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Symmetry and QCD Thermalisation

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"In ultra-relativistic heavy-ion collisions, the tremendous energy density temporarily exceeds the QCD confinement scale, deconfining quarks and gluons into a strongly coupled quark–gluon plasma that quickly thermalises and flows like a near-perfect liquid. QGP (QCD) thermalisation in the early stage is a crucial question. We start from a new perspective—intrinsic symmetry—and demonstrate its subtle relation to quantum thermalisation, providing further insight into the QGP's early dynamics.
We focus on constructing the concept of entropy in quantum field theory, which is essential for understanding thermalisation and the emergence of the second law of thermodynamics in many-body quantum systems. Interestingly, we introduce a symmetry originating from bipartite entanglement, described by the topological group E (represented on Fock space), which directly generates the definition of a generalised entropy H. We then prove the connection between H-production and the eigenstate thermalisation hypothesis (ETH). Finally, by building a quantum-link model of Yang-Mills theory with Wilson quarks, we demonstrate the thermalisation process quantitatively and interpret the accompanying phenomena concerning deconfinement and chiral symmetry ."

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