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Phyiscs informed RG flows and the lower simplicity bound

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Functional renormalisation group (RG) flows have been used since 50 years for the resolution of quantum field theories (QFT) in terms of their generating functionals such as the partition function, the Wilsonian effective action or the one-particle irreducible effective action. From early on, generalised functional RG flows have been devised that do not only accommodate the stepwise integration of fluctuations, commonly in terms of momentum shells, but also general reparameterisations of the theory.

In https://arxiv.org/abs/2409.13679 we introduced a new perspective on generalised RG flows: Instead of viewing them as a tool for the computation of the respective generating functional, one can view them as a tool for resolving the combined flow for the pair of the generating functional and the (composite) field, it is formulated in. This new perspective
opens up new playing fields, both in terms of computational efficiency as well as optimal expansions such as those about the ground state of the theory at hand. In short, this new perspective helps to find and use optimal formulations of the theory at hand, thus zooming in on the 'lower simplicity bound' of a given QFT.

In this talk I report on the structure and existence constraints of these general flows, illustrate its computational prowess within simple examples, discuss its application
within the standard approximation schemes as well as its augmentation with Machine-Learning architectures for efficient computations, and finally indicating its use for sampling algorithms on the lattice.

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