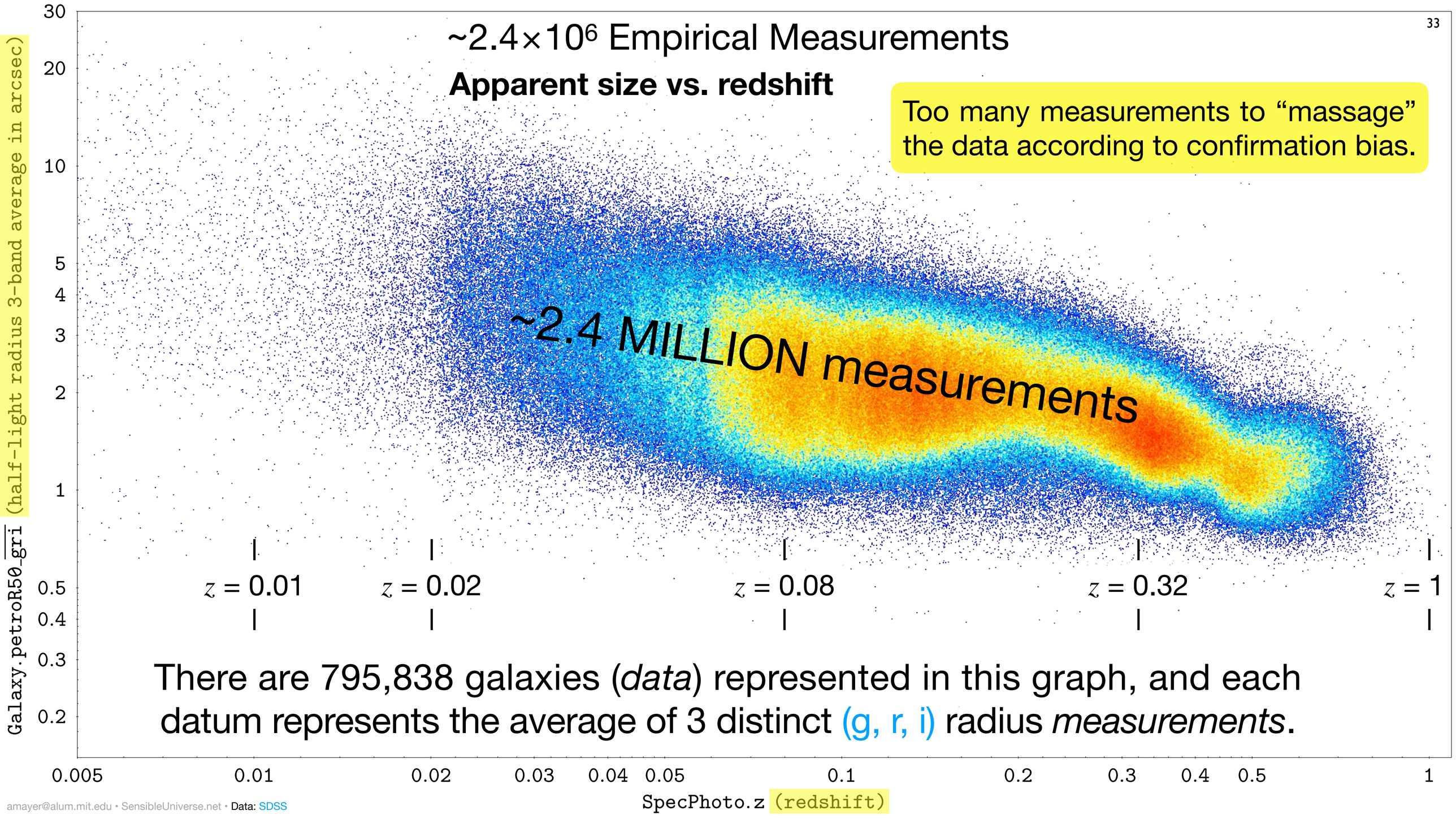
~2.4×10⁶ Empirical Measurements

Apparent size vs. redshift

Too many measurements to “massage” the data according to confirmation bias.



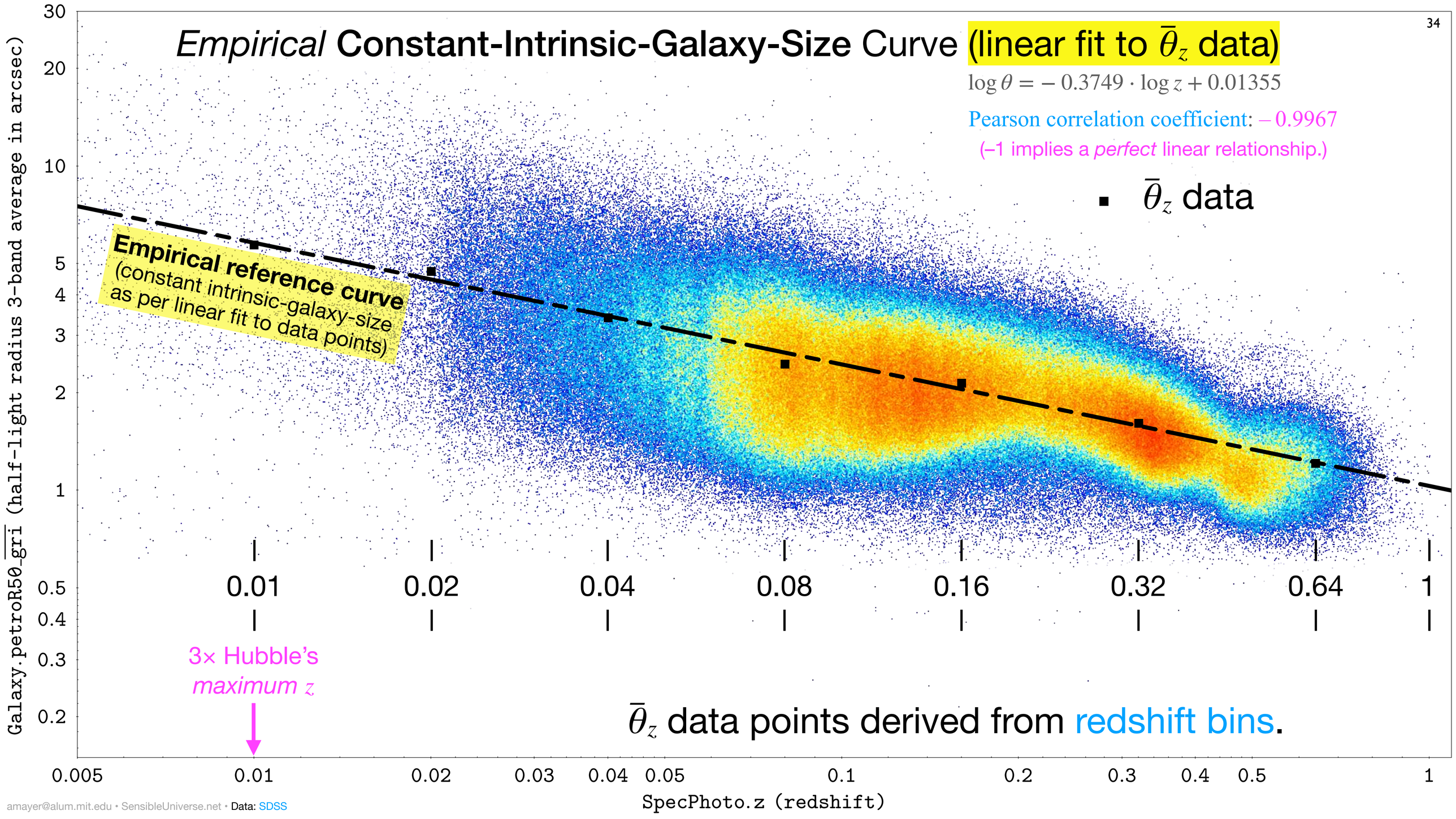
There are 795,838 galaxies (*data*) represented in this graph, and each datum represents the average of 3 distinct (g, r, i) radius *measurements*.

