



Revisiting the Mixed-Signature Foundations of Special Relativity

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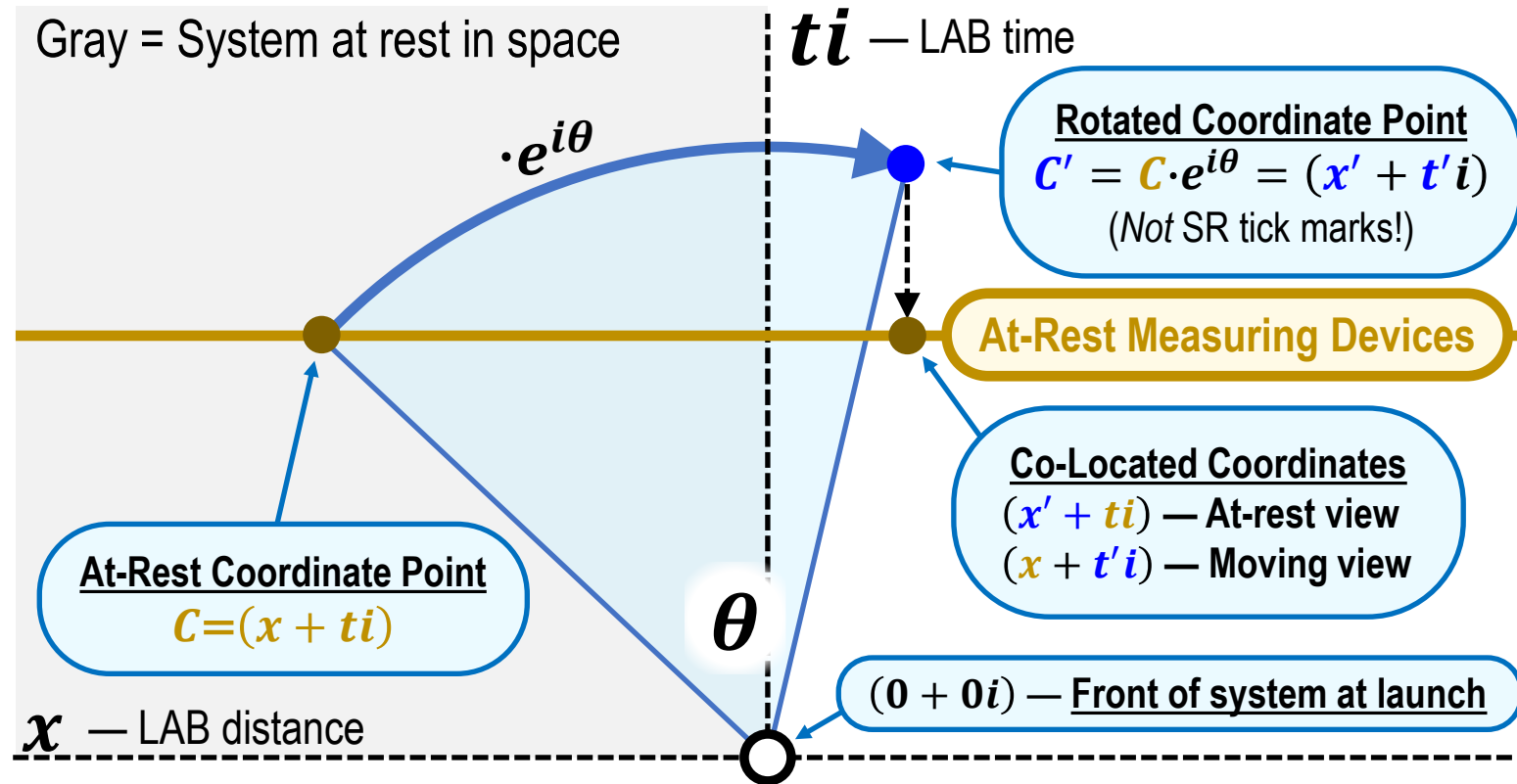
Overview

- The Minkowski formalism of special relativity has some difficulties:
 - It does not handle or predict large-scale, **multi-frame interactions** well
 - It does not model the process of **acceleration** with sufficiently specificity
 - Assertion: Using **mixed signatures** (+++ – for $xyzt$) **is not fundamental**
 - Minkowski space typically assumes that the existence of **spacetime is independent of matter** (and yes, that can be a problem)
- This presentation develops two new formalisms:
 - An intuitive **tilted-block formalism** that uses only Euclidean space
 - An unexpectedly simple **quantum-like phase rotation method** that predicts SR while also resembling quantum mechanics



Part I. An Unexpected Outcome

Complex Plane Relativity (CPR)



$$\mathbf{C}' = \mathbf{C} \cdot e^{i\theta} = (\mathbf{x}' + t'\mathbf{i}) \quad \text{where} \quad \mathbf{x}' = \text{Re } \mathbf{C} \cdot e^{i\theta} \quad \text{and} \quad t' = \text{Im } \mathbf{C} \cdot e^{i\theta}$$

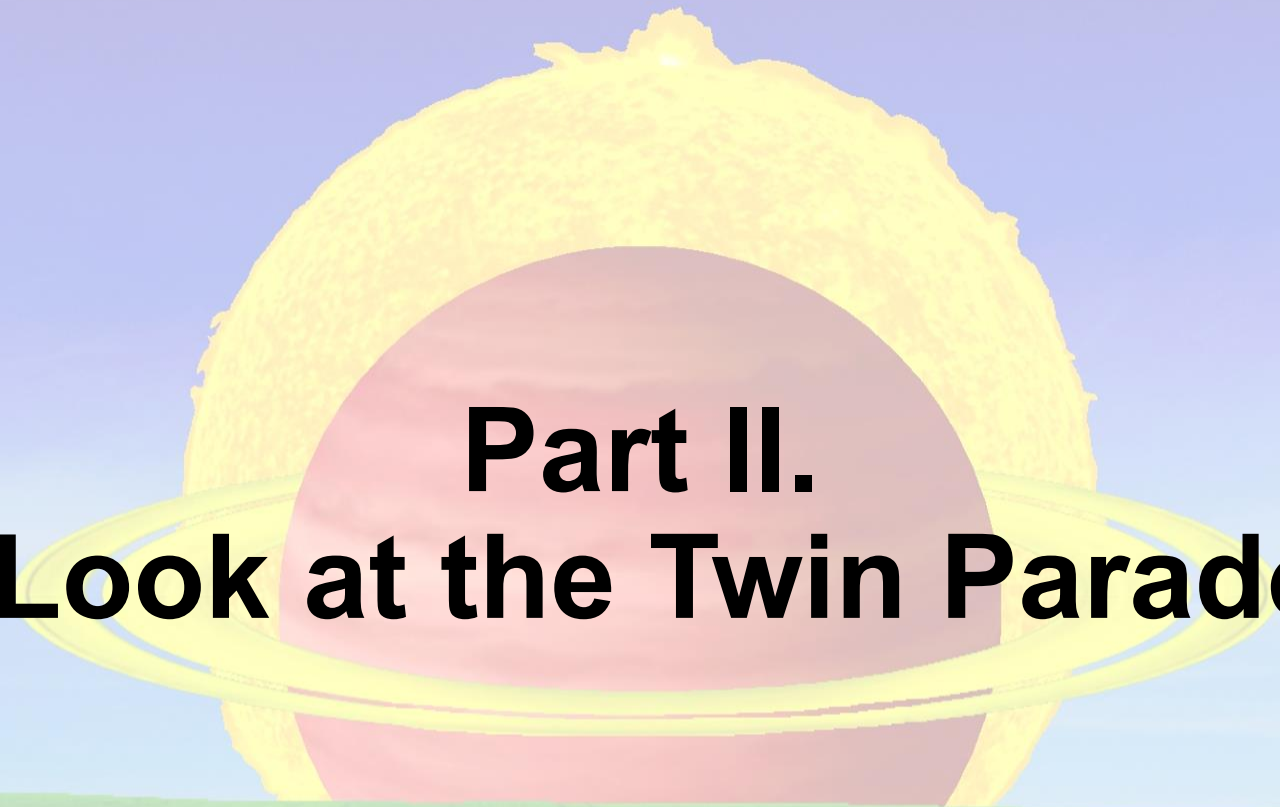
$$\mathbf{C}_R = \mathbf{C}_{Rest} = (\mathbf{x}' + t\mathbf{i}), \quad \mathbf{C}_M = \mathbf{C}_{Moving} = (\mathbf{x} + t'\mathbf{i}) = \mathbf{M}(\mathbf{C}_M)$$

A Few Implications of Complex Plane Relativity

- Inertial frame coordinates exist only in hierarchies
 - Inertial frames form in hierarchies centered on rotation points
 - Every new subframe *retains* the coordinates of its ancestor frame; its own values are only functions of those coordinates
 - Focusing *only* on identical physics within each frame ignores this important frame hierarchy
- Poincaré (and Lorentz) symmetries are local-only
 - These symmetries exist *only when created by matter systems*
 - The belief that symmetries exist *independently* of measuring devices creates an *illusion of universal spacetime*

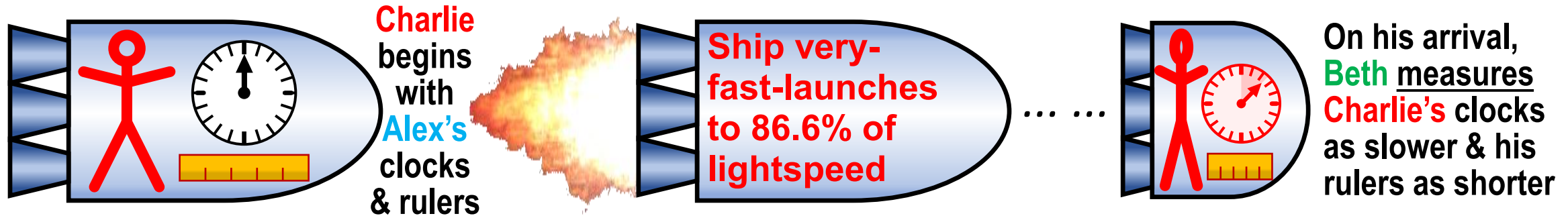
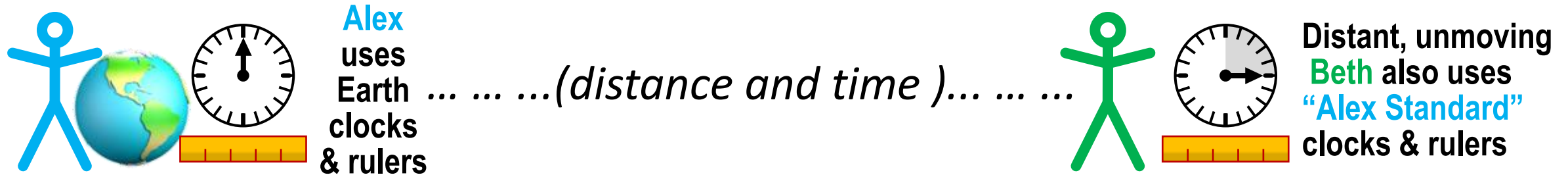
Assumptions in this Presentation

- **Einstein got it right** (but with a few very subtle math errors)
 - Every inertial frame has **identical physics** to every other inertial frame
 - No cheating by excluding extreme energies (no **“ultraviolet cut-offs”**)
- **Only direct contact** fully resolves the relative timing of events
 - **Distance** between entities *always* introduces **space-time ambiguity**
 - Only direct contacts can **irreversibly remove** such ambiguities
- Fine-grained, observer-owned **clouds of clocks** (from Einstein's *The Theory of Relativity*, 1911) **fully resolve complicated cases**
 - Einstein invented and first used clouds of clocks to **predict time dilation**
 - Fine-grained clouds give the observer a **fully Euclidean** interpretation (!)
- **Almost-instantaneous acceleration** is always feasible (muons)



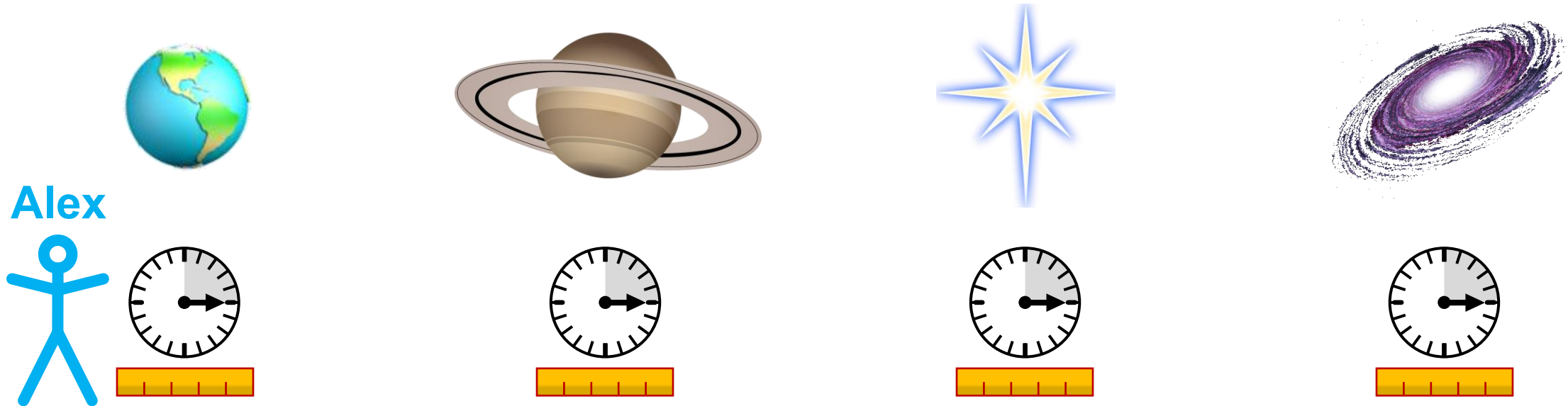
Part II. A Look at the Twin Paradox

Special Relativity Says: Speed Affects Clocks & Rulers



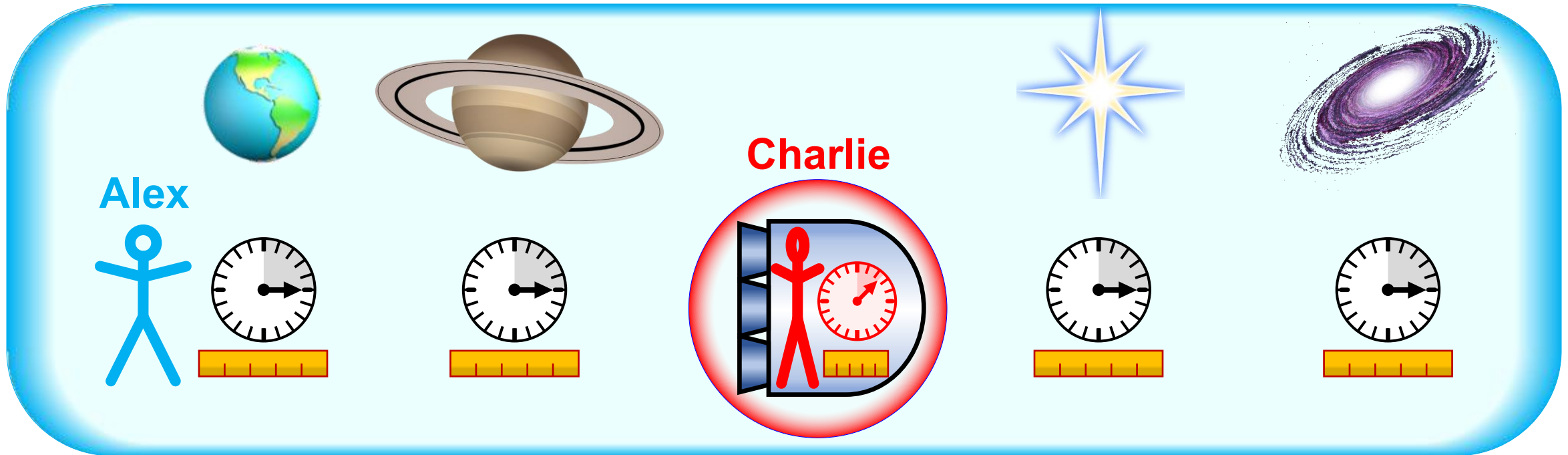
- If an object moves fast, special relativity says its:
 - **Clocks tick slower**, and
 - **Rulers are shorter** in the direction of motion
- At **86.6%** of lightspeed ($0.866 c$), both are **half their original values**

Vast Regions Can Share Similar Clocks & Rulers



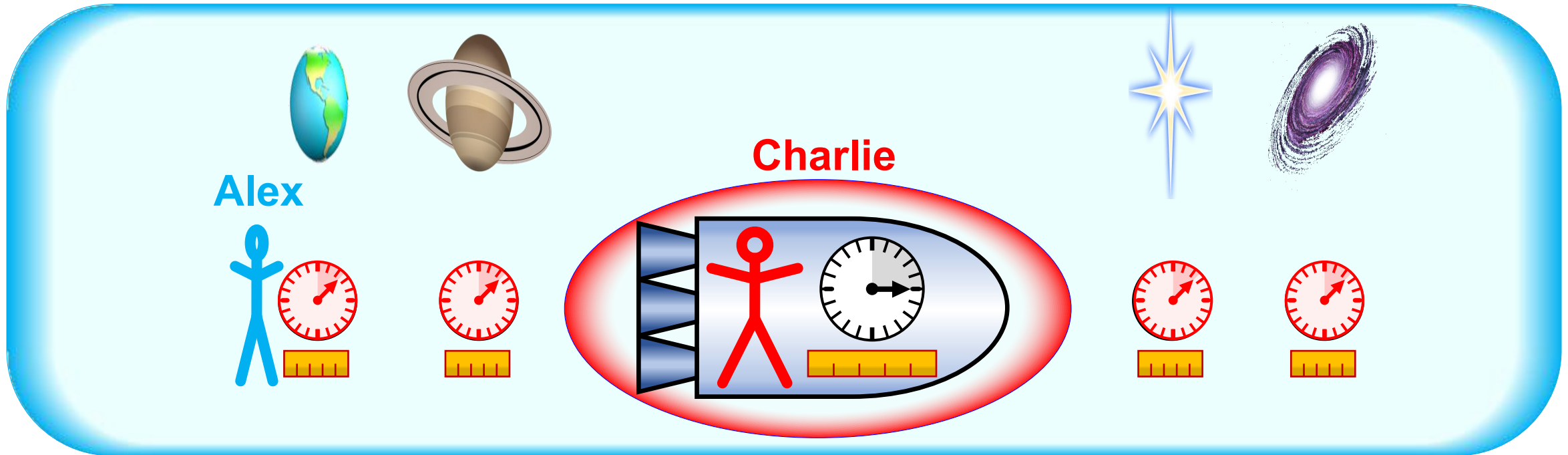
- Clocks and rulers that **move slowly relative to Alex remain similar**
- Distance makes no difference. **Only relative velocity counts.**
- This means **Earth's “rest frame”** of similar clocks and rulers is **enormous**, including **planets**, **stars**, and even **distant galaxies**

Fast Spaceships Have Unique Clocks and Rulers



- Clocks & rulers on Charlie's fast-moving ship **disagree** with Alex-standard ones
- When Charlie's clock **passes an Alex-standard clock**, the Alex-standard clock always measures an **increasing loss of time for Charlie** (relativity is lost)
- Einstein used clock comparisons (*not* acceleration) to **predict time dilation**

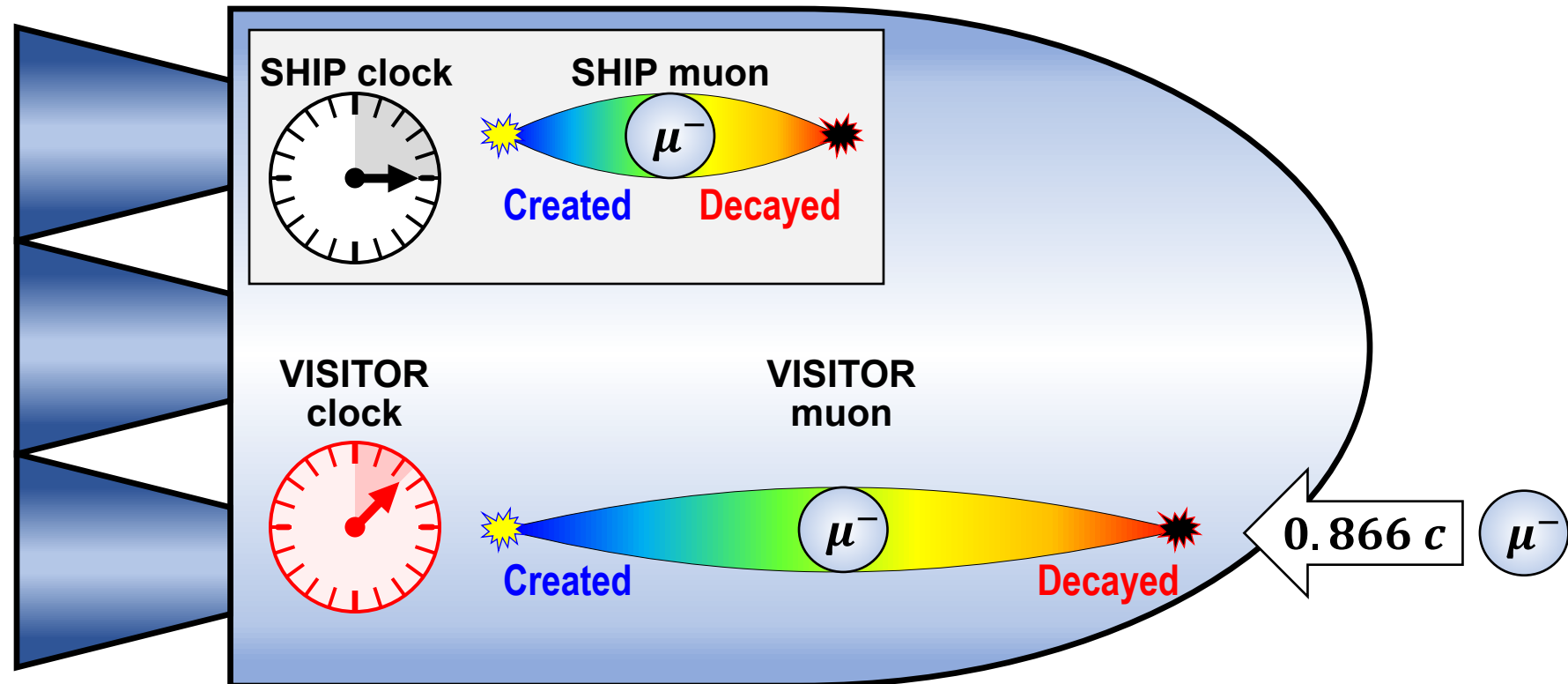
So Where Is the Paradox?



