Impact of dynamical fermions on the centre-vortex structure of QCD ground-state fields

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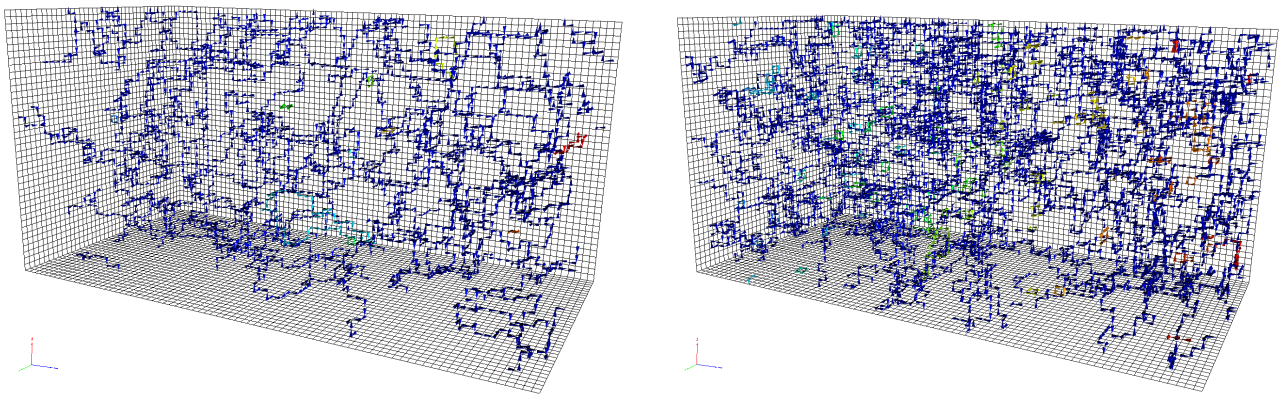
The self interactions of gluons in QCD make the empty vacuum unstable to the formation of quark and gluon condensates. These ground-state QCD-vacuum field configurations permeate spacetime and form the foundation of matter. Using modern visualisation techniques, this presentation examines the microscopic structure of these fields.

Of particular interest are the centre vortices identified within the ground-state fields generated in lattice QCD simulations. This vortex structure is illustrated through 3D renderings of oriented spatial plaquettes. Our current focus is on understanding the manner in which light dynamical fermions in the QCD vacuum alter the centre-vortex structure. The impact of light dynamical fermions is not subtle, changing both the density of vortices and the complexity of the vortex structures observed.

The results provide new insights into the role of centre vortices in underpinning both the confinement of quarks and the origin of mass in QCD. Indeed, the centre-vortices identified within the QCD ground-state fields confine quarks, generate mass, and thus are responsible for these emergent salient features of QCD.



Flow of centre charge in SU(3) gauge theory (left) and full QCD (right). (*Click to activate in Adobe Acrobat.*)

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[3] A. Virgili, W. Kamleh and D. Leinweber, PoS **LATTICE2021** (2021), 082

[4] J. Biddle, W. Kamleh and D. Leinweber, [arXiv:2206.00844 [hep-lat]].

[5] D. Leinweber, J. Biddle and W. Kamleh, SciPost Phys. Proc. **6** (2022), 004