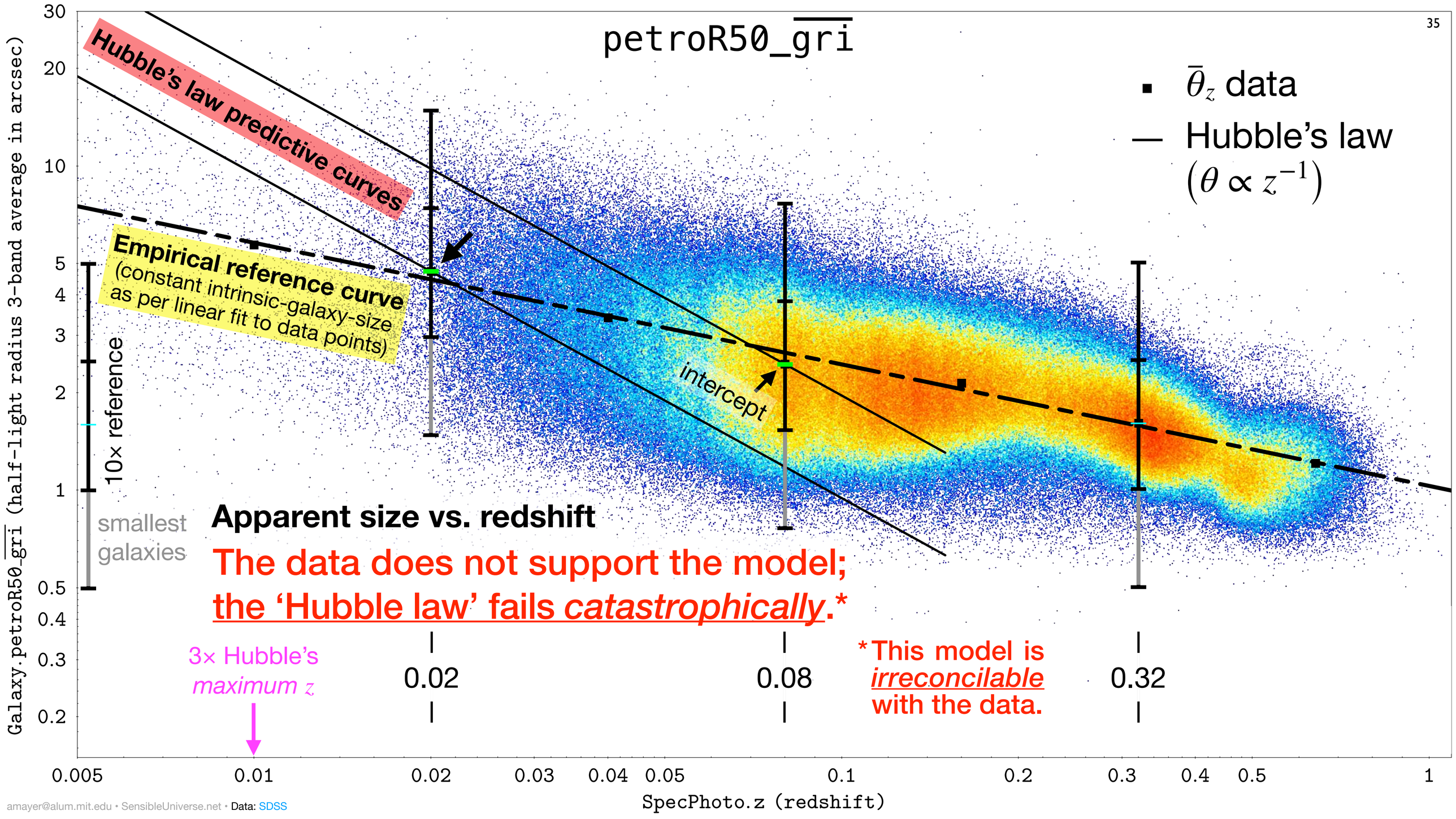
Empirical Constant-Intrinsic-Galaxy-Size Curve (linear fit to $\bar{\theta}_z$ data)