- **We're not done yet!** Special relativity also says: **Charlie's clocks and rulers are as "fundamental" as those of any outside observer**
- This means **Charlie should also measure time losses & shorter rulers** when viewing Alex's clocks & rulers, no matter where they reside in the universe
- This symmetry between Alex and Charlie is called the **Poincaré Symmetry**

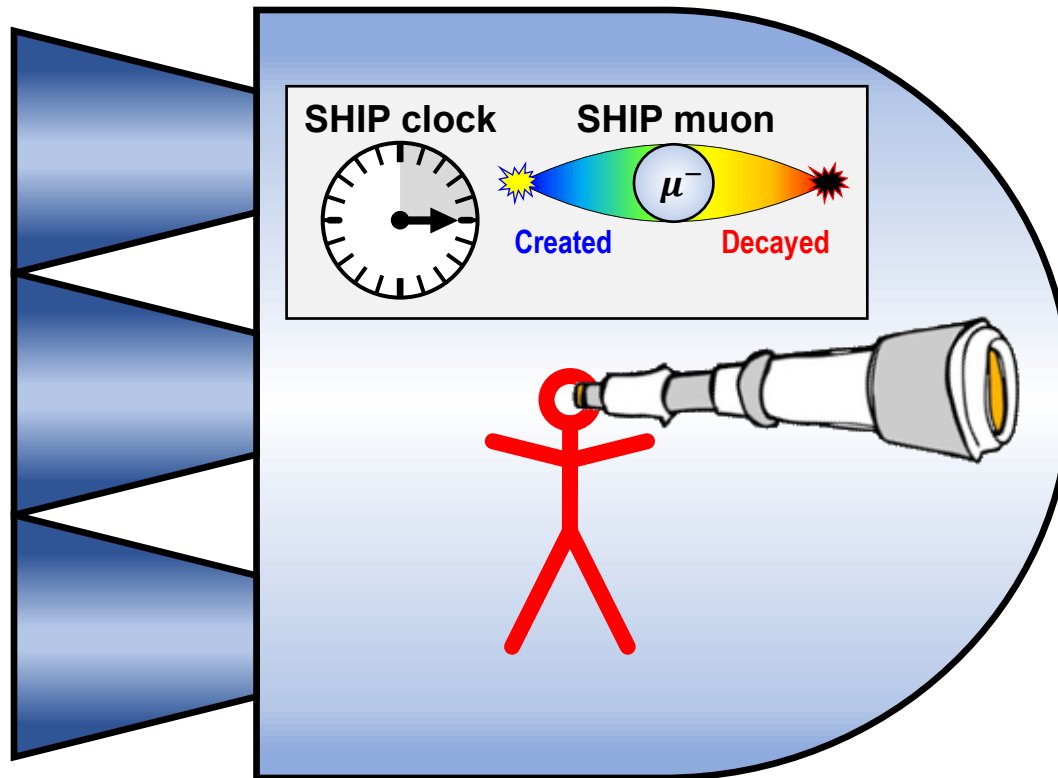
Poincaré Confirmed! Visiting Muons Decay Slower

- All experiments done inside the ship confirm Poincaré!
- VISITOR muons (“particle clocks”) from outside decay at **0.5 the rate** of motionless muons created inside the ship (SHIP muons)

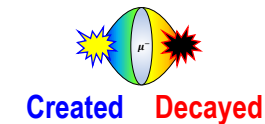


Poincaré Contradicted! Muons in Front Decay Faster

- Forward observations **contradict Poincaré**
- Muons in front of the ship (FRONT muons) **decay at 3.732 times the rate** of SHIP muons (almost 4 times faster)



FRONT muon

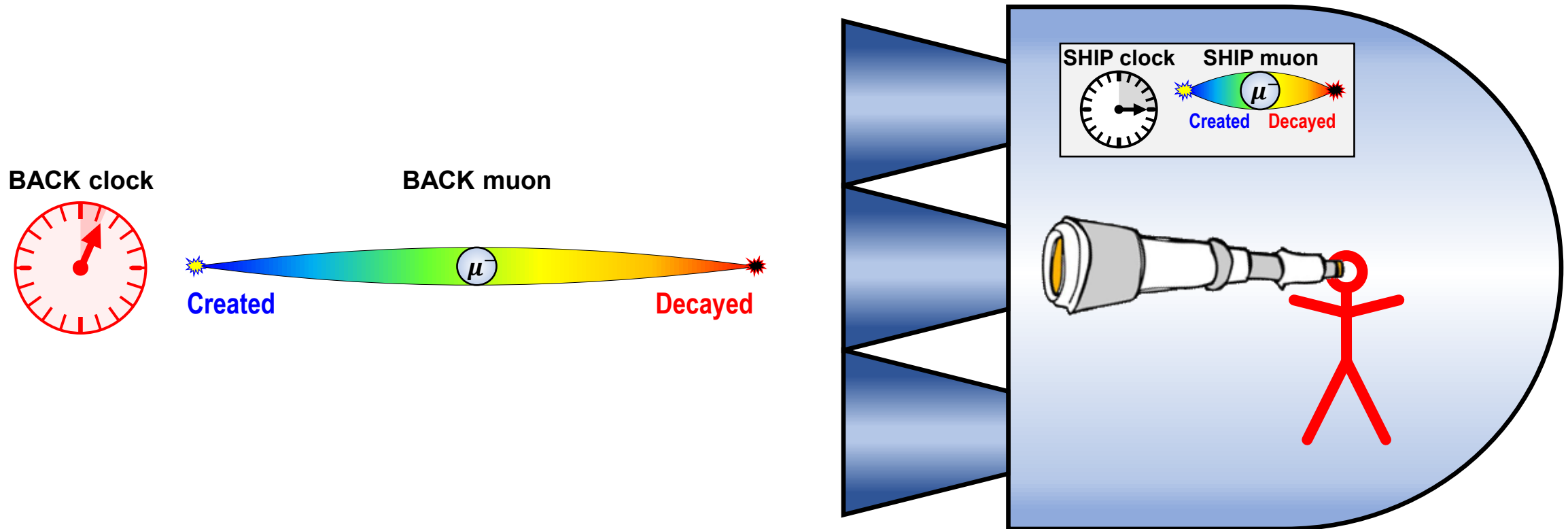


FRONT clock



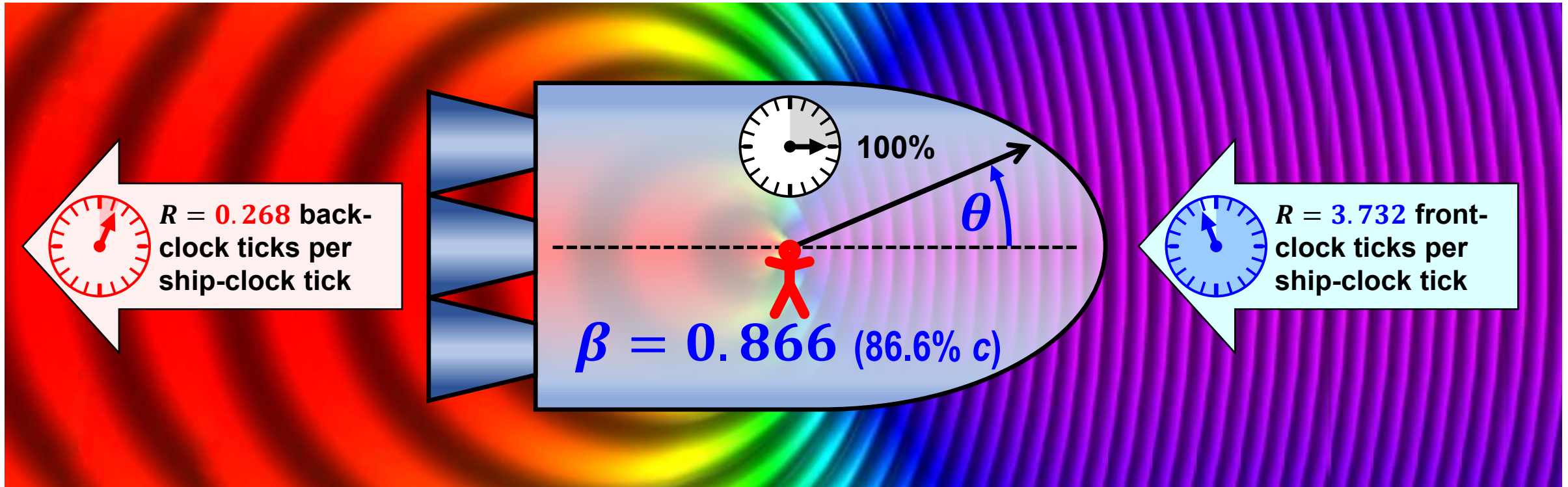
Poincaré Contradicted! Muons in Back Decay Slower

- Backward observations also **contradict Poincaré**
- Muons behind the ship (BACK muons) **decay at 0.268 times the rate** of SHIP muons (almost 4 times slower)



What Is Going On? Think Ambulance Sirens

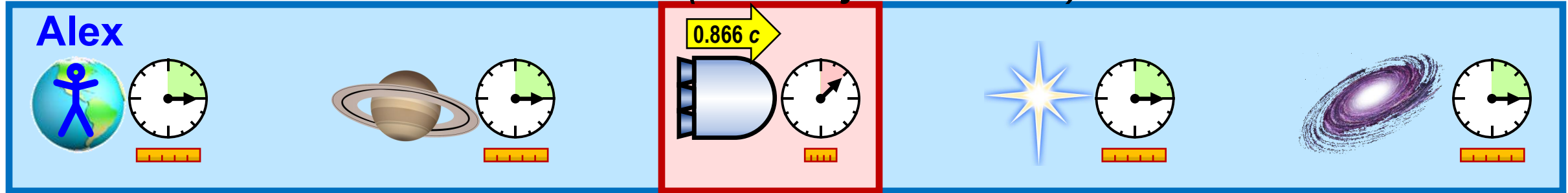
- Outside the ship, time follows **Relativistic Doppler rules**
- The full equation is: $R(\beta, \theta) = \sqrt{1 - \beta^2} / (1 - \beta \cos \theta)$



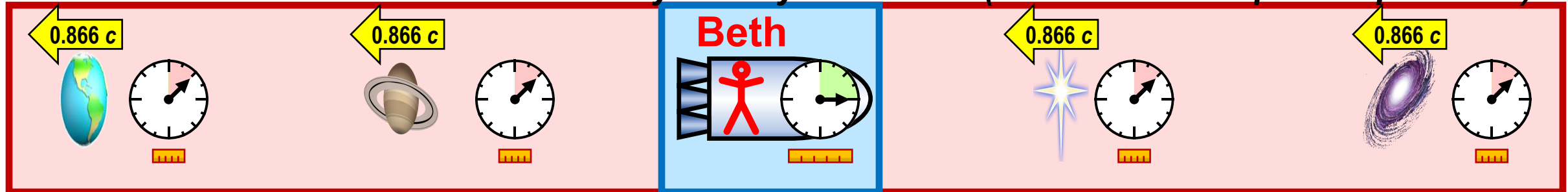
Relativistic Doppler background by TxAlien, CC BY-SA 3.0 (Wikimedia Commons)

Traditional Symmetry Groups Ignore Boundaries

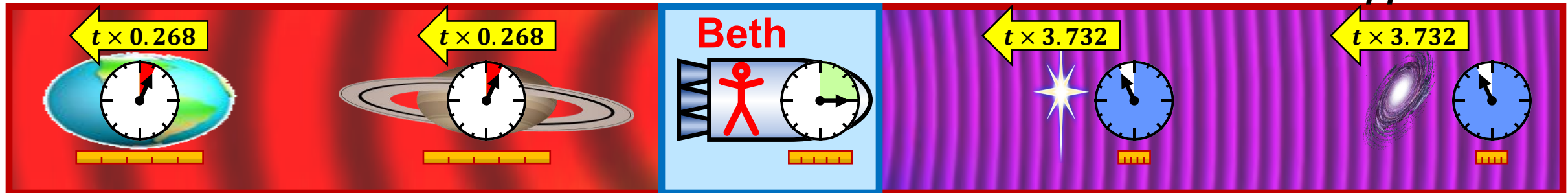
Einstein's 1911 Time-Dilation Prediction (extremely well-verified)



Einstein's 1905-1907 Exact Poincaré Symmetry Prediction (no resolution equation provided)

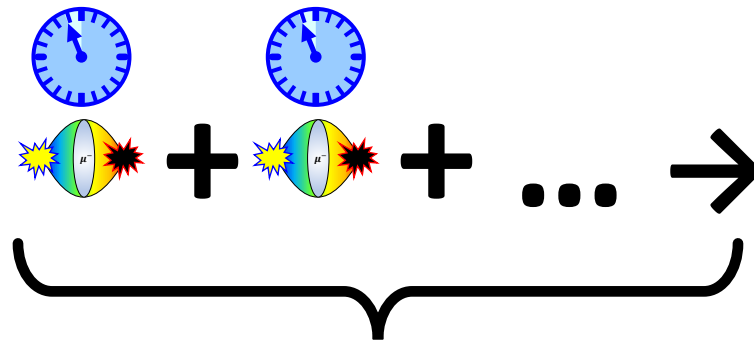
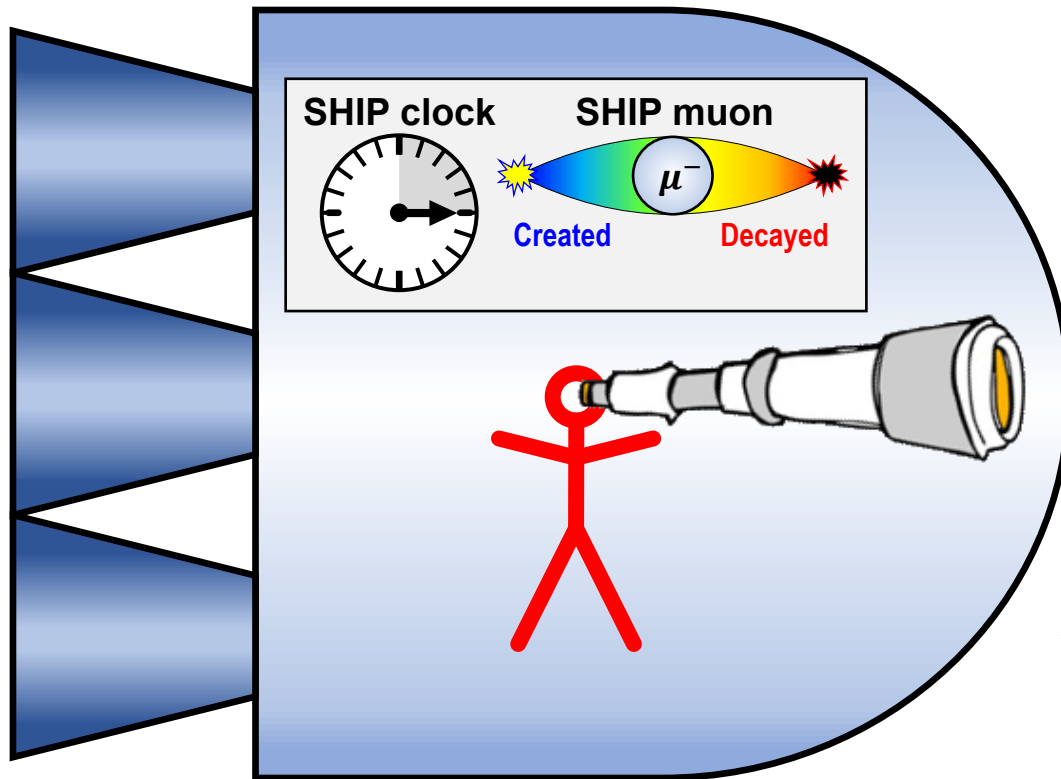


Observed Behavior: Local Matter-Bound Poincaré Bubble in a Vast Relativistic Doppler Sea

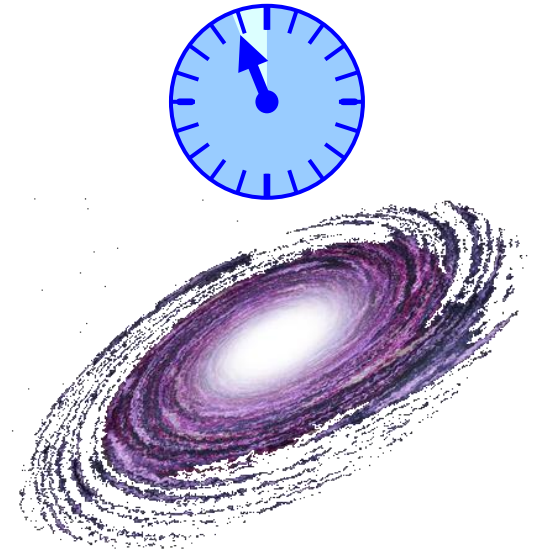


But Terry, This is Just Blueshift, Not Time! Right?

- **Nope.** What light encodes **cannot be forgotten**; it becomes history.
- On arrival, **the final clock must match the individual speedups**

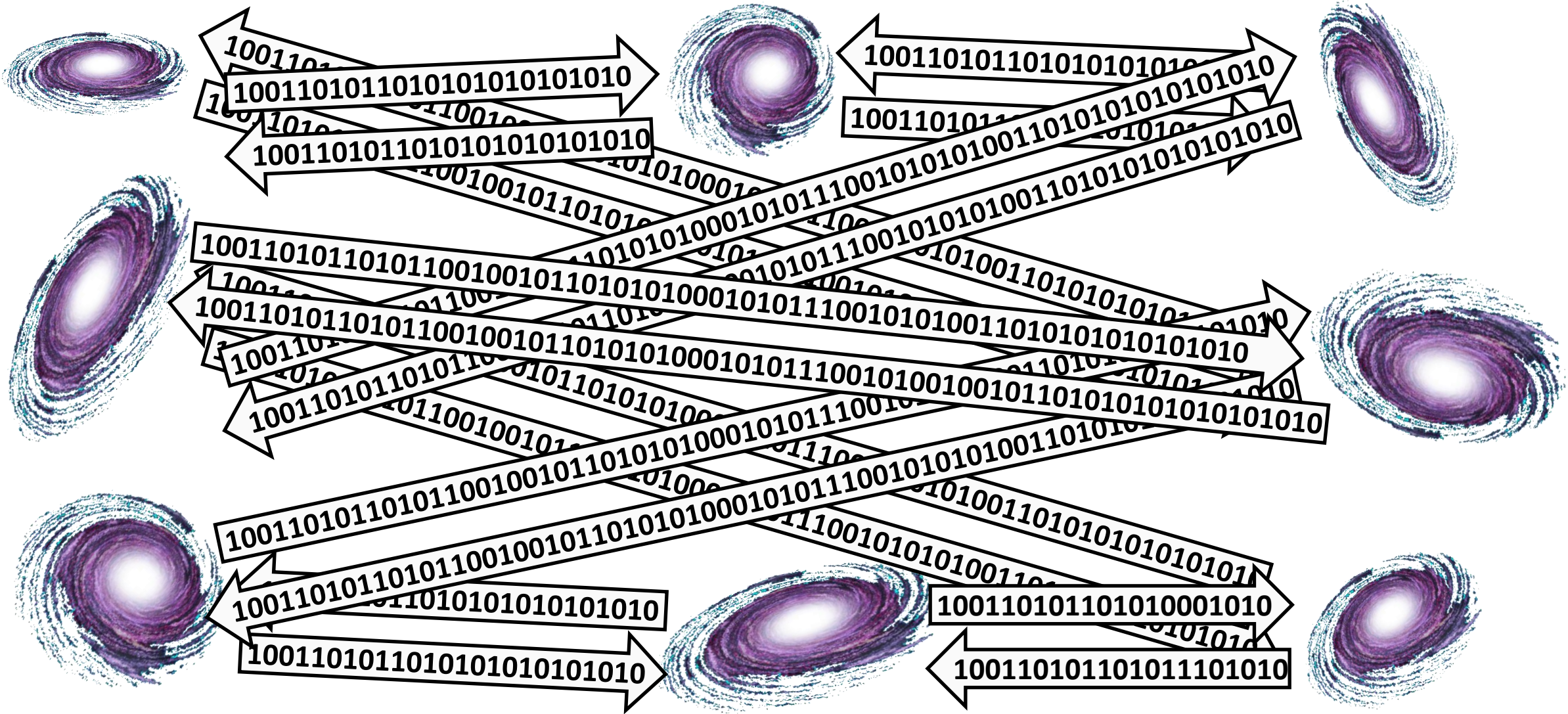


Adding individual speed-ups along the path requires the destination clock to match



Andromeda Destination

The Cosmic Photon Database of No Less Than 10^{84} Bits



Causality Implications of the Cosmic Photon Database

- Once light is emitted into the vacuum, history has been created
- It *does not matter* whether you have seen the data yet
 - The photon data is now stored in the cosmic photon database (CPD)
 - The CPD behaves as an observer of that past
 - Ironically, quantum uncertainty only impacts *where* that data finally lands
- Alternatives:
 - You can invoke a “universal quantum wave function” and assert none of this is happening until an observer “sees” the photons
 - The result is philosophical, not observational; *we only observe in time*

Resolution: There Are Two Symmetries in Play

The Poincaré symmetries only apply inside a **constructed** Poincaré “bubble” that moves through a **vastly larger** **interpretive** symmetry space

Poincaré Bubbles

(PBs) emerge *after* manually **altering** components. Only cooperating items “see” this “isotropic” symmetry.



Relativistic Doppler

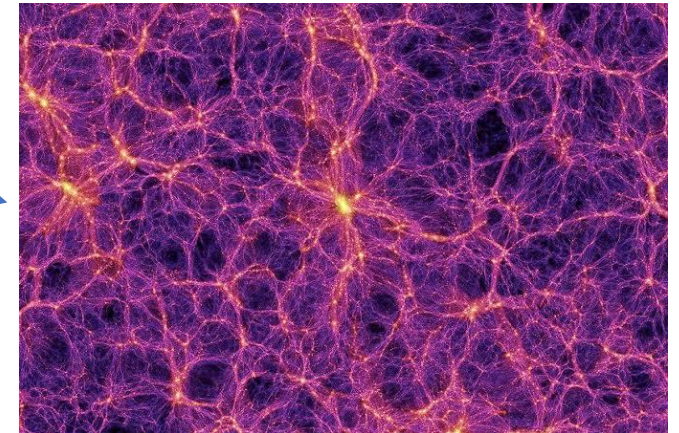
symmetries apply to all *regions* outside the bubble. They are **interpretive only**, so they do not alter the outside world.

