Variational Quantum Eigensolver
- SQUANDER -

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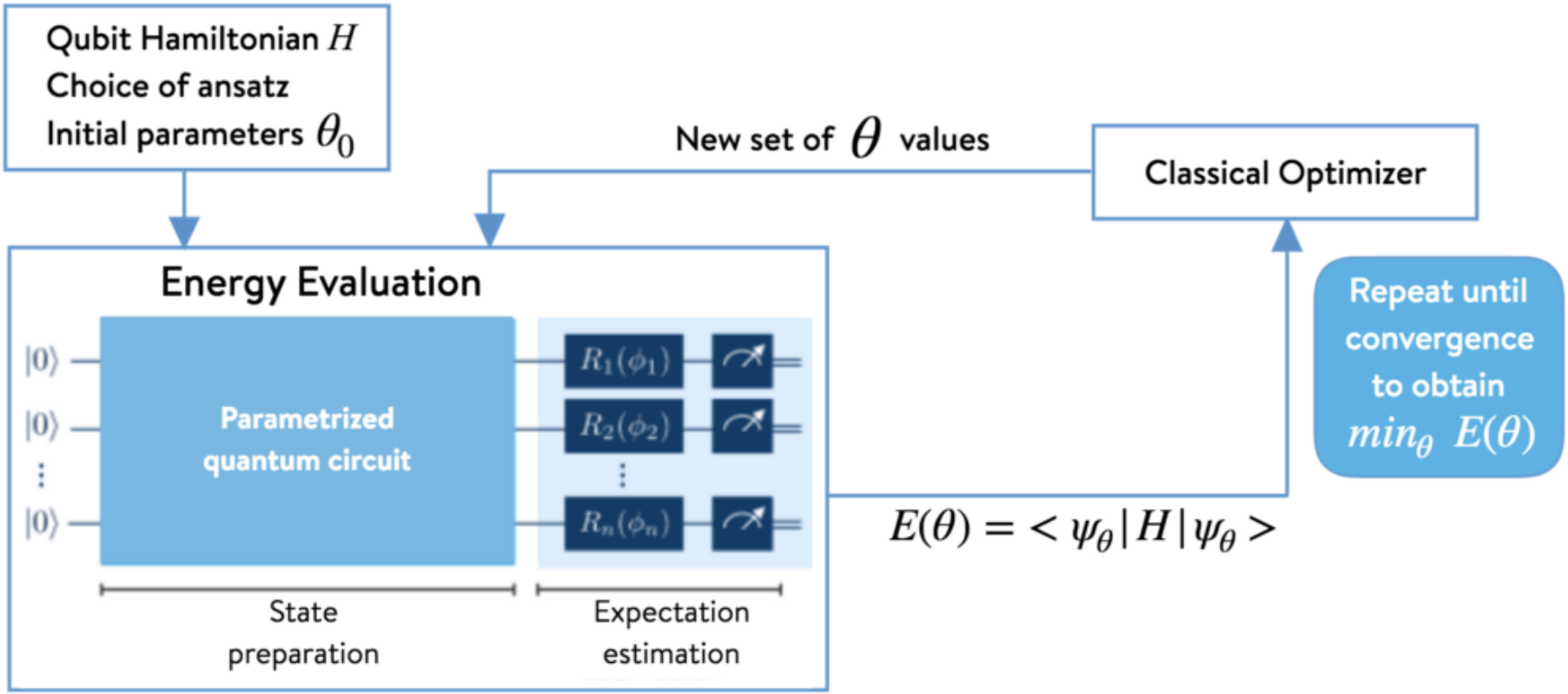
Variational Quantum Eigensolver (VQE)