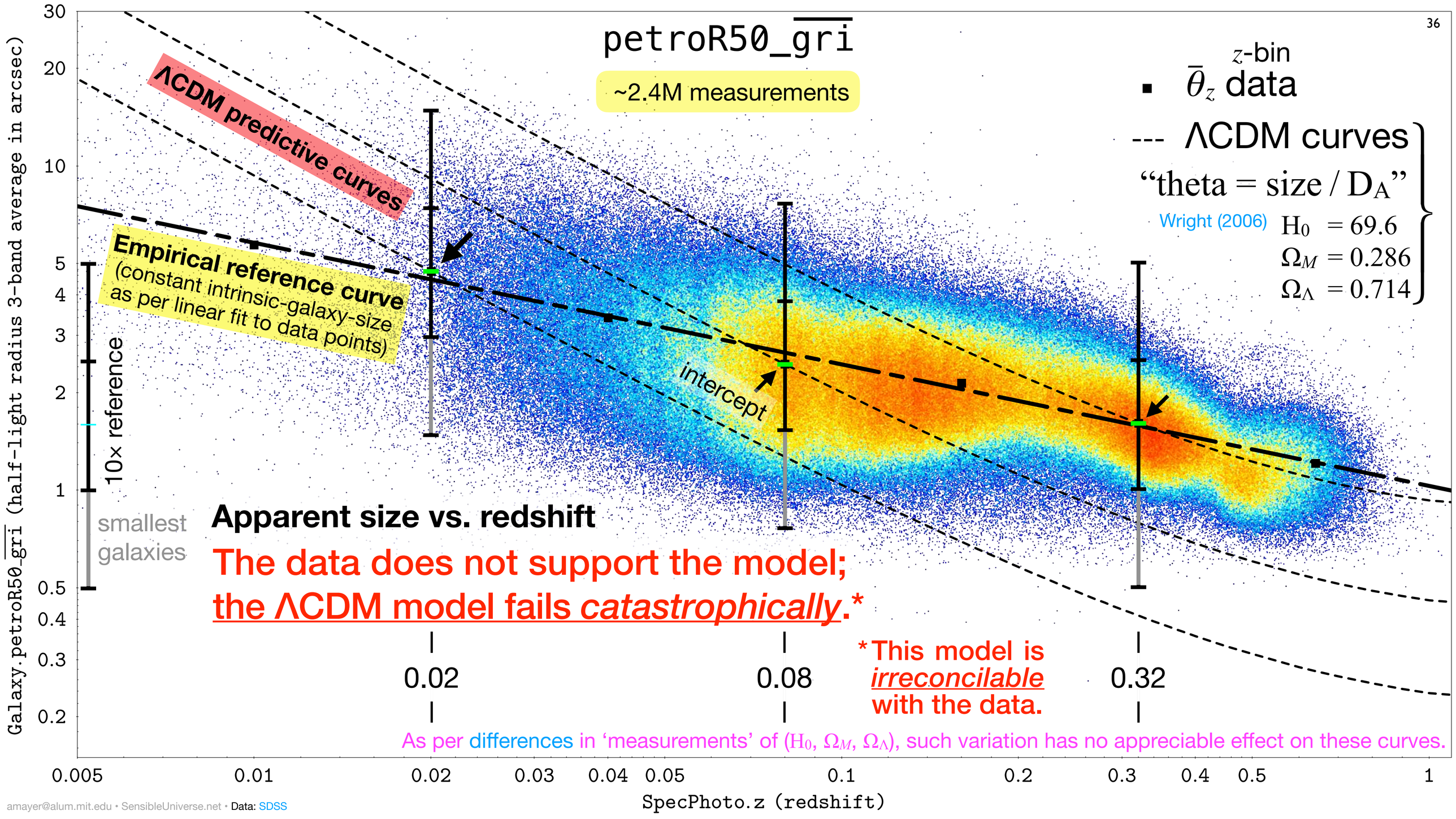
$$\log \theta = -0.3749 \cdot \log z + 0.01355$$

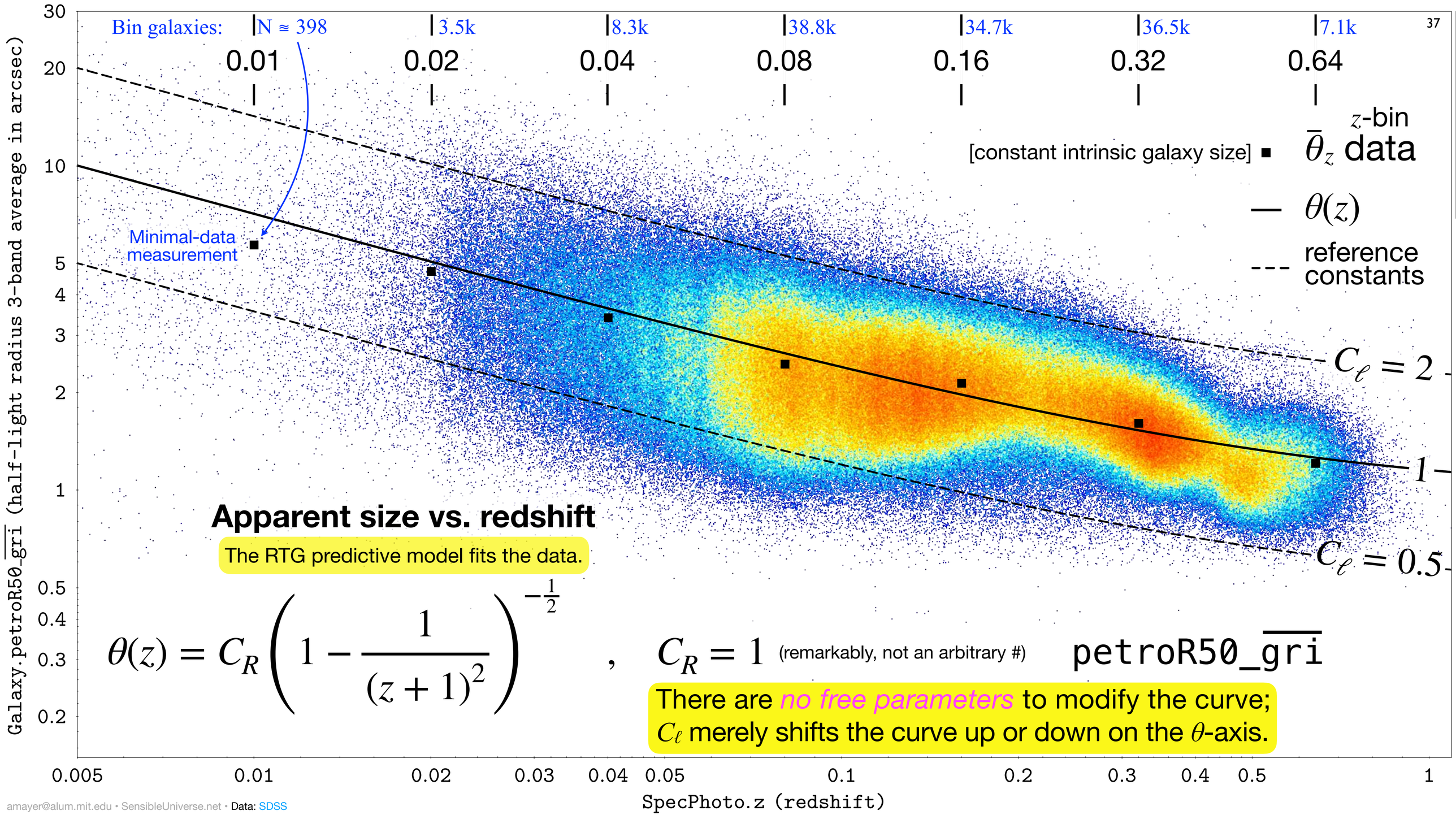
Pearson correlation coefficient: −0.9967

