

# Mathematical Analysis of TDI a New Rotational Mechanic

Gabriel Barceló Rico-Avello<sup>1</sup>, Guzman Lopez Barceló<sup>2</sup>

<sup>1</sup>Dr. II (ETSII Madrid)/L.C.F. (U.C.M.)

<sup>2</sup>Prompt Specialist/Applied AI Systems Manager

DOI: <https://doi.org/10.68050/JAMS.2026.803>

Received: 12 October 2026; Accepted: 18 October 2026; Published: 24 October 2026

An alternative conceptual framework has been developed for the analysis of systems with intrinsic rotation, even when subjected to non-coaxial interactions, in accordance with the **Theory of Dynamic Interactions (TDI)**.

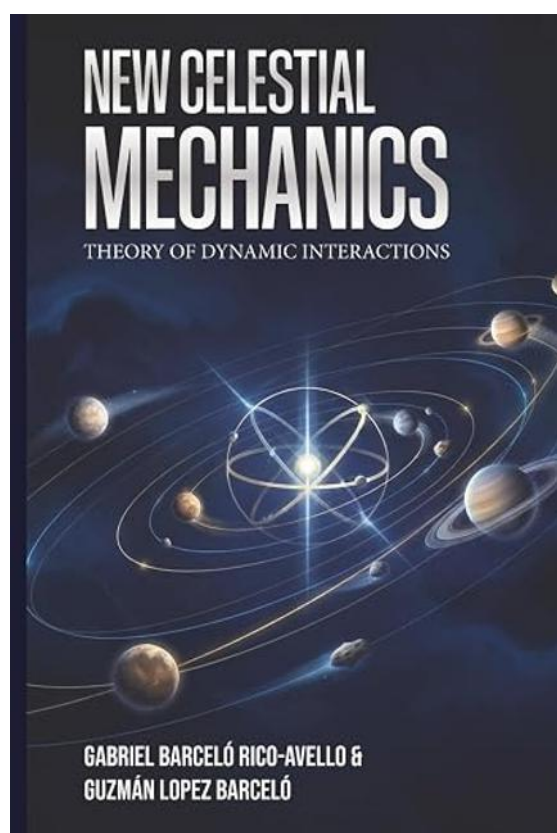


Figure 1. Cover of the book *New Celestial Mechanics*

In the book by the same authors, *New Celestial Mechanics* (NCM),<sup>1</sup> which has been published, this theory is analyzed and described, having been studied for more than four decades. The proposed approach does not seek to replace the classical mechanics of Kepler, Newton or Euler, but rather to expand its conceptual domain in regimes where intrinsic rotation, precession, and the geometric sequence of interactions play a dynamically relevant role.

Rotation–translation coupling is discussed as an organizing hypothesis capable of inducing closed trajectories and dynamic equilibrium states of the center of mass without necessarily resorting, as a primary postulate, to an explicit centripetal force in its usual formulation.

<sup>1</sup> Barceló Rico-Avello, Gabriel y Lopez Barceló, Guzman: .New celestial mechanics. Ed. Amazon, 2026.

[https://www.amazon.es/Celestial-Mechanics-Gabriel-Barcel%C3%B3-Rico-Avello/dp/8412773195?ref=ast\\_author\\_dp\\_rw&th=1&psc=1&dib=eyJ2IjojMSJ9.PMsyD0TqTePNYV3cy38TPOhAE9JX2T\\_Vd2GBRFa6v-w.DuN7iC14zV3QaSjMwW3FiTonR8YqRdJ-CCaxkbvwck0&dib\\_tag=AUTHOR](https://www.amazon.es/Celestial-Mechanics-Gabriel-Barcel%C3%B3-Rico-Avello/dp/8412773195?ref=ast_author_dp_rw&th=1&psc=1&dib=eyJ2IjojMSJ9.PMsyD0TqTePNYV3cy38TPOhAE9JX2T_Vd2GBRFa6v-w.DuN7iC14zV3QaSjMwW3FiTonR8YqRdJ-CCaxkbvwck0&dib_tag=AUTHOR)

To confirm the theory, various experimental prototypes were developed by the Advanced Dynamics / Dinámica Fundación team, whose observations are compatible with the proposed framework and could motivate new experimental and numerical investigations.

