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Numerical evidence for a CP broken deconfined phase at $\theta = \pi$ in 4D SU(2) Yang-Mills through simulations at imaginary θ

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We investigate the possibility of the spontaneous breaking of CP symmetry in 4D SU(2) Yang-Mills at $\theta = \pi$, which has recently attracted much attention in the context of the higher-form symmetry and the 't Hooft anomaly matching condition. Here we provide a numerical evidence that the CP symmetry is indeed spontaneously broken at low temperature and it gets restored above the deconfining temperature at $\theta = \pi$, which is consistent with the anomaly matching condition and yet differs from the situation predicted in the large-N limit. We avoid the severe sign problem by performing simulations at imaginary θ. Then we estimate the relation between the critical temperature of the CP restoration and that of deconfinement at $\theta = \pi$ by analytic continuation.

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