Time's Arrow Revisited

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The field of chemical and physical processes, using principal microscopic techniques such as coupled cluster-, density matrix- and density functional methods identifiy today a fundamental branch of science at a crossroads between physics, chemistry and biology. The present consideration characterizes in more detail progress and developments that does not only define *ab initio* quantum chemistry as the most accurate emerging computational area in chemical applications [1], but also goes beyond long-established interpretations and understanding, see e.g. [2,3].

Within this broadening framework we have re-considered the 7 traditional arrows of time using precise conjugate operator representations [2]. The categorization entails original theoretical advances including non-Hermitean extensions of conventional operator representations accommodating quantum- and statistical mechanics. These developments are shown to unify various proposals of theoretical understanding including the law of self-reference. The latter unexpectedly appears as an analogy between general relativistic order and the illustrious Gödel theorem of mathematical logic, i.e. the assertion of the inherent limitations of all non-trivial axiomatic systems.

Previous considerations portraying the foundation of temporal processes and the possibility to unify the various arrows of time [2] including the prospect to tackle complex issues on the border between physics and biology [3] are extended further, establishing gravitation as the "Gödelian arrow of time". Additionally the present formulation supports the possible gravitational origin of molecular chirality and other fundamental symmetry violations.

[1] C. A. Nicolaides, E. J. Brändas, Eds. Unstable States in the Continuous Spectra, Part I: Analysis, Concepts, Methods, and Results; Elsevier: Amsterdam, *Adv. Quant. Chem.,* **60**, (2010); *ibid.* Part II: Interpretation, Theory and Applications; **63**, (2012).

[2] Erkki J. Brändas, Arrows of Time and Fundamental Symmetries in Chemical Physics, *Int. J. Quant. Chem,* **113**, 173 (2013)

[3] Erkki J. Brändas, In Quantum Systems in Chemistry and Physics. Progress in Methods and Applications., eds. K. Nishikawa, J. Maruani, E. J. Brändas, G. Delgado-Barrio, P. Piecuch, Springer Verlag, Vol. **22**, (2012) 3.