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Hypothetical six-dimensional topology

UNIVERSITÀ DEGLI STUDI DI MILANO DIPARTIMENTO DI FISICA — INFN MILANO — POLITECNICO MILANO 1863 — UNIVERSITÀ DEGLI STUDI DI MILANO BICOCCA

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- Venue: **"La Statale" University of Milan – Dept. of Physics**
- Room: **Aula C – Maria Gaetana Agnesi**
- Co-chairs: **Prof. Daniela Di Martino – Prof. Ileana Rabuffo**

The 2007 talk in Pisa

In the 93rd Congress of the Italian Physical Society we gave the talk "Extension of Einstein's Relativity" based on the **three-dimensional time**.

We proposed new EFE(6D), Einstein field equations in six dimensions, over SO(3,3) symmetry **[2−4]**.

Although multi-dimensional time theories are edged out of the mainstream, such work raised an unexpected interest **[5−7]**.
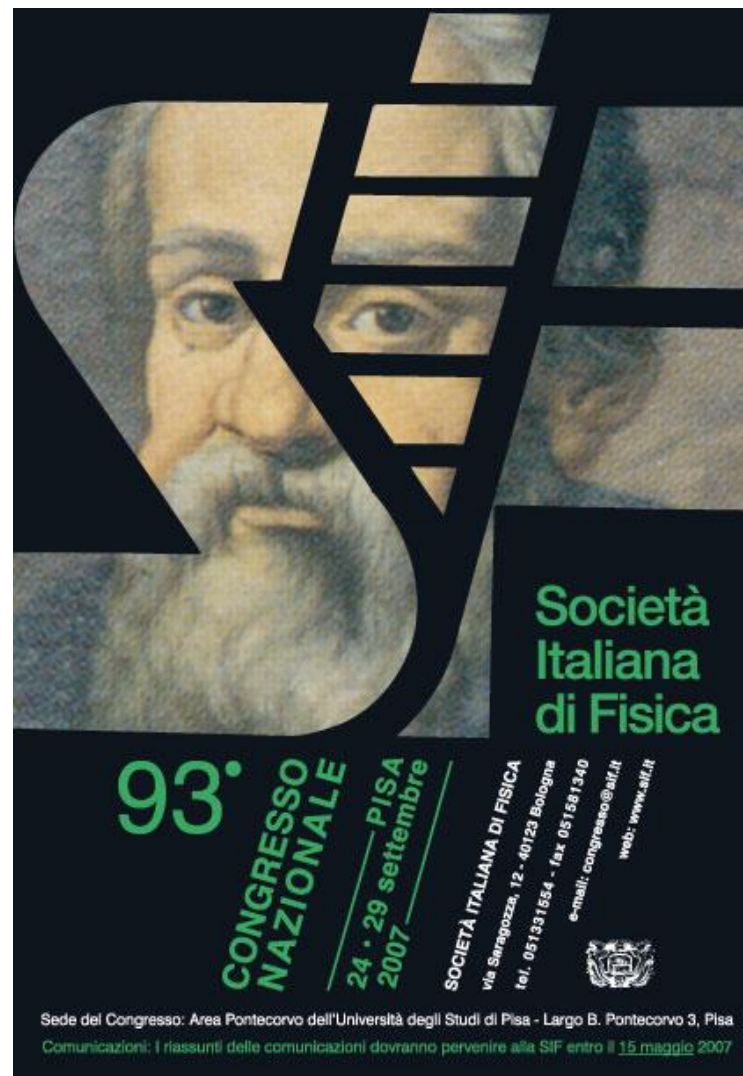
The 2022 talk in Odesa

The four dimensions of Einstein's spacetime manifold define *where* and *when* an event occurs. In the international scientific conference AGMA 2022 **[8,9]** we asked a further question: ***how can an event occur?***

The answer consists of a spin angular velocity associated to each point of the continuum as Euclidean axial vector. The axiom of a punctual spinning axis involves two timelike extra-dimensions extending the 4D framework of the 1916 General Relativity to a new 6D geometrodynamics.

This **Inherently Spinning Spacetime** (ISST) is compatible with any six-dimensional scenario on SO(3,3)-group and its topology entails an interpretation of two quantum phenomena in terms of "hidden" variables.

Construction of the 6D ISST

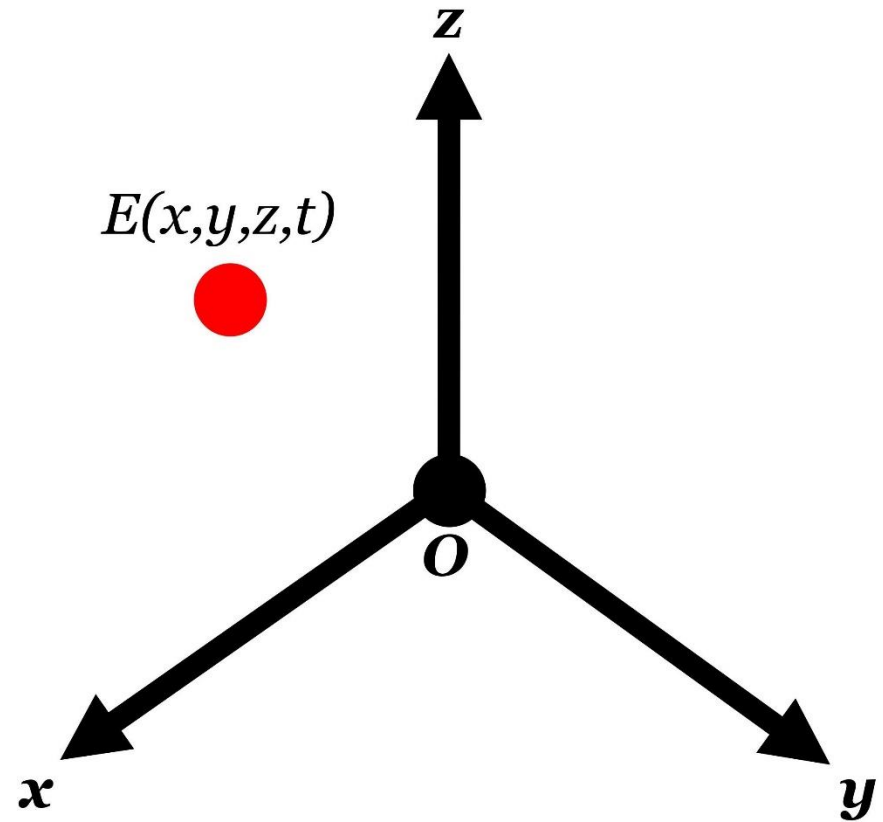A point in the continuum is a structureless rotating sphere with null radius

