MUNICH QUANTUM SOFTWARE FORUM
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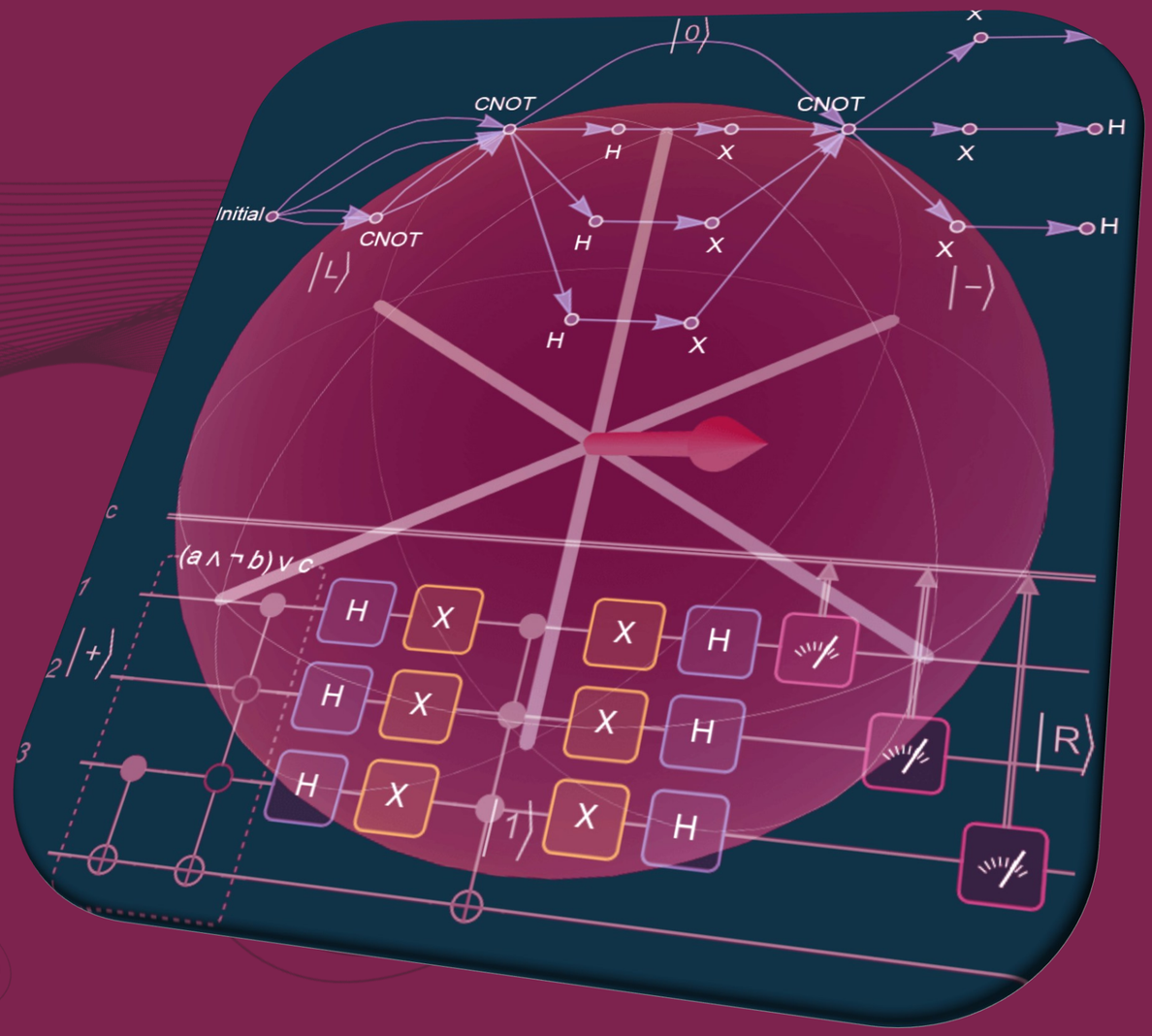
Wolfram Mathematica and the Quantum Computing Framework

A toolkit for quantum circuits and other finite-dimensional quantum systems



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WOLFRAM

Rapid Prototyping of Algorithms

Wolfram Language is an extremely flexible language, suitable for rapid prototyping and high-performance execution. The unique power of the system comes from its elegant unification of an immense range of capabilities, algorithms, models and data into the breakthrough Wolfram Language — transcending programming to provide a full computational representation of the world.

Symbolic Tensors

The Wolfram System offers many functions to efficiently manipulate lists, matrices, and arrays of any depth and dimension. Among them there are functions to perform algebraic operations, like sums, products, inner or outer products, transpositions, etc. The Wolfram System also has powerful algorithms to manipulate algebraic combinations of expressions representing those arrays.

Noncommutative Algebra & Structural Operations

Noncommutative algebra is a generalization of matrix algebra in which matrix multiplication is replaced by a noncommutative multiplication operator in an associative algebra. This generalization, along with state-of-the-art algorithms for basic polynomial operations, Gröbner basis computations, is crucial in quantum theory, special functions, differential equations, etc.

Symbolic Vectors, Matrices and Arrays

By using a symbol to represent a vector, matrix or array, one gets an efficient notation to model a mathematical problem. The Wolfram Language has a rich symbolic array language to describe problems and support symbolic array expressions and array variables, making it easy and efficient to specify high-dimensional problems.

- **Quantum Circuits**

Take advantage of a symbolic representation of quantum gates, quantum operators, measurement operators and more to compose quantum algorithms. Start from scratch or use any of the named gates available to design, visualize and simulate quantum circuits.

- **Time Evolution**

Use time-evolution functionalities to study the continuous transformation of the quantum objects over time, symbolically or numerically, under different scenarios.

- **Compute Distances and Entanglements**

Compute various distances between quantum states. Quantify and characterize entanglement in quantum states.

- **Symbolic Quantum Computation**

Perform symbolic calculations involving a wide range of quantum entities and processes, including quantum states, operators, unitary transformations, quantum channels, and quantum measurements. Access a comprehensive library of commonly used and named quantum objects with ease.

- **Rich Visualization Capabilities**

Generate visual representations of quantum states, circuits, and measurements using built-in graphical tools, which include circuit diagrams, Bloch sphere plots and more.

- **Interoperability with external quantum platforms**

Interact directly with various quantum platforms, submit queries, and compare experimental data with predictions of quantum theory.