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Colored noises near UV/IR fixed points

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In the presence of “criticality”, in the sense that scale separations become large, non-trivial structures with clean boundaries exists only near a small number of extremely narrow sharp peaks in the logarithmic scale. At the intermediate scales, “colored noises”, or self-similar random fluctuations without clear shapes/boundaries, characterized by simple scaling laws with logarithmic corrections, dominate.

This vast and colored sea of noises, although brutally neglected in many over-simplified QFT narratives based on Lagrangian pictures adopted superficially from the classical physics, actually lies in the origin of local quantum fields, and serves as an amorphous bridge joining smoothly the otherwise divided worlds in the IR and UV, witnessing the matching of EFTs. And if you look deeply into the cloud, you see beauties, such as $G(z) \rightarrow \frac{1}{z^{\frac{1}{4}}}$ or $g(L) \rightarrow \frac{16\pi^2}{3 \ln L}$, lasting forever.

Following the above philosophy, this talk presents several examples of asymptotic expansions induced by (marginally) relevant and irrelevant operators near UV and IR fixed points. The examples range from the XXX spin-chain in the IR limit, OPE with condensates in 2D quartic-model/NLSM, to Bjorken asymptotics of lattice correlators in QCD.

We also raise the question regarding boundary of universality, and use the example of a non-inclusive particle number observable in 2D Ising QFT to demonstrate this notation.

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