Is There a Poincaré “Bubble of All Bubbles”?

- Acceleration — creating a Poincaré Bubble or PB — is messy. It’s *not* a simple scalar “boost.”
 - Particle PBs form instantaneously. The algebraic boost model works well for these simple cases.
 - Cosmic web PBs require billions of years to form, if they form at all. (This impacts dark matter theory.)
- PB creation, evolution, and termination always stay **fully visible** within the larger and faster originating PB. (Analogy: Spaces in games.)
 - Poincaré Bubbles have **multiple usable applicable coordinates**: Local only, **Latest Ancestral Bubble** (LAB), or **First Ancestral Bubble** (FAB = CMB),
 - FAB “bubble of all bubbles” **enables universal time** (no “block” universe).

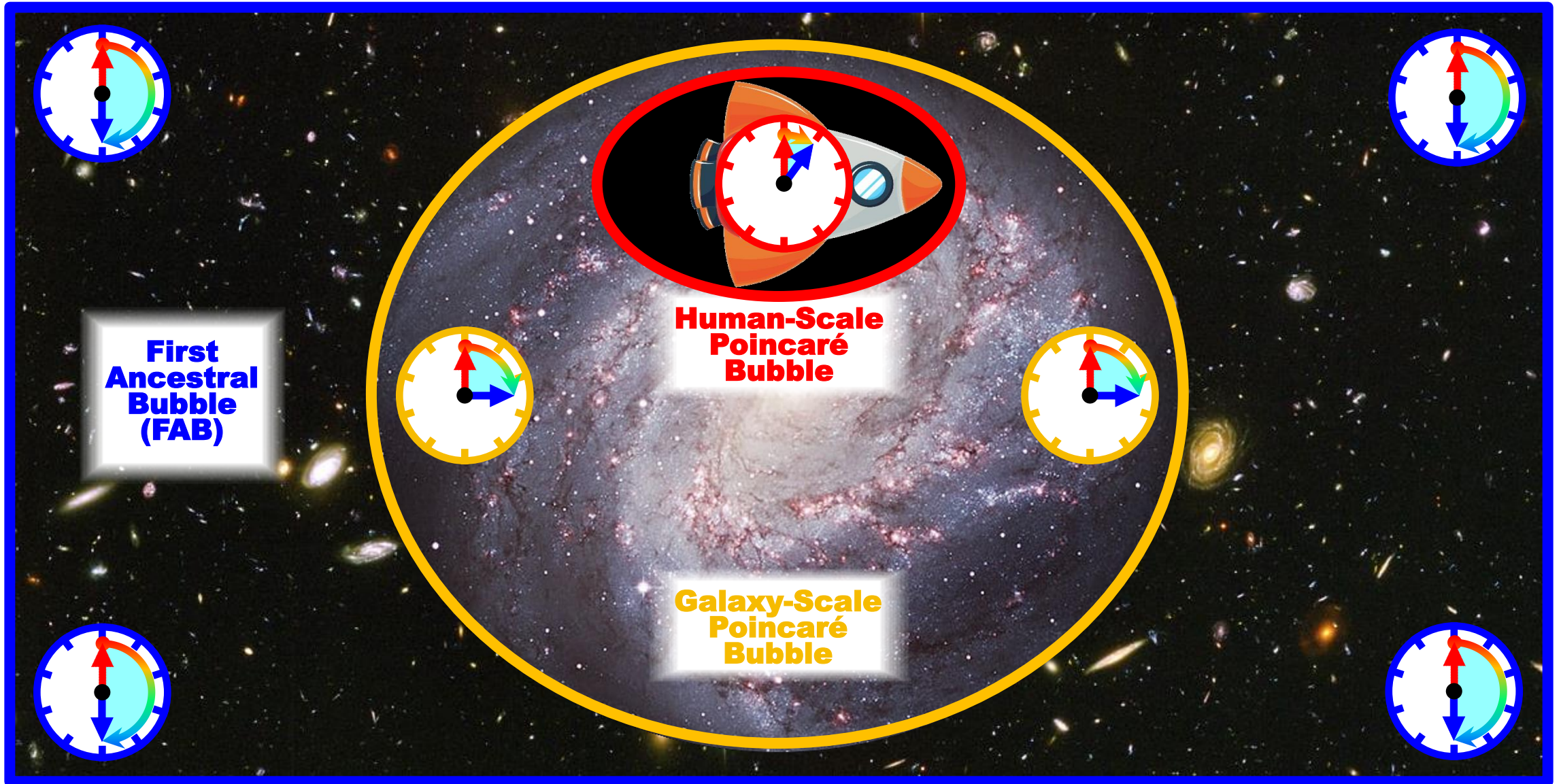


Kebuk Awan, CC BY-SA 4.0

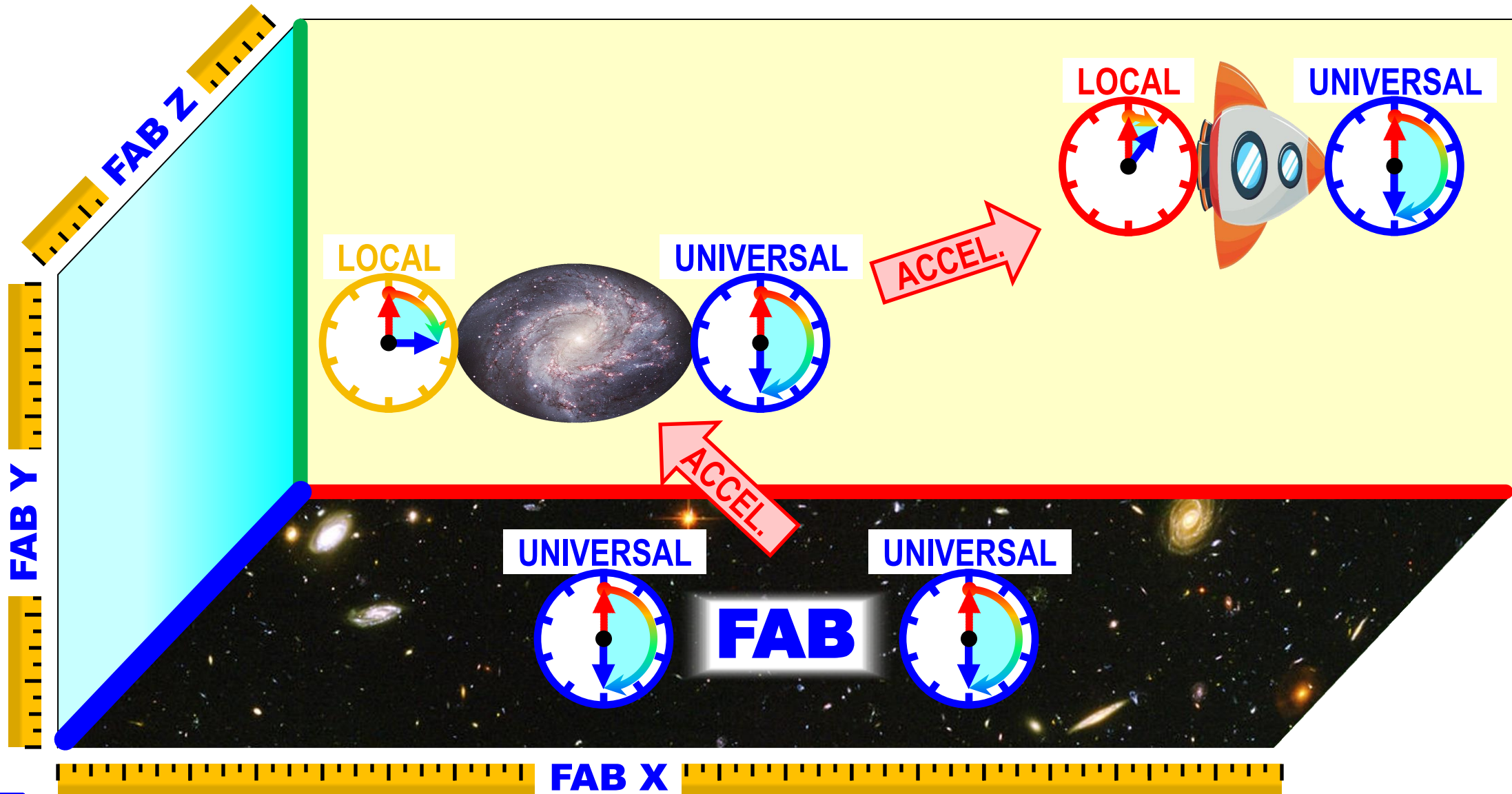


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The Poincaré Bubble Hierarchy: Biggest, Oldest = Fastest

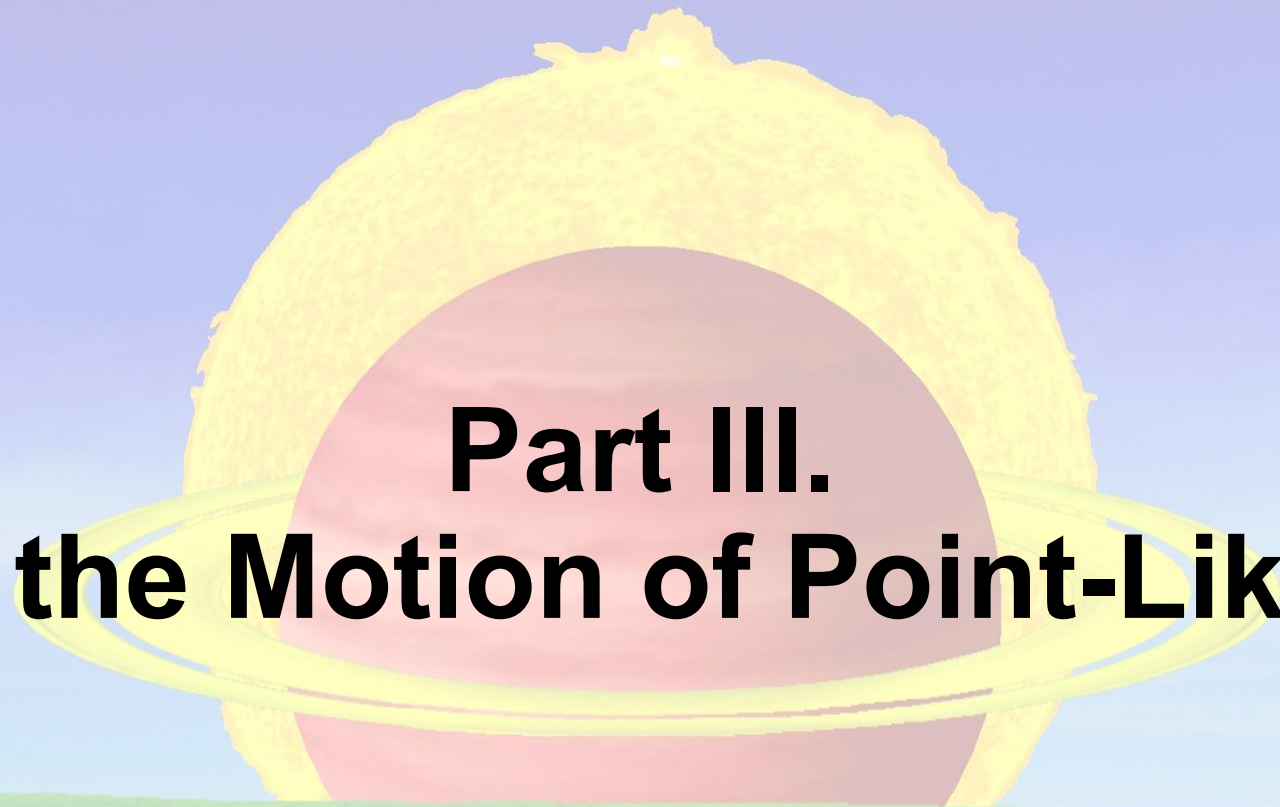


Universal First Ancestral Bubble (FAB) Coordinates



Why Don't Textbooks Address Poincaré Locality?

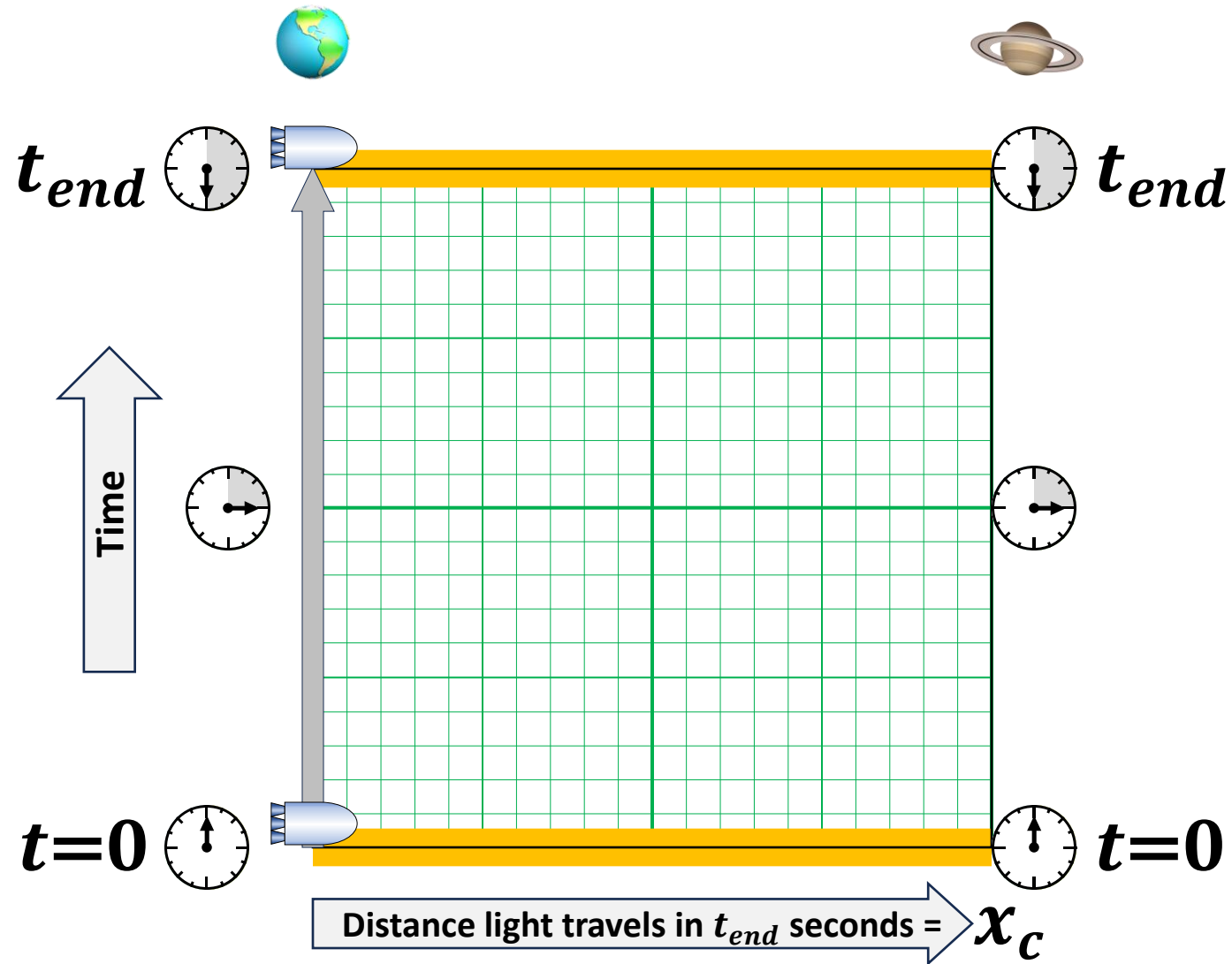
- Overextending the ranges of the Poincaré Symmetries dates back to Einstein (multiple **minor math errors in 1907, 1911**)
- Excessive reverence caused the next century to brush off known corrections (e.g., in GPS satellites) as “**engineering details.**”
- The infinities-friendly Hilbert school inadvertently worsened this **assuming all math symmetries have infinite ranges** (violates c)
- Physically meaningful symmetries fall into two categories:
 - **Constructed symmetries** (bubbles) require *altering material objects*
 - **Interpretive symmetries** (spaces) change only *how you interpret data*
- **Constructed symmetries can expand only at up to lightspeed**



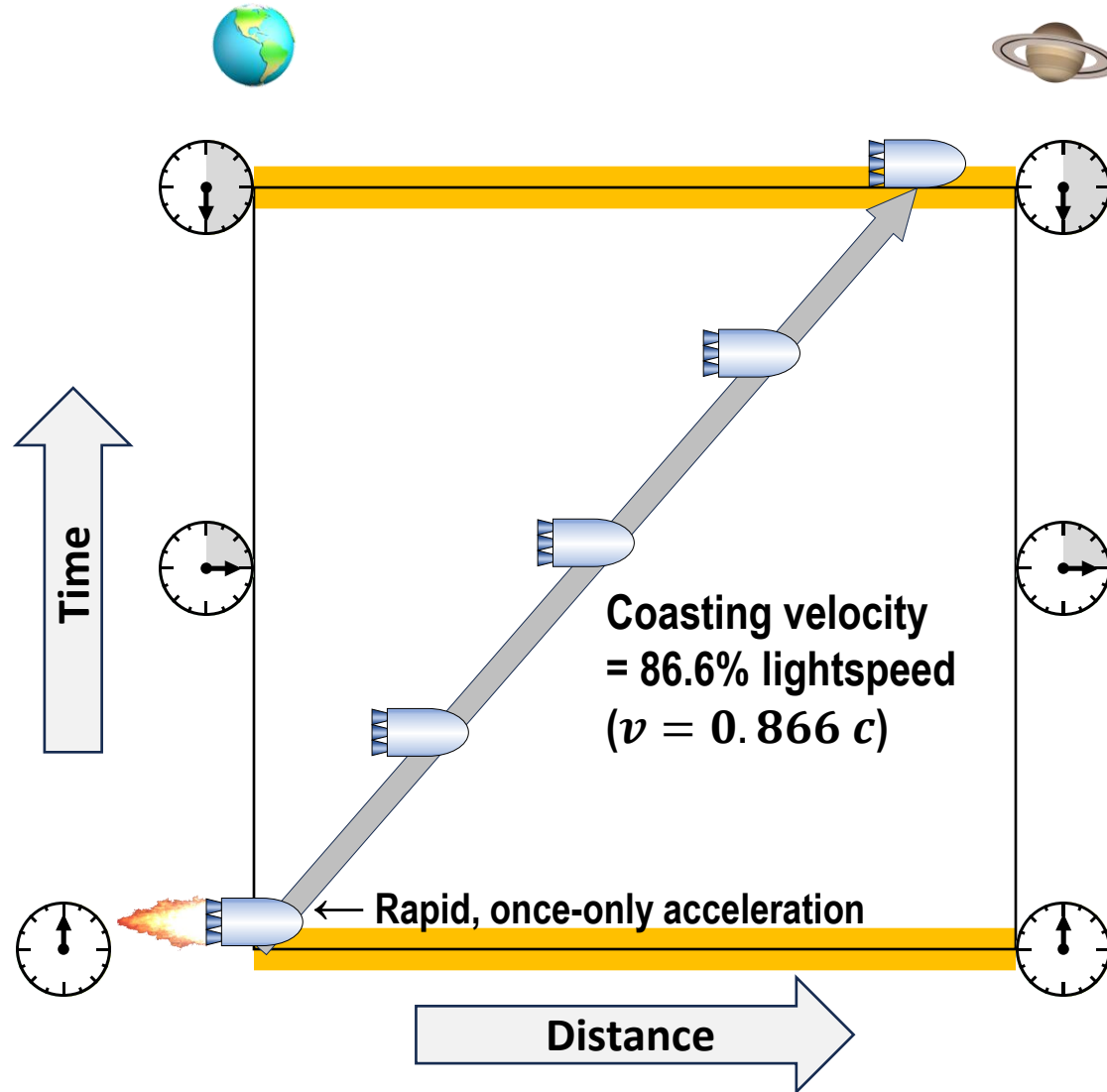
Part III.