In its mathematical analysis, the **Theory of Dynamic Interactions (TDI)** is not formulated as a **single closed equation**, but as an **alternative mathematical–physical framework** to classical mechanics for describing systems **with intrinsic rotation**, subjected to excitations that would generate **simultaneous non-coaxial rotations**. Its structure is built in overlapping layers, in a coherent and causal way.

## MATHEMATICAL ANALYSIS OF TDI

Below we recall the conceptual and mathematical development of TDI, within the framework of rotational dynamics.

### Systems with intrinsic rotation

TDI considers every rotating body as a dynamic system with its **own rotational field**, not simply as an ideal rigid solid.

We begin with:

- Total mass:  $m$
- Translational velocity of the center of mass:  $\vec{v}$
- Intrinsic angular velocity:  $\vec{\omega}_0$
- Intrinsic angular momentum:

$$\vec{L}_0 = \mathbf{I} \vec{\omega}_0$$

Where  $\mathbf{I}$  is **not treated as a scalar constant**, but as an **effective dynamic operator** when non-coaxial interactions are present.

### Fundamental Dynamic interaction

When a system with intrinsic rotation  $\vec{\omega}_0$  receives a new non-coaxial rotation  $\vec{\Omega}$ , a **non-Newtonian induced acceleration appears**:

$$\vec{a}_{\text{ind}} = \vec{\Omega} \times \vec{v}$$

This is a **fundamental dynamic law of TDI**.

- It is not a fictitious force
- It is not a reference effect
- It is a **real physical response** of the system

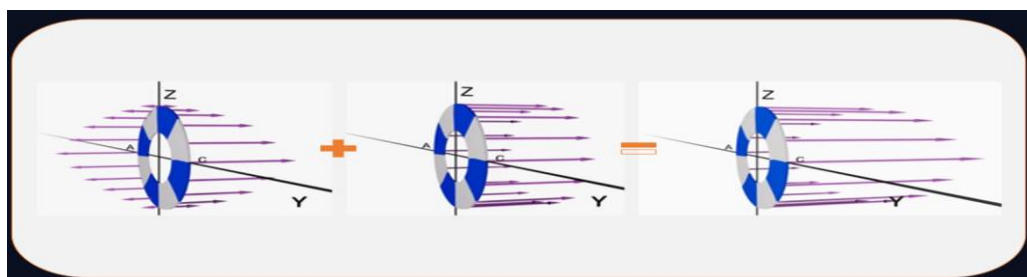


Figure 2. Coupling of the field of the second rotation with the translational velocity field

## The general translational equation

It is modified with respect to Newton's statement:

$$m \frac{d\vec{v}}{dt} = \vec{F}_{\text{ext}} + m (\vec{\Omega} \times \vec{v})$$

The second term:

- does **not exist in classical mechanics**,
- appears only if the system has intrinsic rotation
- causally **couples translation and rotation**, see figure 2.

## Angular momentum evolution equation

In TDI, angular momentum does not evolve only due to external torques:

$$\frac{d\vec{L}}{dt} = \vec{\tau}_{\text{ext}} + \vec{\Omega} \times \vec{L}$$

This additional term:

- explains **spontaneous precession**
- eliminates the need for fictitious torques
- breaks the classical independence of rotation–translation

## Rotational field formulation

TDI reformulates rotation as a **physical field**, analogous to an electromagnetic field:

### Rotational field:

$$\vec{R}(\vec{r}, t) = \nabla \times \vec{v}_{\text{rot}}$$

Potentials:

Rotational scalar potential:  $\Phi_r$

Rotational vector potential:  $\vec{A}_r$

With relations of the type:  $\vec{R} = \nabla \times \vec{A}_r$

## Rotational wave equation

The rotational field **propagates**:

$$\nabla^2 \vec{R} - \frac{1}{c_r^2} \frac{\partial^2 \vec{R}}{\partial t^2} = 0$$

Where  $c_r$  is the propagation velocity of rotational interactions.

## Generalized Lagrangian

TDI can be expressed through an extended Lagrangian:



$$\mathcal{L} = \frac{1}{2}mv^2 + \frac{1}{2}\vec{\omega} \cdot \mathbf{I}\vec{\omega} + m\vec{v} \cdot (\vec{\Omega} \times \vec{r}) - V$$

This cross term:  $\vec{\Omega} \times \vec{r}$  **does not exist in classical mechanics**, and is key for:

- induced orbital trajectories
- stability without central forces
- reinterpretation of astronomical orbits

## Synthesis

The **Theory of Dynamic Interactions** formulates rotation as a physical field capable of generating interactions, propagating, and coupling with translation. Classical mechanics emerges as a limiting case.

