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Yang-Mills Flow in the Abelian Higgs Model

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The Yang-Mills flow equations are a parabolic system of partial differential equations determined by the gradient of the Yang-Mills functional, whose stationary points are given by solutions to the equations of motion. We consider the flow equations for a Yang-Mills-Higgs system, where the gauge field is coupled with a scalar field. In particular we consider the Abelian case with axial symmetry. In this case we have vortex-type classical solutions corresponding to Ginzburg-Landau model of superconductivity. In this case the flow equations are reduced to two coupled partial differential equations in two variables, which we can solve numerically given initial conditions. Looking at the behaviour of the flow near the solutions in this model tells us about the stability of the solutions, and in the case of stable solutions allows us to approximate the solutions numerically. Study of the flow in the dimensionally reduced Abelian case provides a starting point for studying flows in more complicated cases, such as non-Abelian Higgs models, or full 3+1 dimensional theories. Using the AdS/CFT correspondence, which provides an equivalence between a field theory and a gravitational theory in one higher dimension where Yang-Mills flow could be compared with more well known geometric flow equations such as Ricci flow.

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