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Lattice QCD at imaginary chemical potential in the chiral limit.

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We report on an onging study on the interplay between Roberge-Weiss(RW) and chiral transition in simulations of (2+1)-flavor QCD with an imaginary chemical potential. We established that the RW endpoint belongs to the Z(2) universality class when calculations are done with the Highly Improved Staggered Quark (HISQ) action in the Roberge-Weiss plane with physical quark masses. We also have explored a range of quark masses corresponding to pion mass values, $m_\pi \geq 40$ MeV and found that the transition is consistent with Z(2) universality class. We argue that observables, that were usually used to determine the chiral phase transition temperature, e.g. the chiral condensate and chiral susceptibility, are sensitive to the RW transition and are energy like observables for the Z(2) transition, contrary to the magnetic (oder parameter) like behavior at vanishing chemical potential. Moreover the calculations performed at $m_\pi \sim 40$ MeV also put an upper bound for a critical pion mass at zero chemical potential for a possible $1st$ order chiral phase transition. We furthermore determine the curvature of the pseudo-critical line close to the RW point and compare it with that at vanishing chemical potential.

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