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Confinement, the Abelian Decomposition, and the Contribution of Topology to the Static Quark Potential

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In the past few years, we have presented a new way of considering quark confinement. Through a careful choice of a Cho-Duan-Ge Abelian Decomposition, we can construct the QCD Wilson Loop in terms of an Abelian restricted field. The relationship between the QCD and restricted string tensions is exact; and we do not need to gauge fix, apply any path ordering of gauge links, or additional path integrals. This hints at why mesons are colour neutral.

Furthermore, the Abelian restricted field contains two parts: a Maxwell term, and a topological term. The topological term can describe magnetic monopoles and other topological objects, which can be studied both numerically and theoretically. By examining the topological part of the restricted field strength we have found evidence suggesting that these objects, which will contribute to confinement if present, are indeed there.

Previous studies have used simplifications, breaking the exact relationship between the restricted and QCD string tensions, but it was found that the topological term dominated the restricted string tension. Here we remove those simplifications, and show that the Abelian restricted field does indeed fully explain confinement. However, we find that the topological component of the restricted field only accounts for $\sim \frac{1}{3}$ of the static quark potential, meaning that the Maxwell term also has a large contribution to the string tension. We comment on this discrepancy.

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