Inherently Spinning Spacetime (ISST): each point has its own spinning axis

The plane of rotation of each point is identified by two extra-parameters

The two extra-parameters are timelike, so that the ISST is six-dimensional

- General Relativity's EFE are rather difficult, but the logic behind the 4D manifold is trivial.

- The minimum number of information needed to identify an event is four, connected to *where* (3 spatial coordinates) and *when* (1 temporal coordinate) it occurs.

- Although rational, such construction is incomplete.

$E(x,y,z,t)$

- We should respond to a further question: *how* can an event occur?

- The answer is an unexplored property of the continuum: each point could *spin*.

- It means that any point is viewed as a structureless rotating sphere, of null radius, with an intrinsic *spin angular velocity* axial vector $\vec{\omega}$.
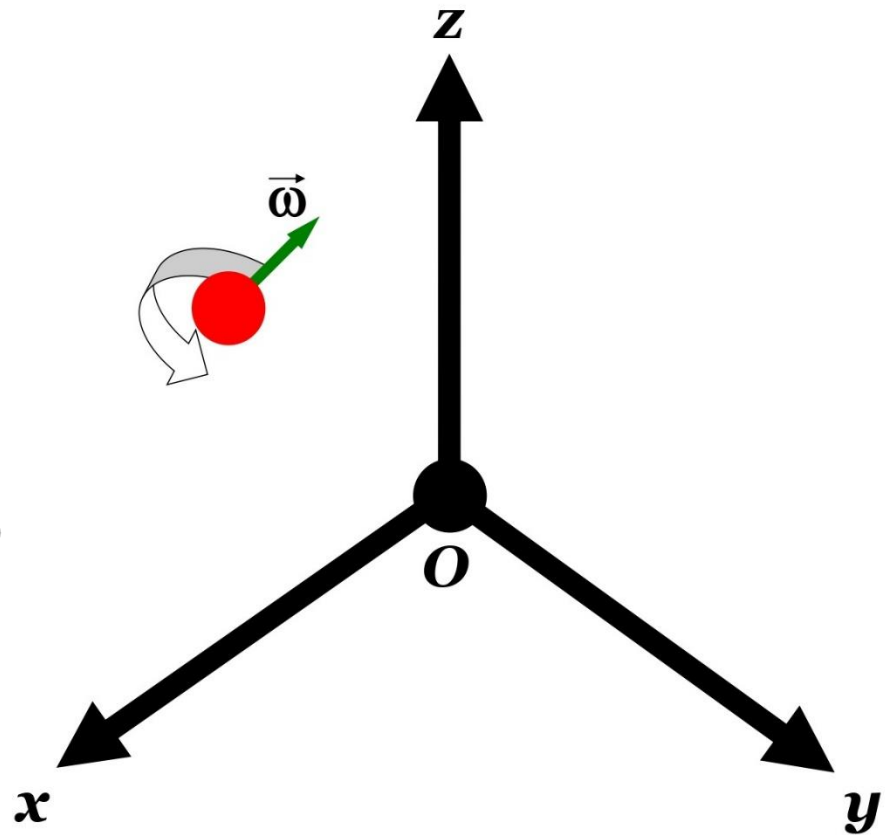
- We ignore both the magnitude and the direction (up or down) of the pseudovector $\vec{\omega}$, focusing only on the plane of rotation (perpendicular to the spinning axis) as essential information about *how* an event happens.

