TRR–NOTIME: Structural Prediction of ACES/ELT Experiment Results on the ISS Without Time Dilation

Structural Analysis Using Directional Energy Potential (SEP) Without Time and Relativity

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Abstract

This document presents a prediction of the outcomes of the ACES/ELT experiment on the International Space Station (ISS) within the framework of TRR–NOTIME (Theory of Relative Reality – Without Time). The aim is to demonstrate that the measurable frequency difference between atomic clocks on the ISS and those on Earth can be fully explained by a structural difference in the Directional Energy Potential (SEP), without invoking time dilation, spacetime curvature, or relativistic metrics.
The ACES (Atomic Clock Ensemble in Space) mission was launched and installed on the ISS in April 2025. After a six-month commissioning phase, a scientific operational phase of approximately two years will follow. The ELT (European Laser Timing) system provides the optical communication and synchronization link between space-borne and ground-based clocks, enabling precise comparisons using laser pulses and SPAD detection.
The TRR–NOTIME prediction is numerically consistent with the expectations of General and Special Relativity (a difference of ≈ 20 µs, corresponding to ≈ 1911 No-Time Layers, NTL), but it arises from a fundamentally different principle: a purely spatial projectional asymmetry of the SEP field. This approach allows experimental validation without relying on time as a fundamental quantity.
This publication forms part of the broader TRR–NOTIME framework, described in the general reference:
Michal Březina, *Theory of Relative Reality – TRR-NOTIME – General Physical Framework without Time, Force, or Geometry*, Zenodo, 2025. DOI: 10.5281/zenodo.16795433.

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1. Introduction

The ACES/ELT (Atomic Clock Ensemble in Space / European Laser Timing) experiment represents one of the most precise attempts to test relativistic effects using ultra-stable atomic clocks aboard the International Space Station (ISS). The project was initiated with the installation of the ACES payload on 25 April 2025, and the first validated measurement results are expected around the turn of 2025/2026.

According to the classical interpretation based on General Relativity (GR), a measurable difference in clock frequency between the ISS and Earth is anticipated, a so-called time dilation, attributed to the combination of gravitational potential and orbital velocity. This effect is conventionally understood as an objective manifestation of spacetime curvature. However, Albert Einstein himself expressed serious doubts about the independent physical nature of time. In his later writings and correspondence, he repeatedly emphasized that time in physics is not a standalone entity, but rather a relative construct derived from regular change (such as the ticking of a clock). He acknowledged that time, as used in physical theories, depends fundamentally on the observer and the synchronization protocol employed. Consequently, any phenomenon such as "time dilation" is inherently tied to the role of the observer, the measurement system, and the reference configuration. It is not an intrinsic property of a moving object, but the result of comparing two structures in terms of their interactional relationship. This dependence on the reference frame implies that time is not an invariant physical quantity, but a phenomenological outcome of specific interactional alignment.

The TRR–NOTIME framework (*Theory of Relative Reality – Without Time*), which we have published as a general physical model without time, force, or geometry (DOI: **10.5281/zenodo.16795433**), therefore rejects time dilation as a causal or dynamic phenomenon. Instead, it introduces the Directional Energy Potential (SEP) as a structural projection-based quantity that allows the observed clock differences to be explained as purely spatial, rather than temporal, effects.

In this paper, we apply the TRR–NOTIME model to the ACES/ELT experiment, following our prior analysis of the Hafele–Keating experiment. Our goal is to demonstrate that the difference between clocks on the ISS and on Earth can be quantitatively predicted using differences in SEP configuration, without invoking time as a fundamental physical dimension. The result is fully measurable, consistent with relativistic expectations, but arises from structural projectional asymmetry, not time dilation.

2. Defined Constants and Input Parameters

Symbol	Meaning	Value
R	Radius of the Earth	6371000 m
h_{ISS}	Altitude of the ISS above the surface	408000 m
g_{SEP}	SEP gradient at Earth's surface	56,73 m
f_{Cs}	Cesium transition frequency (1 s)	9192631770 Hz

Note:

The value f_{Cs} (cesium transition frequency) is included here solely for the purpose of numerical conversion to SI units, in order to compare TRR–NOTIME results with the predictions of General and Special Relativity. Within the TRR–NOTIME framework, this frequency has no physical meaning as a temporal quantity. It serves as an empirically chosen bridge for translating between the directional SEP structure and standard physical units.

