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|  | Variational Quantum Eigensolver Deep Dive |

# January 28th

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| 9am to 9:30am | Breakfast |
| 9:30am to 10am | Welcome and Introduction |
| 10am to 10:45am | 0. VQE Overview — Going from cost functions to a Hamiltonian and computational complexity of short depth circuits Bryce Fuller, IBM. |
| 10:45am to 11am | Coffee Break |
| 11am to Noon | 1. Optimizers —VQE-Aqua flow and empirical study of optimizers  Nate Earnest-Noble, IBM. JN: comparing optimizers |
| Noon to 1pm | Lunch |
| 1pm to 2pm | 2. Hamiltonian Mapping Basics — From qubit measurements to observables, introduction to second quantization & different mapping overview  Nate Earnest-Noble, IBM. JN: different qubit mappings |
| 2pm to 3pm | 3. Hamiltonian Mapping & Reduction — Understanding different mapping’s benefits, & reduction methods  Charles Hadfield, IBM. |
| 3 to 3:15pm | Coffee Break |
| 3:15pm to 4:30pm | 4. Hardware Introduction — Understanding circuit QED, superconducting qubits, and their limitations  Nate Earnest-Noble, IBM. JN: qubit readout |
| 4:30pm to 5pm  5pm – 5:30pm | Open Discussion and Walk to Shuttle  Shuttle to White Plains Crown Plaza |
| 6:30pm | Group Dinner at The Brazen Fox (White Plains) |

# January 29th

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| 9am to 9:30am | Breakfast |
| 9:30am to 9:45am | Welcome and Group Activity |
| 9:45am to 10:30am | 5. Dealing with real hardware — Understanding sources noise  Nate Earnest-Noble, IBM. JN: Noise Models & Readout Error Mitigation |
| 10:30am to 10:45am | Coffee Break |
| 10:45am to Noon | 6. Neural Network Estimators — Improving Sampling Errors with the use of Neural Networks  Guglielmo Mazzola, IBM. (R) |
| Noon to 1pm | Lunch |
| 1pm to 2:15pm | 7. Initial States + Variational Forms— Understanding the Circuit Unitary  Panagiotis Barkoutsos, IBM. JN: Drawing Quantum Unitary. Compare variational forms |
| 2:15pm to 3:15pm | 8. Hardware Control — Introduction to 1&2 qubit gates  Nick Bronn, IBM. JN: Rabi Oscillations & Qutrit notebook |
| 3:15pm to 3:30pm | Coffee Break |
| 3:30pm to 4:30pm | 9. Error Mitigation Techniques — Richardson Extrapolation at pulse level and “above”  Nate Earnest-Noble, IBM. JN: Using simulated control of noise |
| 4:30pm to 5pm  5pm – 5:30pm | Open Discussion and Walk to Shuttle  Shuttle to White Plains Crown Plaza |
| 6:30pm | Group Dinner at The Cheesecake Factory (White Plains) |

# January 30th

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| 9am to 9:30am | Breakfast |
| 9:30am to 10:30am | 10. Building on top of VQE — Overview of methods to study excited state dynamics (VQE-QSE, protein folding, QVector) and qEOM  Panagiotis Barkoutsos /Nate, IBM. JN: qEOM |
| 10:30 am to 10:50am | qEOM notebook |
| 10:50am to 11am | Coffee Break |
| 11am to 11:30am | 11. VQE-cVAR — Improved Sampling for VQE application when not measuring observables (i.e. VQE for optimization) and QAOA  Panagiotis Barkoutsos, IBM. |
| 11:30am to Noon | Closing Remarks |
| Noon to 1pm | Lunch |
| 2pm | Shuttles Leave |