

# Probing Phases by Squinting Your Eyes

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It is said that nature is organised by scale. From a reductionist point of view, underneath everything must lie a fundamental theory of fundamental constituents. But as you squint your eyes and let these little details wash out, the picture can look very different, and it becomes more appropriate to talk about an effective theory of new effective constituents. Underneath all these observations is the statement that nature is organised by scale. This is the idea of the Renormalisation Group (RG).

We begin with an operational review of Functional methods and Feynman diagram techniques, and elements of Linear Response theory that are necessary. We'll then move on to discuss RG, and in particular, a non-perturbative implementation known as functional RG (fRG). We'll then see how these tools can be used to explore phase diagrams of models of highly correlated systems (or their low energy or high energy properties).

Finally, we'll end by discussing work in progress qualitative results for the behavior of the "attractive Hubbard Model" in 2D, where we uncover the sequence of a sensational battle which ending has been spoiled by an oracle by the name of the "Mermin-Wagner-Coleman theorem".