Modeling the Motion of Point-Like Objects

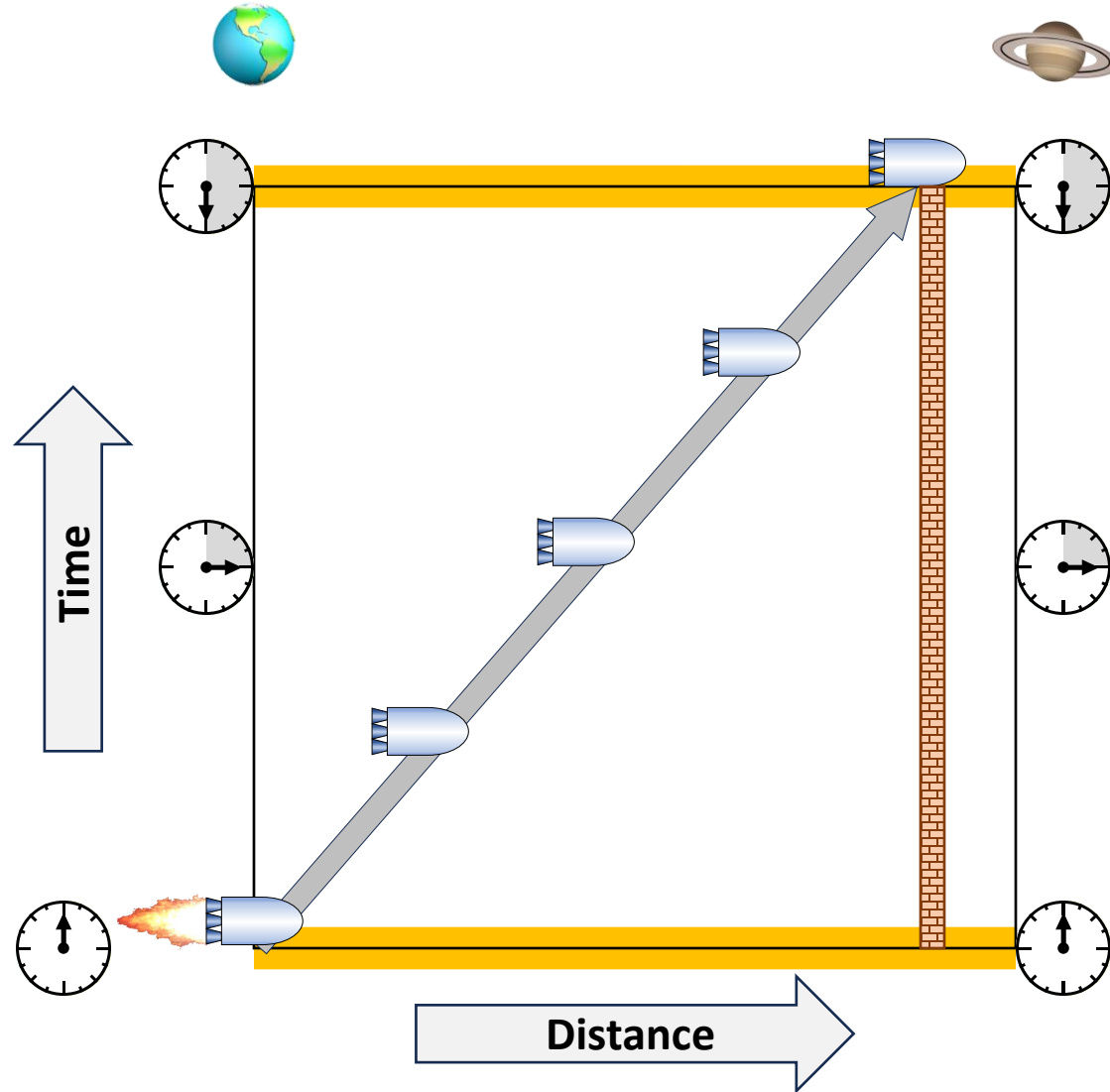
(1) Draw a Square with Equal-Size Time and Distance Units



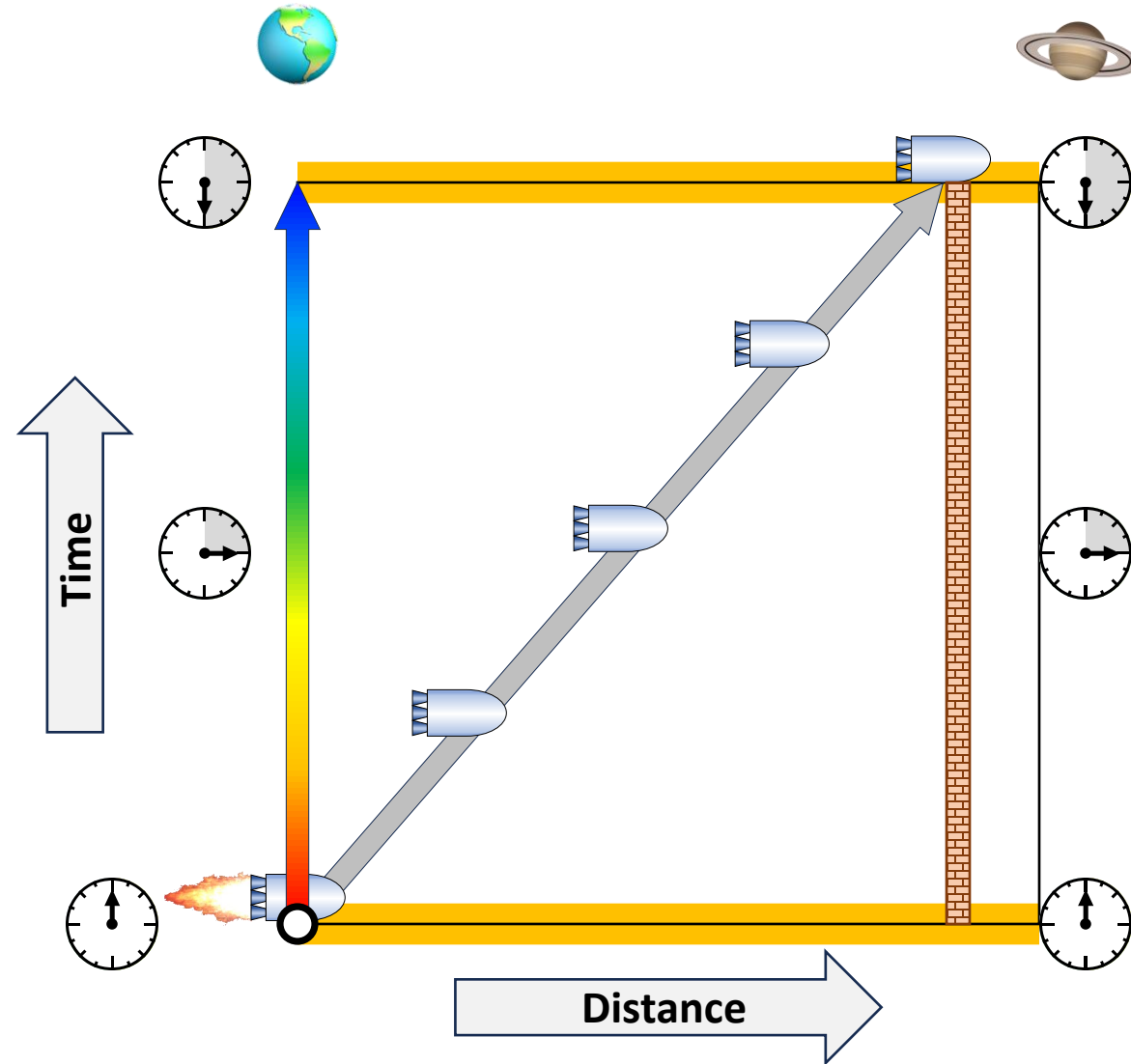
(2) Fast-Launch the Ship, Then Let It Coast to the End



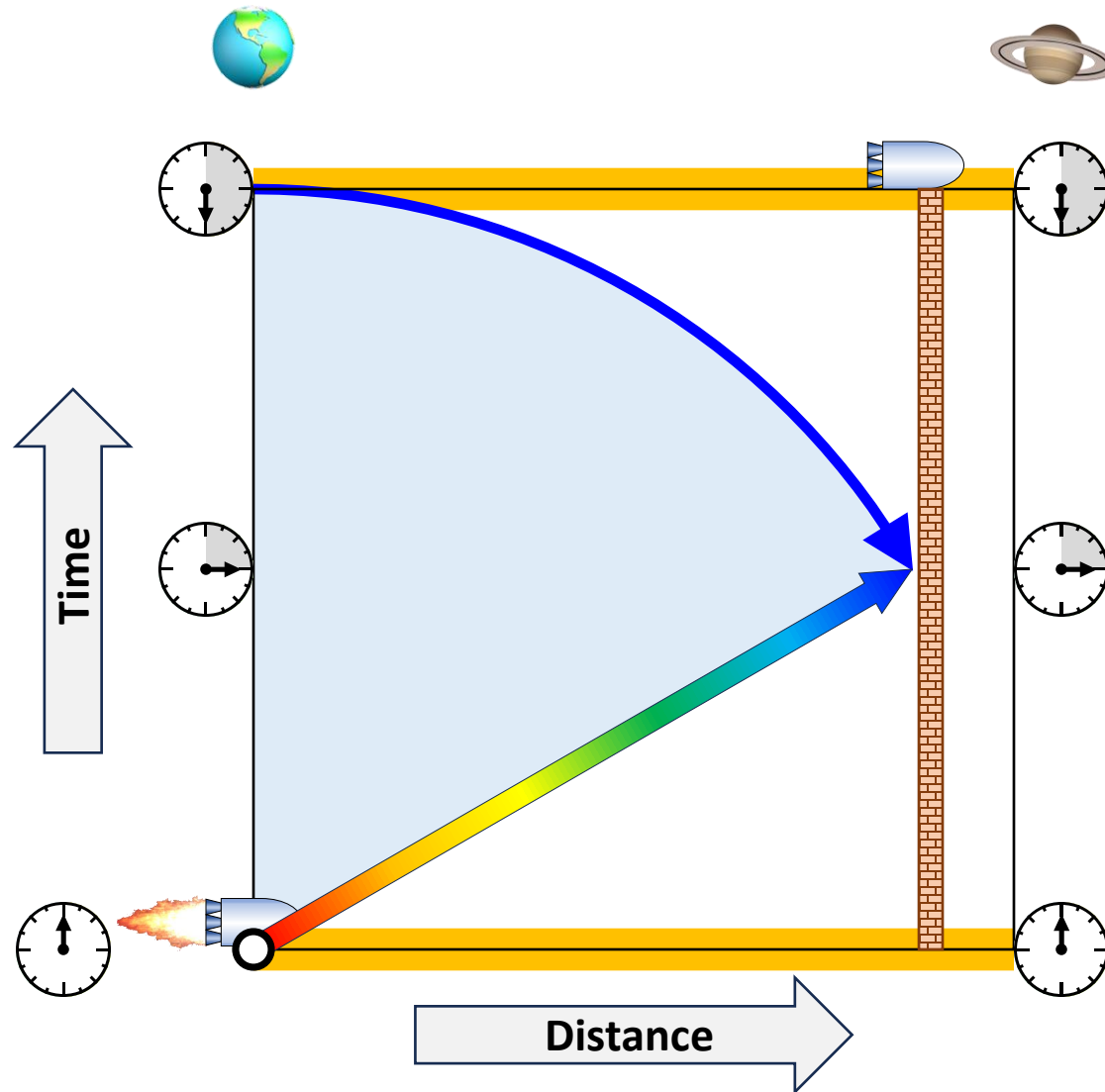
(3) Drop a Vertical “Wall Line” from Journey’s End



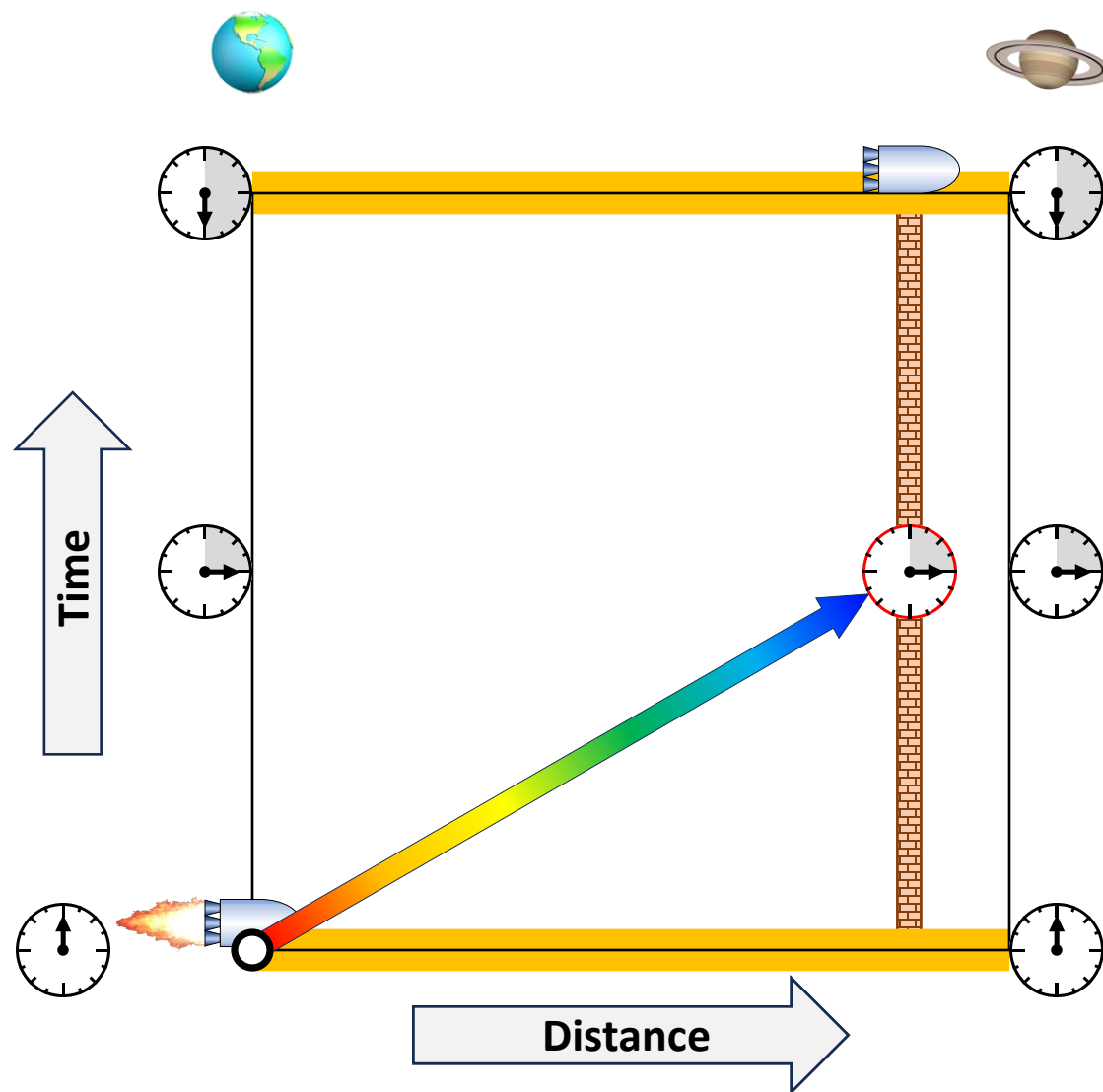
(4) Draw a Rigid *Invariant Edge* Over the Time Axis



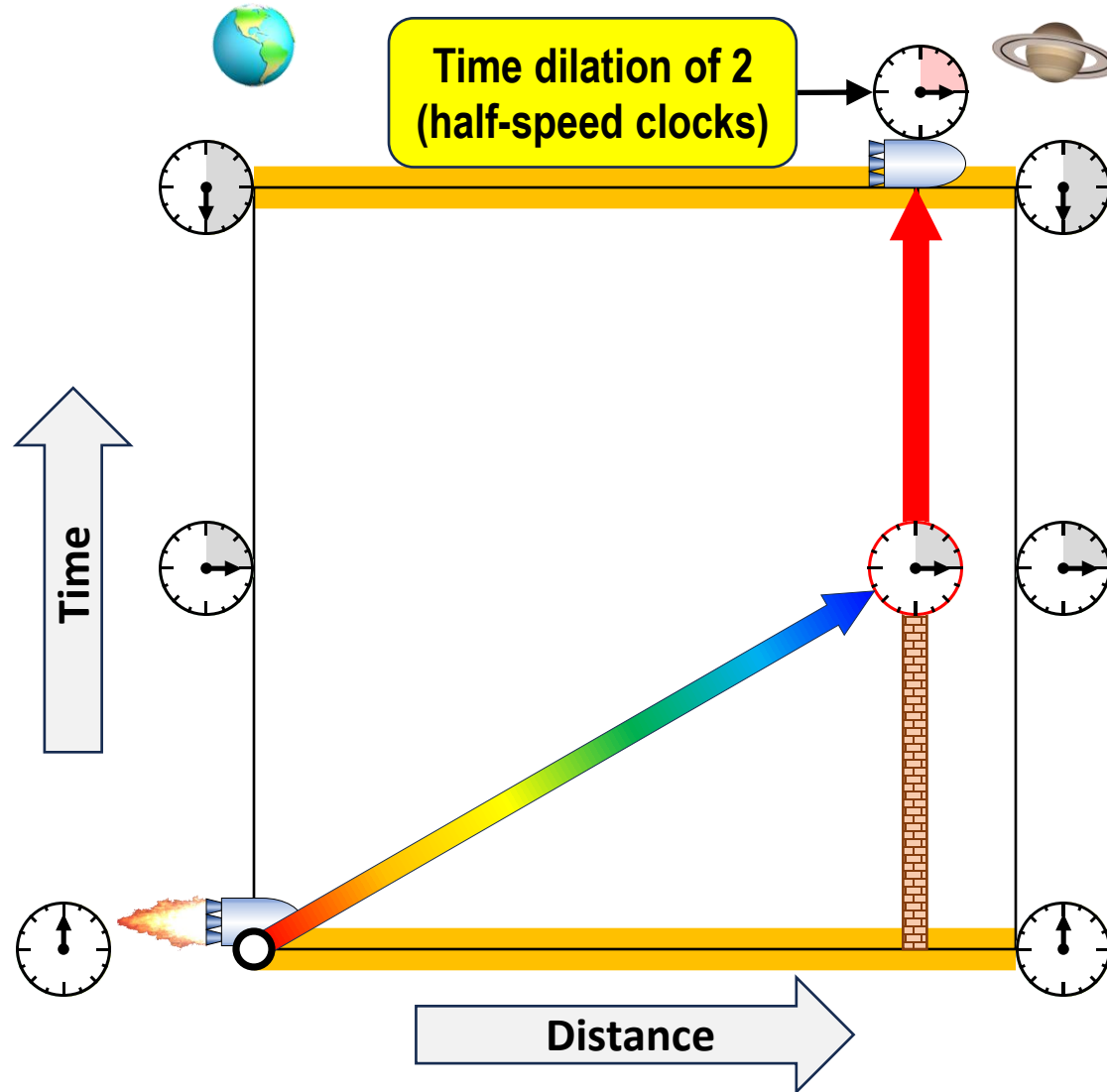
(5) Let the Invariant Edge Fall Until It Hits the Wall



(6) Read the Time at the Hit Point



(7) Copy that Time to the Ship to Get its Final Time Dilation



Why Does this Method Work?

Experimental givens

c in m/s , $0 < c$

v in m/s , $0 \leq v \leq c$

t in s , $0 < t$ ($t_e = t$)

From special relativity

$\beta = v/c$

$\gamma = 1/\sqrt{1 - \beta^2}$

Geometries

$x = vt$

$x_c = ct$

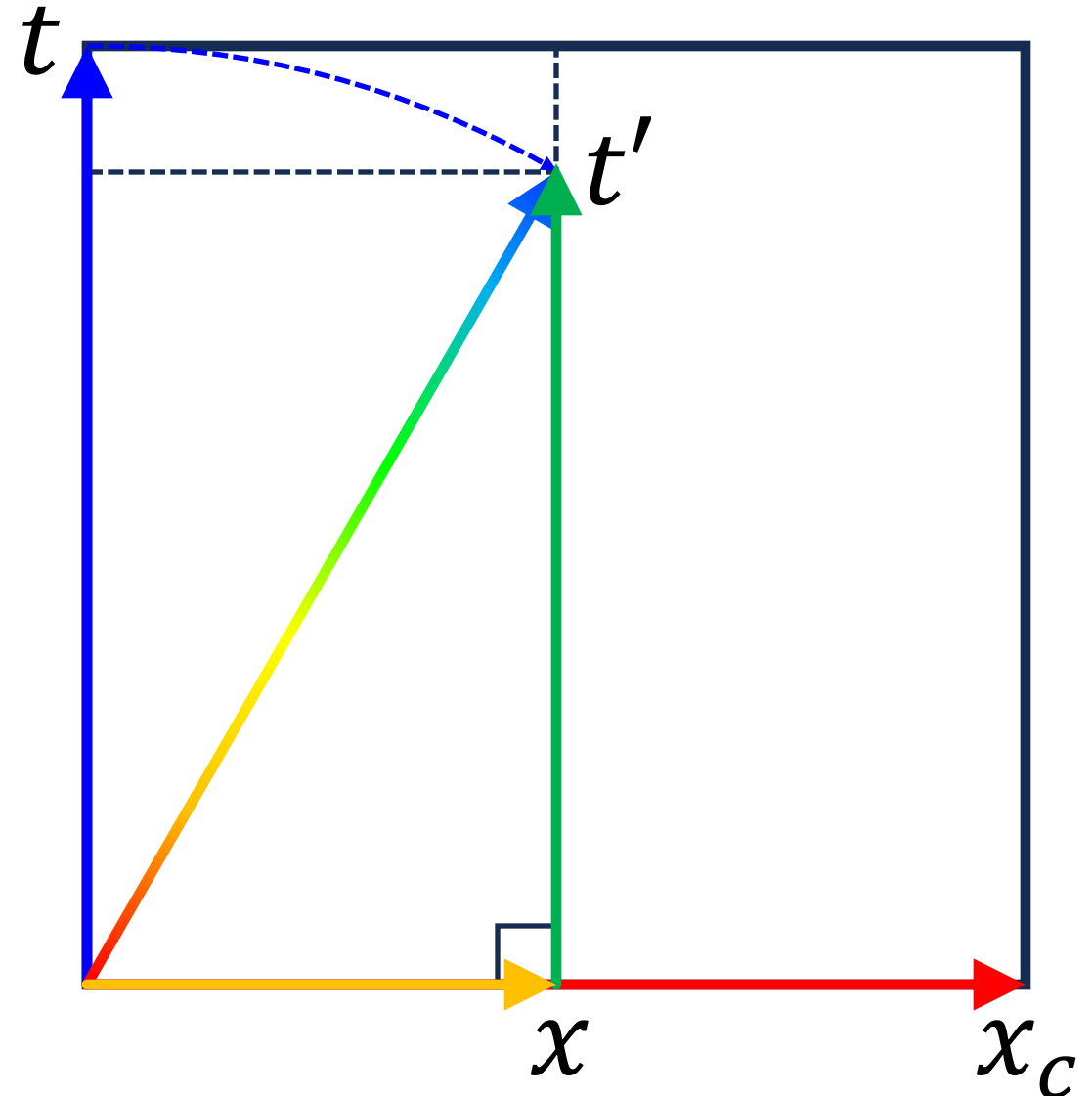
$t' = at$

Derivation of a

$$\begin{aligned} a &= \sqrt{1 - (x/x_c)^2} \\ &= \sqrt{1 - (vt)^2/(ct)^2} \\ &= \sqrt{1 - (v/c)^2} \\ &= \sqrt{1 - \beta^2} = 1/\gamma = \gamma^{-1} \end{aligned}$$

Conclusion

$t' = \gamma^{-1}t$ (same as in special relativity)



Special Relativity as Sines and Cosines

Experimental givens

c in m/s , $0 < c$

v in m/s , $0 \leq v \leq c$

$t = \hat{t}$ in s , $0 < t$

From special relativity

$\beta = v/c$

$\gamma = 1/\sqrt{1 - \beta^2}$

Geometries

$x = vt$

$x_c = ct$

$t' = t/\gamma = t\gamma^{-1}$

theta ($0 \leq \theta \leq 90^\circ$)