(–1 implies a *perfect* linear relationship.)




petroR50_gri
Hubble's law predictive curves
Empirical reference curve
(constant intrinsic-galaxy-size
as per linear fit to data points)
intercept
10× reference
smallest
galaxies
$\bar{\theta}_z$ data
Hubble's law
$(\theta \propto z^{-1})$
Apparent size vs. redshift
The data does not support the model;
the 'Hubble law' fails *catastrophically*.*
*This model is
irreconcilable
with the data.
3× Hubble's
maximum z
Galaxy.petroR50_gri (half-light radius 3-band average in arcsec)
SpecPhoto.z (redshift)
30
20
10
5
4
3
2
1
0.5
0.4
0.3
0.2
0.005
0.01
0.02
0.03
0.04
0.05
0.1
0.2
0.3
0.4
0.5
1
0.02
0.08
0.32


petroR50_gri
~2.4M measurements
ΛCDM predictive curves
Empirical reference curve
(constant intrinsic-galaxy-size
as per linear fit to data points)
intercept
10× reference
smallest
galaxies
z-bin
$\bar{\theta}_z$ data
--- ΛCDM curves
"theta = size / D_A"
Wright (2006) $H_0 = 69.6$
$\Omega_M = 0.286$
$\Omega_\Lambda = 0.714$
Apparent size vs. redshift
The data does not support the model;
the ΛCDM model fails catastrophically.*
*This model is
irreconcilable
with the data.
0.02
0.08
0.32
As per differences in 'measurements' of (H_0, Ω_M, Ω_Λ), such variation has no appreciable effect on these curves.
Galaxy.petroR50_gri (half-light radius 3-band average in arcsec)
30
20
10
5
4
3
2
1
0.5
0.4
0.3
0.2
0.005
0.01
0.02
0.03
0.04
0.05
0.1
0.2
0.3
0.4
0.5
1
SpecPhoto.z (redshift)



Apparent size vs. redshift

The RTG predictive model fits the data.

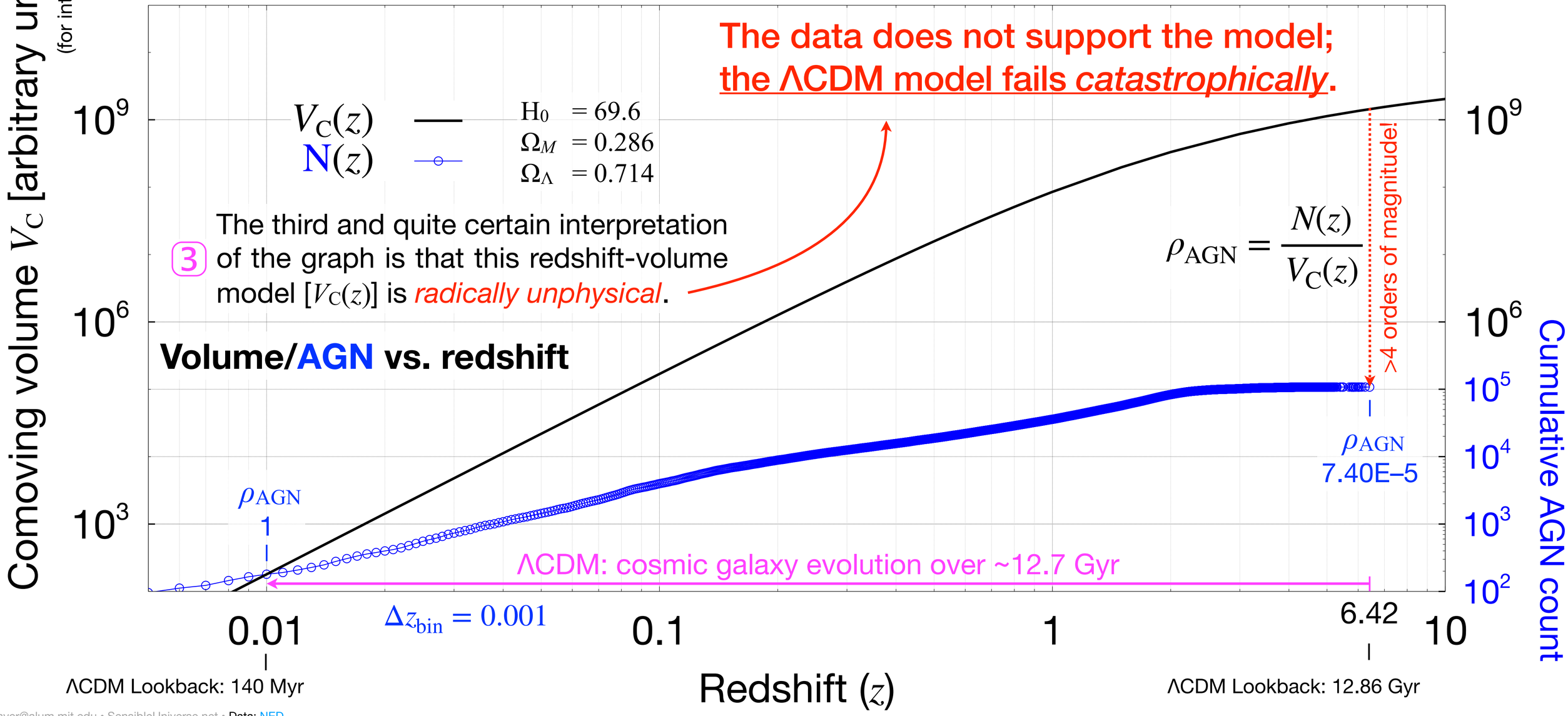
$$\theta(z) = C_R \left(1 - \frac{1}{(z+1)^2} \right)^{-\frac{1}{2}} , \quad C_R = 1$$ (remarkably, not an arbitrary #)

petroR50_gri

There are *no free parameters* to modify the curve; C_ℓ merely shifts the curve up or down on the θ-axis.

