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Generalized Nuclear Reactions

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The experimental evidence for piezonuclear reactions, namely nuclear reactions of a new type induced by mechanical pressure, leads to envisage a generalized nuclear cycle, involving stable nuclides like iron, in non-Minkowskian conditions, i.e., in presence of violated local Lorentz invariance.

KEYWORDS:

1. INTRODUCTION

The nuclear reactions producing new nuclei by separation or fission, otherwise by union or fusion, have been historically taken in consideration due to their utility since they are esothermic, at least for suitable nuclei. We can refer to them as standard nuclear reactions. However, in the last decade experimental evidence has been accumulated for an entirely new class of nuclear reactions. They have been named "*piezonuclear reactions*," due to the fact that they are induced by mechanical pressure.[1]

A basic difference between these two classes of nuclear reactions is the role played by space-time. In fact, while in the standard nuclear reactions the geometrical structure of the interaction space-time is not directly involved in the processes considered—so that space-time is a stage acting as a spectator,—in piezonuclear reactions space-time takes part in an active way deforming itself due to the interaction energy "stored" in the geometrical structure.[2,3] This allows the occurrence of new reactions otherwise impossible in an undeformed space-time, such as the flat-rigid Minkowski one. Moreover, the classical fission or fusion reactions have as endpoint iron, since only esothermic reactions are taken in account (as is well known, the fusion of nuclei having mass heavier than iron and the fission of nuclei with mass lighter than iron are endothermic).

But all this occurs in a rigorously flat Minkowskian space-time, or in a space-time where local Lorentz invariance is strictly valid and the geometry is still unchanged during the interaction, say the space-time is "spectator." In the present paper, we wish instead to consider an entirely novel kind of nuclear reactions, namely those having the iron as startpoint and which can be catalyzed by a "deformation" (in the sense specified below) of space-time–thus becoming an "actor" in the interaction –, or rather in presence of a violation of local Lorentz invariance.[2,3] Due to the very peculiar geometrical features which catalyze their occurrence, we adhere here to the proposal of calling them "*Deformed space-time (DST)*[a] *reactions*."[4,5] In general, these are to be regarded as a totally new concept of matter modifications. The phenomenological evidences for these generalised reactions are grounded, not only on the cavitation experiments on water solutions,[1] but also on the emission of alpha rays from compressed steel[6] and the transformations shown to occur in sonicated steel.[7,8] From the theoretical side, these experimental facts are related to the existence of a curvature in the generalised Lagrange space rising from the deformed space-time metric.[9] The energy difference between the Minkowskian case and a non-Minkowskian one, in union or separation of nuclei, is absorbed or released by space-time geometry. This mechanism might invert the energy balance of the reactions, e.g., the endothermic reactions in a Minkowskian space-time would become esothermic in a non-Minkowskian one, and vice-versa. This conjecture opens a wide field for deeper investigations.

2. REACTION ENERGY THRESHOLD

Let us recall that, rigorously speaking, a deformed Minkowski space is one endowed with a metric whose

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[a]Rigorously speaking, in a deformed space-time the metric depends on the energy of the process considered.[2,3]

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