- We adopt the Saturn icon to highlight the *orientation* of each spinning point.
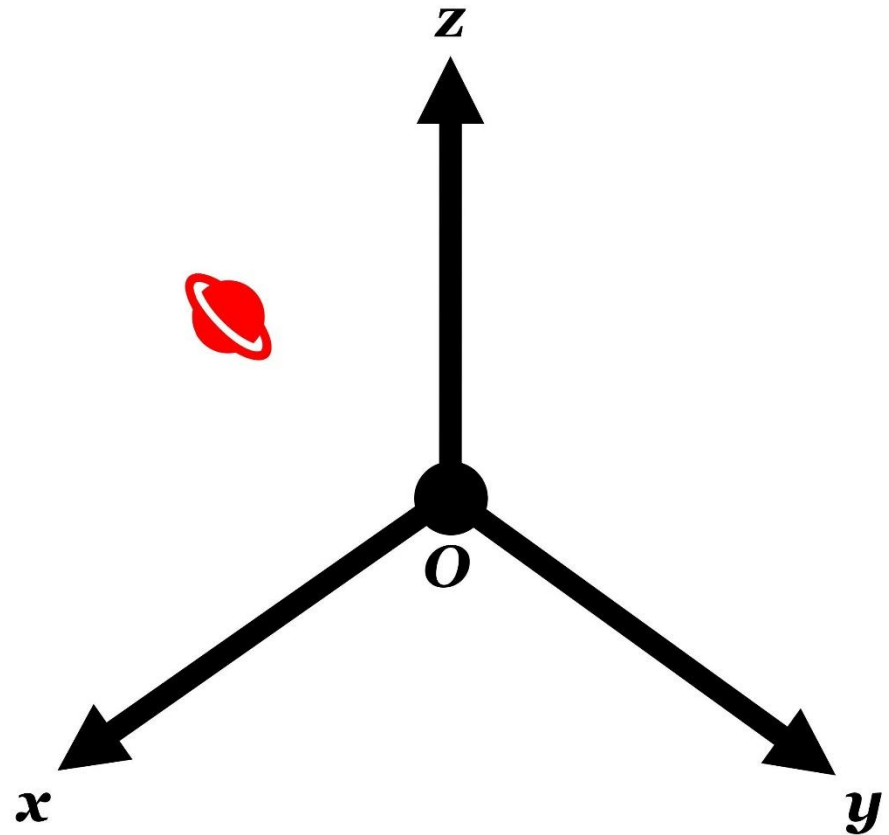
- The plane of rotation of each spinning point has an orientation defined by *two* parameters like, e.g., the first two classic Euler angles α,β.

- We interpret α,β as *time* extra-dimensions because they are independent from the event's position (i.e., not spacelike) and, as surface measures, they are basically timelike **[6]**.
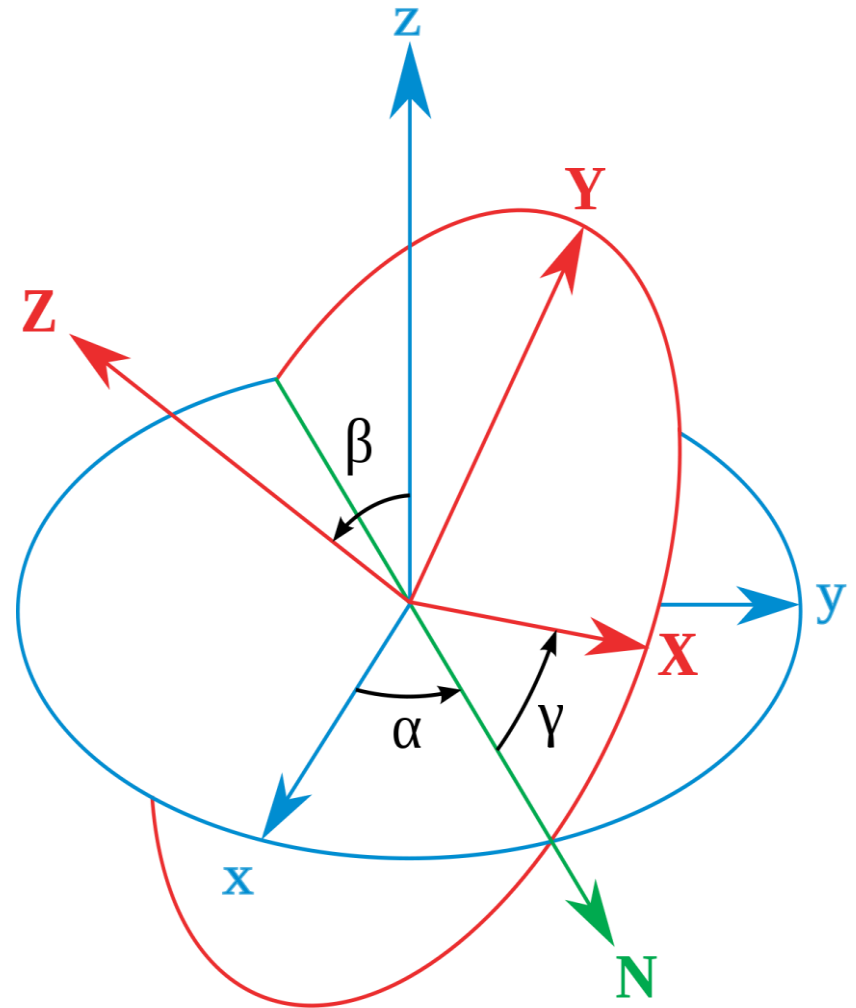
- An ISST event has six coordinates: **E(x,y,z,t,α,β)**.

- If the point orientation does not change, time extra-dimensions α,β should not show up. It means $\alpha_1 = \alpha_2$ and $\beta_1 = \beta_2$ in the passage between two events $E_1(x_1,y_1,z_1,t_1,\alpha_1,\beta_1)$ and $E_2(x_2,y_2,z_2,t_2,\alpha_2,\beta_2)$.

- The invariance **Δα=Δβ=0** could be the reason why two temporal dimensions are *hidden*, letting us perceive time passing only as *t*.