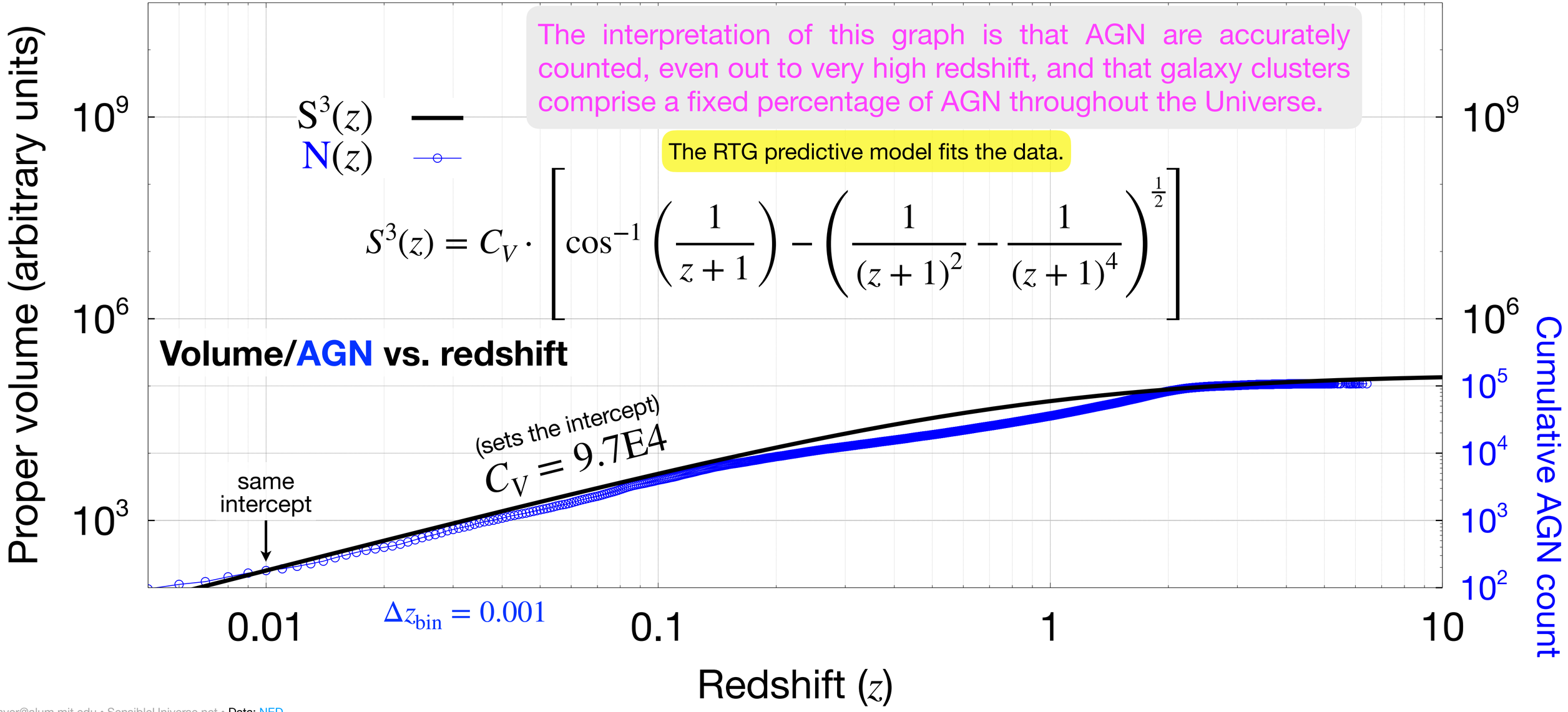
1 ΛCDM: over time, AGN space density increases by >4 orders of magnitude.

2 Another possible interpretation of the graph, is that ≪1% of AGN that exist at higher redshift are observed and counted by the various astronomical surveys.



S^3 represents the volumetric 'surface' of a Riemannian 3-sphere

The fit of this a priori theoretical predictive curve to the empirical AGN population data is equally remarkable to that for the theta-z data; there are no free parameters available to achieve this fit.



RTG: $$m(z) = C_M - 2.5 \log \left[\frac{1}{4\pi \left((z+1)^4 - (z+1)^2 \right)} \right] + \epsilon_\lambda \cdot \cos^{-1} \left(\frac{1}{z+1} \right)$$

$C_M = 14.82,\ 13.22 \quad \epsilon_\lambda = 0.5$ extinction

$C_M = 15.17,\ 13.57 \quad \epsilon_\lambda = 0$

ΛCDM: $$m(z) = K_M - 2.5 \log \left[\frac{1}{4\pi D_L^2} \right]$$

$K_M = -0.68,\ -2.28$

Data: ~136k
SDSS LRGs (z-band)

intercepts
(0.32, 18.2)
(0.32, 16.6)

RTG constant-intrinsic-brightness model

The RTG predictive model fits the data.

ΛCDM constant-intrinsic-brightness model

The data does not support this model.*

*** The ΛCDM model fails *catastrophically*.**

The only 'free parameter' incorporated in the set of cosmological predictive equations on page 30 is the IGM-extinction parameter ε_λ. Although ε_λ is empirically a function of photon wavelength ($d\lambda/z$) the approximation of a constant value is reasonably accurate for other than very-high-z objects. The thin solid curves model $m(z)$ without taking extinction into account ($\varepsilon_\lambda = 0$). The thick solid curves employ an arbitrary choice of ($\varepsilon_\lambda = 0.5$) to demonstrate its effect on the model.