Source: qmunity.thequantuminsider.com

Classical Optimization Processes

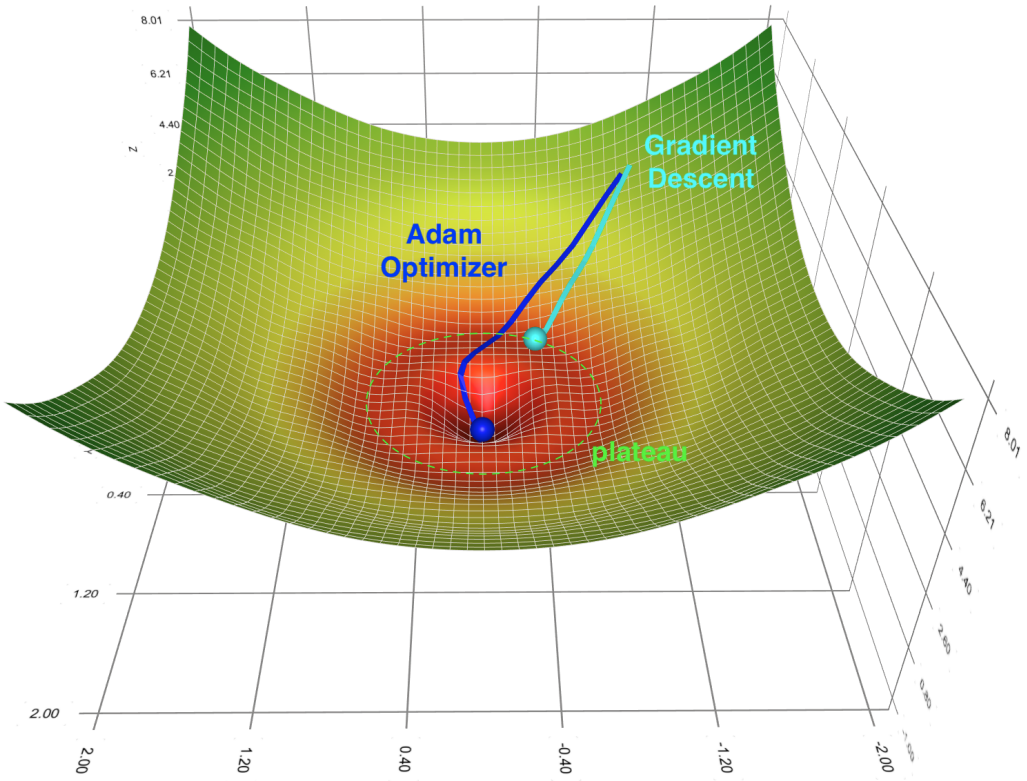
Gradient-based methods

- **Gradient Descent**
- **Parameter Shift Rule** (Quantum GD)
- **ADAM** (Adaptive Moment Estimation)
- **BFGS** (Broyden–Fletcher–Goldfarb–Shanno)

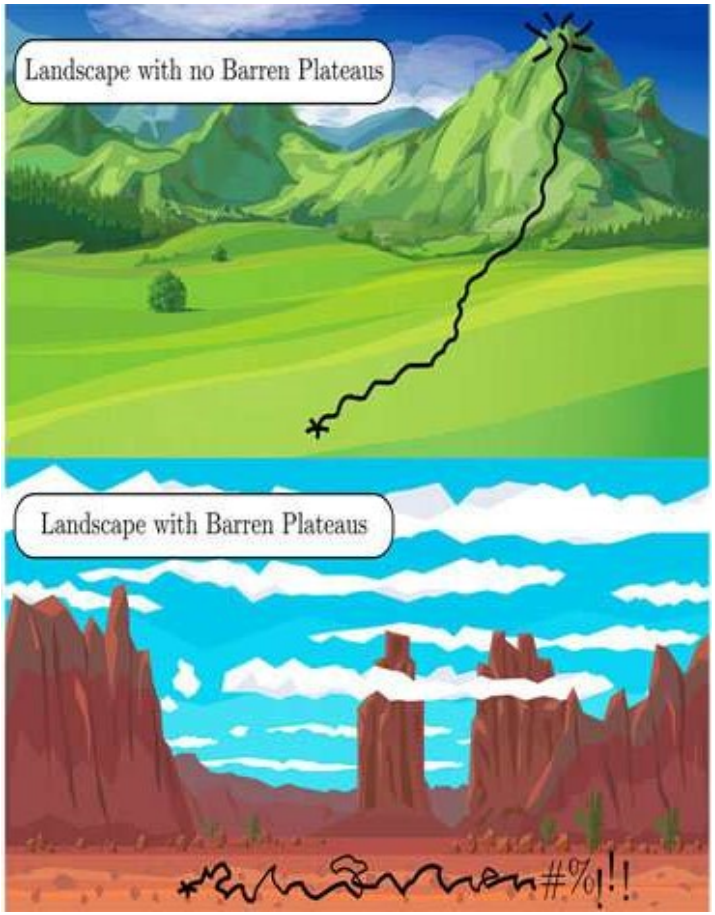
Gradient-free methods

- **Powell's method**
- **COBYLA** (Constrained Optimization BY Linear Approximation)
- **Nelder–Mead**
- **Batched Line Search Strategy** (SQUANDER built-in)

