Quantum Computing for Fusion Energy Science Applications

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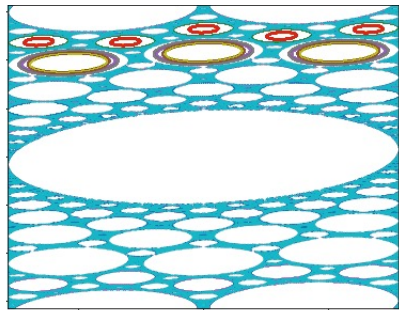
- **Quantum computing holds great promise for accelerating scientific discovery**
  - Efficient Fourier transforms, sparse linear solvers, Hamiltonian simulation, variational eigensolvers, …
  - Chemistry, materials science, high-energy physics, nuclear physics, …, **fusion energy science!**

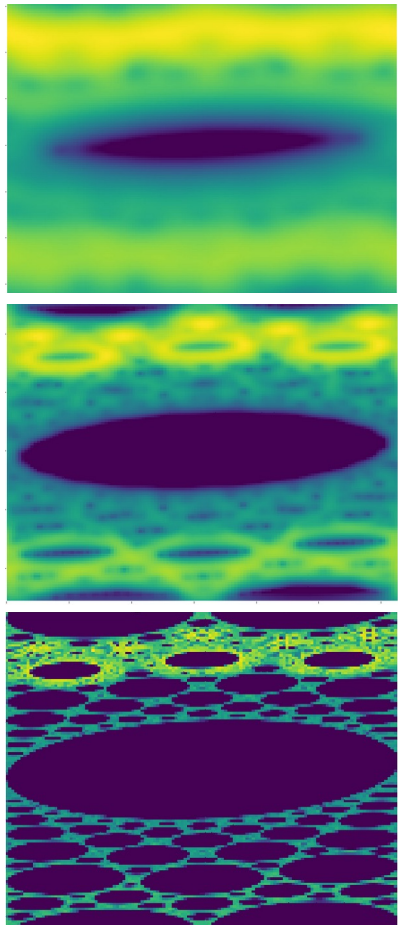
- **Quantum simulation of the PDF of nonlinear dynamical systems can achieve exponential speedup over Eulerian methods and up to quadratic speedup over Monte Carlo methods**
  - Simulations of fluids, plasmas, molecular dynamics, finance, ecology, epidemiology, …
  - Quadratic speedup attained for high dimension and lack of smoothness
  - Exponential speedup for end-to-end app's requires problems with special structure

- **Algorithms that utilize noise have potential for near-term quantum advantage**
  - Simulate open system dynamics with an open quantum system
  - Passive and active error mitigation are under extensive development
  - Decoherence controls the **"information confinement time"**

Classical phase space



Quantum phase space



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