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SU(3) gauge theory on quantum hardware

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A beautiful description of nature's fundamental forces has been devised through gauge fields introducing local symmetries or conserved charges. While classical techniques continue to provide invaluable information on the emergent properties of gauge field theories relevant to experimental programs throughout the scientific domains, some experimentally relevant parameter regimes (e.g., where coherent dynamics demand exponentially large Hilbert spaces) remain beyond current or foreseeable computational capabilities. Leveraging quantum architectures directly within a computational framework is expected to explore such parameter regimes more naturally. Unfortunately, the inefficient utilization of Hilbert space caused by local symmetries demands careful considerations while devices remain unprotected from quantum noise. In this talk, we will discuss current strategies and progress in representing gauge theories, from Abelian to SU(3) Yang-Mills, on qubit degrees of freedom and performing subsequent dynamical evolutions.

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