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Deconfined quantum critical point of the $O(3)$ non-linear KI-SEOK KIM, Korea Institute of Advanced Study, Seoul 130-012 — We investigate the quantum phase transition of the $O(3)$ non-linear σ model without the Berry phase contribution in two spacial dimensions. Utilizing the CP^1 representation of the non-linear σ model, we obtain an effective action in terms of bosonic spinons with spin 1/2 interacting via compact U(1) gauge fields. Based on the effective field theory, we find that the bosonic spinons are deconfined at the quantum critical point of the non-linear σ model. It is emphasized that the deconfinement of the spinons is obtained in the absence of the Berry phase contribution. This is in contrast with the previous study of Senthil et al. [Science **303**, 1490 (2004)] where the Berry phase plays a crucial role resulting in the deconfinement of the spinons. It is the reason why the deconfinement is obtained even in the absence of the Berry phase effect that the quantum critical point is described by the XY ("neutral") fixed point, not the IXY ("charged") fixed point. The IXY fixed point is shown to be unstable against instanton excitations resulting from the compact U(1) gauge field and the instanton excitations are proliferated. At the IXY fixed point it is the Berry phase effect that suppresses the instanton excitations, causing the deconfinement of the spinons. On the other hand, the XY fixed point is found to be stable against the instanton excitations because an effective internal charge is zero at the neutral XY fixed point. As a result the deconfinement of the spinons occurs at the quantum critical point of the $O(3)$ non-linear σ model in two dimensions.

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