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High Energy Physics - Theory

From Fixed Points to the Fifth Dimension

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4D Lorentzian conformal field theory (CFT) is mapped into 5D anti-de Sitter spacetime (AdS), from the viewpoint of "geometrizing" conformal current algebra. A large-N expansion of the CFT is shown to lead to (infinitely many) weakly coupled AdS particles, in one-to-one correspondence with minimal-color-singlet CFT primary operators. If all but a finite number of "protected" primary operators have very large scaling dimensions, it is shown that there exists a low-AdS-curvature effective field theory regime for the corresponding finite set of AdS particles. Effective 5D gauge theory and General Relativity on AdS are derived in this way from the most robust examples of protected CFT primaries, Noether currents of global symmetries and the energy-momentum tensor. Witten's prescription for computing CFT local operator correlators within the AdS dual is derived. The main new contribution is the derivation of 5D locality of AdS couplings. This is accomplished by studying a confining IR-deformation of the CFT in the large-N "planar" approximation, where the discrete spectrum and existence of an S-matrix allow the constraints of unitarity and crossing symmetry to be solved (in standard fashion) by a tree-level expansion in terms of 4D local "glueball" couplings. When the deformation is carefully removed, the resulting conformal symmetry combines with this exact 4D locality to yield 5D AdS locality. The sense in which AdS/CFT duality illustrates the possibility of emergent relativity, and the special role of strong coupling, are briefly discussed. Care is taken to conclude each step with well-defined mathematical expressions and convergent integrals.

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Subjects: **High Energy Physics - Theory (hep-th)**; Strongly Correlated Electrons (cond-mat.str-el); General Relativity and Quantum Cosmology (gr-qc); High Energy Physics - Phenomenology (hep-ph); Nuclear Theory (nucl-th)

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