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Lattice study for conformal windows of $SU(2)$ and $SU(3)$ gauge theories with fundamental fermions

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We present results from our study of $SU(2)$ gauge theory with eight flavours, and $SU(3)$ gauge theory with twelve flavours. These two theories may be very close to the lower ends of the conformal windows for the $SU(2)$ and $SU(3)$ gauge groups, respectively, when only the fundamental-representation fermions are present. For the $SU(2)$ theory with eight flavours, we report our investigation for the distribution of the lowest-lying eigenvalues of the Dirac operator. In particular, we compare our numerical results with predictions from Random Matrix Theory and extract the chiral condensate. As for the $SU(3)$ theory with twelve flavours, we show our final analysis for the Gradient-Flow running coupling constant using the step-scaling method. In this presentation, we demonstrate our detailed study of the continuum extrapolation in the step-scaling approach, and comment on the challenges in such computations.

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