

Physico-Mathematical Models in Rotational Motions*

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Abstract

This paper was the prologue to the first book published by Gabriel Barceló on the Theory of Dynamic Interactions, entitled: *The Flight of the Boomerang*. However, this text, is fully current, as well as the book itself. The book described mainly the initial historical analysis made by Dr. Barceló on the rotational dynamics. For Professor Garcia Moliner, the book contains an extremely positive message. It shows us that scientific research consists of constantly questioning hitherto accepted theories and seeing if they can always be applied to new situations.

Keywords

Boomerang, Dynamics of Rotation, Dynamic Interactions, Lagrange Equation, Hamilton Equation, Alternative Model, Inquisitive Mind, Intrinsic Rotation, Physico-Mathematical Models

Arnold J. Toynbee, the historian, said that curiosity is the sap that instills life into real civilization. A remark that also serves to characterize science as a natural part of culture; because if there is one product of human thought which has been, from the beginning, a driving force behind curiosity, surely that force is science.

Professor Barceló's *The Flight of the Boomerang* [1] is a prime example of a

*This text was originally written by Dr. Federico García Moliner in 2005, as a prologue to the first book published by Gabriel Barceló on the Theory of Dynamic Interactions, entitled: *The Flight of the Boomerang*.

#Federico García Moliner (see **Figure 1**, professor emeritus of contemporary science) holds doctorates from Cambridge University (1958) and in the Universidad Complutense de Madrid (1960), in Physics. He began his professional career at the Consejo Superior de Investigaciones Científicas (CSIC) scientific research council in Madrid, like scientific researcher, and later took up a three-year lectureship position at the University of Illinois in the USA. Dr. Moliner is a Princess of Asturias Technical and Scientific Research Award Laureate for his contributions to solid state physics.



Figure 1. Dr. Federico García Moliner Physicist and scientific researcher.

painstaking search born solely out of a desire to know. Though its author was ideally prepared to pursue a scientific-technical career (holding as he does degrees in both Industrial Engineering and Physics) he chose not to do so. Instead he focused his professional career in other areas inspired, perhaps, by a versatile curiosity. Nonetheless, in spite of dedicating his working hours to other tasks, in which he has also distinguished himself, he continued to feel that curiosity to learn more about and delve deeper into certain problems in physics. The dynamics of rotation particularly intrigued him, representing as it does a genuinely peculiar field of research owing to the fact that comparatively simple systems, and ones that have been known for some time, display such unique dynamic behavior. Think no further than the gyroscope or the boomerang, for instance. A cursory glance at the table of contents of the book, *The Flight of the Boomerang*, reveals just how much work the author [2] has dedicated to studying rotational dynamics in depth.

After a brief reflection on the development of scientific thought, the first part of the book sets the scene by analyzing the approaches that have come up against problems in the field of dynamic rotations. While at the same time, affording the reader a first glimpse of the paradoxes—or the perplexities according to some—that the author finds in traditional approaches to the subject.

The second part smacks of an extensive and detailed treatise on the dynamics of rotation [3]. It begins with a historical overview of the introduction of the concept of inertia into scientific thought from Galileo to Einstein, to later delve into the mathematical formulas that arose in different periods of history to explain the dynamic theory of rotation, leaving the two particularly important ones until the end. This part is of itself more detailed than the corresponding parts in a lot of the most frequently used academic texts. After dedicating a chapter to some of the most important experimental studies, the author gives a critical analysis of the numerous approaches taken to the subject, once again airing his perplexity at some of the ways of formulating rotational dynamics, and particularly at the general attitude taken toward this question.

In the third part of the book, the author develops the equations of both Lagrange and Hamilton in great depth, entering into what he considers to be the very heart of the formulations of dynamics as far as rotation is concerned. He delves into formal and advanced mathematical issues, as well as concrete problems, discussing the implications of some of the most important experiments.

Indeed, he also looks at contemporary issues, like some of the new studies undertaken by NASA and current cosmological theories. This is followed by the author putting forward possible options, which leads, on the one hand, to the development of new mathematical and formal issues raised by some of the algorithms applied. On the other hand, to a critical look at the current views of the subject, in the course of which he offers his own conjectures.

It goes without saying that the foregoing is a detailed preparation, painstakingly elaborated, for the fourth and last part of what is in essence the last movement of a symphony in which the author brings together all his previous reflections and earnestly embarks on an in-depth development of what he calls his alternative model.

The word “model” has here further significance than generally afforded it. That is to say, the idea is not to work from a basic, generally accepted formulation and modify the system under study by just simplifying it. Quite the contrary, what is brought into question is precisely the validity of the generally accepted basic formulation of rotation in some spatial systems; a formulation that proposes adding an extra term to the normal Lagrangian approach. Dr. Barceló is, consequently, introducing a quite radical innovation for which he puts forward explanatory arguments, further supported by concrete experiments to verify it.

Given all that is presented and argued in this book it is not easy, at least for the time being, having reached the core of the issue, to decide whether or not his theory is wholly correct. This is no trivial proposal, neither on account of its background, which is based on a lot of preliminary work, nor its implications, which would mean a significant innovation of an as yet accepted Lagrangian. Moreover, a detailed analysis would be required to definitively decide on the validity of the proposed change. Nonetheless, it should be made quite clear here that he holds the usual Lagrangian to be correct, except with respect to the special class of problems that are dealt with in the course of the text.

In fine, in the last analysis, it is not of such great consequence whether or not the author is right as regards this particular matter. This book contains an extremely positive message. It shows us that scientific research consists of constantly questioning hitherto accepted theories and seeing if they can always be applied to new situations [4]. When one is right in proposing significant changes, this does not normally invalidate the theory with respect to situations that it has successfully described up to that time. It simply reveals that there are new situations for which the theory in question needs to be appropriately broadened.

This is what Dr. Barceló holds in this book, *The Flight of the Boomerang*, as regards the dynamics of rotations in a special type of system. Of itself, the book bears the fruit of well grounded work. Whether right or not, it raises a question that constitutes a legitimate subject for later study. The most positive aspect of this whole labor is that someone with the capacity to do so takes it upon himself to invest a considerable amount of research work, driven by curiosity and justi-

fied by what the author himself, at the very outset, puts forward as a statement in support of an inquisitive mind.

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