physikalisches Kolloquium

Prof. Dr. Florian Marquardt
Max Planck Institute for the Science of Light
Erlangen

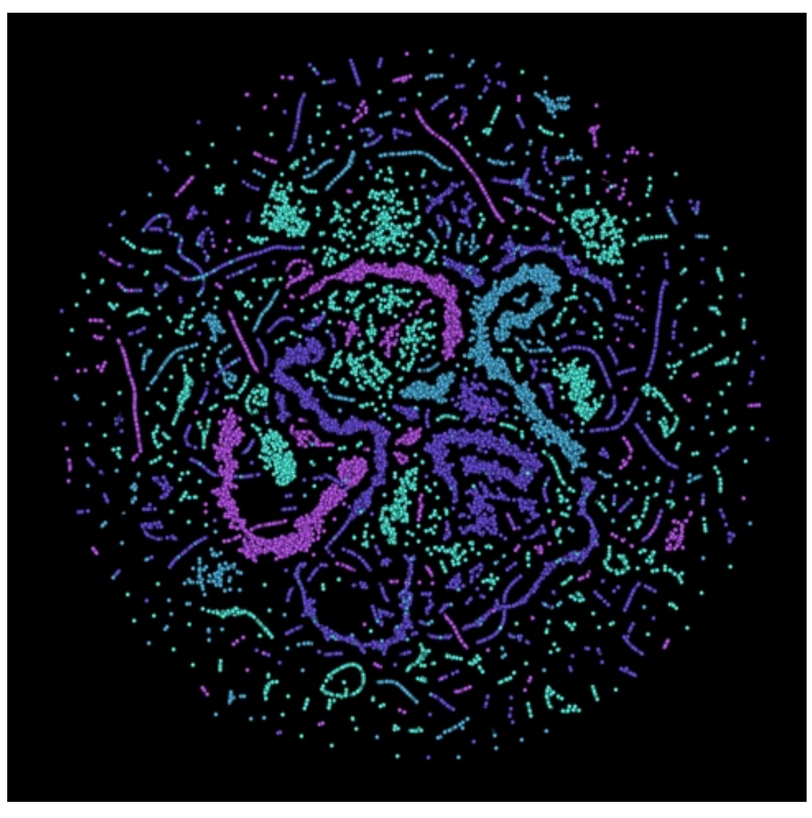
Neural networks discovering quantum error correction strategies

Mo. 13.1.20
16:00 Uhr
Ort: H34

Machine learning with artificial neural networks is revolutionizing science. The most advanced challenges require discovering answers autonomously. In the domain of reinforcement learning, control strategies are improved according to a reward function. The power of neural-network-based reinforcement learning has been highlighted by spectacular recent successes such as playing Go, but its benefits for physics are yet to be demonstrated.

Here, we show how a network-based “agent” can discover complete quantum-error-correction strategies, protecting a collection of qubits against noise. These strategies require feedback adapted to measurement outcomes. Finding them from scratch without human guidance and tailored to different hardware resources is a formidable challenge due to the combinatorially large search space.

To solve this challenge, we develop two ideas: two-stage learning with teacher and student networks and a reward quantifying the capability to recover the quantum information stored in a multiqubit system. Beyond its immediate impact on quantum computation, our work more generally demonstrates the promise of neural-network-based reinforcement learning in physics.



•Reinforcement Learning with Neural Networks for Quantum Feedback, Thomas Fösel, Petru Tighineanu, Talitha Weiss, Florian Marquardt
Physical Review X 8(3) 031044 (2018)