$\theta = \tan^{-1}((x/x_c)/(t'/t))$

$= \tan^{-1}(\beta/(1/\gamma))$

$= \tan^{-1}(\beta\gamma)$

$= \tan^{-1}(\beta/\sqrt{1 - \beta^2})$

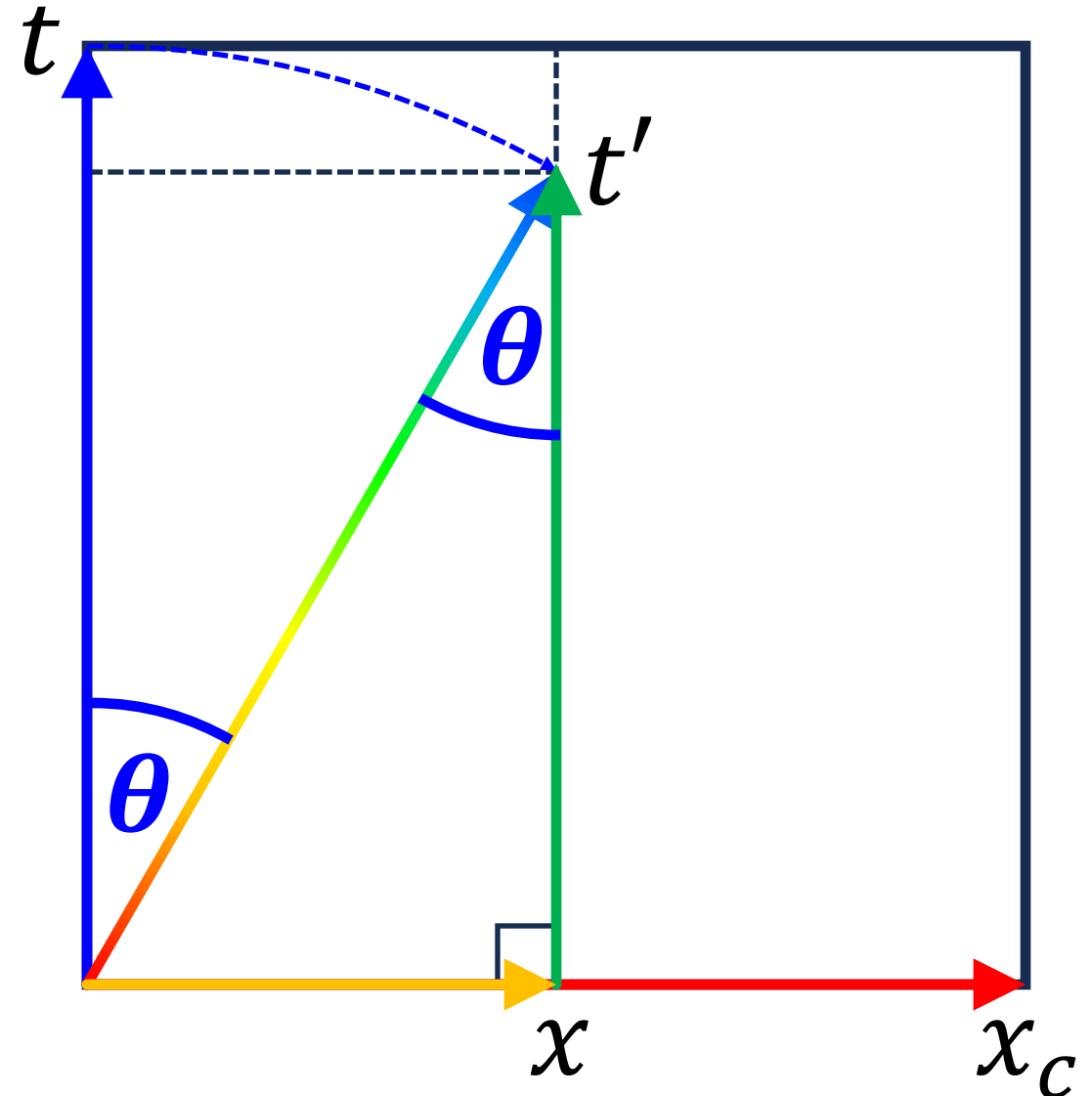
$\cong \beta \text{ radians (if small)}$

SR from theta

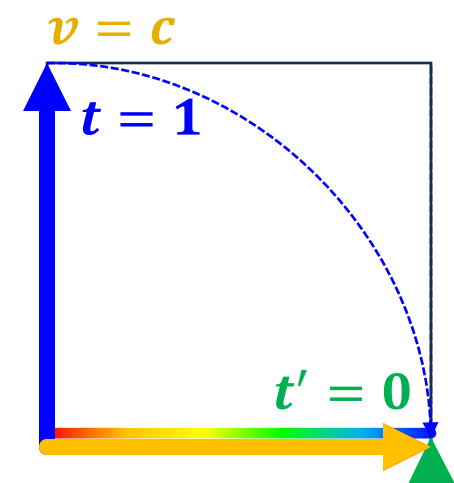
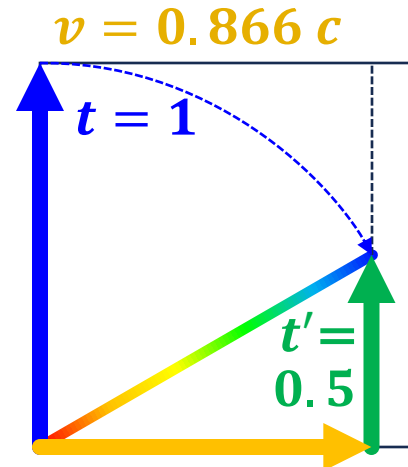
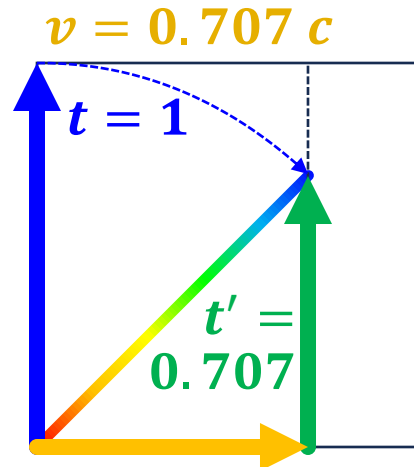
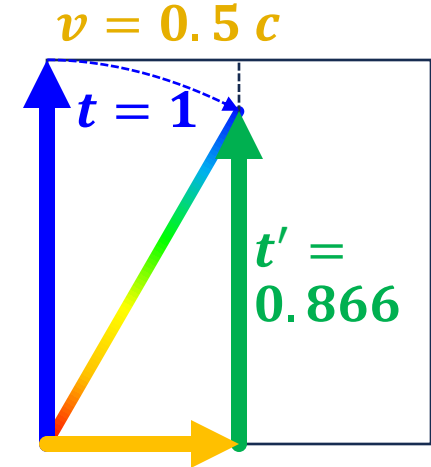
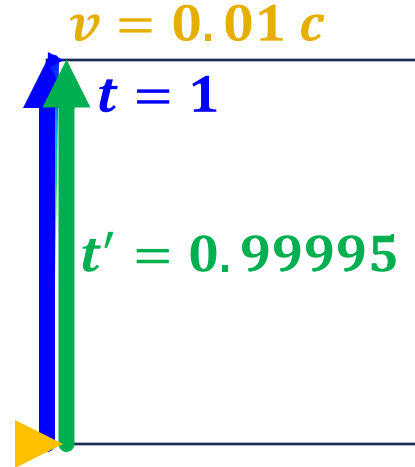
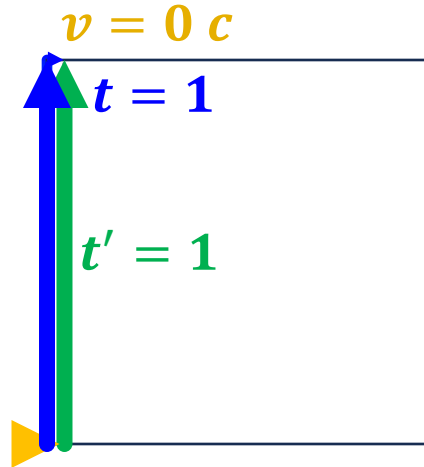
$v = c \sin \theta$

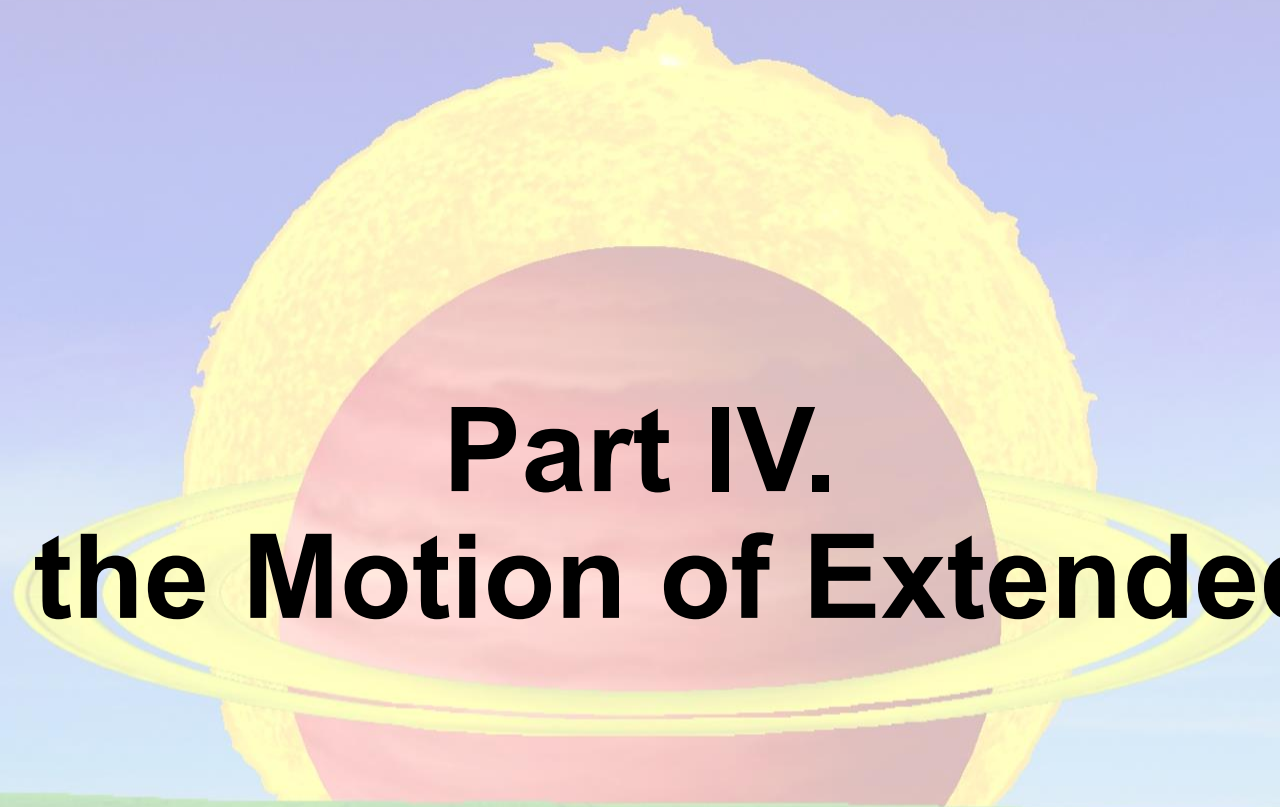
$\beta = \sin \theta$

$\gamma^{-1} = \cos \theta = \sqrt{1 - \sin^2 \theta}; \quad \gamma = 1/\cos \theta$



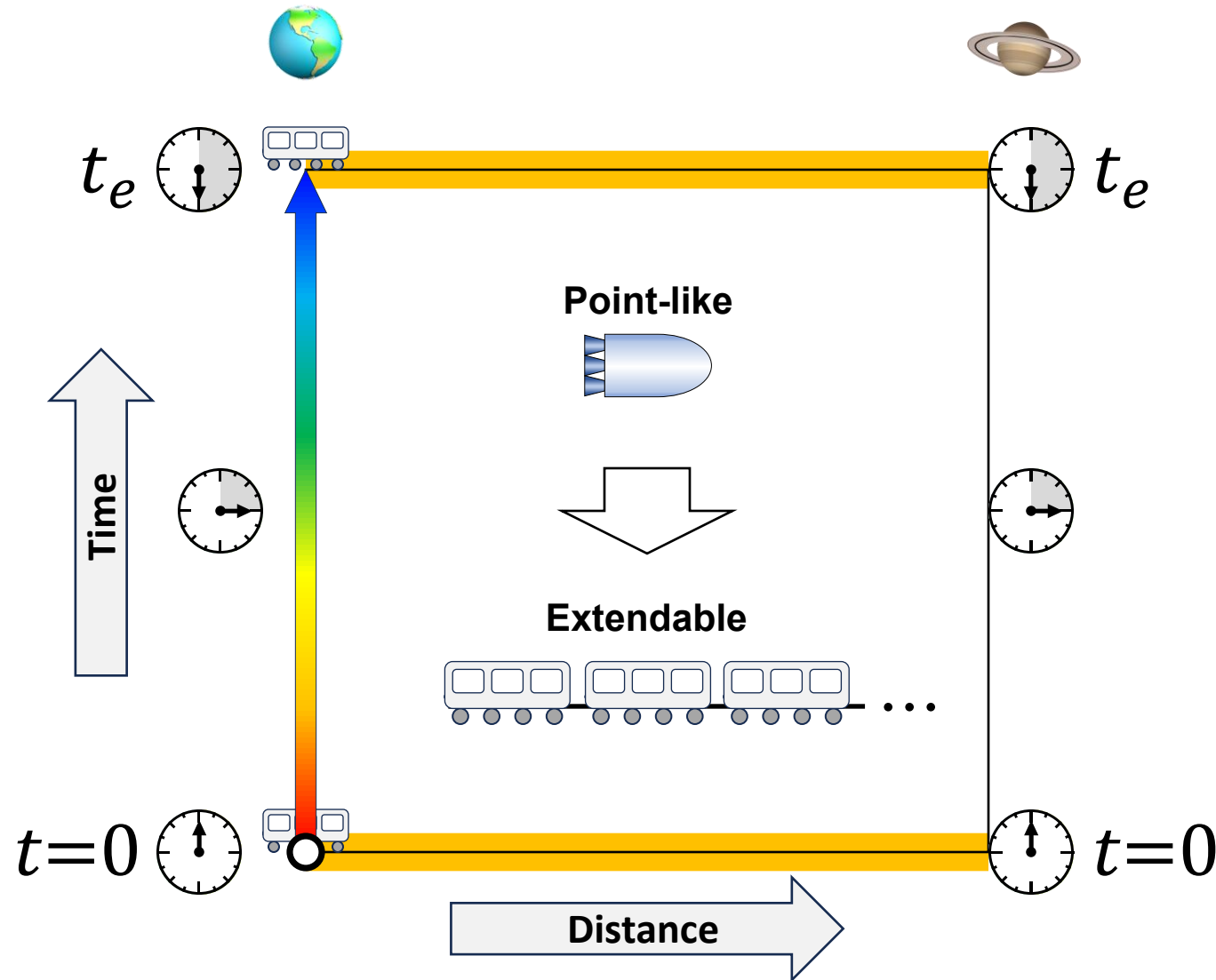
Examples of Rotating Invariant Edges



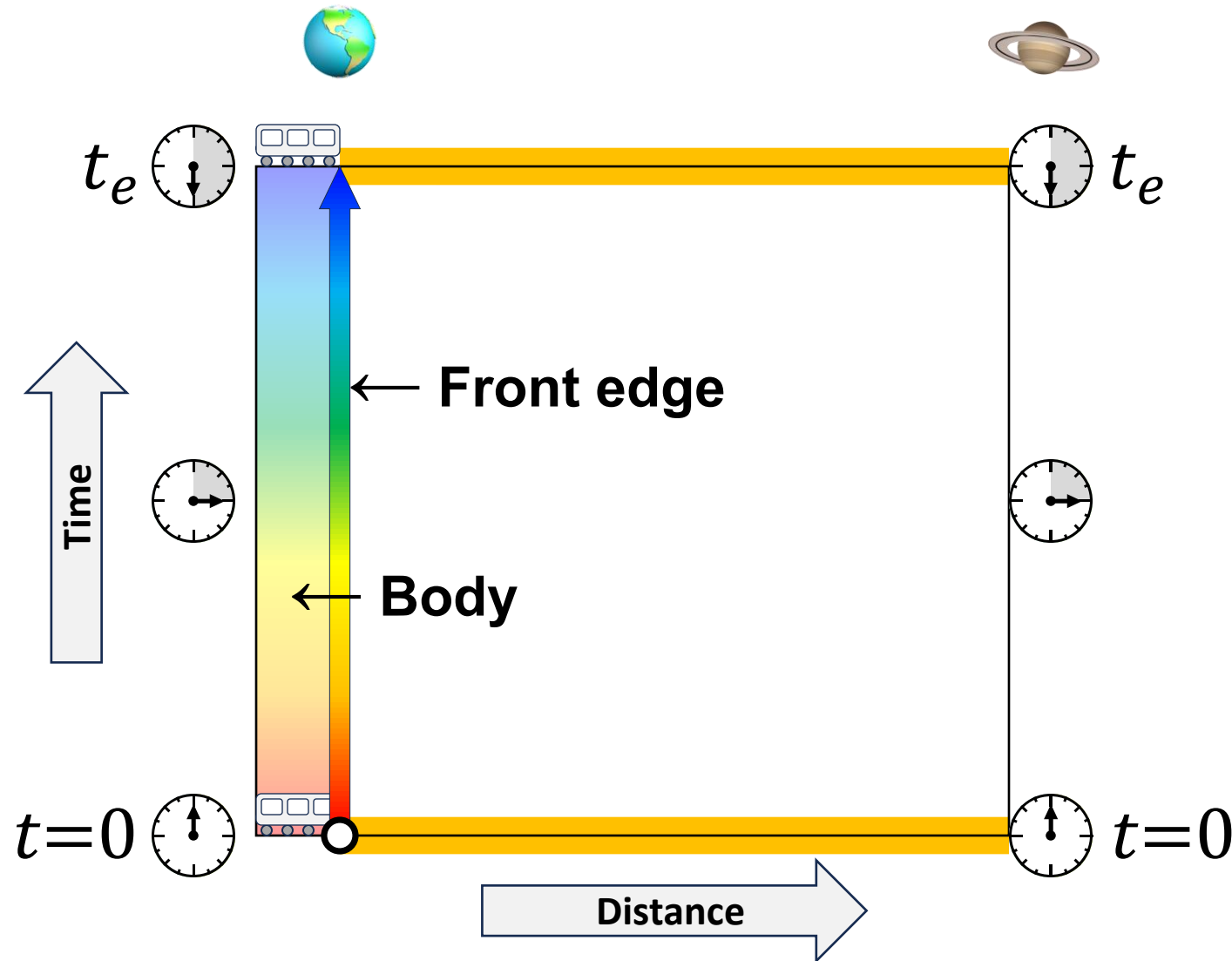


Part IV. Modeling the Motion of Extended Objects

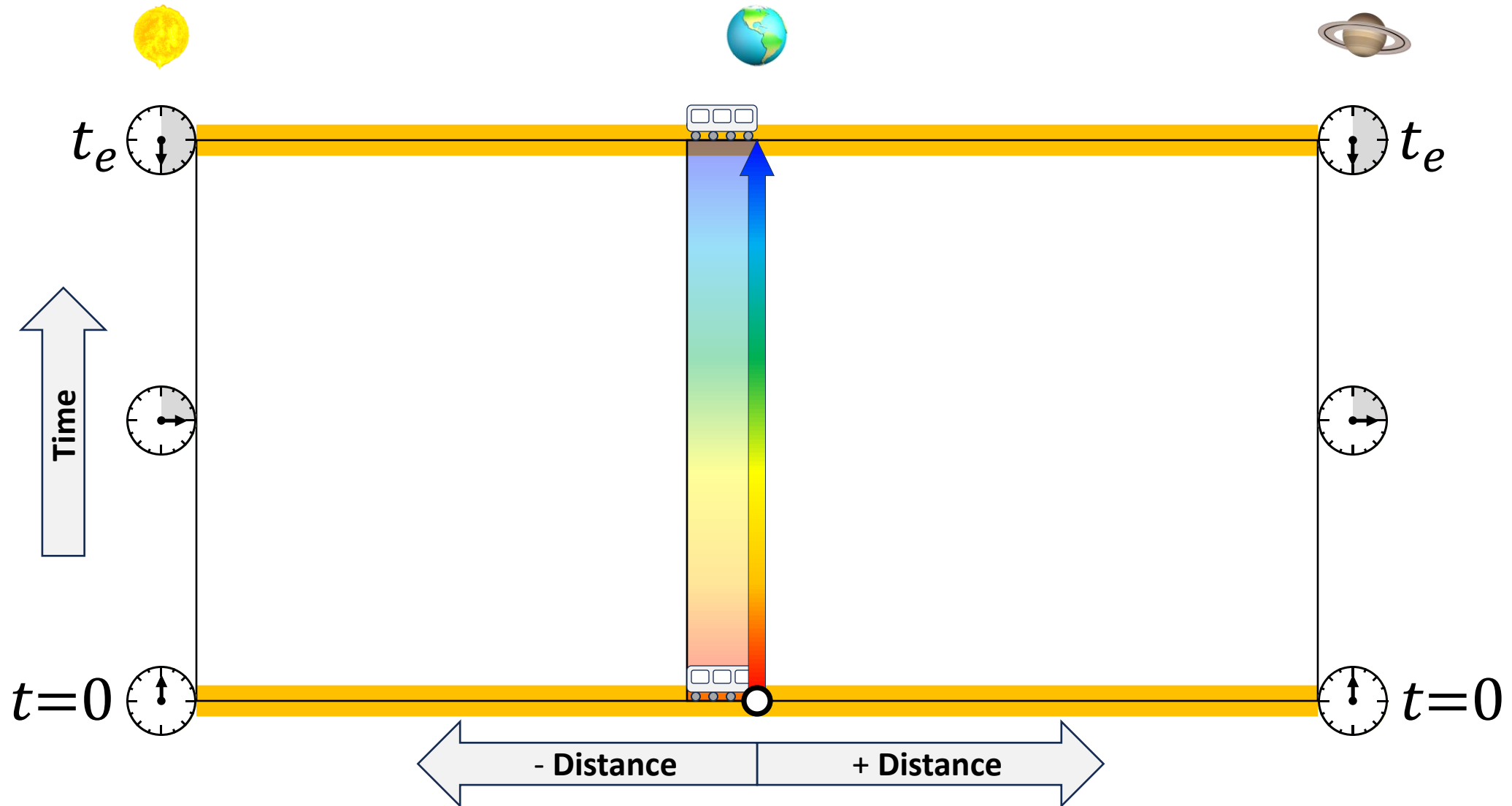
How Does this Work for Extended Objects?



