⟨NuMeriQS⟩

C02 Hybrid Approaches to Quantum Many-Body Systems

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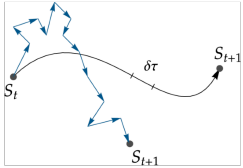
Different methods across different disciplines have their intrinsic strengths and weaknesses

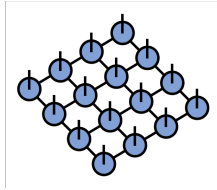
Monte Carlo



Particle physics

- Pros
  - favourable scaling
  - agnostic to form of interaction
  - works in Fock or particular Hilbert spaces
- Cons
  - sign problem
  - ergodicity
  - finite temperature

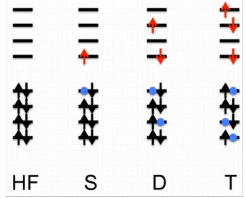
Tensor Network



Condensed matter physics

- Pros
  - no sign problem
  - real-time evolution
- Cons
  - unfavourable scaling
  - finite temperature
  - works best with low-entanglement systems

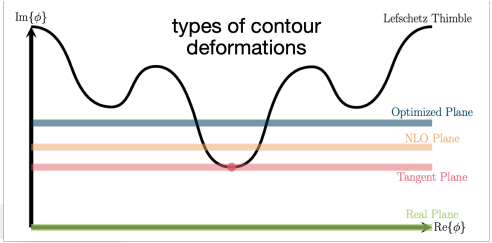
Configuration Interaction



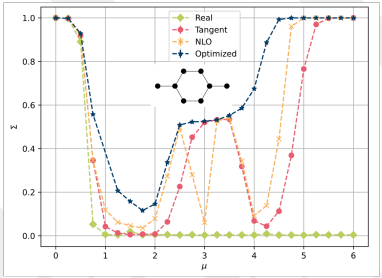
Quantum chemistry

- Pros
  - zero temperature
  - no sign problem
- Cons
  - unfavourable scaling

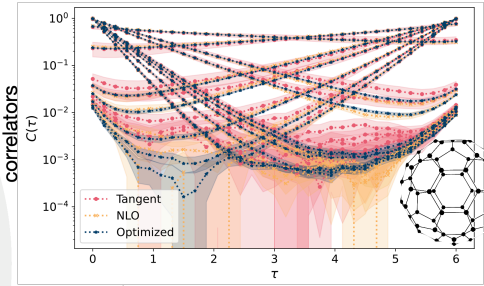
Tackling the sign problem with contour deformation



severity of sign problem



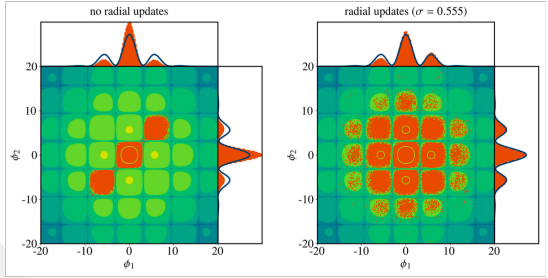
quasi-particle correlators



C. Gäntgen, E. Berkowitz, **TL,** J. Ostmeyer, & M. Rodekamp, [arXiv:2307.06785] Phys.Rev.B **109** (2024) 195158

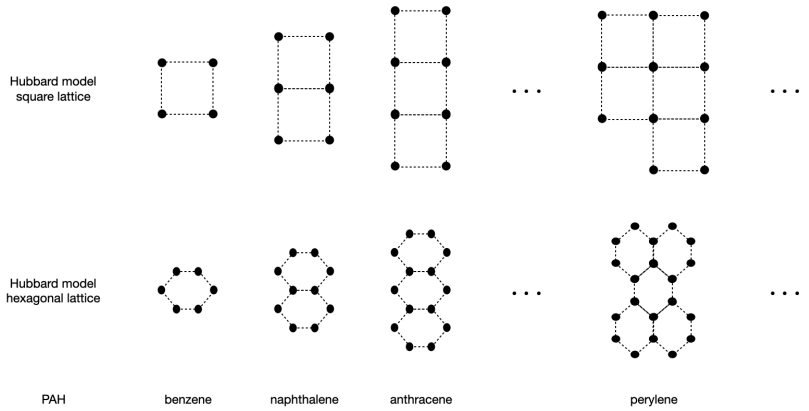
Resolving ergodicity issues

- Simulations of Hubbard model have formal ergodicity problem
- Developed radial updates that jump between topological sectors
  - see F. Temmen's C02 poster
  - see also D. Schuh and J. Kreit's poster related to normalising flows and the Hubbard model



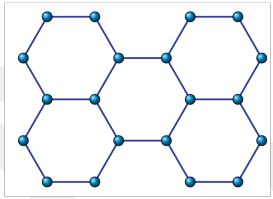
F. Temmen, E. Berkowitz, A. Kennedy, **TL,** J. Ostmeyer, X.Yu, *in preparation*

Benchmark systems for all methods



PAH='polycyclic aromatic hydrocarbon'

Spectrum of perylene as a function of doping



M. Rodekamp, E. Berkowitz, C. Gäntegen, Stefan Krieg, **TL,** J. Ostmeyer, & G. Pederiva [arXiv:2406.06711]