Redshift-magnitude curves modeling constant intrinsic brightness

Galaxy.petroMag_z (mag)

20.0 19.5 19.0 18.5 18.0 17.5 17.0 16.5 16.0 15.5 15.0 14.5 14.0 13.5 13.0 12.5 12.0 11.5 11.0 10.5 10.0

0.01 0.02 0.03 0.04 0.05 0.1 0.2 0.3 0.4 0.5 1

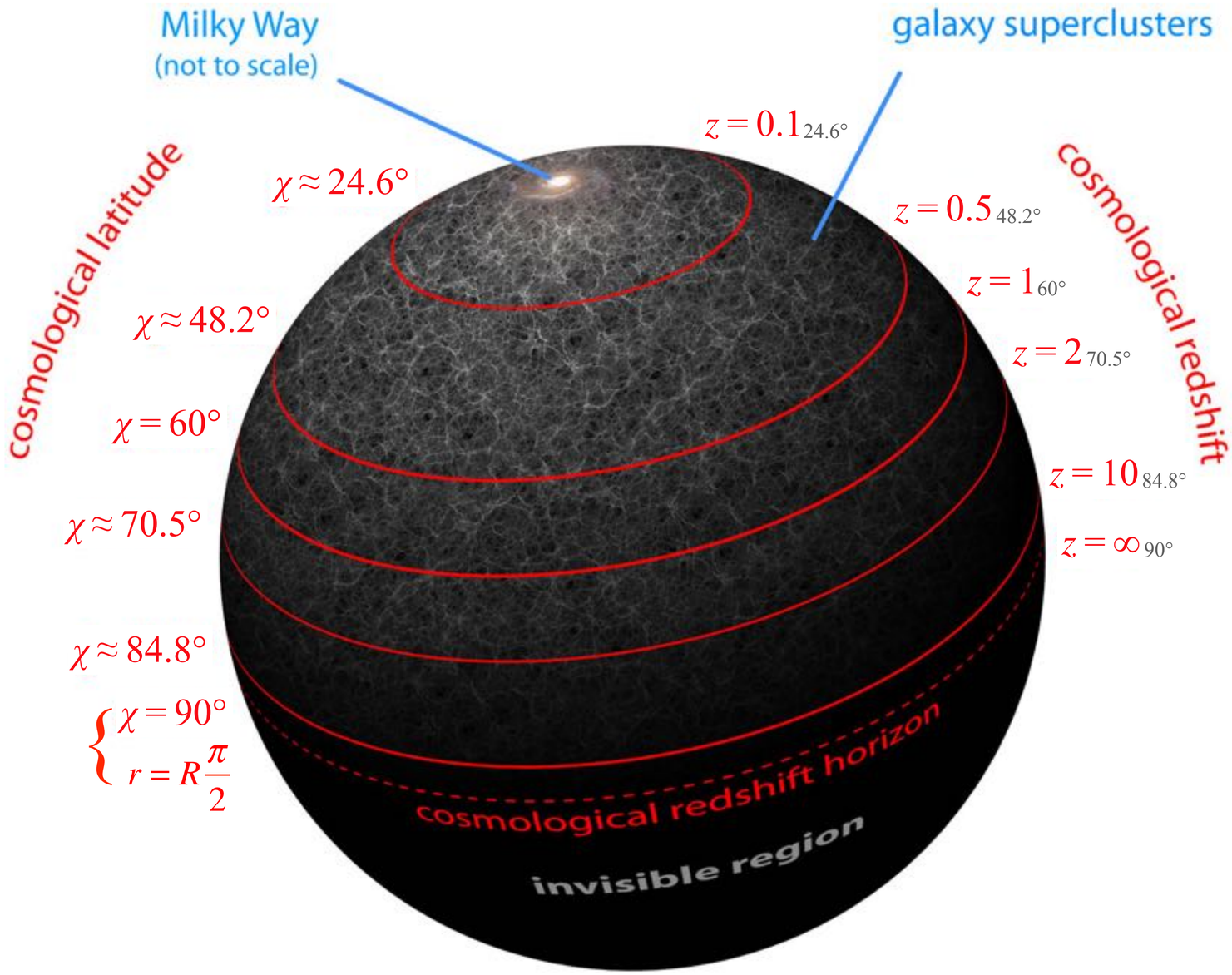
SpecPhoto.z (redshift)

Note: g-band data must exhibit 4000 Å break!

A complete cosmological map of the S^2 surface *locally* defined by Galactic latitude $b = 0$ (i.e., the Galactic plane)

$$\chi = \cos^{-1}\left(\frac{1}{z+1}\right)$$

$$z = \frac{1}{\cos\chi} - 1$$



$$\chi \equiv \frac{r}{R}$$

$$r = R\cos^{-1}\left(\frac{1}{z+1}\right)$$

$z = \infty$
@ horizon
$(\chi = \pi/2)$

Graphic by Fabio Basile after an original rendering by Hollin Calloway.

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Catastrophic Failure of the ΛCDM Model

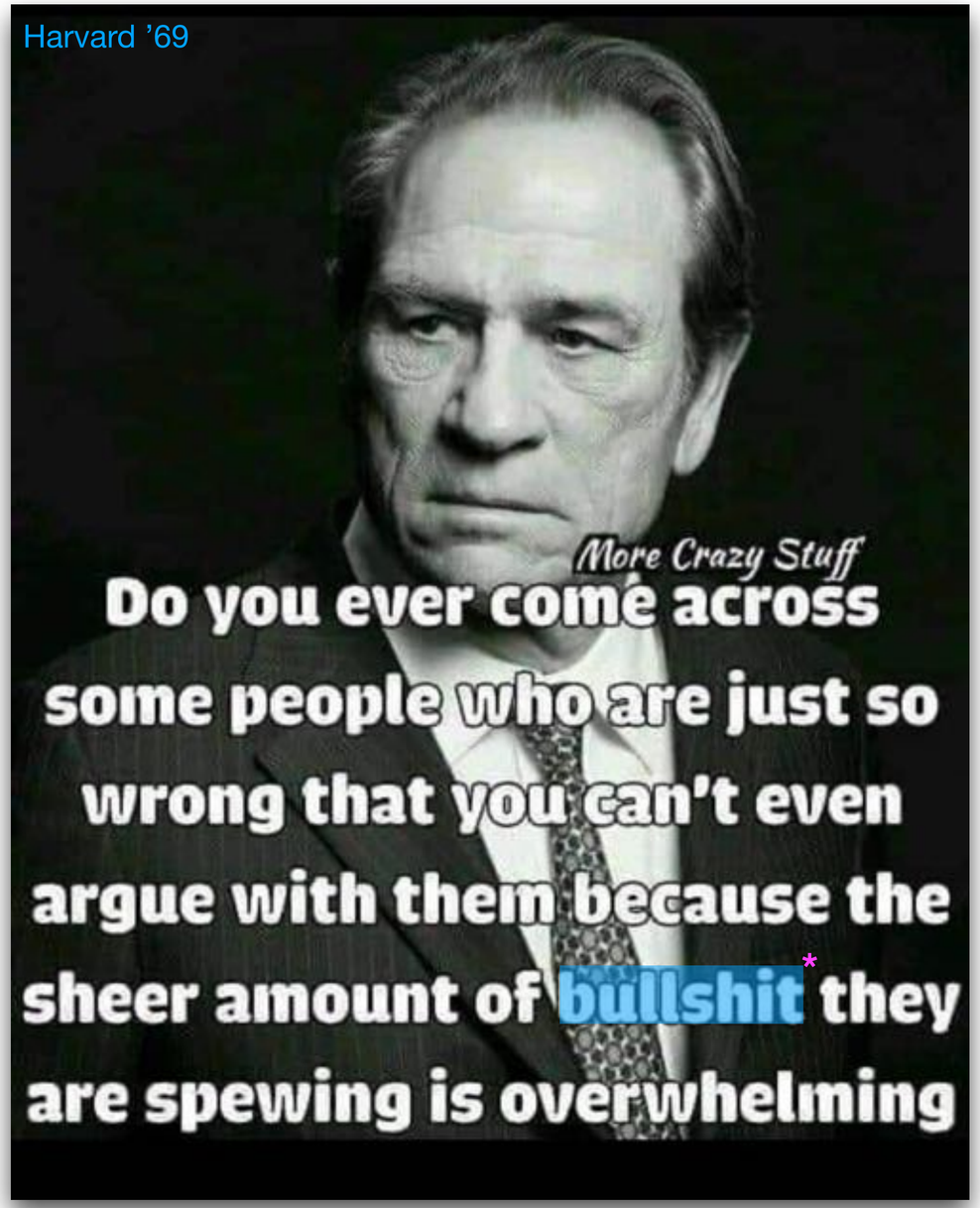
IRREFUTABLE EMPIRICAL FACT: The Universe is *not* expanding.