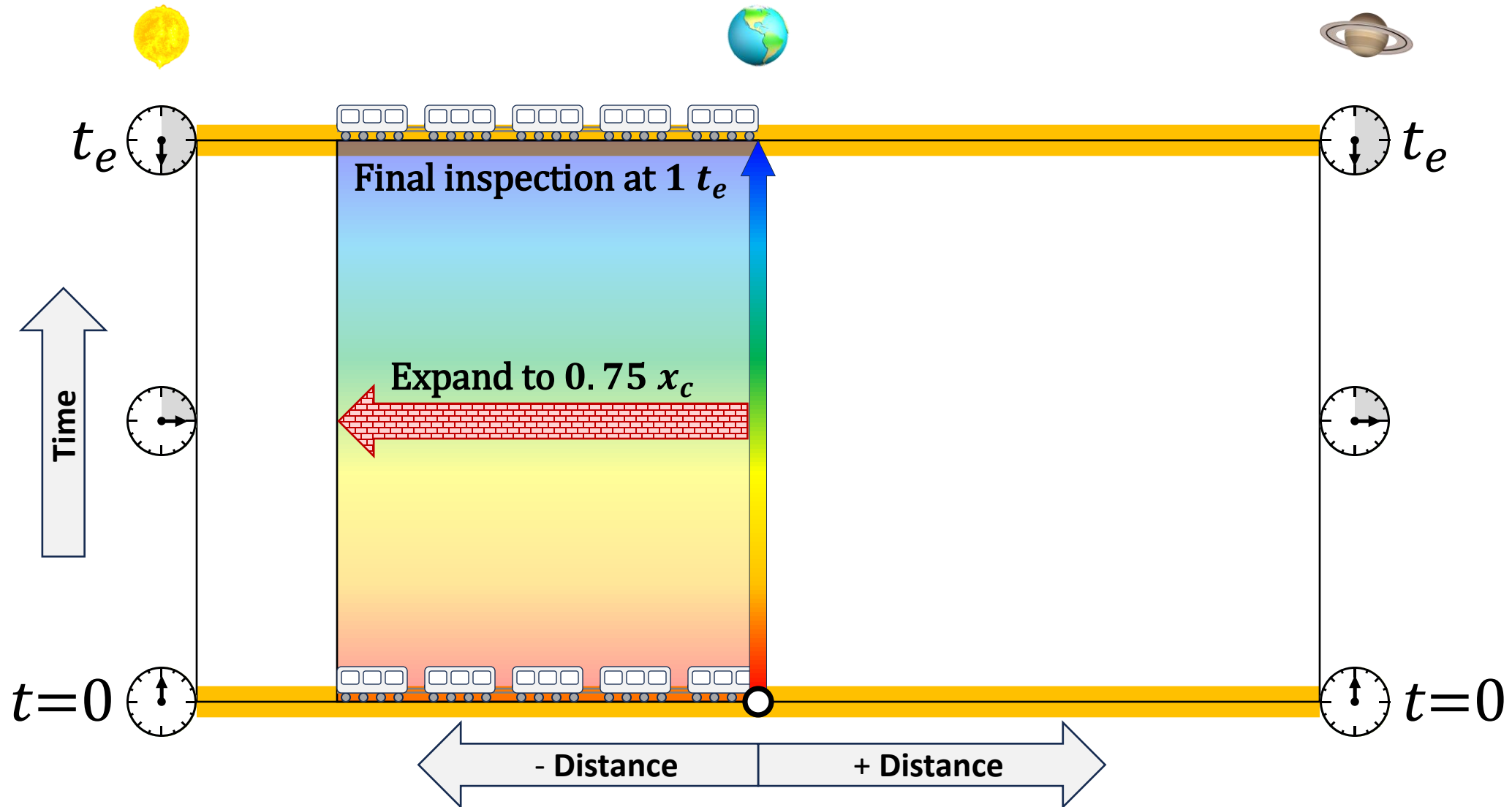
(1) Important Rule: Always Keep the Invariant Edge in Front



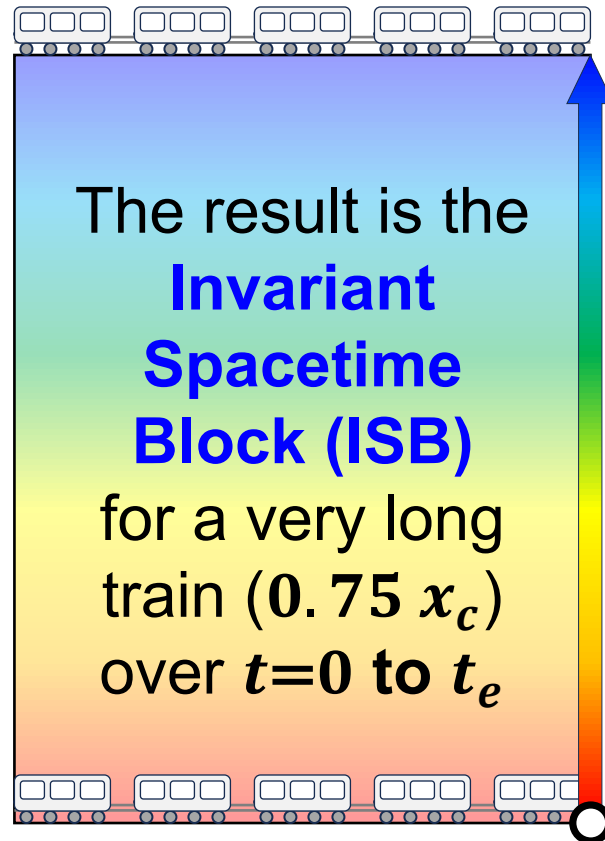
(2) Make Room on the Left to Expand the Object



(3) Expand the Object, e.g., to Length $0.75 x_c$ (Enormous!)

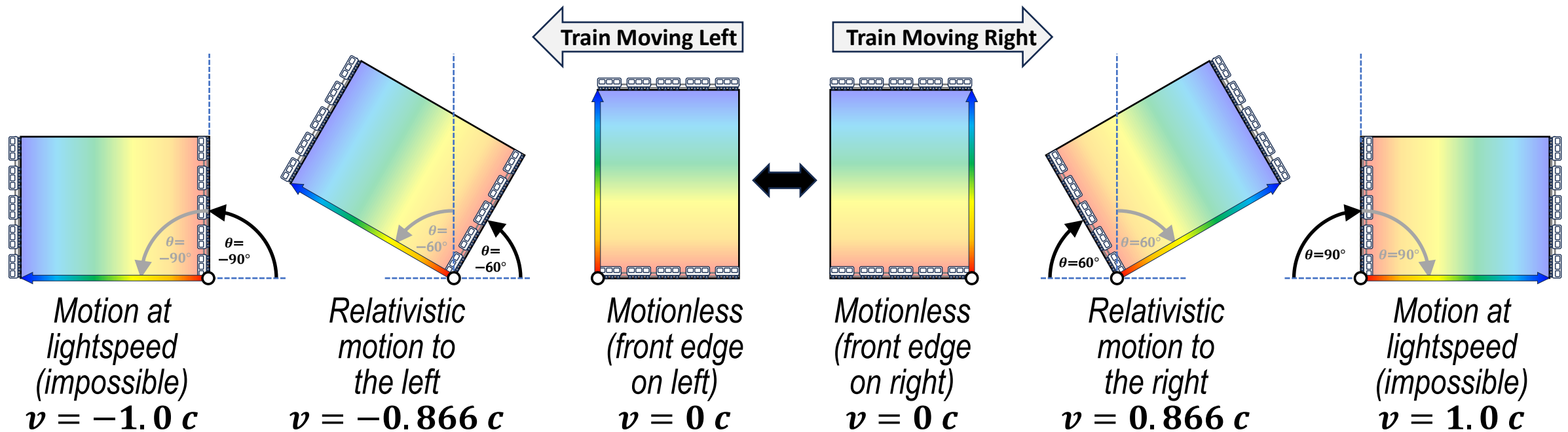


(4) Length $\times$ Time is the Invariant Spacetime Block (ISB)

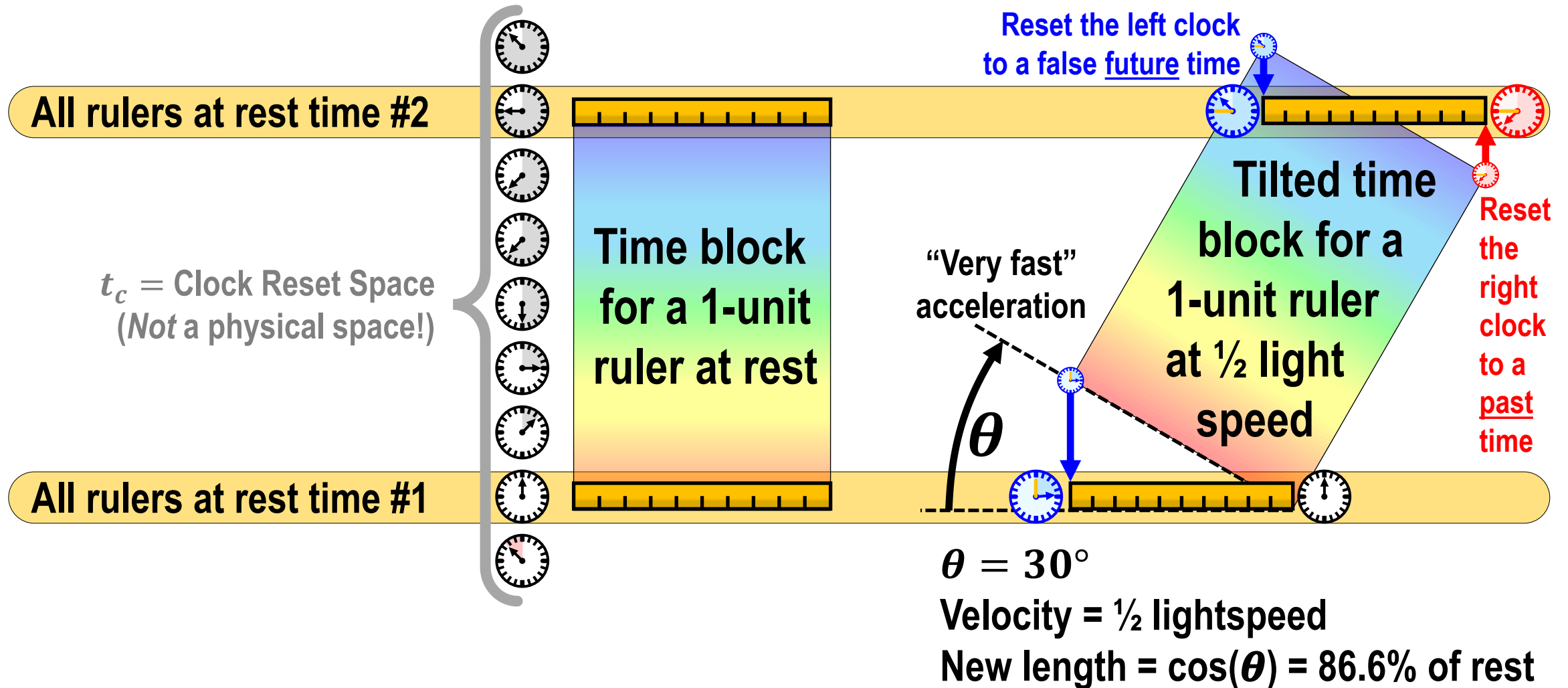


- **Claim:** The simple block shape of an ISB **stays unaltered** for all velocities from 0 to lightspeed.
- To specify a block velocity, **tilt the block forward by θ** at its forward edge (front of object).
- Once tilted, the block predicts the **lengths and clock values** for all object parts, as measured by instruments in the launch frame.

(5) Examples of Invariant Spacetime Block Tilting



Using Tilted-Blocks as Lorentz Calculators



Why Do the Train Cars Have Different Times?

- Einstein first realized that objects in a moving frame cannot be simultaneous when tested from another frame. One can find this “time slope” by starting with Einstein’s frame conversion equation:

$$t' = \gamma \left(t - \frac{v}{c^2} x \right) = \gamma \left(t - \frac{\beta x}{c} \right) = \gamma \left(\frac{ct - \beta x}{c} \right) = \frac{\gamma}{c} (ct - \beta x)$$

- Applying the above to two x points gives the time slope α :

$$\alpha = \frac{\Delta t'}{\Delta x} = \frac{t'_2 - t'_1}{x_2 - x_1} = \frac{\frac{\gamma}{c}(ct - \beta x_2) - \frac{\gamma}{c}(ct - \beta x_1)}{x_2 - x_1} = \frac{\gamma}{c} \left(\frac{-\beta x_2 + \beta x_1}{x_2 - x_1} \right) = \frac{\gamma}{c} \left(\frac{-\beta(x_2 - x_1)}{x_2 - x_1} \right) = -\frac{\beta\gamma}{c}$$

- Summarizing:

$$\text{Time slope of a moving object} = \alpha = \frac{\Delta t'}{\Delta x} = -\frac{\beta\gamma}{c} = -\beta\gamma c^{-1}$$

Converting the Time Slope to an Angle

From the earlier slide on trigonometric special relativity using θ :

$$\beta = \sin \theta \quad \gamma^{-1} = \cos \theta \quad \gamma = 1 / \cos \theta \quad c = x_c / t_e = 1$$

Time slope of a moving object (from Einstein frame equations):

$$\alpha = -\beta\gamma c = -\sin \theta / \cos \theta = -\tan \theta$$

Deriving θ from Einstein frame-conversion time slope:

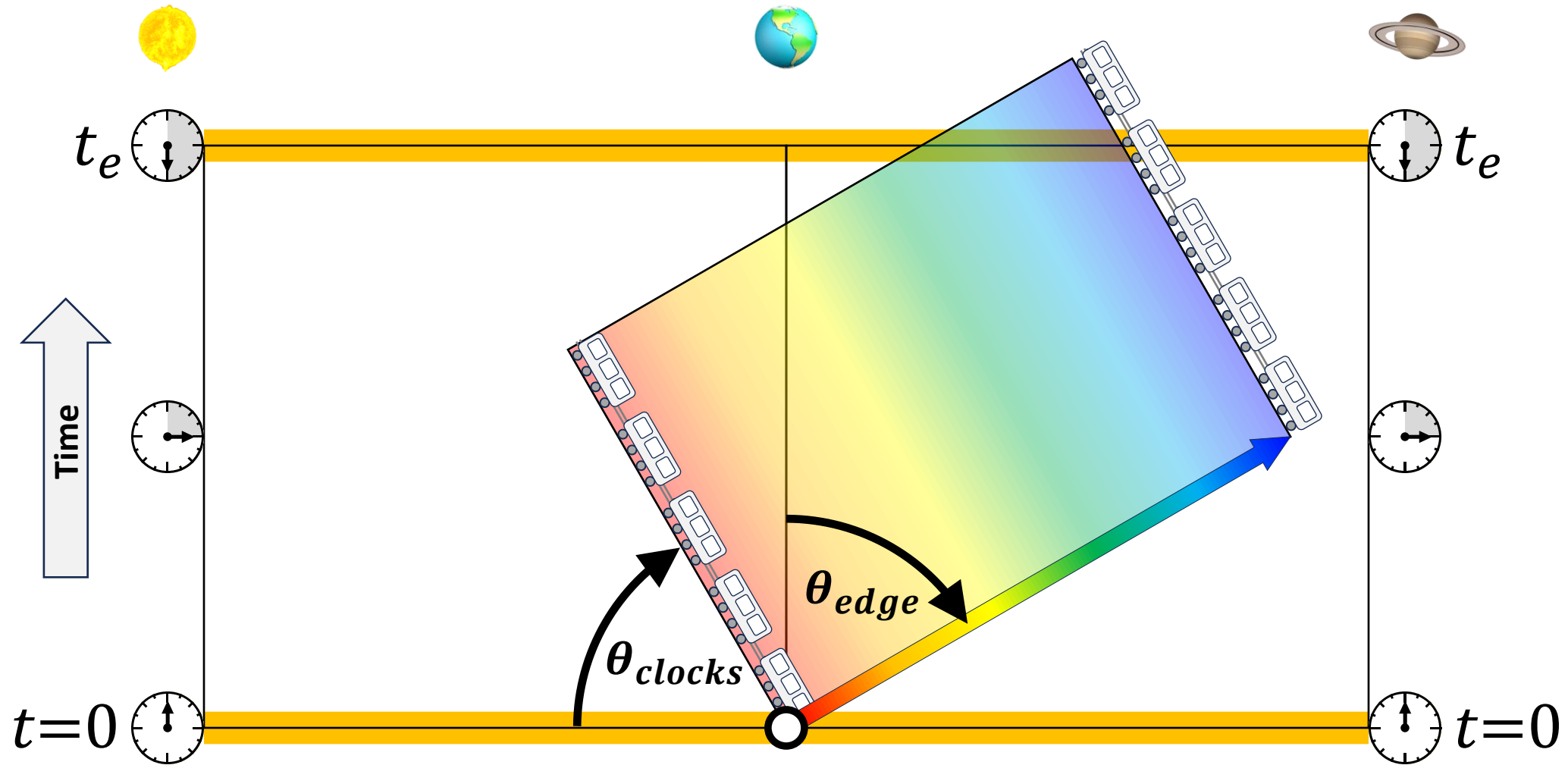
$$\alpha = -\tan \theta$$

$$\tan \theta = -\alpha$$

$$\theta = \tan^{-1}(-\alpha) = \tan^{-1}(\beta\gamma) = \tan^{-1}\left(\beta / \sqrt{1 - \beta^2}\right)$$

$$\theta = \tan^{-1}\left(\beta / \sqrt{1 - \beta^2}\right) \text{ — Same as for point-case invariant!}$$

Two Identical θ Rotations Keep the Block Invariant



Tilting an Extended Object Requires Time and Effort!