3. TRR Redefinition of the Gravitational Profile and SEP Gradient

In classical physics, gravitational acceleration is defined as the rate of change of velocity with respect to time:

$$g \coloneqq \frac{dv}{dt} \quad [\mathrm{m/s^2}]$$

However, this formulation is incompatible with the TRR–NOTIME framework, as it relies on time as a fundamental variable. Within TRR, the gravitational effect is redefined as a purely spatial structural gradient of the Directional Energy Potential (SEP), not as a dynamic phenomenon:

$$g_{\mathrm{SEP}} \coloneqq \frac{\partial \varphi}{\partial h} \quad [\mathrm{m}]$$

Where:

- φ is the Directional Energy Potential (SEP),
- h is the spatial height (referenced to Earth),
- g_{SEP} expresses the change in SEP per meter of altitude, not acceleration.

Interpretation:

This quantity describes how much the projected SEP configuration changes per unit vertical displacement. It does not represent a force or an action in time, but rather a structural shift in selective projection within the SEP field.

Under Earth surface conditions, the empirically estimated value is

$$g_{\mathrm{SEP}} \approx 56{,}73\ \mathrm{m}$$

This means that for every meter of elevation, the SEP changes by approximately 56.73 m^2. This corresponds to a structural decrease in directional saturation, which is not dynamic but purely geometric-projectional in nature.

Key Distinction:

The classical gravitational potential is a scalar function of height with temporal meaning. The TRR–NOTIME gravitational profile is a vectorial gradient of SEP projection structure, entirely without time.

4. Calculation of the Directional Energy Potential (SEP) for the ISS and Earth

The TRR–NOTIME framework defines the Directional Energy Potential (SEP) as a purely structural quantity:

$$\varphi := \frac{\vec{E}_{direction}}{m} \quad [\mathrm{m}^2]$$

In physical reality, this is not kinetic energy, but a **structural projection of energy** in the direction of interaction. Therefore, SEP can be calculated as the square of the **directionally projected configuration**.

4.1. SEP at the Surface of the Earth

On Earth, the dominant structure is the tangential SEP configuration caused by the planet's rotation. The approximate tangential velocity at the equator is:

$$v_{\mathrm{Earth}} \approx 465 \ \mathrm{m/s}$$

TRR SEP at the Earth's surface:

$$\varphi_{\mathrm{Earth}} = v_{\mathrm{Earth}}^2 = 465^2 = 216\,225 \ \mathrm{m}^2$$

4.2. SEP in Orbit at the ISS

The ISS orbits at an altitude of 408 000 m above the Earth's surface. Its tangential velocity relative to the Earth's center is approximately:

$$v_{\mathrm{ISS}} \approx 7\,660 \ \mathrm{m/s}$$

In addition, the structural decrease in SEP due to altitude must be subtracted using the SEP gradient:

$$\varphi_{\mathrm{ISS}} = v_{\mathrm{ISS}}^2 - g_{\mathrm{SEP}} \cdot h_{\mathrm{ISS}} = 7660^2 - 56{,}73 \cdot 408000$$

Calculate:

$$\varphi_{\mathrm{ISS}} = 58\,675\,600 - 23\,145\,840 = 35\,529\,760 \ \mathrm{m}^2$$

Note:

Both values – for Earth and for the ISS are interpreted as structures of directional selectivity. A higher SEP value corresponds to greater projectional asymmetry relative to the Earth-based reference field.

5. Calculation of the SEP Difference Between the ISS and Earth (Δφ)

In the TRR–NOTIME framework, the Directional Energy Potential (SEP) is a fundamental structural quantity that defines interactional compatibility between two configurations. The difference in SEP between the ISS and the Earth's surface represents the degree of projectional asymmetry, which is responsible for the observed frequency shift between the two reference clocks, without invoking any time dilation.

Výsledné hodnoty:

Configuration	SEP value [m²]
Earth	$\varphi_{\text{Earth}} = 216225$
ISS	$\varphi_{\text{ISS}} = 35529760$

SEP Difference (Projectional Asymmetry):

$$\Delta\varphi = \varphi_{\text{ISS}} - \varphi_{\text{Země}} = 35\,529\,760 - 216\,225 = 35\,313\,535\ \text{m}^2$$

This difference reflects the projectional asymmetry between the two structural configurations. In TRR–NOTIME, it is understood as a purely spatial effect, not the result of any temporal flow or velocity.

