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Monopoles of the Dirac type and color confinement in QCD

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When non-Abelian gauge fields in $SU(3)$ QCD have a line-singularity leading to non-commutability with respect to successive partial-derivative operations, the non-Abelian Bianchi identity is violated. The violation as an operator is shown to be equivalent to violation of the Abelian-like Bianchi identities. Then there appear eight Abelian-like conserved magnetic monopoles of the Dirac type in $SU(3)$ QCD. Using lattice Monte-Carlo simulations, perfect Abelian and monopole dominances are shown to exist without introducing additional smoothing techniques like partial gauge fixings when we define lattice Abelian-like monopoles following the DeGrand-Toussaint method adopted in the study of the Dirac monopole in lattice compact QED. As reported separately, the Abelian dual Meissner effect around a pair of static quark and antiquark is caused by the solenoidal Abelian monopole current.

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