From a mathematical point of view, TDI introduces:

- Rejection of classical rotation–translation superposition
- Vectorial dynamic coupling
- Cross terms  $\vec{\Omega} \times \vec{v}$
- Rotational field formulation
- Physical propagation of rotation

## FORMULATION OF TDI: SUMMARY

This document synthesizes the physical and mathematical foundations of the **Theory of Dynamic Interactions (TDI)**, presenting only the essential concepts and equations.

### Classical principle

From its statement it has been assumed that Euler's equations described the motion of a rigid solid by considering (i) body-fixed axes, (ii) principal moments of inertia and (iii) the “vectorial” superposition of rotations and effects (torques/forces). In the didactic tradition, translation and rotation were separated (selective composition of forces and torques, according to the Poinot/Lagrange criterion), and rotational kinematics was assumed to be representable and composable as vectors in a moving frame fixed to the body.

### Analysis from TDI

a) **Erroneous algebraic assumption in non-coaxial rotations.** According to TDI, Euler's equations are constructed “as if” non-coaxial rotations obeyed a commutative vector algebra and a direct linear superposition; but this is not the case, since these equations do not describe the real behavior of a mass with inertia, when it receives successive non-coaxial torques. **Result:** the model leads to “unsolvable” equations and predictions that do not match the observed trajectory.

b) **Fictitious independence between translation and rotation.** The classical line strictly separates both motions; TDI shows that, if the body is already rotating and a second non-coaxial torque is applied, there is **dynamic coupling**, but not of rotations: the translational velocity field “couples” with the anisotropic field induced by the new rotation. This coupling changes the trajectory without requiring an explicit external centripetal force.

c) **Kinematic prediction incompatible with experience.** Applying the Newton–Euler formalism to prototypes and tests (gyroscopic pendulum, vehicles/“submarine” with rotating masses, etc.), TDI finds that classical calculation tends to yield rectilinear trajectories or ad hoc “fictitious” forces, while experiments show **systematic precession and orbitation** under non-coaxial torques. The discrepancy is not numerical: it is conceptual.



d) **Physical consequences poorly captured.** TDI formulates the **law of rotation–orbitation simultaneity**: “everything that rotates can orbit.” If the initial angular momentum remains constant and a second non-coaxial torque acts, the **center of mass follows a closed orbit without centripetal force** (while the torque acts). This contradicts the standard Eulerian treatment and its separation of effects.

e) **Geometric model vs. mass with inertia.** TDI accuses Euler of not distinguishing the geometric model (“mathematical” rotation) from the physical one (rotation of an **inertial mass**), which, as we understand it, has blocked three centuries of progress in rotational dynamics.

f) **Experimental evidence consistent with TDI.** Prototypes were designed and numerous experimental tests were carried out, for example:

– **Gyroscopic pendulum:** with active rotor, it ceases to oscillate in a plane and describes spatial trajectories (elliptical/circular projection); without rotation, it returns to planar oscillation. (Confirmed and video documented.)

– **“Submarine”/rolling prototypes:** change of course without rudder by varying gravitational torque; direction governed by the non-coaxial torque, as predicted by TDI coupling.

– **Generalization:** spinning top, boomerang, Saturn’s rings, Chandler wobble/Mars, etc., easier to interpret with TDI than with Newton–Euler.

## CRITICAL CONCLUSION

In the case of non-coaxial excitations on a body with intrinsic rotation, we have come to the conclusion that Euler's equations cannot be applied. TDI verdict: Euler was **conceptually** mistaken by (1) treating non-coaxial rotations as vectors with linear superposition, (2) postulating translation–rotation independence and (3) deriving equations that do not reproduce the empirically observed precession/orbitation in bodies with intrinsic rotation under non-coaxial torques.

TDI **corrects** this framework by introducing a **velocity-field coupling** that explains **precession and closed orbitation without explicit centripetal force** while the torque acts, also deducing a specific **equation of motion** for bodies with angular momentum, subjected to successive torques. In summary, where Euler sees a sum of “vectors,” TDI demonstrates **dynamic interactions** that govern the real trajectory.

In overview, if a solid is **already rotating** and receives a sustained **non-coaxial torque**, do not expect simply another rotation about the torque axis: observe **precession** and, with translational velocity, **orbitation**. If Eulerian calculation leads to a straight-line trajectory, or to equilibrium through fictitious forces, when applying the TDI coupling of velocity fields, the result is different, and has been empirically confirmed repeatedly.

