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**Celestial Mechanics: The Non-Stability of The Newtonian Model**

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**Abstract**

Multiple researchers and the three-body problem highlight a potential instability in the Classic model of the Solar System, indicating a possible fundamental instability in the system's dynamics.

Therefore, we consider that the Classical model does not reflect reality, and we propose an alternative model that we call: **Theory of Dynamic Interactions**, providing a brief exposition of the studies carried out by Advanced Dynamics, until defining a Rotational Dynamics of Interactions, applicable to bodies subjected to multiple pairs of successive non-coaxial forces.

**Keywords** Solar System, instability, Rotational Dynamics, Dynamic Interactions, Orbital instabilities, Theory of Dynamic Interactions.

**Introduction**

History confirms that the everyday life scenario in our solar system appears unchanging and has remained stable for centuries. This is evidenced by the Earth's unaltered annual orbit since the earliest written chronicles or even since the time of oral traditions.

In the 17th century, Johannes Kepler (1571-1630), a German scientist, proposed laws to explain planetary motion based on precise orbital measurements. *These laws were kinematic descriptions of the planets' movements in our solar system. Verifying and confirming Kepler's laws required laborious calculations over subsequent centuries*.[1]

Later, in the same century, Isaac Newton proposed a solar system model based on the law of gravitation, which seemingly justified the immutable dynamics of our nearby celestial mechanics. However, multiple researchers and the three-body problem highlight a potential instability in this model, indicating a possible fundamental instability in the dynamics of the solar system.

By the 18th century, scientists like Pierre-Simon Laplace and Joseph-Louis Lagrange asserted the stability of planetary orbits' sizes and shapes. However, Henri Poincaré, in his investigation of the three-body problem, found it impossible to calculate exact solutions to Newton's equations using the available mathematical tools, **leading him to question the stability of the solar system.**

Poincaré was the first to propose the three-body problem in 1890 to begin a dynamic analysis of the solar system. He developed a *theory of dynamic systems* in 1901, and used the concept of chaos to explain changes in dynamic systems. Among his publications, we can highlight the **Theory of Dynamical Systems**, which he documented in his book *Les Méthodes Nouvelles de la Mecanique Céleste* (1890). This theory established a new approach to study the dynamics of physical systems, allowing us to better understand the behavior of objects in space.

In 1889, Poincaré won a mathematical prize from King Oscar II of Sweden and Norway with his essay *On the three-body problem and dynamic equations*, aiming to analyze the solar system's dynamic stability.

In 1964, mathematician Vladimir Arnold investigated the stability of nonlinear systems, proposing a model predicting potential system instability over time. He conceived a dynamic model different from the one that was usual in celestial mechanics and calculated that with enough time, the system could become instable.[2]

*Arnold then conjectured that most dynamical systems should exhibit this type of instability. In the case of the solar system, this could mean that the orbital shapes, or eccentricities, of certain planets could change over billions of years.*

*Mathematicians and physicists eventually made significant progress in demonstrating that instability generally arises, although they struggled to prove it in celestial models. This is because the gravitational effect of the sun is overwhelmingly strong, causing many features of the clockwork planetary model to persist, even when considering the additional forces exerted by the planets. (In this context, Newtonian mechanics offers such a good approximation of reality that these models do not need to consider the effects of general relativity).*[3]

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**Subsequent Work**

In 2009, Jacques Laskar and Mickaël Gastineau from the Paris Observatory made a surprising discovery. They had conceived a Newtonian model of the solar system and had carried out numerous detailed numerical simulations. After constructing a detailed computational model of our solar system, they ran thousands of numerical simulations, projecting the movements of the planets billions of years into the future.[4]

These simulations included gravitational forces from the sun and interplanetary interactions. Many simulations maintained dynamic stability despite slight variations in Mercury's initial position: The planets continued orbiting around the Sun, tracing ellipses, as they have done throughout the history of humanity. However, there were scenarios where absurd anomalies were generated, causing the orbits to change significantly, leading to unforeseen disturbances, such as a planet being projected towards the Sun or colliding with another. There were instability scenarios where a planet could be expelled from the solar system or could crash with another planet. Jacques Laskar and Mickaël Gastineau proposed that there is a mathematical possibility of such instability. Although simulations are not the same as a mathematical demonstration, they determined that a small inaccuracy could, over the course of the simulated time, produce clear results of instability.

