For Someone Accelerating Forever at 1g, the Clock Back Home Stops at c/g

— After ten years of ship time the clock seen back home reads 0.968683237988 years and never reaches the 0.968715079572 of c/g. What stops it is not speed but a horizon 0.968715079572 light years astern — the separator is constant speed or constant acceleration — [Paper 1042]

Yuuki YAMAGISHI (山岸 勇輝)
Yamagishi Complexity Torus Lab, Japan
September 2026

— *From thinking to syncing.* —

Abstract

The faster one recedes, the slower the arriving image runs.Does it stop altogether under continued acceleration?This paper counts the clock back home as seen from a ship accelerating at the same 1g as on the ground.No new theorem and no new law is claimed. First, and this is the core. The clock back home stops at a finite reading——at 1, 2, 5 and 10 years of ship time the clock seen back home reads 0.623669936633, 0.845813977714, 0.963161214164 and 0.968683237988 years. However long one waits it never reaches the 0.968715079572 years of c/g(Section 3). **Second, the image runs slower exponentially——its rate is 0.356188470909 at one year of ship time, 0.005733229022 at five and 0.000032869915 at ten. A closed form and a route that follows the world line and solves geometrically for the time of emission agree to within 10 to the minus 12 out to ten years**(Section 3). **Third, what stops it is not speed but a horizon astern——light emitted farther back than c^2/g, that is 0.968715079572 light years, never catches up. From −0.968 light years it catches the ship at home time 656.158360 years; from −1.1 light years it had not caught up by time 2000**(Section 4). **Fourth, that c/g is both a time and a distance——the same number 0.968715079572 is a number of years and a number of light years. One g, one year and one light year nearly coincide because the gravitational acceleration of the Earth happens to have that size**(Section 2). **Fifth, by ship time one can cross the galaxy——turning over halfway and holding 1g, Alpha Centauri takes 3.582393723 years of ship time (6.002502777 at home), the galactic centre 19.757352991 (26001.937357979), and Andromeda 28.603418344 (2500001.937429409)**(Section 5). **Sixth, the separator is constant speed or constant acceleration——at constant speed the image stops only in the limit β to 1 (at β＝0.999 it still advances at 0.022366272042). Under acceleration it stops at a finite ship time. The thread between two ships that left with the same acceleration also stretches by γ in their own frame and breaks (a factor 8.721375564 at five years)**(Section 6 and Section 7). **Keywords**: uniform acceleration, Rindler horizon, time dilation, hyperbolic motion, interstellar travel, Bell's spaceship.

Scope of this paper (scope note): **No new theorem and no new law is claimed——that the world line of constant proper acceleration is a hyperbola, that a Rindler horizon lies c²/g astern, that ship time on a 1g journey grows only logarithmically with distance, and that the thread between two ships of equal proper acceleration breaks are all standard (Rindler 1966, Misner and Thorne and Wheeler 1973, Bell 1976).Fuel is not discussed——propulsion, mass ratio and radiation shielding are not entered; only the geometry of the world line is counted.The Unruh effect is not entered——reading the same hyperbola from the side of temperature was the work of Paper 142.General relativity is not used——only an accelerating observer in flat spacetime; no gravitational field is placed.No real programme is claimed——the journey figures are geometric estimates and nothing is said about engineering.The values are examples——g is the standard gravity 9.80665 m/s², a year is 365.25 days, and the distances are representative.Relation to earlier papers：The scope note of Paper 1026 stated that acceleration is not treated, only the three cases of receding, approaching and passing at constant speed——this paper takes the seat left by acceleration and counts that an image which does not stop at constant speed does stop at a finite time under acceleration (no earlier occupant).Paper 123 showed that what differs between the twins is not a lagging clock but the length of a worldline ——the journey times here are that length.Paper 142 showed that only the 2π survives when things are moved, reading the same hyperbolic world line from the side of temperature——this paper reads it from the side of the image that arrives.Paper 234 showed that distance is six things——here too the distance from ship to home is a different number in the static frame and in the ship's frame.Paper 1036 showed that the radius of the slice of a light sphere is the Doppler factor of that direction——the constant-speed control in Section 6 uses that same quantity.Paper 1041 showed that order alone gives the dimension and the longest chain gives proper time——there proper time is measured by counting points, here by integrating along a hyperbola.**What is added is **obtaining the clock seen back home by two routes**, **checking the position of the horizon directly by whether light catches up**, **noting that c/g is both years and light years**, and **setting constant speed and constant acceleration side by side**.

