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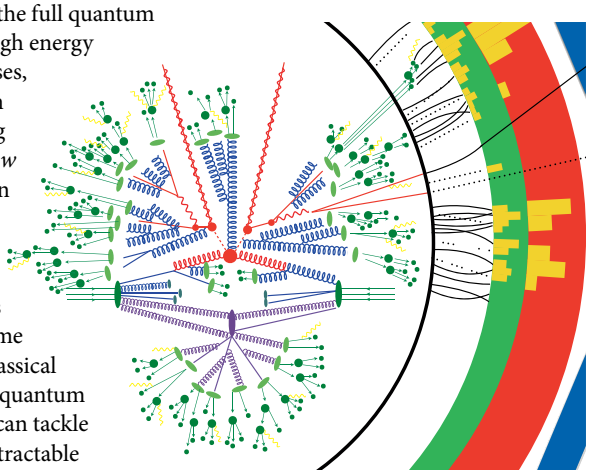
QUANTUM ALGORITHMS

Simulating parton showers

To study high energy particle collisions and analyse experimental data, physicists rely on complex simulations using probabilistic algorithms. The simulations require considerable computing power and encounter bottlenecks such as the inclusion of the full quantum description of high energy radiative processes, known as parton showers. Writing in *Physical Review Letters*, Benjamin Nachman and colleagues show that these limitations could be overcome by combining classical simulation with quantum algorithms that can tackle the otherwise intractable quantum effects.

Parton showers (pictured) describe the particles and radiation resulting from high-energy particle collisions. Traditionally, parton showers have been described using Markov chain Monte Carlo algorithms, but these fail to capture quantum interference effects. Nachman et al. designed a quantum algorithm that describes the quantum properties of parton showers. Whereas in the Markov chain Monte Carlo approach the full classical calculation scales exponentially with the number of steps, the quantum algorithm scales polynomially.



Credit: Benjamin Nachman

Nachman and co-workers tested the algorithm on an IBM quantum computer and found the results encouraging. With more powerful quantum computers these simulations will be able to go beyond what is currently possible with classical computations and provide new insights.

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ORIGINAL ARTICLE Nachman, B. et al. A quantum algorithm for high energy physics simulations. *Phys. Rev. Lett.* (in the press); preprint at https://arxiv.org/abs/1904.03196 (2021)