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Non-equilibrium field theory and decay widths: a new golden rule

Motivated by magnetic quantum systems in the regime of finite temperatures and close vicinity to a quantum critical point, we develop a generalisation of the Fermi Golden Rule appropriate to handle the calculation of large decay widths. The 'generalised golden rule' is a self-consistent procedure, and the central results are generic. However, the present study specifically considers an $O(3)$ non-linear field theory; $\bar{\varphi}^4$ theory, as a toy application of the generalised golden rule. Following this, we directly apply our results to the real quantum antiferromagnet TlCuCl_3 , which is very well described by the $O(3)$ field theory with an anisotropic term. We compare our results to the very recent INS data and find excellent agreement.

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