Barren Plateau (BP) Problem



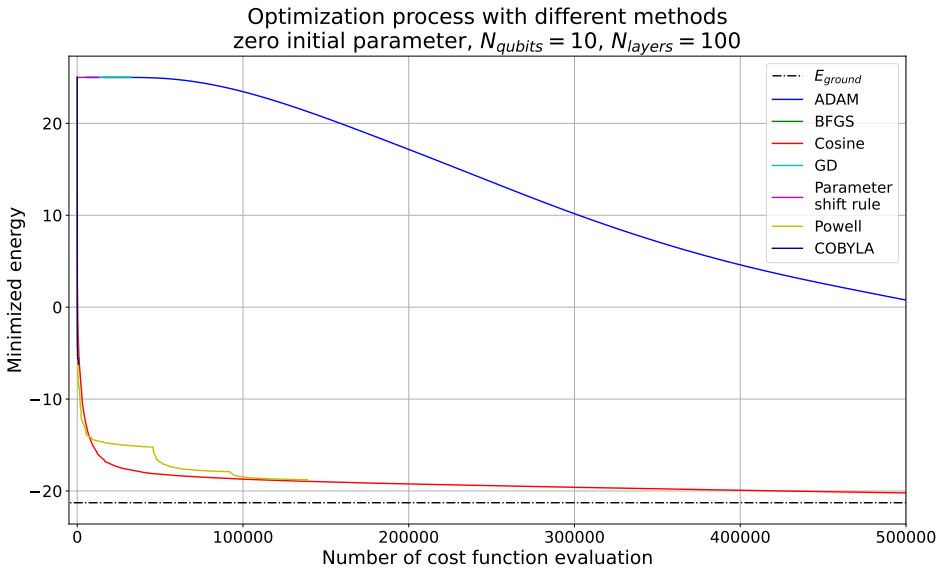
www.quair.group



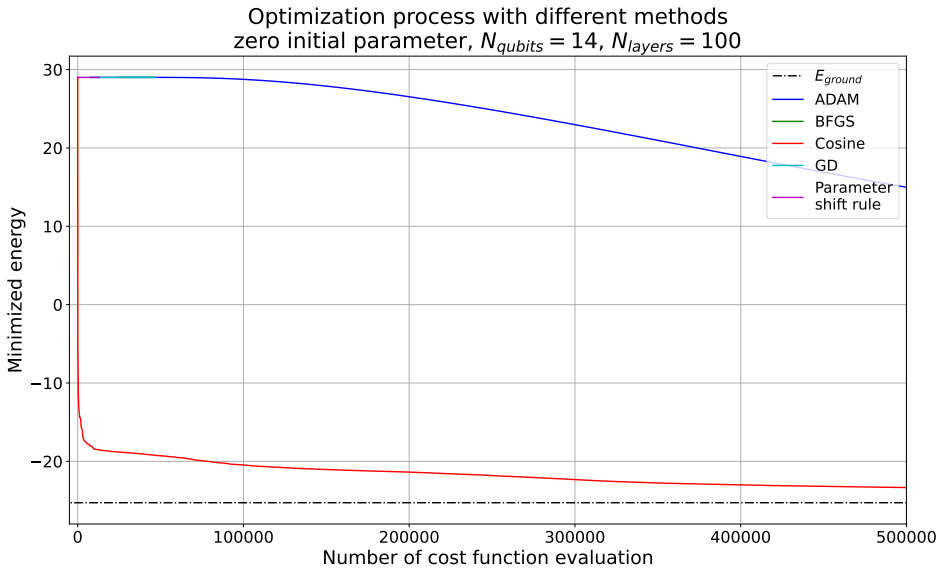
www.phys.org/news

Results of Different Optimizer Engines

Zero-Initial Parameter Vector



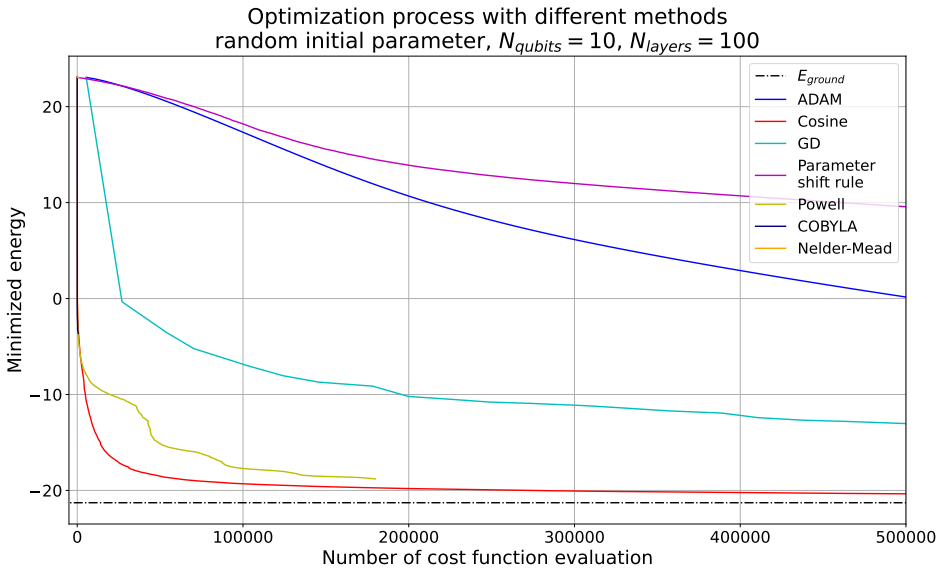
$N_{qb} = 10$



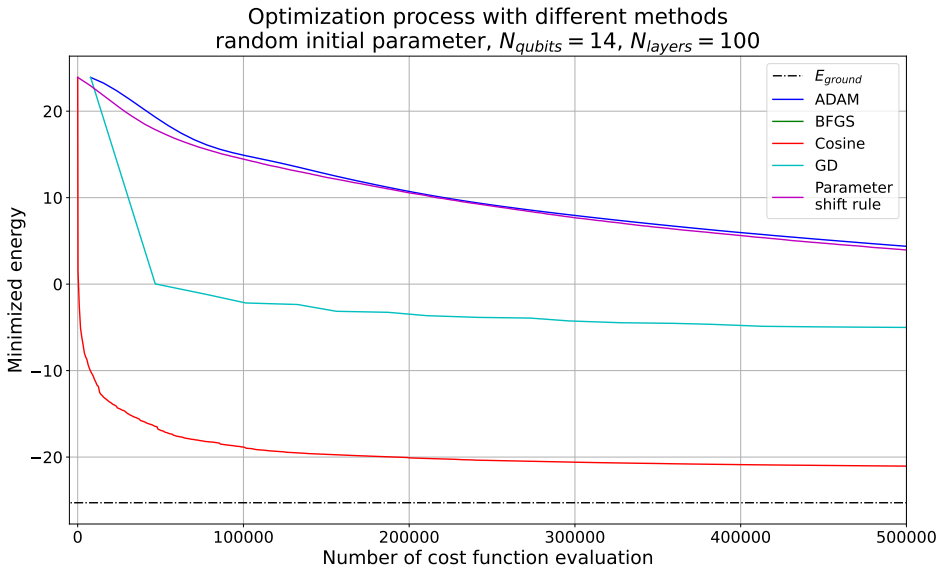