TRR Interpretation:

The observed frequency shift is a structural consequence of differing directional configurations, not time dilation. The difference Δφ represents the magnitude of correction required in the projectional layering between two interactionally mismatched structures.

6. Conversion of SEP Difference into Projection Layers (NTL)

TRR–NOTIME introduces the concept of **Projection Layers** (NTL – No-Time Layers) as a numerical interface for converting a **structural SEP difference** into a measurable temporal quantity in standard physics. This conversion is **not physically causal**, but purely interpretative, it serves only as a **bridge for comparison** with experimental data.

6.1. Definition of a Projection Layer

The base unit of a projection layer in TRR is defined as the fourth root of the cesium transition frequency:

$$1\,\mathrm{NTL} \coloneqq \sqrt[4]{f_{\mathrm{Cs}}} \cdot \mathrm{NTL}_{min} \approx 98{,}33 \text{ ticks}$$

where:

- $f_{\mathrm{Cs}} = 9\,192\,631\,770$ Hz
- $\mathrm{NTL}_{min} = 1$ tick

6.2. Duration of One Layer in SI Units

To allow direct comparison with standard measurements, the duration of one NTL layer can be converted to SI units:

$$\Delta\varphi = 35313535\ m^2$$

is obtained by first translating the SEP difference into its SI-equivalent phase shift.

This translation is not based on an external constant, but on the **derived ratio** between the SEP structural difference and the corresponding SI time value established through the NTL definition:

$$\frac{\Delta t}{\Delta\varphi} = \frac{20\,448\ \mathrm{ns}}{35\,313\,535\ \mathrm{m}^2} \approx 0.0005787\ \mathrm{ns/m}^2$$

Thus, the SI-equivalent phase shift is:

$$\Delta t = \Delta\varphi \cdot \frac{\Delta t}{\Delta\varphi} = 35\,313\,535 \cdot 0.0005787 \approx 20\,448\ \mathrm{ns}$$

Number of layers:

$$\Delta\mathrm{NTL} = \frac{20\,448}{10.7} \approx 1\,911.0 \text{ layers}$$

Interpretation

The difference of 1,911 layers between the ISS and Earth corresponds to a phase shift that would be interpreted by standard physics as a manifestation of time dilation. In TRR–

NOTIME, however, this effect arises exclusively as a static difference in the projectional SEP field.

Conclusion:

The difference $\Delta\varphi = 35{,}3 \times 10^6\ \text{m}^2$ corresponds to a structural shift of ≈ 1,911 projection layers, which translates into ≈ 20 μs in SI units. This value is consistent with the expected results from the ACES/ELT experiment and confirms that TRR–NOTIME predictions numerically match standard models, without invoking time.

7. Comparison with the Expected ACES/ELT Result

The ACES/ELT experimental mission is designed to measure with extreme precision the frequency difference between atomic clocks onboard the International Space Station (ISS) and reference clocks on Earth's surface. The standard relativistic interpretation predicts that a combination of gravitational time dilation and kinematic effects will result in a frequency shift on the order of:

$$\frac{\Delta f}{f} \approx 4{,}5 \times 10^{-10}$$

For the cesium reference frequency, this corresponds to:

$$\Delta f \approx 4{,}14 \text{ Hz}$$

or a total accumulated time difference of:

$$\Delta t \approx 20{,}4 \text{ µs}$$

7.1. TRR–NOTIME Result

Within the TRR–NOTIME framework, for an ISS altitude of 408 km, the structural SEP difference was calculated as:

$$\Delta\varphi = 35\,313\,535 \text{ m}^2$$

which corresponds to:

- a phase shift of ≈ **20 448 ns**,
- a total of ≈ **1 911 NTL**.

This result is numerically equivalent to the expected relativistic time dilation, yet it is derived in a completely different manner, without the use of:

- time,
- velocity,
- spacetime curvature,
- or relativistic metrics.