$E_1(x_1,y_1,z_1,t_1,\alpha_1,\beta_1)$

$E_2(x_2,y_2,z_2,t_2,\alpha_2,\beta_2)$

z

O

x

y
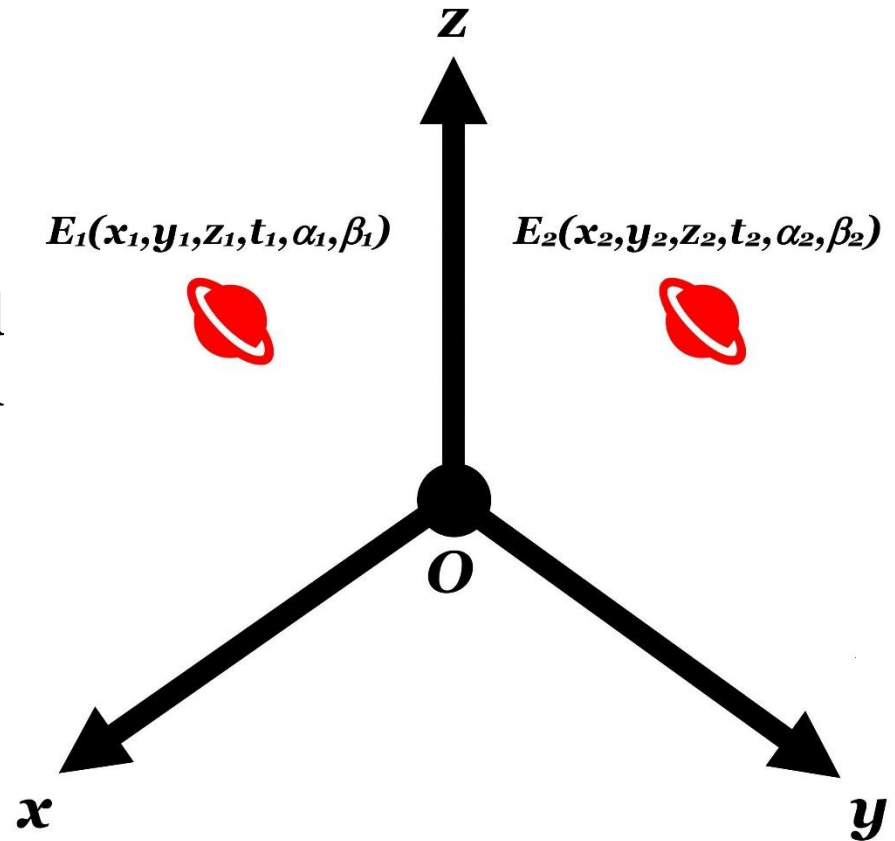
Features of the 6D ISST

An event $E(x,y,z,t,\alpha,\beta)$ is described by three spacelike $S(x,y,z)$ and three timelike $T(t,\alpha,\beta)$ dimensions
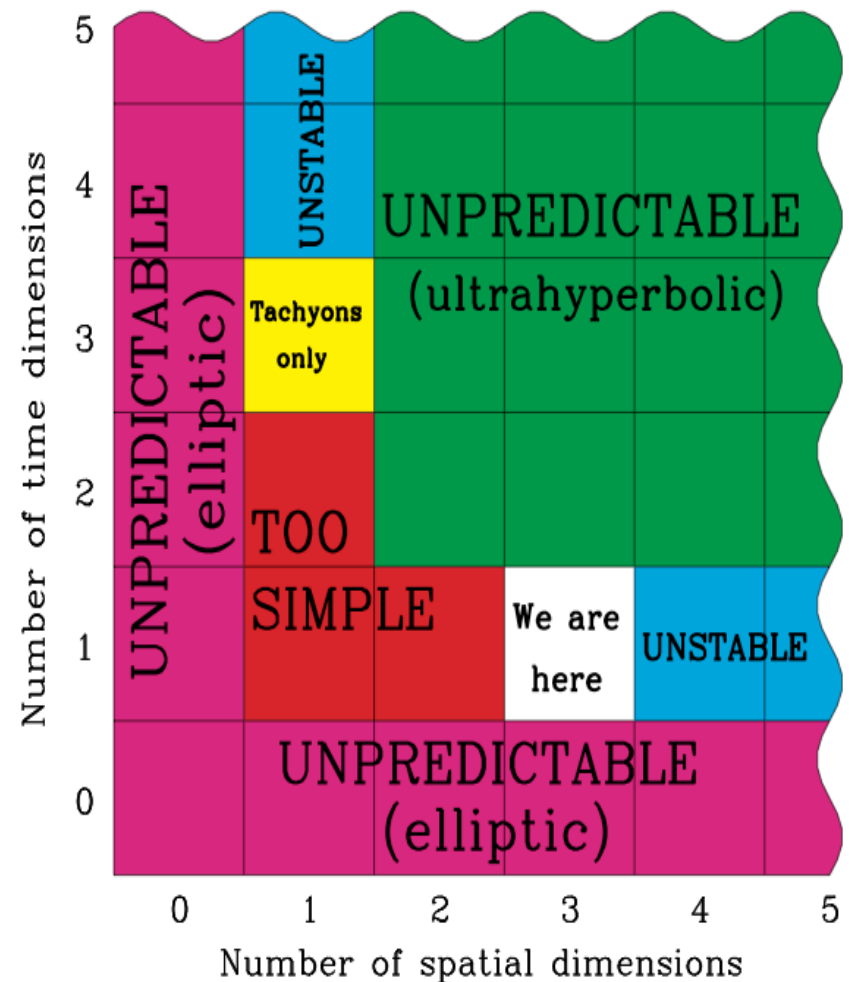
The 6D ISST implies six-dimensional Einstein field equations: $G_{\mu\nu} = kT_{\mu\nu}$ ($\mu,\nu=1,2,3,4,5,6$)

Each event is represented in reference frames with three spatial lines and three temporal surfaces.