A professional in the field who denies this fact is gaslighting: “Gaslighting is a form of psychological manipulation in which the abuser attempts to sow self-doubt and confusion in their victim’s mind. Typically, gaslighters are seeking to gain power and control over the other person, by **distorting reality** and forcing them to question their own judgment and intuition.”* They try to invalidate your own powers of reasoning — that is psychological malware.

*source: Newport Institute

***Ignoring* facts, *pretending* that they do not exist, is similarly abusive.**

Internet meme



* "bollocks" 🇬🇧

So…

the Big-Bang theory, the 'Hubble law', the 'Hubble constant', 'Hubble time', 'dark energy', 'dark matter', etc. are *all*

"…not even wrong."

– Wolfgang Pauli

That was Pauli's expression for "half-baked".

"Lies don't end trust in false authority — the *truth** does."

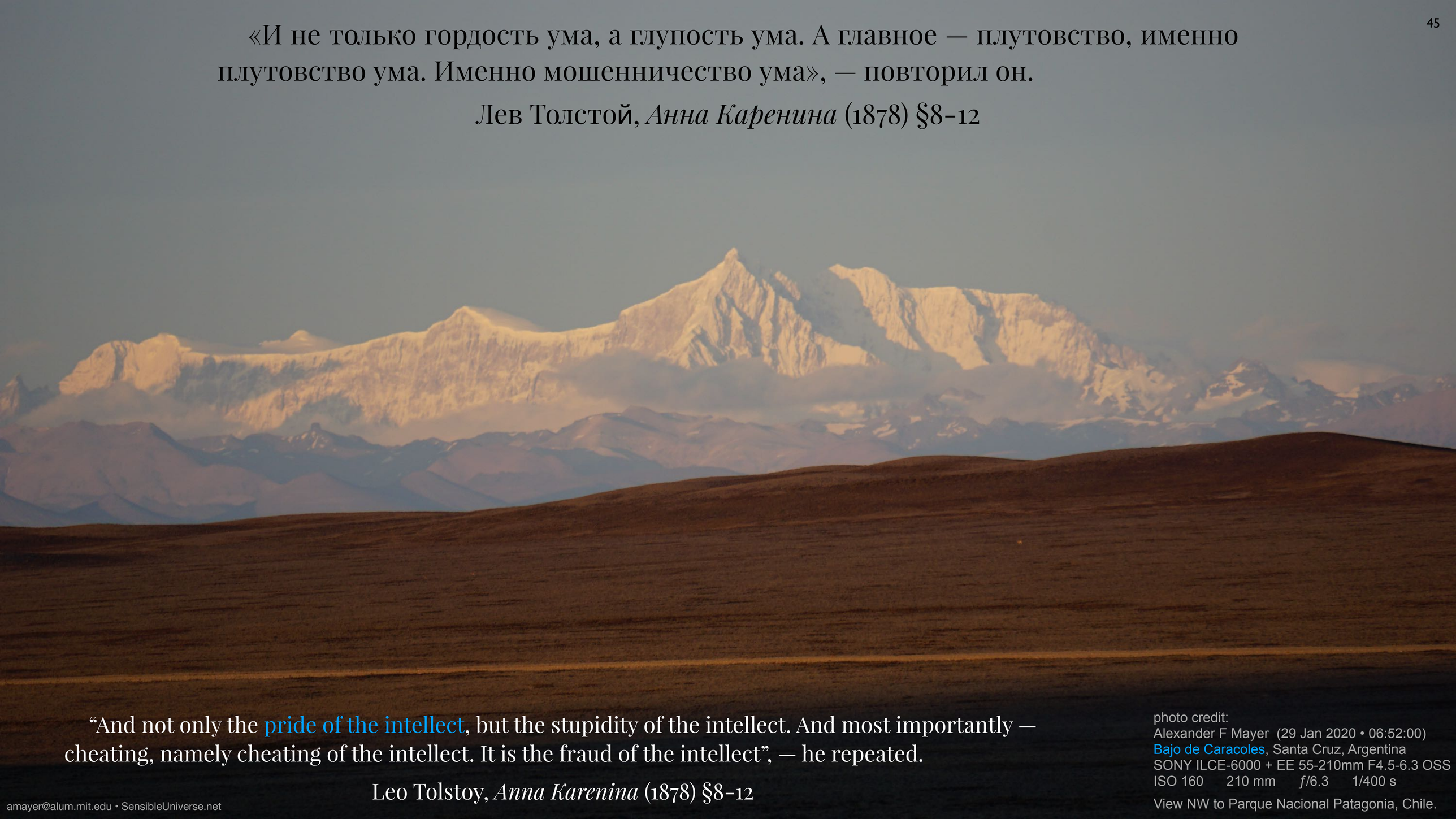
* (p. 50)

Re: 'dark matter' — GravitySim

"It may be wrong, but it's how I feel."

«И не только гордость ума, а глупость ума. А главное — плутовство, именно плутовство ума. Именно мошенничество ума», — повторил он.