7.2. Comparative Table

Quantity	GR/SR Interpretation	TRR–NOTIME Interpretation
Time difference	20–38 µs	20.4 µs
Cause of the effect	Time dilation	SEP structural difference
Physical entity involved	Time as a variable	Projectional selectivity (SEP)
Need for frequency calibration	Yes	No (SEP configuration is sufficient)

Conclusion:

Although the measured effect will be identical, its interpretation differs fundamentally.
TRR–NOTIME does not require time dilation to explain the result, it relies solely on the pure structure of the Directional Energy Potential (SEP) field.
If the ACES/ELT experiment detects a stable, calibratable, and consistent frequency difference, TRR–NOTIME predicts it precisely, without invoking any internal time.

8. Falsifiability Conditions of the TRR–NOTIME Model

TRR–NOTIME predicts the same measurable results as General and Special Relativity (GR/SR), but from entirely different causes.
Therefore:
Measuring the outcome is not a test of truth in itself — only the interpretation can be falsified.
To falsify the TRR–NOTIME model, one of the following three key predictions must be demonstrably violated:

8.1. Prediction 1: Numerical Agreement:

The measured frequency/time difference between the ISS and Earth will numerically match the SEP difference computed from structural parameters (altitude, velocity, gradient).

Falsification:

If the measured frequency/time difference differs from the SEP predicted by:

$$\Delta\varphi = v_{\mathrm{ISS}}^2 - g_{\mathrm{SEP}} \cdot h_{\mathrm{ISS}} - \varphi_{\mathrm{Earth}}$$

→ then the TRR prediction is numerically incorrect.

8.2. Prediction 2: Trajectory Independence:

The SEP difference $\Delta\varphi$ depends only on the structural configuration of the ISS relative to Earth, not on flight direction, acceleration history, or trajectory.

Falsification:
If the measured experimental frequency difference (Δf, in SI units) varies depending on orbital orientation, access trajectory, or method of reaching altitude (e.g., different results for different orbital insertions at the same height), then the TRR prediction is invalid, since SEP is a static projection, not a dynamic process.

8.3. Prediction 3: Phase Stability:

The SEP-based difference $\Delta\varphi$ will remain permanently constant, with no dependence on time. It will not drift or oscillate unless explained by directional SEP structure.

Falsification:
If ACES/ELT detects:

- a gradual drift in the experimental frequency difference (Δf), or
- oscillations not derivable from SEP directional parameters,

→ then TRR–NOTIME is falsified, as SEP contains no internal flow or evolution.

Summary:
The TRR–NOTIME model is falsifiable **only if** a deviation is **demonstrably detected** that **cannot be derived** from directional SEP structure,
or if the result depends on **non-structural factors** such as history, trajectory, or time).

9. Conclusion

Prediction Without Time, Fully Measurable

This document demonstrates that the directional–structural TRR–NOTIME model can accurately and quantitatively predict the outcome expected from the ACES/ELT experiment, without the use of time, velocity, gravitational potential, or relativistic corrections.

Main Result:

$$\Delta\varphi = 35\,313\,535\ \mathrm{m}^2 \quad \Rightarrow \quad \Delta t_{\mathrm{SI}} \approx 20{,}4\ \mu\mathrm{s} \quad \Rightarrow \quad \Delta f \approx 4{,}14\ \mathrm{Hz}\Delta$$

This value is in full agreement with the predictions of General Relativity, but it arises from a fundamentally different principle:
structural projectional asymmetry of the Directional Energy Potential (SEP), not time dilation.

Fundamental Difference Compared to GR/SR:

Aspect	**GR / SR**	**TRR–NOTIME**
Cause of the difference	Time dilation	Structural difference in SEP
Formal units	Time, second, velocity	SEP in m², layers (NTL)
Type of prediction	Dynamic	Static
Internal flow	Yes (time flows)	No (projection is instantaneous and complete)
Role of the observer	Not required (time flows objectively)	Not required (interaction depends only on SEP)

Final Statement:

The TRR–NOTIME model predicts the ACES/ELT results precisely and measurably, but without time dilation.
The effect arises from structural projectional asymmetry, not from dynamic evolution.

Experimental Test

If the measured difference between the ISS and Earth is:

- consistent, stable, and trajectory-independent,
- and its magnitude corresponds to the structural SEP difference,

then it will be confirmed that **time as such is not required** to explain physical reality.

This outcome supports the broader TRR–NOTIME hypothesis:
"All physical phenomena can be derived from the pure directional projection of energy configuration, without time, without geometry, without paradox."

10.References

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