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Bounds on Anomalous Dimensions and OPE Coefficients from Crossing Symmetry in 4D CFTs. Applications to Conformal Technicolor and Unparticles.

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A classic result of 4D CFT says that, in a unitary theory, a scalar operator of dimension $d=1$ is free. We will present results showing in which sense a scalar O of dimension $d>1$ but close to 1 is “nearly free”. Namely, we analyze the OPE $O \times O$ of such a scalar with itself and show that 1) there must be a scalar of dimension $2+O(\sqrt{d-1})$ in this OPE; 2) in the $d \rightarrow 1$ limit, no scalars of dimension different from 2 can appear in this OPE. Our methods use the crossing symmetry constraint for the 4-point function $\langle OOOO \rangle$. They give numerical bounds on anomalous dimensions and OPE coefficients even as $d-1$ gets large. Apart from theoretical interest, such bounds have application to phenomenology (models of conformal EWSB and unparticles).

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