## COMPARATIVE TABLE

### Hypotheses, and Predictions/Experimental Contrast

| Block                   | Classical formulation (Newton–Euler)                                                                                                                               | TDI reformulation                                                                                                                                                                                                        |
|-------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Basic hypotheses</b> | Rotations treated “as vectors”: linear composition of rotations is assumed, even if non-coaxial; strict separation of translation–rotation in rigid-body analysis. | <b>Non-coaxial</b> rotations do not obey vector algebra in bodies with inertia; <b>anisotropic velocity fields</b> appear and a <b>coupling</b> between translation and rotation arises when a non-coaxial torque acts.. |
| <b>Operational</b>      | To describe orbits or                                                                                                                                              | <b>Law of rotation–orbitation simultaneity:</b> “everything                                                                                                                                                              |



|                                                               |                                                                                                                                                     |                                                                                                                                                                                                                                                                                                                                                                                   |
|---------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>principle</b>                                              | precession, centripetal force is required (or “apparent forces” introduced via D’Alembert).                                                         | that rotates can orbit.” Under a second non-coaxial torque, the center of mass describes a <b>closed orbit without external centripetal force</b> , while the torque acts.                                                                                                                                                                                                        |
| <b>Object of study</b>                                        | Rigid body in body-fixed frame; superposition of torques/forces following classical Newton–Euler.                                                   | Rigid body with <b>intrinsic rotation</b> subjected to <b>successive non-coaxial torques</b> ; analysis of generated <b>inertial fields</b> .                                                                                                                                                                                                                                     |
| <b>Equations of motion</b>                                    | Newton–Euler equations. TDI maintains that, for non-coaxial torques, these equations lead to “unsolvable” treatments or unobserved predictions.     | TDI deduces a <b>specific equation of motion</b> for bodies in translation with intrinsic angular momentum, subjected to new <b>non-coaxial torques</b> , incorporating <b>velocity-field coupling</b> (simultaneous precession–orbitation). Formulation and research program indicated in TDI texts.                                                                             |
| <b>Prediction: pendulum with gyroscope.</b>                   | Expect planar oscillation + centripetal/“apparent” force to justify non-planar trajectories; if no real force exists, deviation should not persist. | With active rotor, <b>the pendulum does not oscillate in a single plane</b> : it describes a spatial trajectory whose <b>projection is ellipse/circle</b> ; when the rotor stops, it returns to planar oscillation. The “precession force” classically calculated is identified as <b>fictitious</b> ; motion is explained by <b>dynamic interaction</b> , without central force. |
| <b>Prediction: spinning top / boomerang / rolling bodies.</b> | Treatment through classical gyromoment + external forces; curved trajectories usually attributed to aerodynamic effects (e.g., Magnus).             | <b>Orbital trajectories</b> emerge from TDI coupling; distinguished from Magnus (irrelevant in vacuum) and evidence documented with <b>prototypes and videos</b> (rolling bodies, spinning top, etc.).                                                                                                                                                                            |
| <b>Celestial mechanics.</b>                                   | Orbits by gravitation (central force) over particle–points; no rotation–orbit coupling postulated.                                                  | <b>New celestial mechanics</b> : bodies with intrinsic rotation orbit through <b>dynamic interactions</b> ; <b>flat universe in dynamic equilibrium</b> (rings, disks, galaxies, flat systems...).                                                                                                                                                                                |

## TDI Synthesis:

**Where Euler is mistaken:** in **vectorizing** non-coaxial rotations and **separating** translation–rotation, leading to “apparent forces” or inadequate equations to describe observed precession and orbitation.

**What TDI contributes:** a **dynamic coupling** that **predicts and explains** spatial trajectories (precession + orbitation) **without** postulating external centripetal force while the torque acts; furthermore, it proposes a **law of rotation–orbit simultaneity** and a **specific equation of motion**:

$$\vec{v} = \vec{\Psi} \cdot \vec{V}_0.$$

Being the **rotation operator**  $\vec{\Psi}$ , which transforms the initial velocity into the final velocity, both located in the same plane. We find that the rotation operator is a function of the sine or cosine of  $\Omega t$ , clearly indicating the relationship between the orbital angular velocity  $\vec{\Omega}$ , the acting torque  $\vec{M}$  and the initial angular velocity  $\vec{\omega}_0$ .