$N_{qb} = 14$

Results of Different Optimizer Engines

Random-Initial Parameter Vector



$N_{qb} = 10$

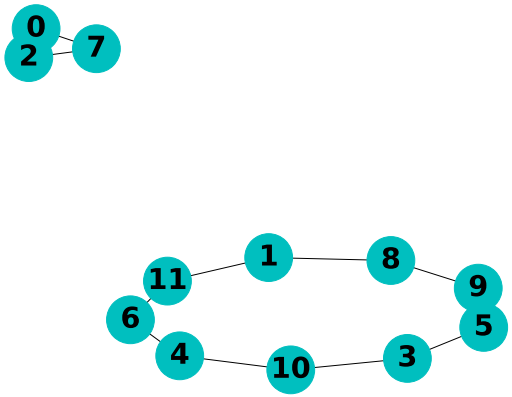


$N_{qb} = 14$

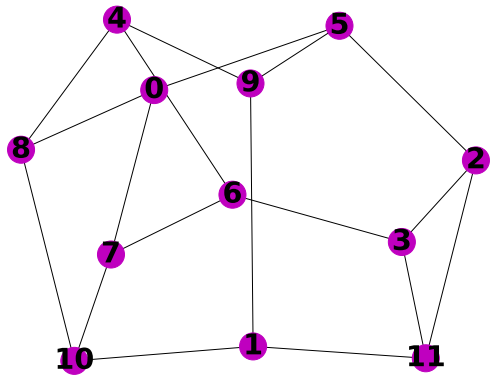
Random Regular Graph as $\hat{H}$

Network Degree Change

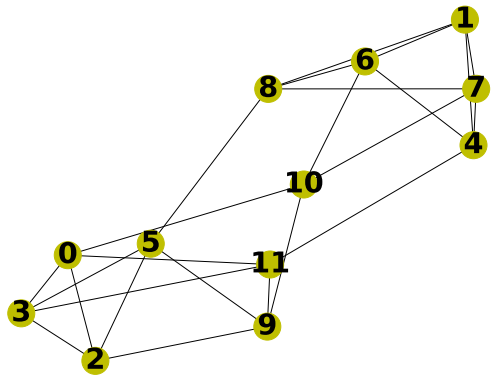
d=2