Since Poincaré, the three-body problem has been extensively studied under multiple scenarios, considering three masses interacting with Newtonian gravity, without any restrictions imposed on the initial positions and velocities of these masses.

Musielak, Z.E., and Quarles, B. later presented, in 2014, a review of the problem in the context of its historical and modern developments, describing the **general** and **restricted** three-body problems (a simplified assumption in which one of the three bodies is assumed to have zero mass).

They discussed different analytical and numerical methods for finding solutions, including methods for performing stability analysis and searching for periodic orbits and resonances. They applied the results to some interesting problems in celestial mechanics. Their article also offered a brief presentation of the general and restricted relativistic three-body problems (circular and elliptical orbits), analyzing their possible astronomical applications.[5]

In 2016, De la Llave[6] and colleagues demonstrated instability in a simplified celestial mechanics model involving a sun, planet, and a massless comet, illustrating that even restricted n-body problems could exhibit instability.

Other researchers have continued studying the instability of the Newtonian solar model and the three-body problem, exploring scenarios with arbitrarily massive bodies interacting over vast distances. Mathematical analyses of solar orbits have demonstrated mechanisms driving instabilities, confirming the Newtonian solar model's potential instability. In this scenario, the so-called *secular dynamics* govern the slow evolution of the Keplerian ellipses but maintain the instability of the system, even in the presence of precession.[7]

By mathematically analyzing the solar orbits and considering which mathematical mechanisms drive the instabilities, it can be demonstrated whether these imbalances truly exist and, therefore, confirm the instability of the Newtonian solar model.

**Antithesis to the Laplace-Lagrange Theorem**

The stability of Lagrange in the restricted three-body problem was studied by Stepan P. Sosnitskii,[8] who obtained the Lagrange stability theorem for an infinitesimally small particle in the spatial elliptical restricted three-body problem. The approach he proposed can also be extended to the general three-body problem.

Andrew Clarke, Jacques Fejoz, and Marcel Guardia later demonstrated the first Laplace-Lagrange stability theorem was erroneous, proving the inherent instability in a Newtonian model with planets orbiting a sun.[9]

Their studies are irrefutable proof that the supposed stability of the solar system based on the Newtonian model was a chimera.[10] They demonstrated for the first time that, with the Newtonian model, instability inevitably arises in a model with planets orbiting a

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sun. Therefore, we are faced with a dilemma: **either the model is reliable, and the dynamic equilibrium of the solar system is illusory, or the Newtonian model of the solar system is incorrect.**

In light of this dilemma, I propose that we accept that the Newtonian model does not represent the true behavior of celestial bodies, as manifested on the pages https://advanceddynamics.net/ and https://dinamicafundacion.com/, and in the numerous texts and books written on this issue.

These writings and portals describe the Solar System model based on the **Theory of Dynamic Interactions (TID)**, which we suggest as real model. This theory also explains why most planets in our solar system have orbits that lie almost in the same plane, the ecliptic, among many other pieces of evidence.

