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Problems with vector confinement in 4d QCD

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The main feature of confinement is the high growing with distance interaction, which produces multiple bound states. It is known, that two types of interaction, scalar and vector, have different spectral properties in the Dirac equation. It is shown in the paper, that the discrete spectrum occurs only in the case, when the scalar part of confinement dominates at large distances, while the spectrum of the vector dominating part has no lower bound. This property can be masked in the high mass limit of the Dirac particle, when both vector and scalar confinement produce the same high-growing spectrum. The reason behind this fall-off of the vector confining spectrum can be traced to the generation of multiple quark-antiquark pairs, which decrease the total eergy in the vector case and increase in the scalar case. It is shown, that this property of the Dirac spectrum can be generalized to the case of heavy-light and light-light quark-antiquark systems. This situation is compared to the quark-antiquark interaction in the 2d QCD, where vector gluon exchange generates the stable spectrum, which happens due to quark vacuum reconstruction via the Bogolyubov–Valatin transformation, possible in the 2d QCD. This analysis is applied to the confinement approaches, suggested in the framework of (i) the dual superconductor model, (ii) the Gribov–Zwanziger model, (iii) the Field Correlator approach. It is shown, that in the cases (i) and (iii) the confinement is of the scalar type, while the Gribov–Zwanziger model (at least in the local form) no stable bound state spectrum exists.

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