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Proof of a 43-year-old prediction by Wilson on anomalous scaling for a hierarchical composite field

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Hierarchical models a.k.a. the approximate recursion played a fundamental role in the discovery
of the epsilon-expansion for critical exponents by Wilson and Fisher. In a not so well known 1972 article,
Wilson showed, at the heuristic level, that at a nontrivial hierarchical model fixed point, the elementary field
has no anomalous scaling whereas the composite square field does have one. I will report on a joint work with Ajay Chandra and Gianluca Guadagni on a particular hierarchical model, the p-adic model, which rigorously proves Wilson's prediction. The two main ideas are a constructive renormalization group for space dependent couplings and a holomorphic partial linearization theorem in infinite dimension, in the spirit of Wegner's theory of nonlinear scaling fields. I will also report on recent progress I am making in the analysis of short distance behavior such as the pointwise representability of correlation functions. The goal is to prove the operator product expansion and generalize the pathwise construction of squares of random distributions given by Wick powers to the setting of a nontrivial fixed point with anomalous dimensions.

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