Лев Толстой, *Анна Каренина* (1878) §8-12



"And not only the pride of the intellect, but the stupidity of the intellect. And most importantly — cheating, namely cheating of the intellect. It is the fraud of the intellect", — he repeated.

Leo Tolstoy, *Anna Karenina* (1878) §8-12

photo credit:
Alexander F Mayer (29 Jan 2020 • 06:52:00)
Bajo de Caracoles, Santa Cruz, Argentina
SONY ILCE-6000 + EE 55-210mm F4.5-6.3 OSS
ISO 160 210 mm *f*/6.3 1/400 s

View NW to Parque Nacional Patagonia, Chile.

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A man may imagine things that are false, but he can only understand things that are true, for if the things be false, the apprehension of them is not understanding.

★

Truth is ever to be found in simplicity, and not in the multiplicity and confusion of things.

– Isaac Newton

photo credit:
Alexander F Mayer (11 Mar 2024)
New Island (51° 42' S , 061° 16' W)
Apple iPhone 15 Pro Max – Telephoto Camera
ISO 50 312 mm ƒ/2.8 1/3344 s

Black-browed Albatross, >2 m wingspan

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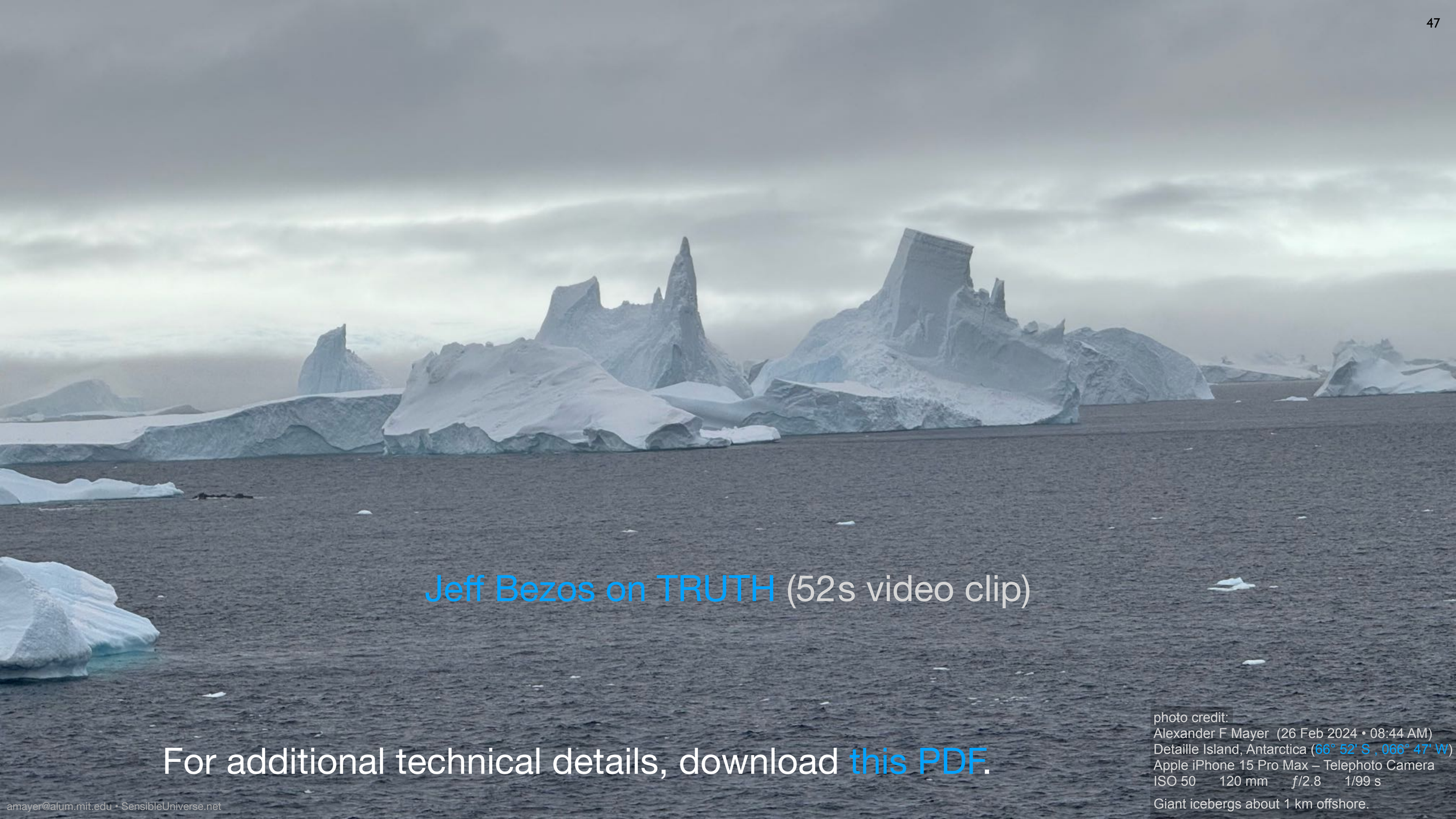

Jeff Bezos on TRUTH (52s video clip)

For additional technical details, download this PDF.

photo credit:
Alexander F Mayer (26 Feb 2024 • 08:44 AM)
Detaille Island, Antarctica (66° 52' S , 066° 47' W)
Apple iPhone 15 Pro Max – Telephoto Camera
ISO 50 120 mm ƒ/2.8 1/99 s

Giant icebergs about 1 km offshore.

This lecture is dedicated to the memory of

Sir Fred Hoyle, British Astronomer Royal

(1915–2001), English astrophysicist and writer. He was one of the proponents of the steady state theory of cosmology, and, mainly with US physicist William A. Fowler (1911–95), described the processes of nucleosynthesis inside stars.

It was Fred who flippantly coined the term "Big Bang", in poking fun at an unlikely theory of cosmic origins…

"Now, cosmology is supposed to be the *Queen of the Sciences* because everything has to fit under that umbrella. But, if cosmology is wrong, misinformation is being fed down to all of the sub-disciplines and sub-sub-disciplines with the result that the thing, as I said, 'Science is a mess.' And you'll notice also, common sense goes out the window immediately with the Big Bang."

– Wallace W. Thornhill (1942–2023)

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Cosmology / Logic / Antarctica / 2024

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* the truth

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Alexander F Mayer (6 Mar 2024)
South Georgia (54° 08' S , 036° 49' W)
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King Penguins at Anchorage Bay.

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