

Dual Duality for Unifying Spacetime and Internal Symmetry

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Abstract : The current efforts for Grand Unification Theory (GUT) can be classified into General Relativity, Quantum Mechanics, String Theory and the related formalisms. In the geometric approaches for extending General Relativity, the efforts are establishing global and local invariance embedded into metric formalisms, thereby additional dimensions are constructed for unifying canonical formulations, such as Hamiltonian and Lagrangian formulations. The approaches of extending Quantum Mechanics adopt symmetry principle to formulate algebra-group theories, which evolved from Maxwell formulation to Yang-Mills non-abelian gauge formulation, and thereafter manifested the Standard model. This thread of efforts has been constructing super-symmetry for mapping fermion and boson as well as gluon and graviton. The efforts of String theory currently have been evolving to so-called gauge/gravity correspondence, particularly the equivalence between type IIB string theory compactified on $AdS_5 \times S^5$ and $N = 4$ supersymmetric Yang-Mills theory. Other efforts are also adopting cross-breeding approaches of above three formalisms as well as competing formalisms, nevertheless, the related symmetries, dualities, and correspondences are outlined as principles and techniques even these terminologies are defined diversely and often generally coined as duality. In this paper, we firstly classify these dualities from the perspective of physics. Then examine the hierarchical structure of classes from mathematical perspective referring to Coleman-Mandula theorem, Hidden Local Symmetry, Groupoid-Categorization and others. Based on Fundamental Theorems of Algebra, we argue that rather imposing effective constraints on different algebras and the related extensions, which are mainly constructed by self-breeding or self-mapping methodologies for sustaining invariance, we propose a new addition, momentum-angular momentum duality at the level of electromagnetic duality, for rationalizing the duality algebras, and then characterize this duality numerically with attempt for addressing some unsolved problems in physics and astrophysics.

Keywords : general relativity, quantum mechanics, string theory, duality, symmetry, correspondence, algebra, momentum-angular-momentum

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