

## From classical to quantum criticality

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We study the crossover from classical to quantum phase transitions at zero temperature within the framework of  $\phi^4$  theory. The classical transition at zero temperature can be described by the Landau theory, turning into a quantum Ising transition with the addition of quantum fluctuations. We perform a calculation of the transition line in the regime where the quantum fluctuations are weak. The calculation is based on a renormalization group analysis of the crossover between classical and quantum transitions, and is well controlled even for space-time dimensionality  $D$  below 4. In particular, for  $D=2$  we obtain an analytic expression for the transition line which is valid for a wide range of parameters, as confirmed by numerical calculations based on the density matrix renormalization group. This behavior could be tested by measuring the phase diagram of the linear-zigzag instability in systems of trapped ions or repulsively interacting dipoles.

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