INFORMATION GEOMETRIC ANALYSIS OF THE RENORMALIZATION GROUP

C. Beny

ITP, Leibniz University Hannover

Renormalization is the art of deducing effective laws governing the behavior of a physical system at a certain scale given its description at a smaller scale. Distinct theories typically merge into simpler, more generic one as the scale of observations is increased. In the context of thermal physics, effective laws are embodied by Hamiltonians, which are related to states through exponentiation. Since changing scale amounts to discarding information about the system, it is natural to formalize the renormalization group in terms of a Lindblad flow on the manifold of microscopic mixed states, which we equip with a distinguishability metric. The renormalization group flow on theories can then be analyzed by lifting these structures to the manifold of Hamiltonians. This framework allows one to formally connect the universality of large-scale theories to the loss of distinguishability between microscopic features along the irreversible renormalization flow. In particular, this approach naturally produces scalars which do not increase along the flow, such as the norm of the semigroup generator on Hamiltonians (beta function), hence providing part of a generalized c-theorem.