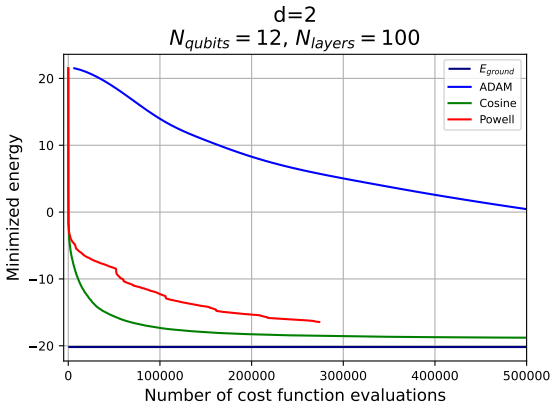


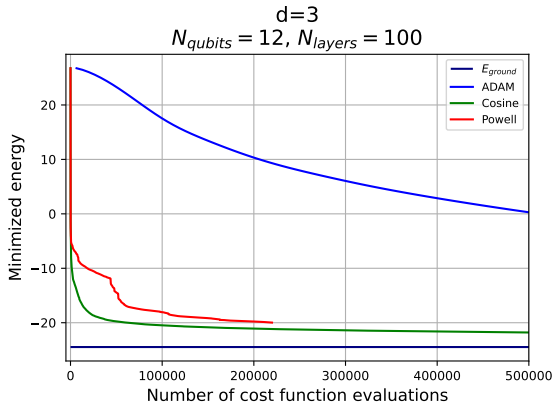
d=3

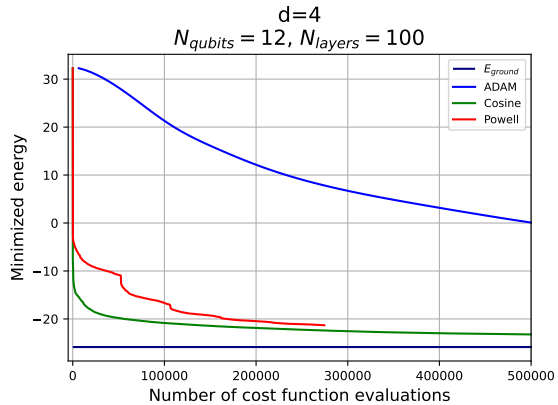


d=4





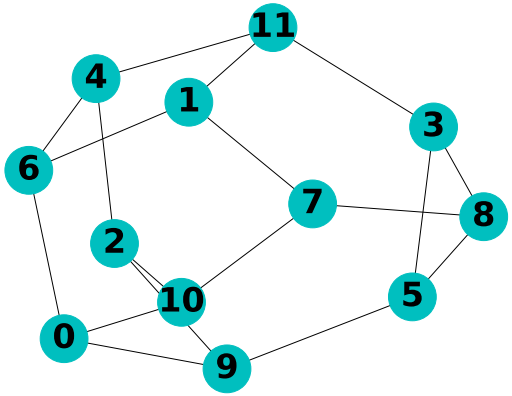




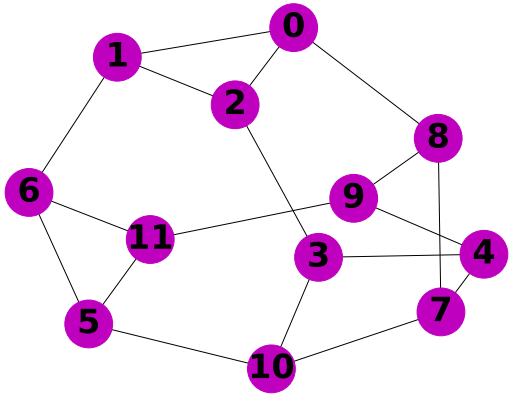
Random Regular Graph as $\hat{H}$

Seed Value Change

d=3, seed=42



d=3, seed=137



d=3, seed=31415