Two timelike extra-dimensions would explain some quantum phenomena in terms of "hidden" variables

Our ultrahyperbolic **[2−6]** spacetime six-dimensionally extends the Lorentz transformations, the squared invariant interval, the metric tensor, and the EFE(6D):
$$G_{\mu\nu}=kT_{\mu\nu} \; (\mu,\nu=1,2,3,4,5,6)$$
Dark matter and *dark energy* would be both artificial tools **[7−9, 11]** compensating the shortage of dimensions, in the Λ-CDM model, with respect to an EFE(6D)-based cosmology.

UNSTABLE

UNPREDICTABLE (ultrahyperbolic)

UNPREDICTABLE (elliptic)

Tachyons only

TOO SIMPLE

We are here

UNSTABLE

UNPREDICTABLE (elliptic)

Number of time dimensions

Number of spatial dimensions

The ISST is compatible with our 6D geometrodynamics, via three-dimensional time, where a six-dimensional event is represented in reference frames with three spatial *lines* and three temporal *surfaces*.

For a *flat* spacetime, an event is referred to a Cartesian-like reference frame with three space axes x, y, z and three time orientations t_x, t_y, t_z mutually orthogonal **[2−6]**.
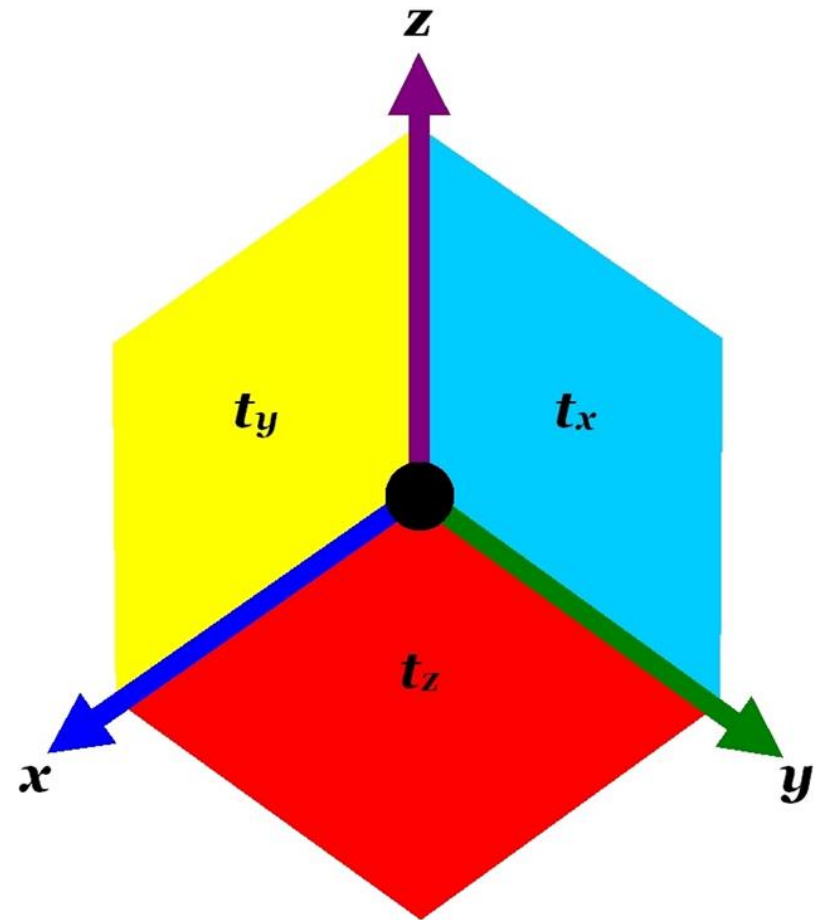
For a curved spacetime, locally almost flat, we refer any event $E(X_1,X_2,X_3,X_4,X_5,X_6)$ to a Gaussian-like reference frame with three spatial *lines X1,X2,X3* not necessarily neither rectilinear nor mutually orthogonal and three temporal *surfaces X4,X5,X6* not necessarily neither plane nor reciprocally orthogonal.

Each six-dimensional event is unique, i.e., representable without ambiguity.
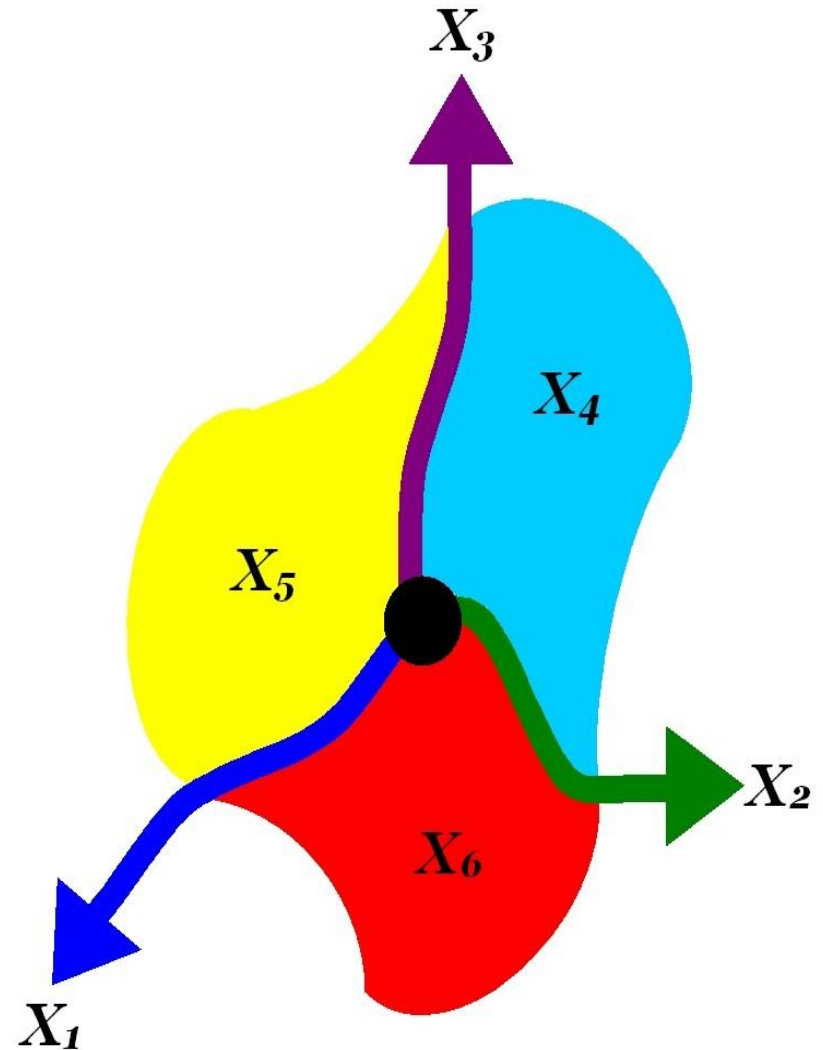
The three-dimensional time could resolve two quantum phenomena:

1) **Double-slit experiment**; two undetected time dimensions would avert the trajectory from splitting because the particle could be beyond the slits with the same temporal coordinate t (but at different timing T_1 and T_2) having passed only one of them.

2) **Quantum tunnelling**; the particle would not find any barrier along its way being located in another temporal triple $T(t,\alpha,\beta)$.

$T_1(t,\alpha_1,\beta_1)$

$T_2(t,\alpha_2,\beta_2)$
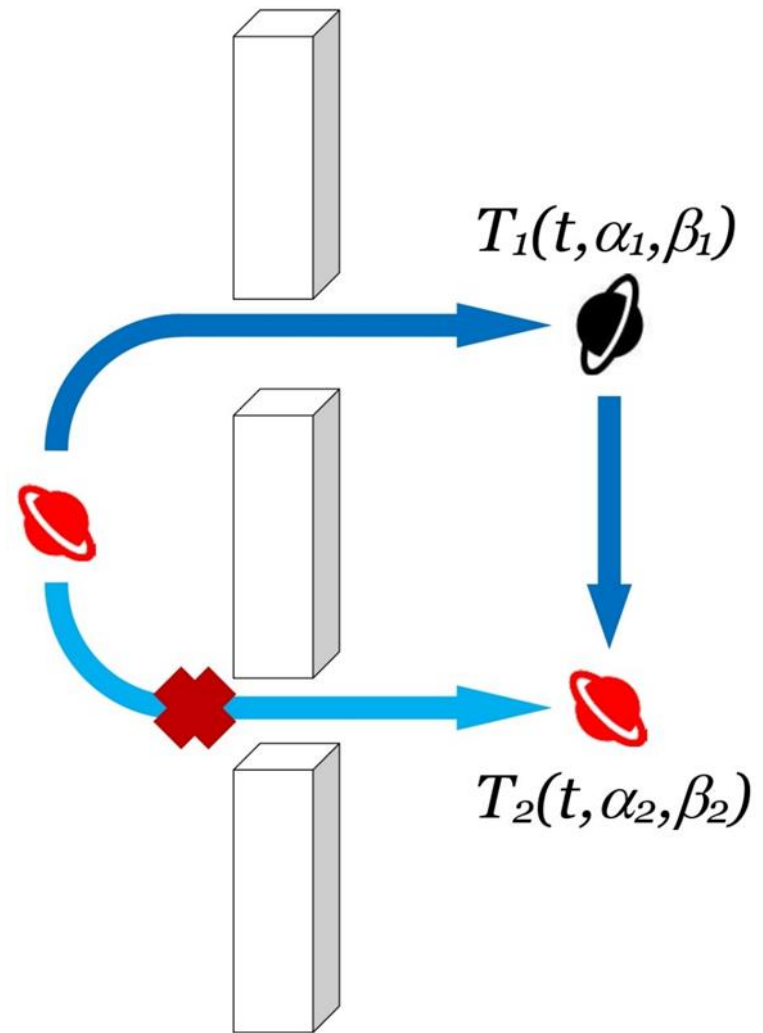
Testing the 6D physics

Astronomical observations could verify the cosmic web created by the 6D axial hypergravity of galaxies

The XENON experiments at Gran Sasso's lab could support the 6D cosmology from lack of dark matter