*Moreover, the universe model resulting from TID explains flat celestial systems, such as our solar system, and its secular dynamic equilibrium. Orbital motion is generated by the coupling of the translational velocity field of each celestial body with the velocity field generated by a moment not coaxial with the intrinsic rotation existing in each planet or satellite. Additionally, the hypothesis is that the forces acting are perpendicular to the trajectory, so no energy is consumed in this dynamic process.*[11]

*For example, TID also explains how flat rings with multiple satellites often form in our Solar System, such as those of Saturn, or the asteroid belt, the Kuiper belt, or the scattered disk. Newton also could not explain why Saturn's rings, or many other ring systems in our Solar System, are flat. Our theory can justify their formation and even the undulations that occur in Saturn's rings and, in general, in all flat celestial systems, due to changes or oscillations of the acting moments. For instance, due to Saturn's gravitational fluctuations during its rotation or the masses of other planets or satellites affecting the movement of the flat disks.*

*This same reasoning could be applied to understand the behavior of many rotating solid objects such as the boomerang, the hoop, or the wheel.*[12]

*As we have already expressed…, our disagreement with the classical model is substantially conceptual, since both models can calculate analogous trajectories. The Newtonian formulation will calculate a slightly elliptical orbit around an attractive mass, but that orbit can also be obtained with our proposed dynamic interactions.*

*However, in the case of a moving object with intrinsic rotation subjected to a non-coaxial couple, the Newtonian paradigm does not detect any trajectory perturbation. As we have stated, Classical Mechanics assumes that only a new rotation will be generated, as the vector sum of the pre-existing rotation and the newly induced one.*

*Conversely, for the same case, TID does not accept the vector composition of rotations and instead calculates an orbit defined by the coupling of the initial translational velocity field present in the body with the field generated by the resulting velocities due to the non-coaxial external action. However, it does not predict a change in the initial intrinsic rotation, which is assumed to remain constant.*[12]

It is important to highlight that in this solar system model, the intrinsic rotation of the Sun, the planets, and their satellites is considered both physically and mathematically. This important characteristic was not considered in the models of Newton and Einstein. Although both seemed to forget the individual intrinsic rotation of all the members of the system, this characteristic is fundamental to understanding the dynamics of our TID model of the celestial structure.

**Theory of Dynamic Interactions**

In 2012, an article outlined the state of research.[12] In our proposal, we specified: *To date, there is no mathematical correlation in the laws of mechanics that relates orbital and rotational motions, despite this effect being ubiquitous in nature. Therefore, I investigated whether there is a physical correlation between these motions, and if so, deriving its mathematical expression.*

*In this study, I investigated non-inertial systems to better understand the response of rigid bodies subjected to simultaneous non-coaxial rotations. As a result, I proposed hypotheses that required extending my studies to* ***field theory*** *to explain the dynamics of such bodies.*

*The superposition of simultaneous motions was discussed by Galileo*[13] *to explain the trajectory of a cannonball. It is important to understand the superposition of fields caused by pairs, and I referred to the superposition of velocity fields generated in these cases as* ***'coupling.'***

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*I analyzed the motion of objects subjected to multiple rotations, such as a spinning top, a boomerang, a hoop, and several other objects whose peculiar behavior is intriguing...*

*I investigated how objects respond when subjected to different simultaneous accelerations by applying non-coaxial rotations. In other words, I investigated the motion of a gyroscope, a spinning top, or a boomerang to determine if they can be described by classical mechanics or if they correspond to laws of nature not yet formulated.*

*To clarify these questions, I conducted several experiments that eventually indicated that the mathematical formulation must use field theory and consider the concept of* ***dynamic interactions****. This implies that the dynamically generated fields interact to produce trajectories that correspond to laws of physics that have not yet been formulated.*

*My initial experiments motivated me to establish a dynamic hypothesis that stated under conditions of simultaneous non-coaxial rotations, an object follows a closed trajectory (i.e., an orbital motion) without requiring a centripetal force*[14] *and maintains its rotation around its initial axis.*[15] *Through numerical simulation, I confirmed that an object traces a closed trajectory similar to the orbit of a body in space subjected to a centripetal force. However, there was no such centripetal force in my simulation.*[16]

Therefore, in the Advanced Dynamics research team, we faced the challenge of continuing these investigations, advancing their mathematical development, and experimentally reproducing our deductions and intuitions.

