

Subject: Talk: "Building bridges between Mathematics, Physics and Biology"

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"Building bridges between Mathematics, Physics and Biology"

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CNRS and Dépt. d'Informatique.

*École Normale Supérieure, and CREA, École Polytechnique
Paris, FRANCE*

Tuesday, October 13, 2009

2:00 pm - 4:00 pm

60 Oxford Street, Room 330

Refreshments provided

The major observables in Physics are largely, if not exclusively, based on or derived from energy (conservation properties as symmetries, geodetic principles as least action principles). Biology forced us to think in the novel terms of "organization" and, even, of *inherited* organization; an organization whose "complexity" grows along Evolution and embryogenesis, against energy degradation in Physics (entropy production, also in non-isolated systems). Since World War II, Information Theory and Cryptography became well defined scientific disciplines, with their own principles and remarkable applications. Can we borrow for the analysis of life phenomena any relevant principle or precise result from these scientific areas? A critique of the abuse of Information in Biology will be hinted.

Some recent work will be introduced on a quantification of "biological (phenotypic) organization" by a proper observable to Biology, Anti-entropy. The idea will be derived by conceptual dualities w. r. to Quantum Physics, where the operatorial approach by Schrödinger to his famous equation will ("dually") guide us towards an equational modeling of Gould's analysis of "phenotypic complexity" along Darwin's Evolution and, if time allows, to some applications to embryogenesis.

Longo G., Tendero P.-E. "The differential method and the causal incompleteness of Programming Theory in Molecular Biology". In **Foundations of Science**, n. 12, pp. 337-366, 2007

Longo G. "From exact sciences to life phenomena: following Schrödinger and Turing on Programs, Life and Causality", in "From Type Theory to Morphological Complexity: A Colloquium in Honor of Giuseppe Longo's 60th birthday", special issue of **Information and Computation**, 207, 5: pp. 545-558, 2009.

Bailly F., Longo G. "Biological Organization and Anti-Entropy", **J. Biological Systems**, Vol. 17, No. 1, pp. 63-96, 2009.