The ATLAS and CMS detectors at CERN's LHC could establish the presence of timelike extra-dimensions
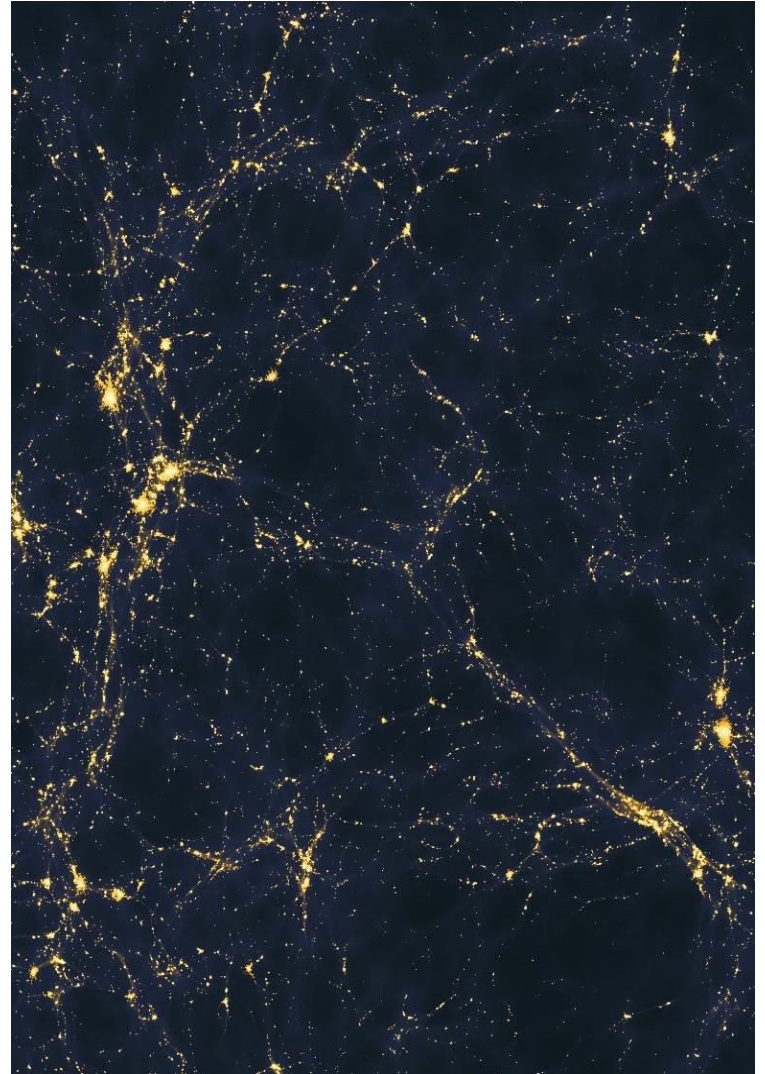
A laboratory experiment on the Casimir effect could confirm the 6D spacetime and improve the photonics

Several astronomers are postulating web-like strings of *dark matter* for the galaxy filaments observed since 1987.

The time distortions around a structureless spinning sphere in 6D could, preferably, justify the super-galactic clusters *without* additional matter.

Namely, the axial hypergravity in 6D would tie galaxies like rings of a cosmic chain.

A team guided by Prof. Elena Aprile at the Italian Gran Sasso National Laboratory has recently found a null yield **[1]** in the scintillation and ionization of liquid xenon for nuclear recoils.

Named XENON, the program is searching for weakly interacting massive particles (WIMPs).

If *dark matter* should remain undetected, it would be an argument in favor of our EFE(6D)-based cosmology.
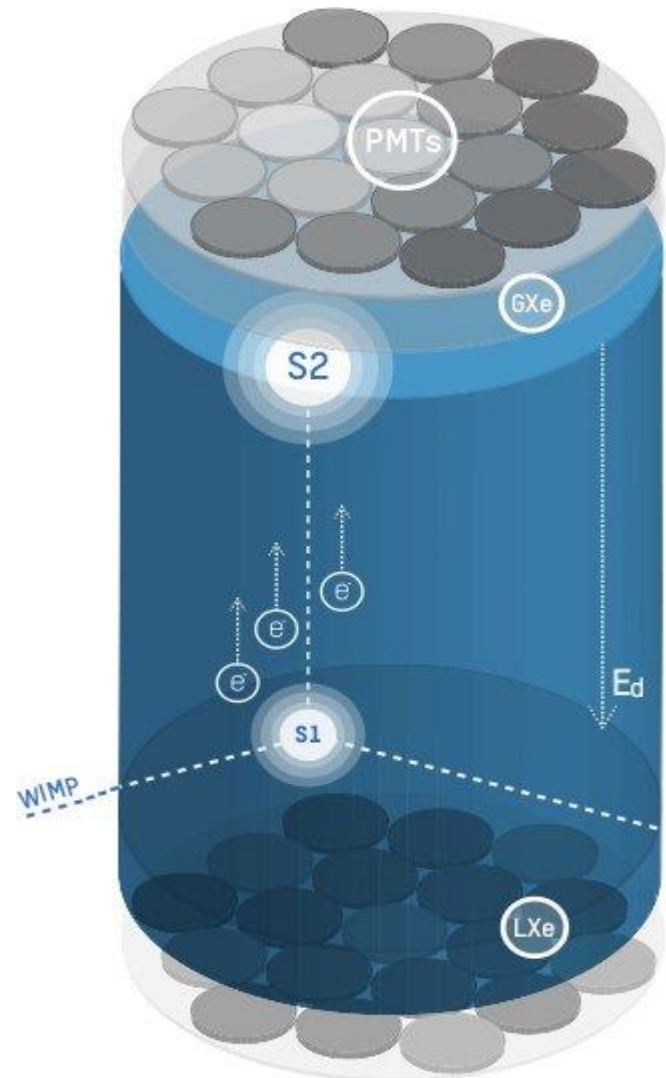
Aimed to reveal *spatial* extra-dimensions, the ATLAS (A Toroidal LHC ApparatuS) and the CMS (Compact Muon Solenoid) at CERN's LHC are looking for phenomena observable at energy equal or greater than 8 TeV.