1. Notation and the Question

Setting: **home sits at the origin of the static frame and a ship recedes from it in a straight line at constant proper acceleration g.Take g to be the standard gravity 9.80665 m/s², time in years (365.25 days) and length in light years.Write τ for the ship's proper time.The world line is $t = (c/g)\sinh(g\tau/c)$ and $x = (c/g)(\cosh(g\tau/c) - 1)$.**

Question: **how does the clock back home look to someone who keeps accelerating?**

2. c/g Is Both a Time and a Distance

Computation 2.1: **in years and light years, $g = 1.032295275554$ per year, $c/g = 0.968715079572$ years and $c^2/g = 0.968715079572$ light years.**

> **Observation 2.2**
>
> the same number is both years and light years.One g, one year and one light year nearly coincide because the gravitational acceleration of the Earth happens to have that size——the coincidence means nothing, but it makes the figures below easier to read.

Computation 2.3: the world line was checked to be a hyperbola. $(x + c^2/g) \div (c^2/g)$ matches $\cosh(g\tau/c)$ and $t \div (c/g)$ matches $\sinh(g\tau/c)$ to within 10^{-12} from 0.5 to 10 years of ship time.Constant proper acceleration was checked in the form $\gamma\beta = t \div (c/g)$, whose ratio is 1.000000000000 at every time, and by numerical differentiation, which gives $d(\gamma\beta)/dt = 1.032295275554$, equal to g.

ship time	home time (years)	distance (light years)	speed
0.5 yr	0.522498304	0.131927180	0.474721281666
1.0 yr	1.187312402	0.563642465	0.774827262643
2.0 yr	3.756289450	2.910475472	0.968317848731
5.0 yr	84.479726364	83.516565150	0.999934262331
10.0 yr	14735.588422535	14734.619739297	0.999999997839

3. The Clock Seen Back Home Stops at c/g

Computation 3.1: for light arriving at the ship, the time of its emission back home was solved. The closed form is $(c/g)(1 - e^{-g\tau/c})$.

ship time	clock seen back home	rate of the image	shortfall from c/g
1.0 yr	0.623669936633	0.356188470909	0.345045142939
2.0 yr	0.845813977714	0.126870226809	0.122901101858
5.0 yr	0.963161214164	0.005733229022	0.005553865409
10.0 yr	0.968683237988	0.000032869915	0.000031841584

The route that follows the world line and the closed form agree to within 1.498×10^{-12} out to ten years of ship time.At thirty years the following route loses the difference between t and x to cancellation, so only the closed form is used: the shortfall is then 3.441691×10^{-14} years.

> **Observation 3.2**
>
> the clock seen never passes c/g.Extend the ship time to ten or thirty years and the clock back home stays just short of 0.968715079572 years——because the rate of the image falls exponentially: by ten years it is 0.000032869915, one part in thirty thousand.

4. What Stops It Is a Horizon Astern

Computation 4.1: light was emitted at time 0 from various positions behind home, and it was checked whether it catches the ship.

position of emission	result
-0.500 light years	catches up (home time 0.769998 years)
-0.900 light years	catches up (home time 6.794983 years)
-0.968 light years	catches up (home time 656.158360 years)
-1.100 light years	does not catch up (out to time 2000)

The boundary is $c^2/g = 0.968715079572$ light years.

> **Observation 4.2**
>
> behind an accelerating traveller there is a surface.Nothing that happens beyond it ever arrives——home itself lies in front of the horizon and stays visible, but light from its clock arrives ever later as it comes from nearer the horizon, so the reading stops short of c/g.

5. By Ship Time One Can Cross the Galaxy

Computation 5.1: journey times were obtained for turning over halfway while holding 1g.

destination	ship time (years)	home time (years)	ratio
Alpha Centauri (4.37 ly)	3.582393723	6.002502777	1.675556413
Barnard's Star (5.96 ly)	4.035521287	7.656093488	1.897175840
galactic centre (26000 ly)	19.757352991	26001.937357979	1316.063815293
Andromeda (2.5 million ly)	28.603418344	2500001.937429409	87402.208622450

Observation 5.2

a hundred thousand times the distance does not multiply ship time by even one and a half.The galactic centre and Andromeda differ by about a factor 96 in distance, and the ship times are 19.757352991 and 28.603418344 years——ship time grows only with the logarithm of distance. In the vocabulary of Paper 123, that is all the world line lengthens.Home time grows nearly as the distance, and is always larger than it, the ship being slower than light.

6. The Separator: Constant Speed or Constant Acceleration

Computation 6.1: **at constant speed the rate of the image is $(1-\beta)\gamma$: 0.229415733871 at $\beta = 0.9$, 0.070888120501 at 0.99 and 0.022366272042 at 0.999.**

Observation 6.2

constant speed does not stop the image; acceleration does.At constant speed the rate reaches zero only in the limit $\beta \to 1$——under acceleration it is 0.000032869915 at ten years of ship time and zero at thirty. What stops it is not speed but the horizon astern.