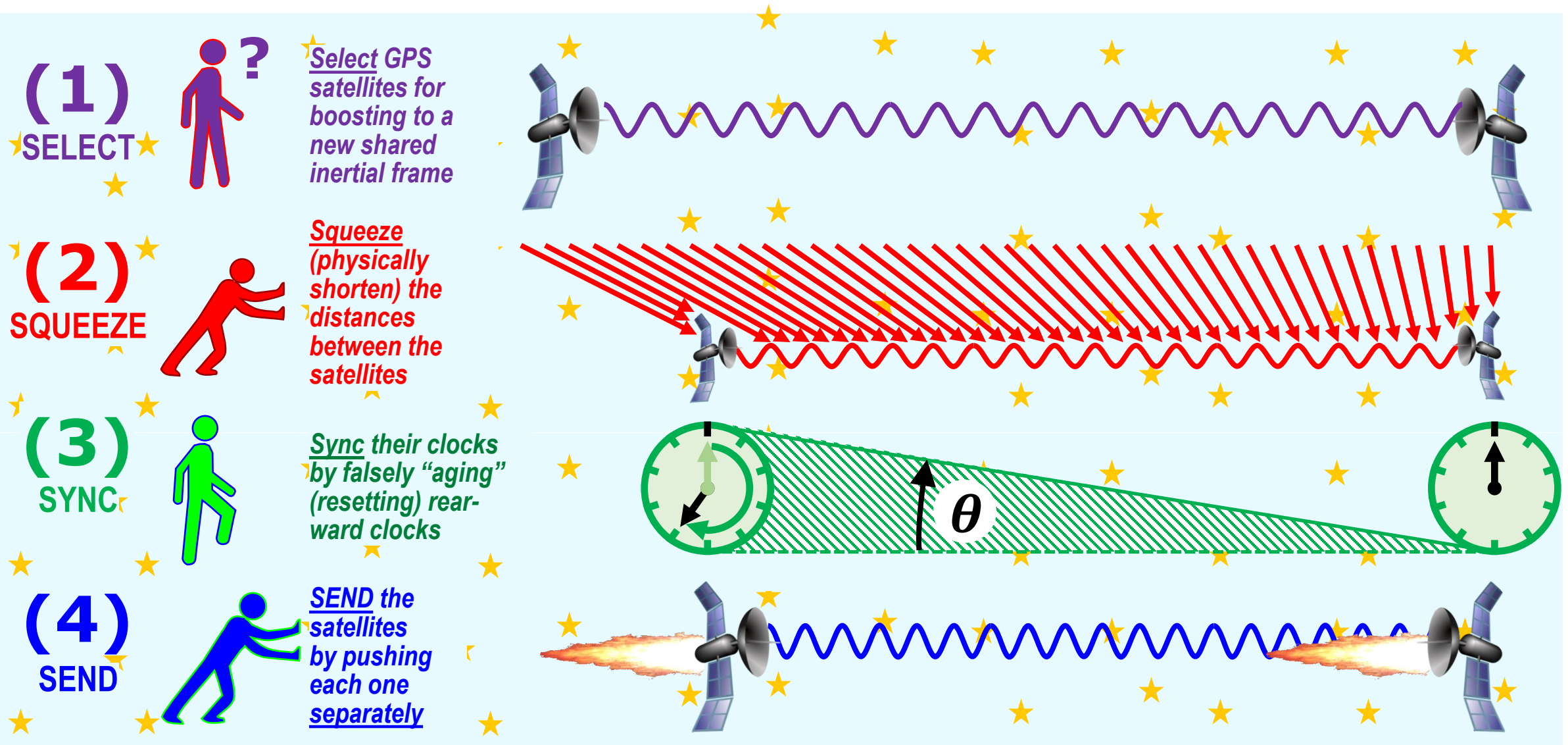
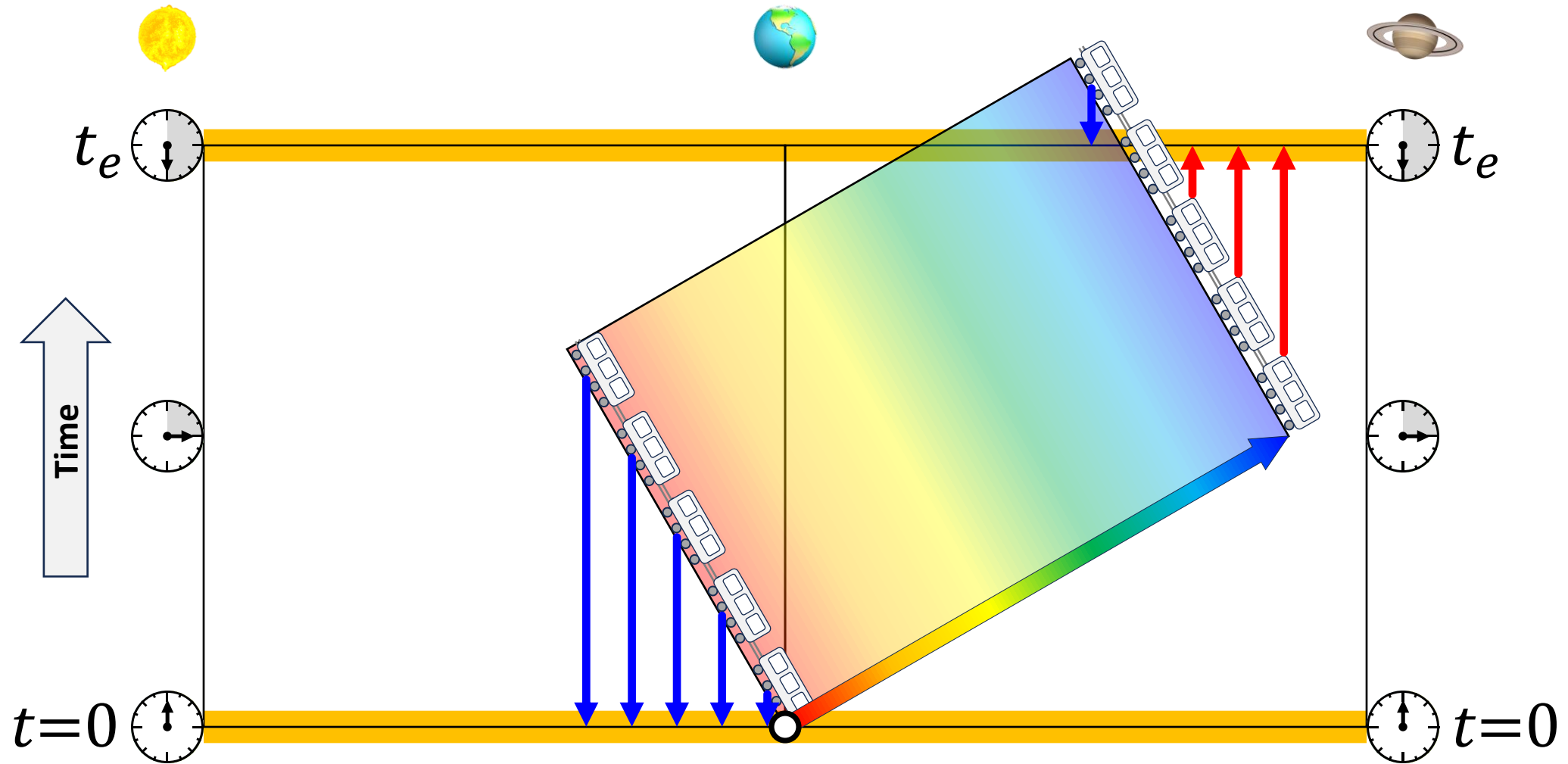
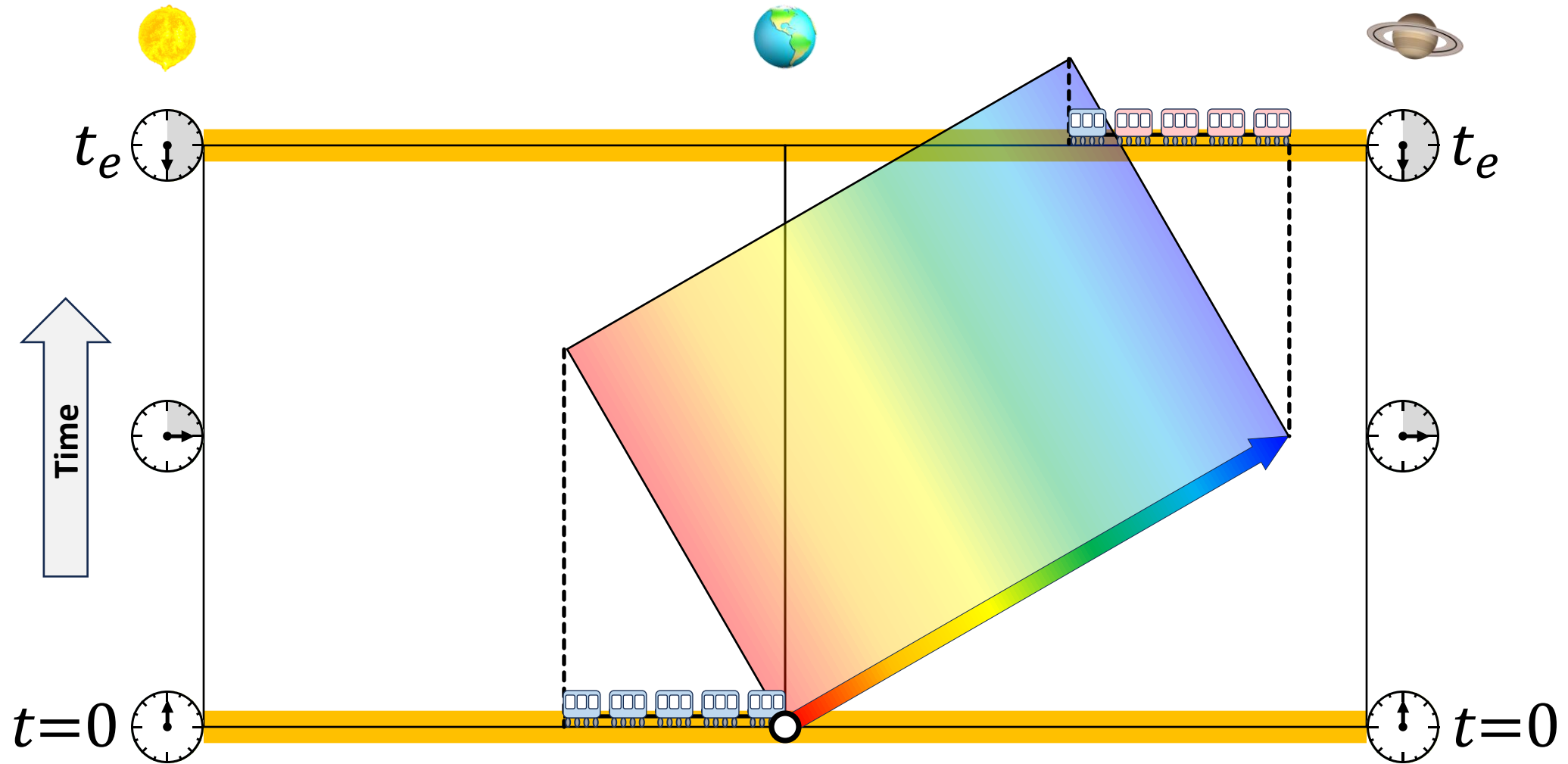


Diagram illustrating the relativity of simultaneity using a spacetime diagram. The vertical axis represents Time, with an upward arrow. Two horizontal lines represent lines of simultaneity in the rest frame, labeled $t=0$ and t_{end} . A tilted line represents a line of simultaneity in a moving frame, labeled $\theta=60^\circ$. A colored wedge (orange to blue) represents the region of spacetime between these two lines. A blue arrow points along the tilted line, labeled $(v = 0.866 c)$. Clocks are shown at various points along the axes and the tilted line. Icons of the Sun, Earth, and Saturn are at the top.

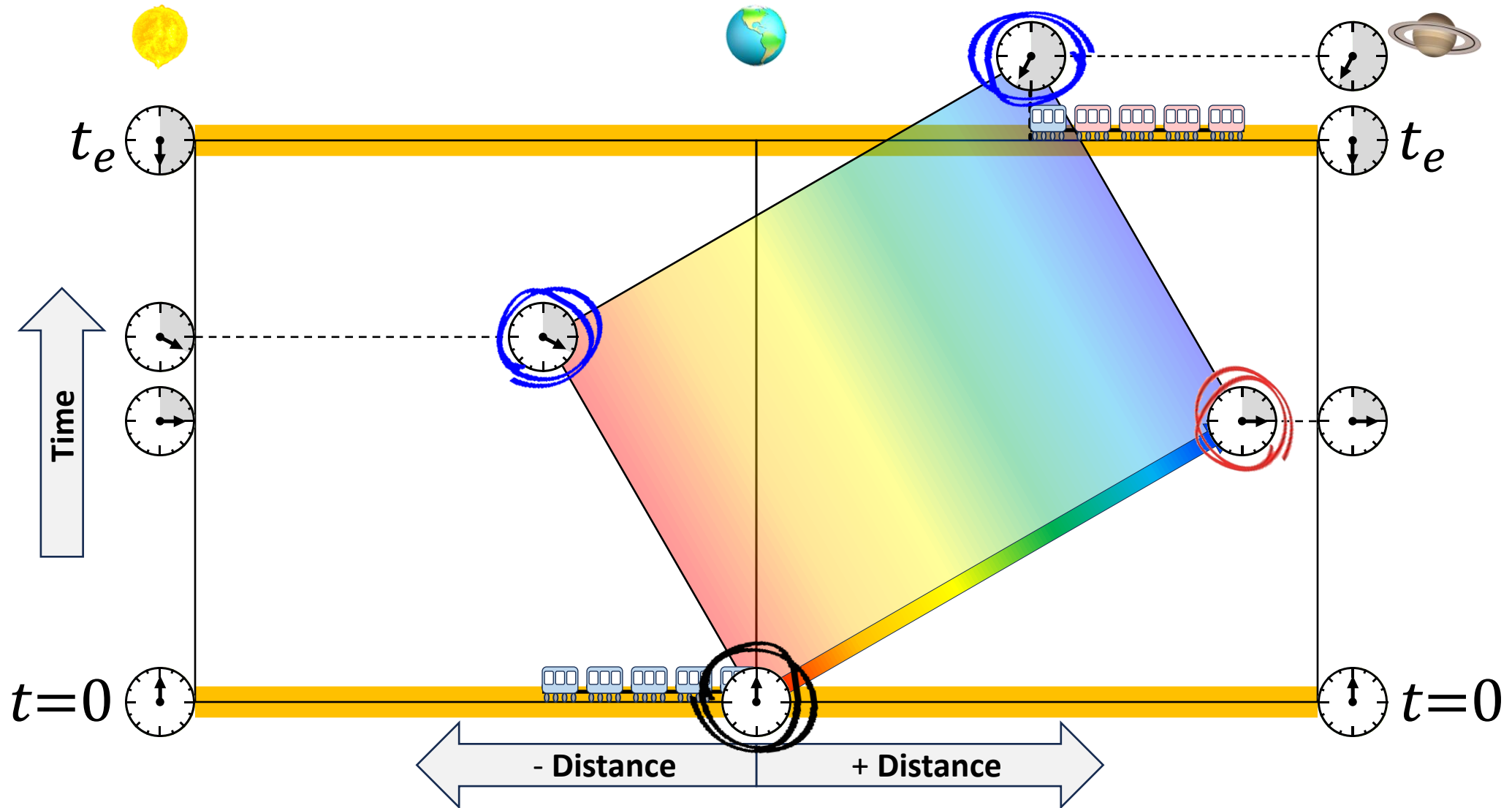
(1) Project Train Images Into the Observation Times (Gold Lines)



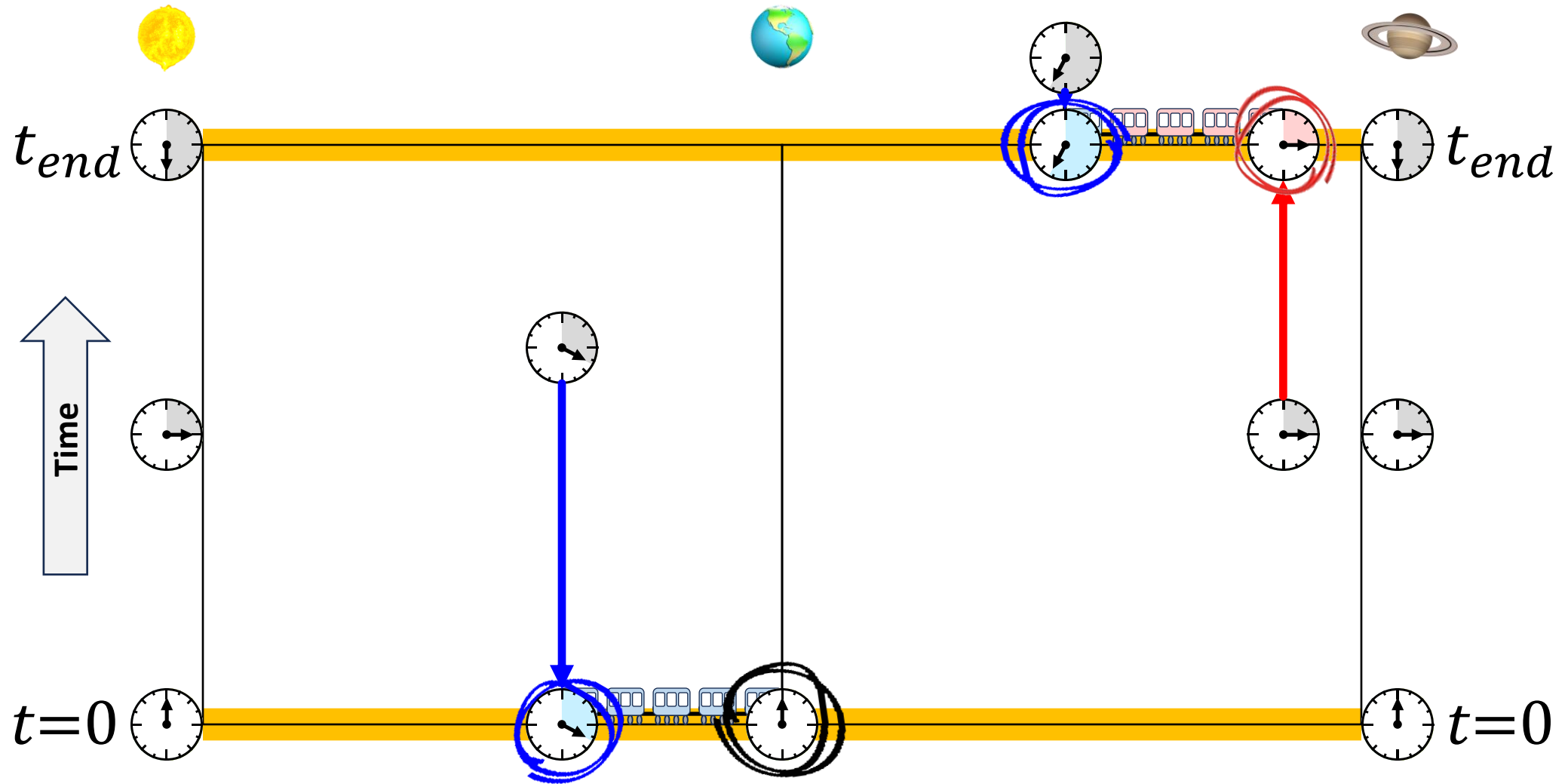
(2) Projected Images Become the Real, Lorentz-Contracted Trains



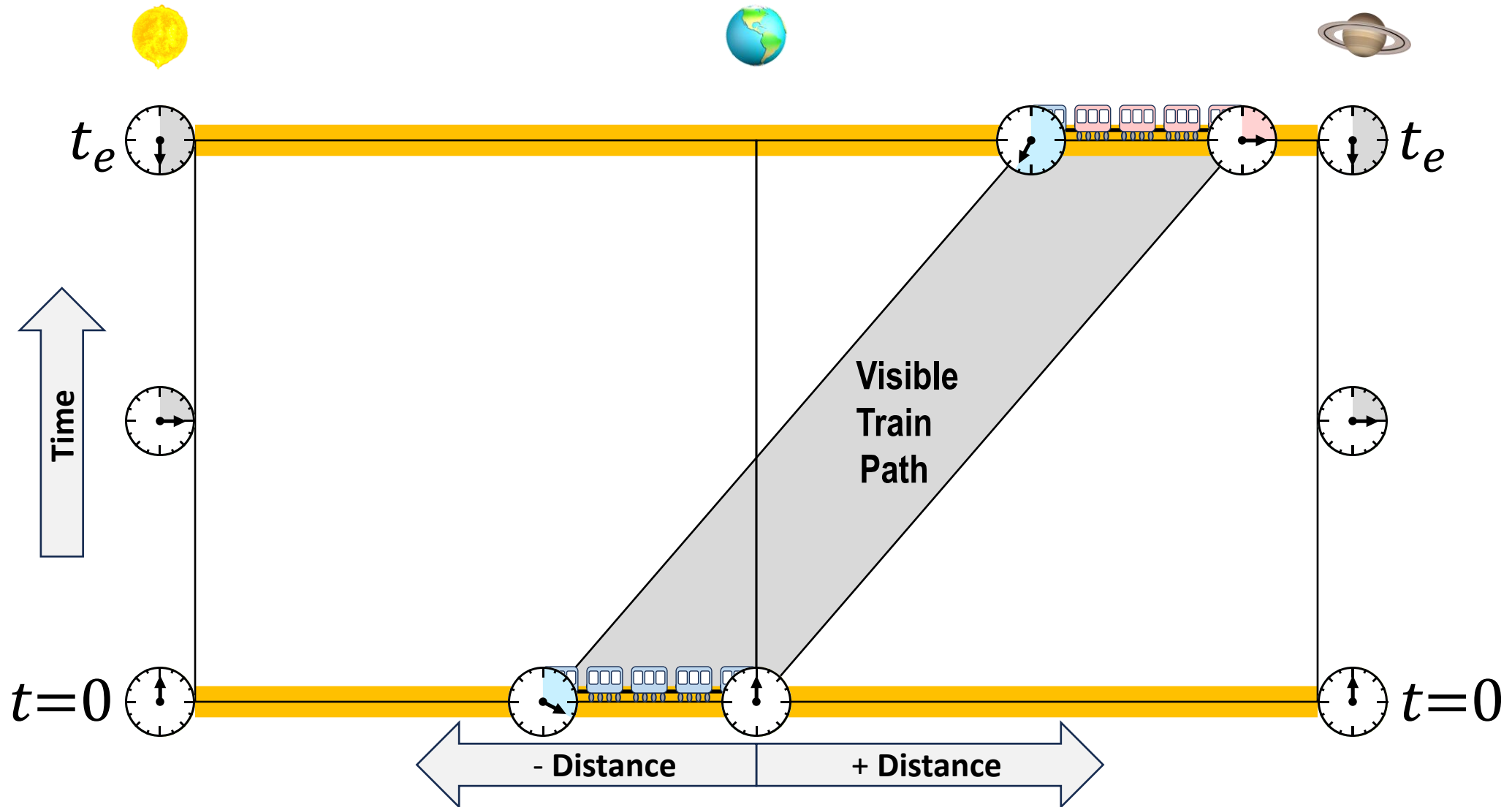
(3) Grab Clock Times from the Launch Observer's Space



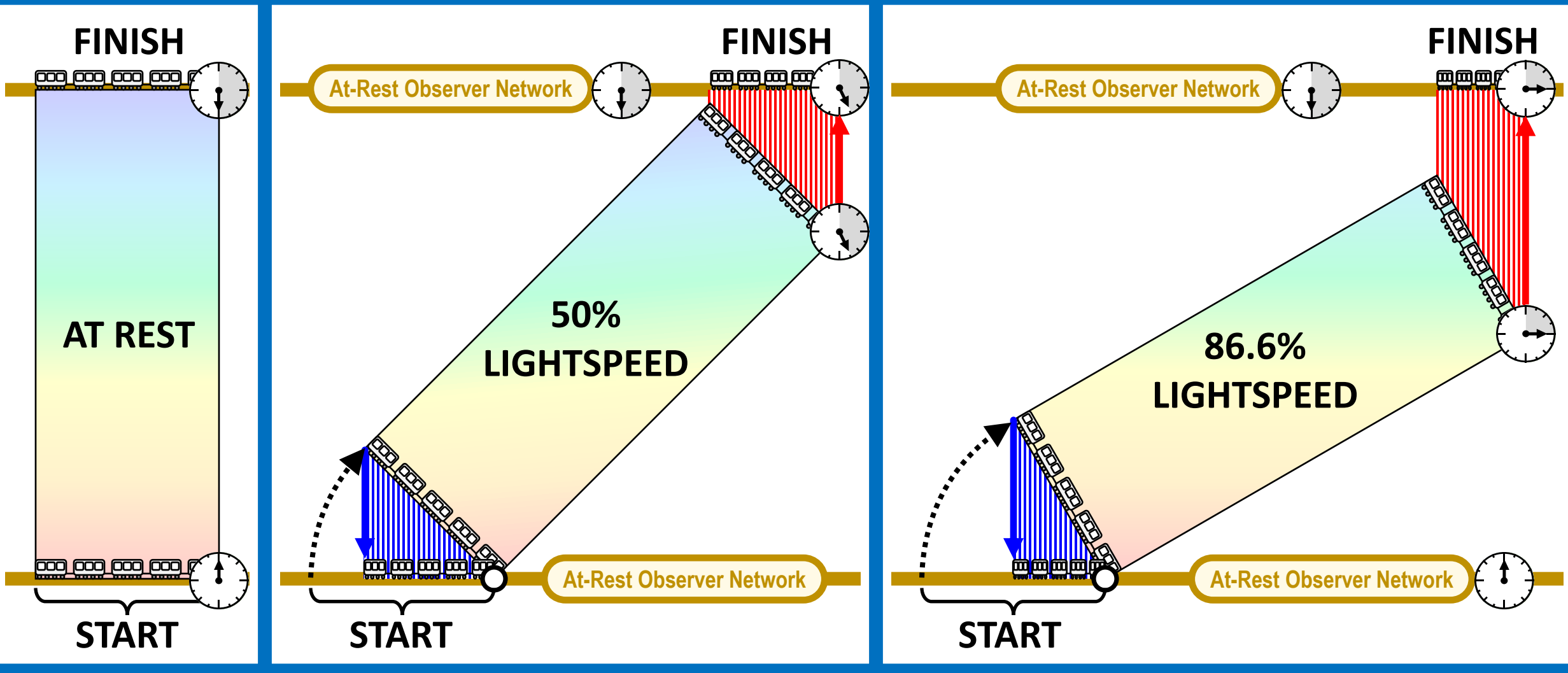
(4) Transfer Clock Times to the $t=0$ and t_{end} Real Train Images