Newton's translational equation modifies its statement, adding a term when a system with intrinsic rotation receives a new non-coaxial rotation  $\vec{\Omega}$ ; a new induced non-Newtonian acceleration appears:

$$\vec{a}_{\text{ind}} = \vec{\Omega} \times \vec{v}$$

Although TDI is still not an accepted paradigm within the scientific consensus, its formulation proposes conceptual criteria that could stimulate debate in areas, such as the dynamics of accelerated systems, satellite inertial navigation, and the modelling of complex rotational systems.<sup>2</sup>

## CONCLUSIONS

The **Theory of Dynamic Interactions** provides a coherent and physically grounded generalization of classical rotational dynamics, opening new perspectives for the analysis of mechanical systems, celestial dynamics and non-inertial phenomena involving intrinsic rotation.

TDI allows an extended dynamic framework in which rotation is treated as an **active physical field**. Our proposal abandons the strict independence between translation and rotation assumed since Poincaré without any foundation, and introduces a natural and causal mechanism for rotation–translation coupling in systems with intrinsic rotation when subjected to non-coaxial **rotational interactions**.

The appearance of **coupling terms** proportional to  $\Omega \times v$  and  $\Omega \times L$  provides a unified explanation for phenomena such as **spontaneous precession** and **trajectory curvature**, without resorting to assumed torques or fictitious forces.

This field-based formulation includes the definition of a **rotational field**, associated potentials and a propagation equation, placing rotational dynamics at a conceptually analogous level to other field theories.

The **variational approach** demonstrates that the proposed equations can be consistently derived from an extended **Lagrangian formalism**.

Importantly, classical Newtonian dynamics remains as a valid limiting case of the theory, ensuring continuity with established results while expanding its scope of application.

This new theory has been experimentally verified positively. With it, the behavior of the universe, its secular dynamic equilibrium and, in general, the dynamics of baryonic mass are better understood. The mathematics described is what has made it possible to conceive our TDI proposal and the foundations of the scientific research carried out by the private research team, whose results have been published in the book: *A New Celestial Mechanics*.<sup>3</sup>

More information about this theory can be obtained by reading the books: *New Paradigm in Physics* (2017–2018, two volumes),<sup>4</sup> and *Theory of the Rotational Field*,<sup>5</sup> or by accessing the portals:

<https://advanceddynamics.net/>  
<https://dinamicafundacion.com/>

<sup>2</sup> Barceló, G. (2024). *New celestial mechanics*. Madrid: Dinámica Fundación.  
<https://advanceddynamics.net/en/>

<sup>3</sup> Barceló Rico-Avello, Gabriel y Lopez Barceló, Guzman.: *New celestial mechanics* Ed. Amazon, 2026  
[https://www.amazon.es/Celestial-Mechanics-Gabriel-Barcel%C3%B3-Rico-Avello/dp/8412773195?ref=ast\\_author\\_dp\\_rw&th=1&psc=1&dib=eyJ2IjoMSJ9.PMSyD0TqTePNYV3cy38TPOhAE9JX2T\\_Vd2GBRFa6v-w.DuN7iC14zV3QaSjMwW3FiTonR8YqRdJ-CCaxkbvwc0&dib\\_tag=AUTHOR](https://www.amazon.es/Celestial-Mechanics-Gabriel-Barcel%C3%B3-Rico-Avello/dp/8412773195?ref=ast_author_dp_rw&th=1&psc=1&dib=eyJ2IjoMSJ9.PMSyD0TqTePNYV3cy38TPOhAE9JX2T_Vd2GBRFa6v-w.DuN7iC14zV3QaSjMwW3FiTonR8YqRdJ-CCaxkbvwc0&dib_tag=AUTHOR)

<sup>4</sup> Barceló, Gabriel: *New Paradigm in Physics: Assumptions and applications of the theory of dynamic interactions*, Volume II: Theory of Dynamics Interactions, Amazon, 2018. (Español e inglés), <http://advanceddynamics.net/>

<sup>5</sup> Rodríguez Palenzuela, Arturo: *Teoría de Campos Rotacionales: La Teoría de Interacciones Dinámicas*, Campos Rotacionales y el movimiento de Chandler, Editorial Amazon, 2022.



<http://www.tendencias21.net/fisica/>  
<https://club.tendencias21.net/mundo/>