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Exotic properties of strongly interacting matter under acceleration and rotation

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Recent first-principles lattice simulations of SU(N) Yang-Mills theory in 3+1 dimensions have revealed that the gluon plasma—a precursor to the quark-gluon plasma believed to have existed in the early Universe—exhibits several unexpected equilibrium properties under extreme conditions: (i) a negative moment of inertia within a certain temperature range; (ii) the formation of a thermodynamically stable inhomogeneous mixed phase that does not align with the conventional Tolman–Ehrenfest relation in static gravitational backgrounds; (iii) a rotation-induced enhancement of the critical deconfinement temperature; and (iv) a pronounced softening of the deconfinement transition under linear acceleration. We briefly review these surprising observations and argue that they may share a common origin rooted in the nontrivial coupling of gluonic degrees of freedom to strong gravitational fields, particularly in rotating or accelerated frames.

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