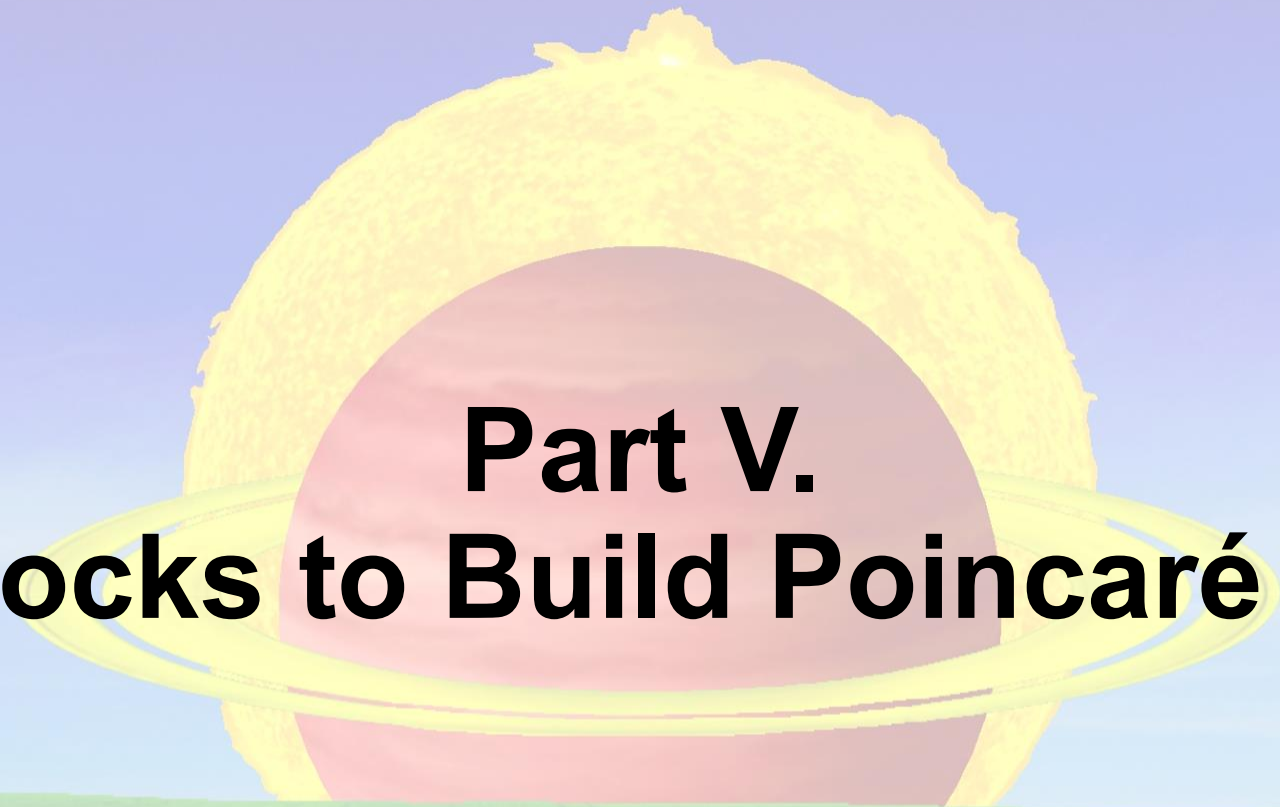


(5) Result: Correct Internal Times (No Time Paradoxes)



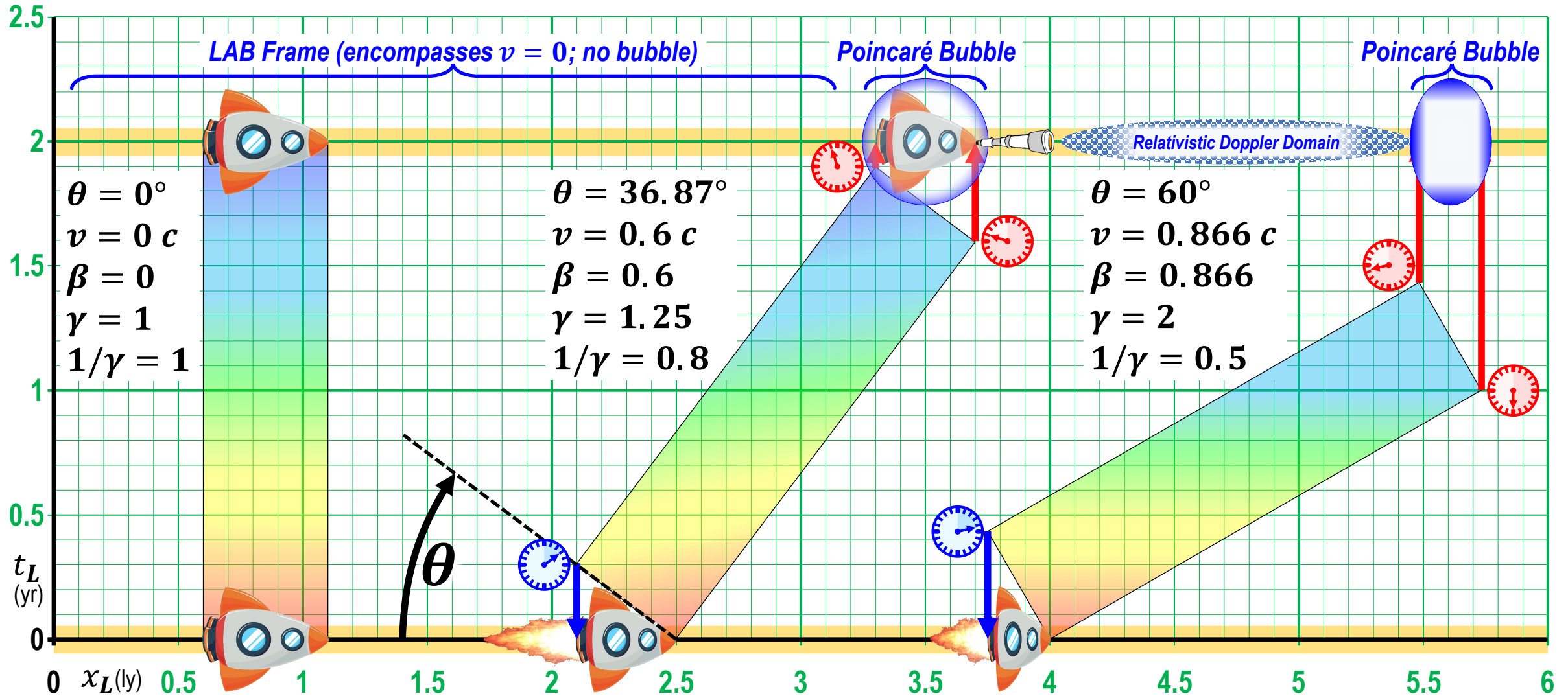
(6) Three Examples of Tilted-Block Special Relativity



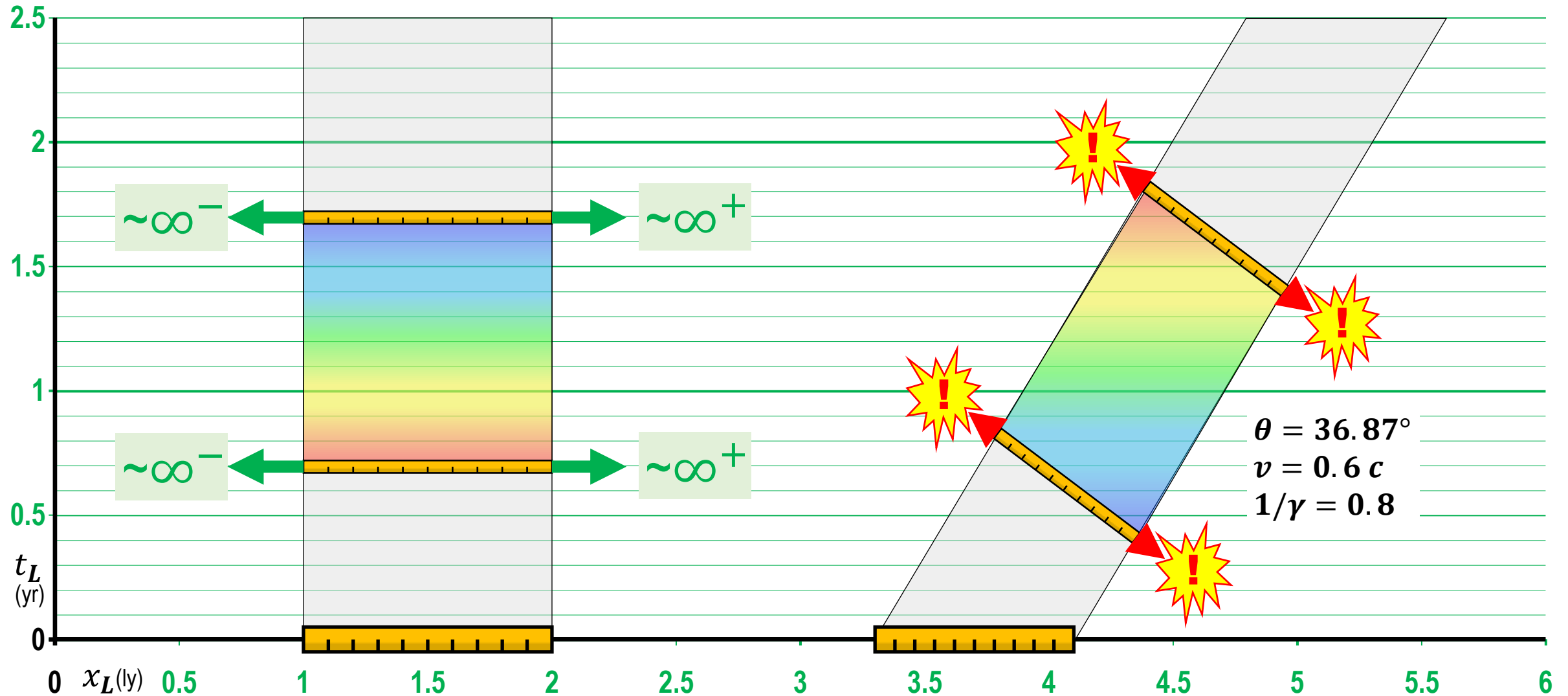


Part V. Using Blocks to Build Poincaré Bubbles

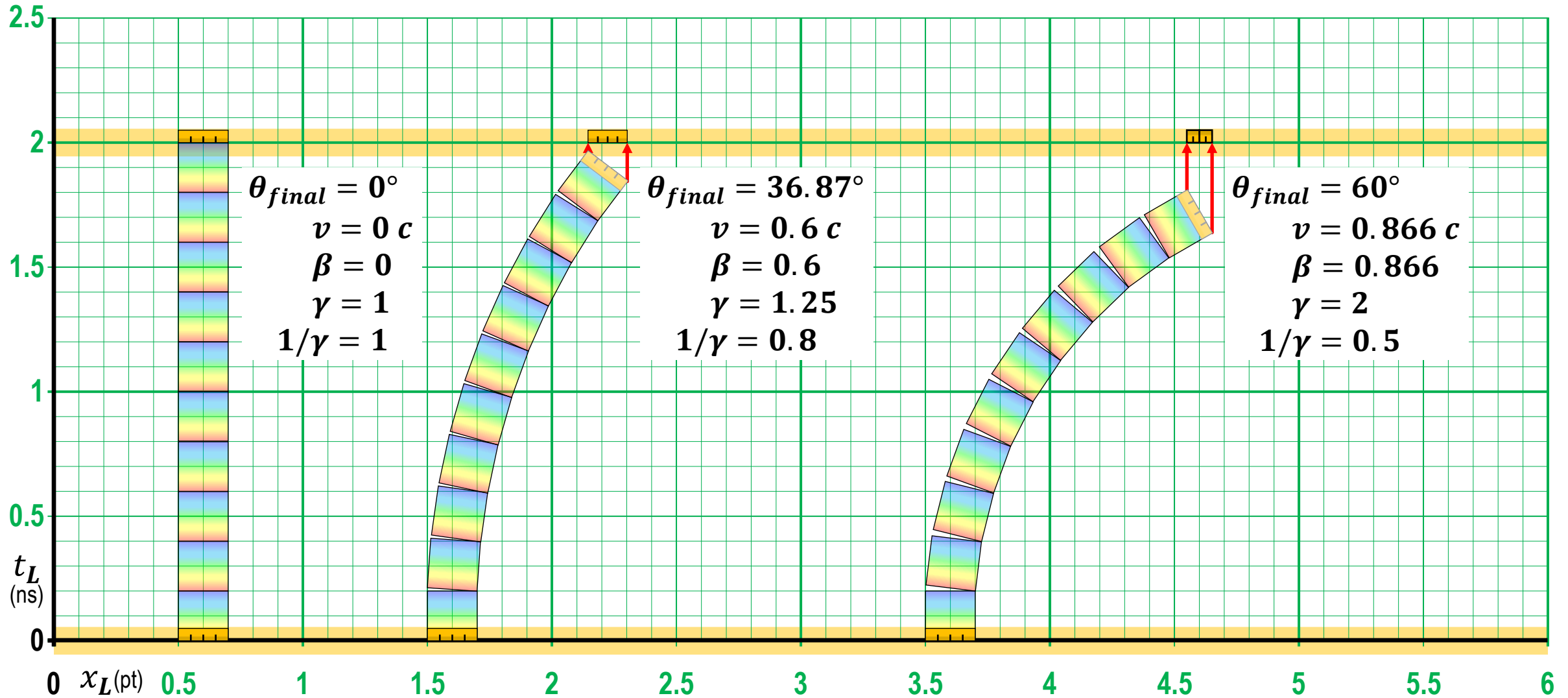
Using Tilted Blocks to Build Poincaré Bubbles



The Bubble Problem: Tilted Rulers Don't Extend



Minkowski's Proper Time τ As Adding Tilt Blocks



Time Dilation is Never Relative in the At-Rest Frame

**At-Rest
Frame
(Huge)**



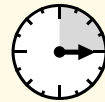
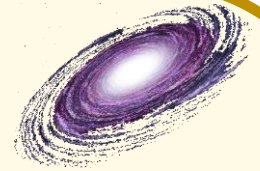
Minimal
relative
motion...



Minimal
relative
motion...



Minimal
relative
motion...



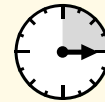
... gives
matching
clocks &
rulers



... gives
matching
clocks &
rulers



... gives
matching
clocks &
rulers



1 TIME UNIT
in *unrotated*
(system at rest)
coordinate space

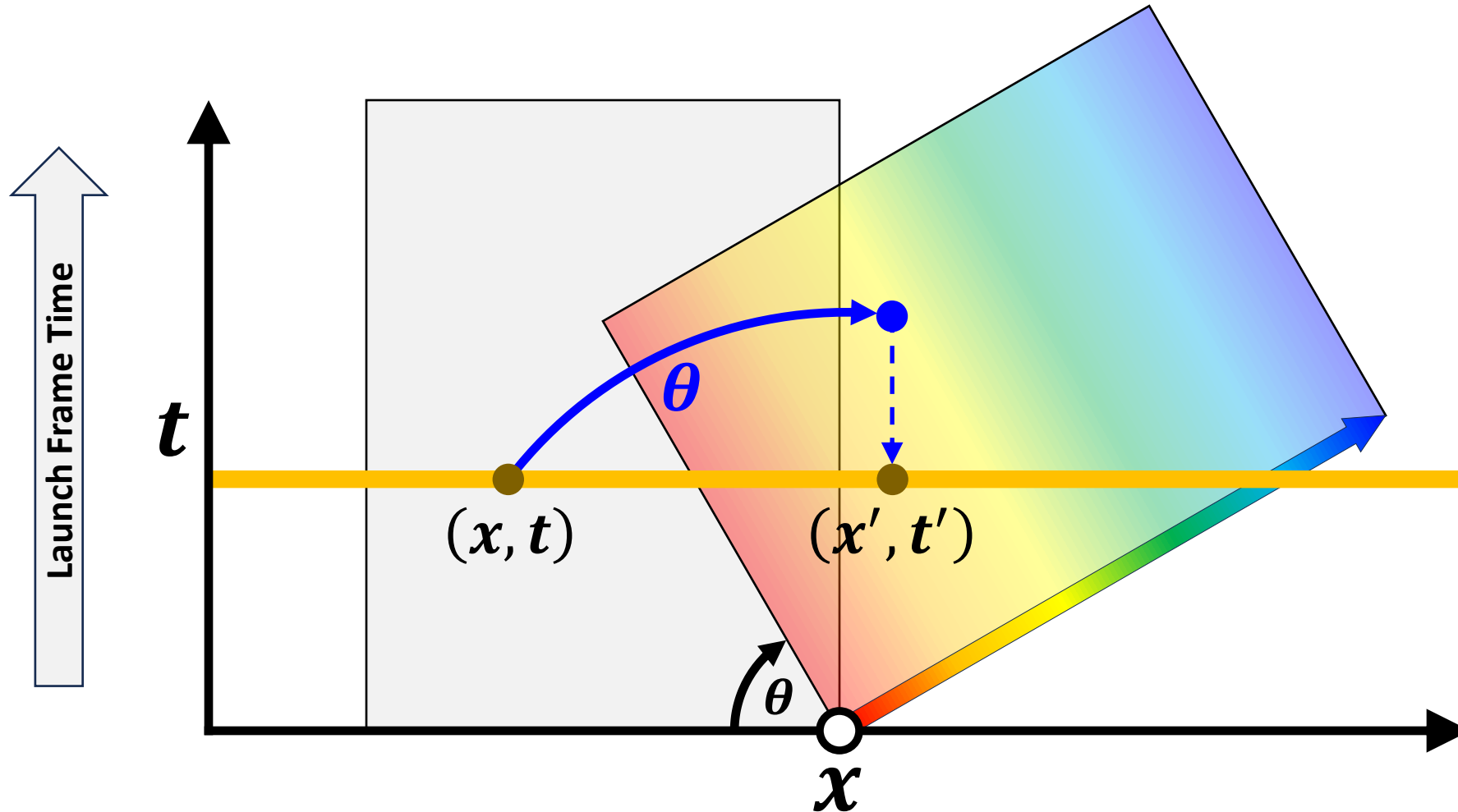
At-Rest Testing Network

1 TIME UNIT in *rotated* (system
in motion) coordinate space

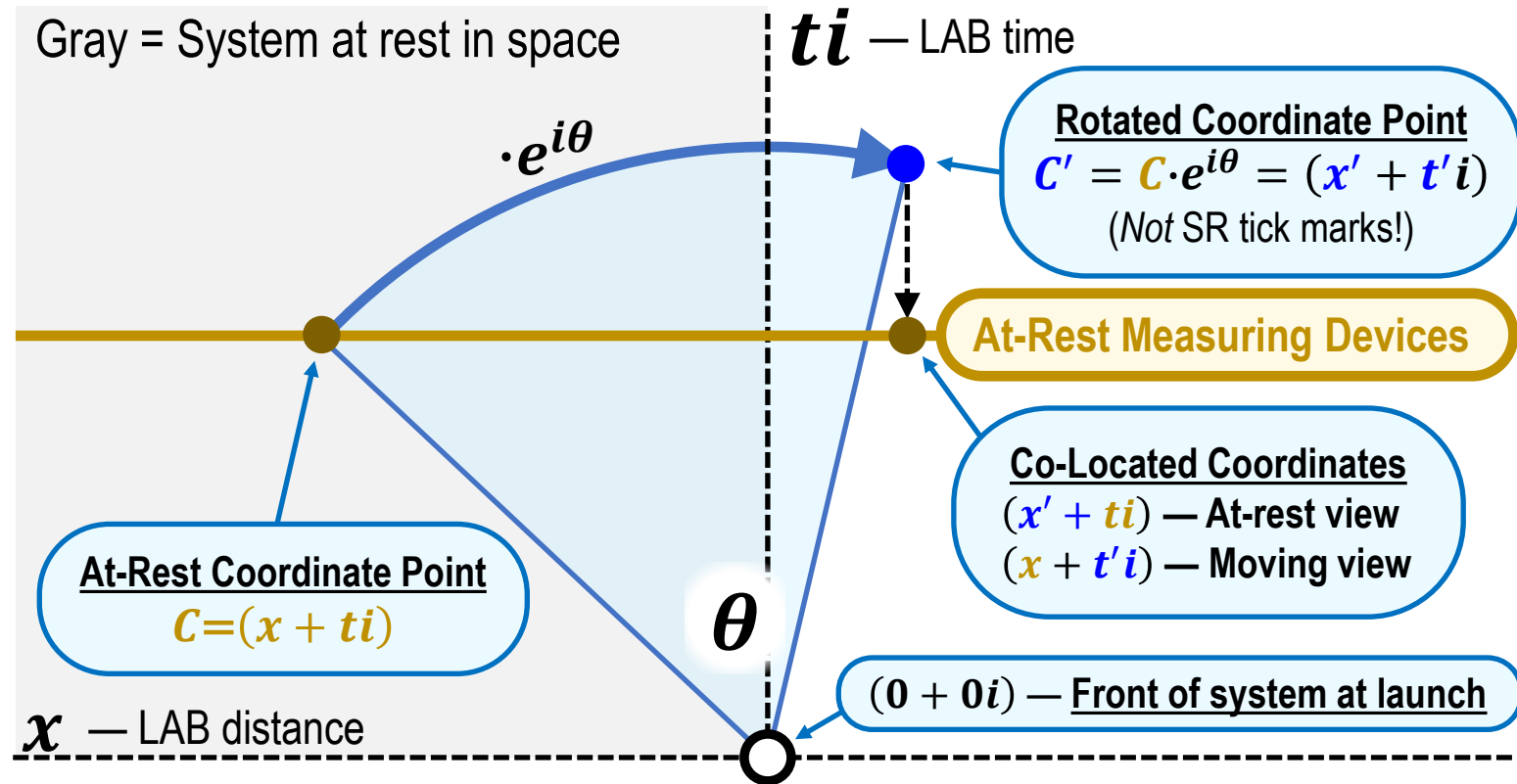


Part VI. An Unexpected Simplification

(1) Notice that All Block Points Transform Identically



(2) Translate Rotations into Complex Plane Relativity (CPR)



$$C' = C \cdot e^{i\theta} = (x' + t'i) \text{ where } x' = \operatorname{Re} C \cdot e^{i\theta} \text{ and } t' = \operatorname{Im} C \cdot e^{i\theta}$$

$$C_R = C_{Rest} = (x' + ti), \quad C_M = C_{Moving} = (x + t'i) = M(C_M)$$

Conclusions

- It's time for a new approach: **Complex Plane Relativity**
- CPR **calculates *all* frame interactions** (no “mysteries”)
- CPR enables new views of space and time by treating them as **emergent matter-and-energy relationships**
- CPR *calculates*, rather than ignores, the strict conditions required to **set up fully working inertial frames**
- The **drastic drop in complexity** — one multiplication — argues that this approach is closer to how physics does it
- CPR suggests immediate **quantum theory connections**