7. The Thread Between Two Ships of Equal Acceleration Breaks

Computation 7.1: **two ships placed 0.1 light years apart in the static frame set out at the same proper acceleration. Their separation stays 0.1 light years in the static frame, while in their own instantaneous rest frame it grows by γ: with $\gamma = 1.581845454$, 11.087060126 and 87.213755635 at one, three and five years of ship time, the separations are 0.158184545, 1.108706013 and 8.721375564 light years.**

Computation 7.2: **as a control, holding the separation fixed in the ship's frame requires a larger proper acceleration astern: a factor 1.115112541 at 0.1 light years back and 2.066746136 at 0.5.**

> **Observation 7.3**
>
> **"the same acceleration" and "an unchanged distance" cannot both hold.Choose equal proper acceleration and the separation grows in the ship's frame; hold the separation and the acceleration astern must rise——at c^2/g astern the required acceleration diverges, and that is the horizon.**

8. What Is Not Said

> **Observation 8.1**
>
> **fuel is not discussed.Propulsion, mass ratio and shielding are not treated——only the geometry of the world line was counted.The Unruh effect is not entered either——reading the same hyperbola from the side of temperature belongs to Paper 142.General relativity is not used——only an accelerating observer in flat spacetime.**

9. Census and Closing

1. **clock seen 0.623669936633, 0.963161214164, 0.968683237988 years** (Computation 3.1): **short of c/g.**
2. **rate 0.356188470909 to 0.000032869915** (Computation 3.1): **exponential.**
3. **horizon 0.968715079572 light years** (Computation 4.1): **−1.1 never catches up.**
4. **from −0.968 it catches at 656.158360 years** (Computation 4.1): **just inside.**
5. **journeys 3.582393723, 19.757352991, 28.603418344 years** (Computation 5.1): **logarithmic.**
6. **home time 2500001.937429409 years** (Computation 5.1): **ratio 87402.208622450.**
7. **constant speed leaves 0.022366272042 at β = 0.999** (Computation 6.1): **no stop.**
8. **separation 8.721375564 light years** (Computation 7.1): **the thread breaks.**
9. **constant speed or constant acceleration** (Observation 6.2): **the separator; Paper 123, Paper 142, Paper 234, Paper 1026, Paper 1036 and Paper 1041.**

Closing: **For someone accelerating forever at 1g, the clock back home stops at c/g.At 1, 2, 5 and 10 years of ship time it reads 0.623669936633, 0.845813977714, 0.963161214164 and 0.968683237988 years, never reaching the**

0.968715079572 of c/g, while the rate of the image falls from 0.356188470909 to 0.000032869915. What stops it is not speed but a horizon 0.968715079572 light years astern, beyond which light never catches up——and that same number 0.968715079572 is both a count of years and a count of light years.The separator is constant speed or constant acceleration——at constant speed the image stops only in the limit, and at β＝0.999 it still advances at 0.022366272042.Placed among the earlier papers——the scope note of Paper 1026 set acceleration aside; this paper takes that seat. Paper 142 read the same hyperbolic world line from the side of temperature, and here it is read from the side of the arriving image. The length of the worldline named in Paper 123 is, for the journey to Andromeda, 28.603418344 years.To be honest——the formulas are in a paper of 1966. What is added is obtaining the clock seen by two routes and checking the horizon directly by whether light catches up.

References

1. Bell, J. S. (1976). How to Teach Special Relativity. *Progress in Scientific Culture*.
2. Misner, C. W., Thorne, K. S., & Wheeler, J. A. (1973). *Gravitation*. Freeman.
3. Rindler, W. (1966). Kruskal Space and the Uniformly Accelerated Frame. *American Journal of Physics*.
4. Yamagishi, Y. (2026). *What Differs Between the Twins Is Not a Lagging Clock but the Length of a Worldline* [Paper 123]. Zenodo. 10.5281/zenodo.22055231
5. Yamagishi, Y. (2026). *Move It, and Only the* 2π *Survives* [Paper 142]. Zenodo. 10.5281/zenodo.22082281
6. Yamagishi, Y. (2026). *“Distance” Is Six Things, and One of Them Satisfies the Triangle Inequality Backwards* [Paper 234]. Zenodo. 10.5281/zenodo.22128226
7. Yamagishi, Y. (2026). *A Receding Clock Tower Looks Stopped Because of Light Delay, and Relativity Rather Speeds the Image Up by* γ [Paper 1026]. Zenodo. 10.5281/zenodo.22860181
8. Yamagishi, Y. (2026). *Slicing a Light Sphere by Another Frame’s Simultaneity Gives an Ellipse of Eccentricity* β *with the Emission Point at a Focus* [Paper 1036]. Zenodo. 10.5281/zenodo.22860709
9. Yamagishi, Y. (2026). *Reduced to Order Alone, the Fraction of Related Pairs Still Gives the Dimension and the Longest Chain Gives Proper Time* [Paper 1041]. Zenodo. 10.5281/zenodo.22860945

— From thinking to syncing. —

Yuuki YAMAGISHI (山岸 勇輝)

© 2026 Yamagishi Complexity Torus Lab, Japan · Licensed under Creative Commons Attribution 4.0 International (CC BY 4.0)