They could accidentally detect anomalies linked to additional *time* dimensions, albeit they are checking specific models about the "hierarchy problem" **[10]**.
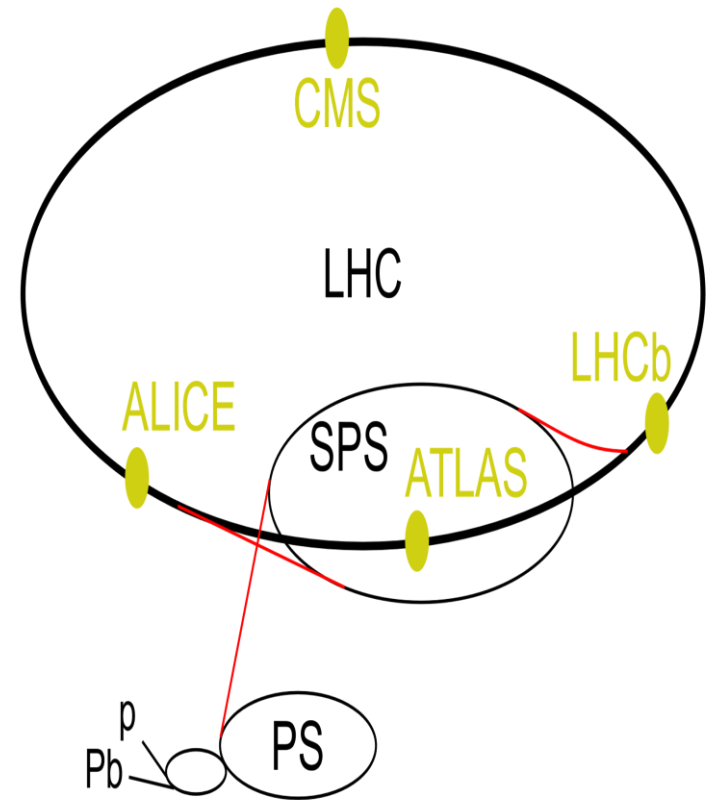
A possible test from the Casimir effect

Supervised by Prof. David Hobill (University of Calgary), Dr Brett Teeple is currently proposing to test the 6D spacetime through a laboratory experiment on the dynamical Casimir effect and the associated production of photons.

The entrepreneur Jode Himann supports the new technology that may result from the introduction of extra time dimensions, being primarily interested in the possible development of quantum devices for the photonics industry.

Casimir plates

Vacuum fluctuations
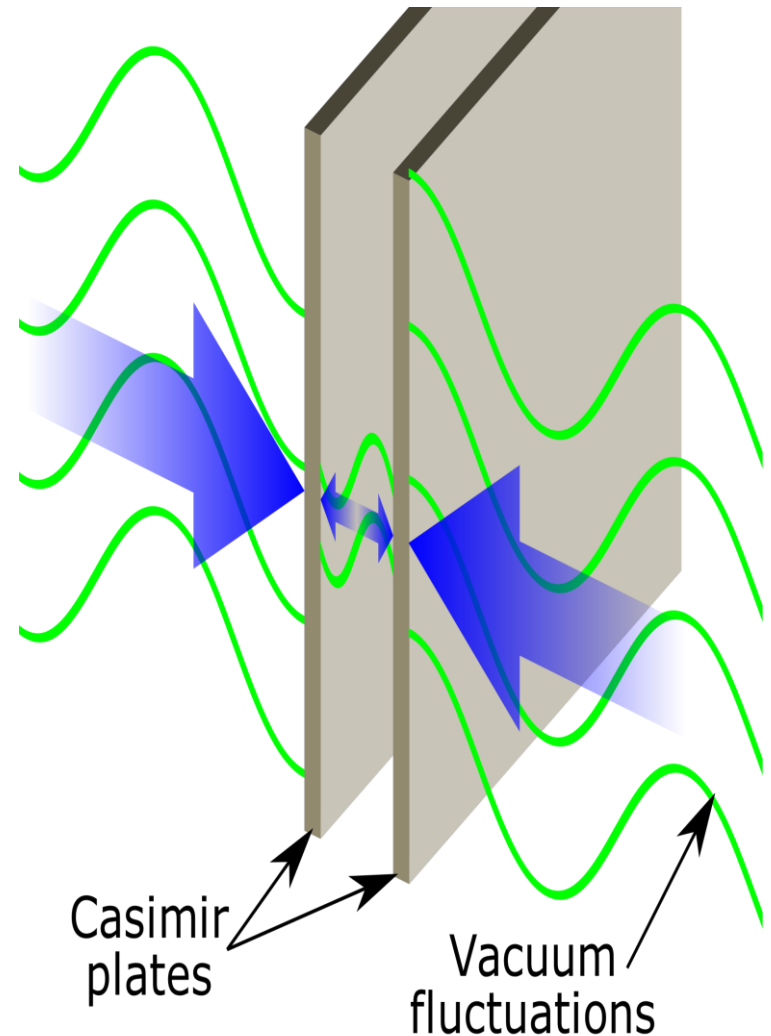
Conclusions

Although the hypothesis of a six-dimensional spacetime with SO(3,3) symmetry has been investigated by several scholars for over four decades, the related topological analysis still seems inadequate. We propose the Inherently Spinning Spacetime (ISST) as proper background for any 6D geometrodynamics based on the three-dimensional time.

The ISST is an axiomatization of the General Relativity manifold where each event is characterized by its own spin angular velocity as additional property. If each point of the continuum is a structureless rotating sphere of null radius, the orientation of its spinning axis is defined by two parameters interpreted as timelike extra-dimensions.

The existence of two "hidden" temporal dimensions would affect cosmology and quantum physics also in testable ways.

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