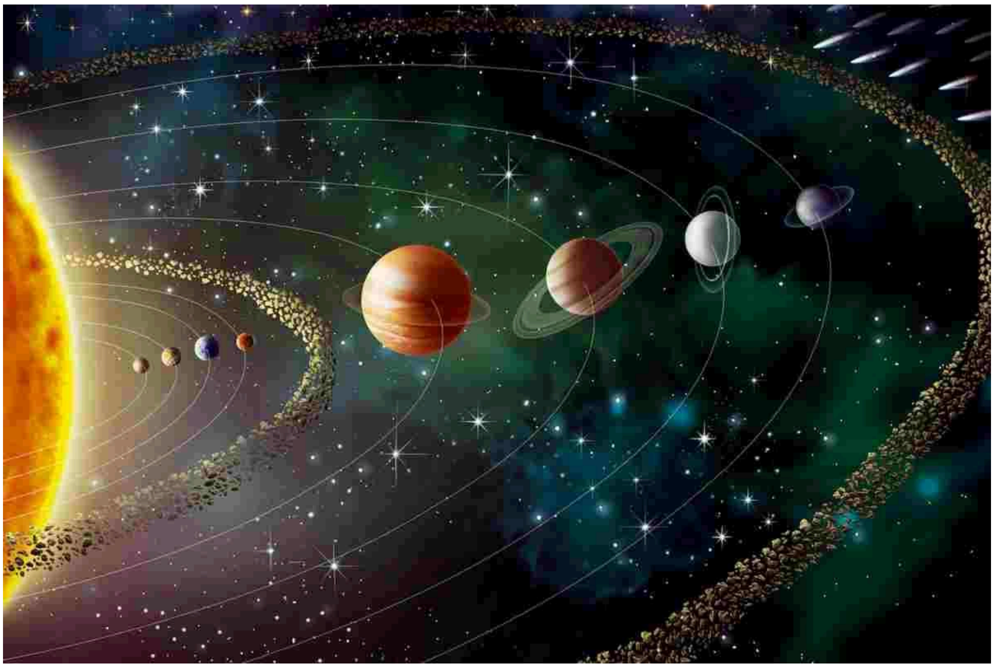

*Figure 1. Solar system*[21]

**Mathematical Formulation**

We developed a new specific mathematical formulation for the new model of the solar system (Figure 1) that we proposed, and which was later complemented by Arturo Rodríguez Palenzuela in his book: **Theory of rotational fields,** [17] with an analysis of gyroscopic fields. This new mathematical framework allowed defining the dynamics of bodies under non-coaxial simultaneous rotations, grounded in Lie group symmetries.

These proposals are the result of a private scientific research project developed by the Advanced Dynamics team over more than 40 years, focusing on conceptual analysis and seeking nomological relationships of non-inertial systems. The objective of these investigations was to understand the dynamic laws governing rotating bodies in space, deducing new laws of dynamic behavior in

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environments where Classical Mechanics laws do not apply, resulting in a new dynamic and mathematical theory for bodies with intrinsic rotation.

Numerous experimental tests have been conducted that have confirmed our dynamic proposal: **TID** (**Theory of Dynamic Interactions**). Other researchers have also conducted similar tests with confirmatory results. Books and numerous articles have been published in scientific journals. The scientific journal *World Journal of Mechanics* published a special issue on *Rotational Dynamics: Theory of Dynamic Interactions* in March 2017,[19] exploring the imagined trajectories of rotating bodies in space subject to new rotations.

In these texts, efforts have been made to imagine the trajectory of a rotating body in space when it is forced to undergo new rotations about different axes, resulting the orbital trajectory observed in celestial bodies.

This research was carried out for more than 40 years, looking for dynamical laws for the rotation of bodies in space, obtaining a new dynamic and mathematical theory for bodies with intrinsic rotation. Numerous experimental tests confirmed this dynamic proposal, and other researchers obtained similar experimental results.

In other articles and videos, we have summarized the Theory of Dynamic Interactions,[20] thus providing a brief exposition of the studies carried out by Advanced, until proposing a Rotational Dynamics of Interactions, applicable to bodies subjected to multiple pairs of successive non-coaxial forces.

**Conclusions**

The initial hypotheses were based on new criteria related to the *coupling* of velocities of moving bodies in space, which were confirmed by experiments and mathematical models that allowed precise physical simulations to be carried out.

*In this study, I found a clear correlation between the initial speculations, original hypotheses, mathematical simulation, deduced physical laws, experiments, and corresponding mathematical models of motion equations resulting from the proposed dynamic laws.*[17]

As a result of this dynamic research effort, the following conclusions were proposed:

1. *There exists a broad thematic area not yet developed in rotational dynamics concerning rigid bodies subjected to accelerations caused by simultaneous non-coaxial rotations.*
2. *This area of knowledge can be analyzed under relativistic and non-relativistic mechanics. Hypotheses are based on new criteria regarding* ***velocity coupling*** *and* ***rotational inertia****.*
3. *Non-relativistic experimental tests have concluded that new general laws of behavior can be obtained based on the analysis of created dynamic fields.*
4. *A motion equation has been obtained for translating rigid bodies with intrinsic angular momentum when subjected to non-coaxial pairs, defining the dynamic behavior of rigid bodies in these cases.*
5. *A clear mathematical correlation between rotation and translation was found. This mathematical connection allows us to identify a physical relationship between the transfer of rotational kinetic energy to translational kinetic energy and vice versa.*
6. *The mathematical model implies that moving bodies subjected to successive non-coaxial pairs could initiate orbital motion as a result of inertial dynamic interactions.*
7. *While keeping the initial angular momentum and the second pair constant, the center of mass of moving bodies would follow a closed orbit without requiring any centripetal force.*
8. *The theory also provides an answer to an initial aporia:* ***understanding the physical and mathematical correlation between orbit and intrinsic rotation****.*

*An example of the theory is the feared aircraft* ***rolling coupling****. This occurs when an aircraft, which is flying in a screw, or any other type of aerial acrobatics that involves, for example, a turn around its principal inertial axis, initiates a new directional maneuver with a curved trajectory. According to the proposed dynamic hypotheses, the non-homogeneous distribution of speeds generated by the new non-coaxial rotation of mass couples with the translation velocity field, causing an unintentional deviation from the trajectory, as well as a potential loss of control of the airplane.*

*I developed this dynamic model and its background in two books on non-Newtonian mechanics: "The Flight of the Boomerang,"*[16] *an essay in honor of physicist Miguel Catalán, and "A Rotating World."* [22]

*The result of this project is the demonstration of a rational field theory that provides a new understanding of matter behavior. In my opinion, applying these dynamic hypotheses to astrophysics, astronautics, and other fields of physics and technology will lead to new, surprising, and stimulating advances.*[17]

We propose the conception of an innovative dynamic theory, specifically applied to rigid physical systems in rotation, with numerous significant scientific and technological applications, especially in orbital dynamics, orbit determination, and orbit control. For example:

- *The variation of the acting torque arises when bodies with intrinsic angular momentum are subjected to new non-coaxial moments.*
- *Conceiving an intrinsic rotating solid, which can be controlled exclusively due to Dynamic Interactions.*
- *Calculating the trajectory in space of any solid body with intrinsic angular momentum.*
- *Proposing a new governance system independent of a rudder or any other external element.*[17]

*We can suggest advances in studies and applications related to orbital mechanics, guidance, navigation, and control of single or multiple spacecraft systems, as well as space robotics and rockets.*[23]

The Newtonian model of the Solar System has been shown to be indeed unstable and does not correspond to the stability that humans have enjoyed, deduced, and verified over time.

Therefore, we understand that the Newtonian model is not real and, logically, cannot be considered the true frame of reference in the space in which human history has developed.

Above all, the result of these investigations has been a **new paradigm in rotational dynamics**, suggesting new keys to understanding our universe and Celestial Mechanics, and specifically, a new dynamic model of the Solar System, stable, without possible imbalances, and even without the risk of potential catastrophes.

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