



Advanced Quantum Chip Design Software

Nanoacademic offers an innovative and unique first-principles computer-aided design tool dedicated to spin-qubit and superconducting-qubit modeling. This is **QTCAD**®.

QTCAD® (Quantum-Technology Computer-Aided Design) is a multi-scale simulator used to predict the performance of spin-qubit and superconducting-qubit devices prior to fabrication. By enabling accurate, physics-based performance forecasting, **QTCAD**® helps reduce development time and cost while allowing designers to explore a broader range of layout configurations, like in the established design workflows of the semiconductor industry. **QTCAD**® computes critical design parameters and predicts the performance of quantum systems based on their native figures of merit. It is used by quantum scientists from private companies, public labs, academic research groups, and their students eager to understand and learn.

Key features

QTCAD® semiconductor device modeling features:

- **NEW!** Generalized k - p solver for encoding of arbitrary Hamiltonians up to quadratic order in momentum
- **NEW!** Jupyter- and browser-compatible device data visualization features (linecuts, slices, isosurfaces)
- **IMPROVED!** Up to 10x speed improvement in Coulomb integrals (exchange) calculations
- **QTCAD**® Builder & device Visualizer: Simplifies 3D device model building from layout files and eases the pre-processing, presentation and debugging
- A sub-K electrostatics solver for quantum dot confinement potentials in semiconductors with adaptive meshing
- 1D, 2D, 3D, and hybrid 3D/1D Schrödinger-Poisson solvers for quantum wells, nanowires, and quantum dots
- A many-body Schrödinger solver for electrons and holes
- A master equation solver for quantum transport calculations in the sequential tunneling regime (Coulomb blockade)
- An NEGF* solver for non-equilibrium quantum statistics and quantum transport in two-probe devices
- A computationally efficient workflow for charge stability diagrams of few-quantum dot systems including cross-capacitive effects
- Treatment of Bloch oscillations in the multi-valley-effective-mass theory (MVEMT) solver
- DFT-based strain and band alignment in $\text{Si/Si}_{1-x}\text{Ge}_x$ and $\text{Ge/Si}_x\text{Ge}_{1-x}$ heterostructures
- Possibility to define custom defect charge-density profiles to model point charges, surface charges and dopants
- A general workflow for electric-dipole spin resonance (EDSR) interfacing with QuTiP for both electrons and holes

QTCAD® Atoms for multiscale simulations of quantum dots using the atomistic tight-binding (TB) method:

- **NEW!** Calculator for effective g -factor for arbitrary magnetic field orientation
- **IMPROVED!** Up to 40% memory savings in TB Schrödinger equation solver
- Atomic structure builder for arbitrary 3D geometries with periodic boundary conditions & nonidealities (random alloys, roughness)
- A TB electronic structure solver which accounts for the effects of strain, magnetic fields, and spin-orbit coupling
- Valley-phase calculator enabling, e.g., electron shuttling fidelity calculations
- Various analysis tools such as atomistic wavefunction visualizers, matrix-element calculators, and g -tensor calculators
- Interfaces to **QTCAD**®'s FEM modeling capabilities like inclusion of a gate-induced confinement potential enabling multiscale simulations

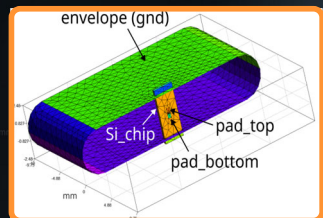
QTCAD® superconducting circuit modeling features:

- **NEW!** New Josephson-junction energy solver that enables E_J variability studies from Al/AlO_x surface roughness effects. The solver leverages NEGF and the Ambegaokar–Baratoff relations and allows the direct use of the exact CAD layouts of junctions
- **NEW!** Driven Maxwell solver with adaptive meshing and microwave network analysis capabilities (S and Z matrices)
- **NEW!** Post-processing module to perform energy-participation ratio analyses directly from the Maxwell eigenmode solver
- A capacitance matrix solver based on an adaptive-mesh linear Poisson solver to handle typical sharp corners & embedded 2D surfaces
- A frequency-domain finite-element Maxwell solver to compute the eigenmodes of superconducting circuits such as resonators, cavities, and transmons. Support inductive lumped ports

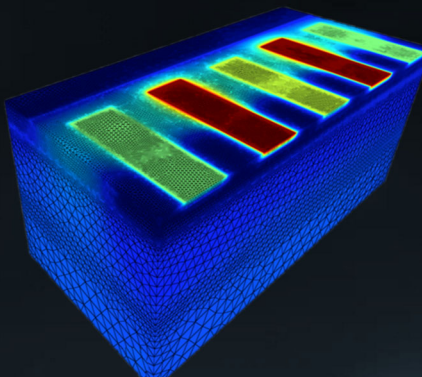
See what **QTCAD**® can enable you to model



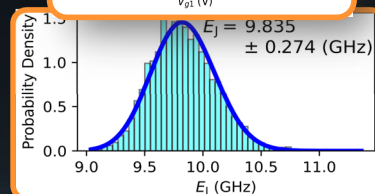
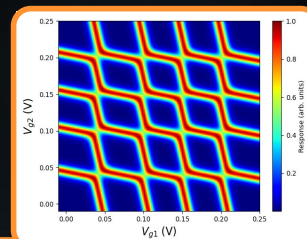
Some examples of what the large set of **||| QTCAD >** solvers can help you with for your quantum research & engineering projects:



SUPERCONDUCTING (SC) QUBITS



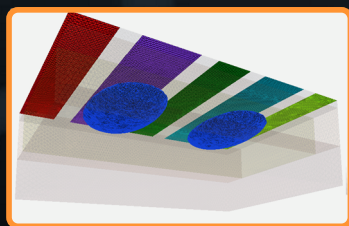
ADAPTIVE MESHING



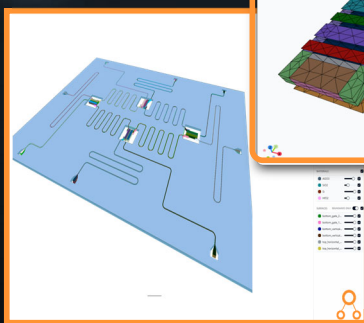
QUANTUM TRANSPORT FOR SPIN & SC QUBITS



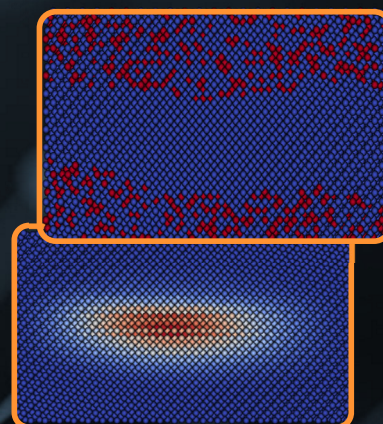
||| QTCAD > v2.2



QUANTUM DOTS



NEW TOOLS: BUILDER & VISUALIZER



ATOMISTIC MODELING

To teach your students in classrooms, check out **||| QTCAD > EDU** →



QTCAD® is the only professionally supported platform offering such a broad and powerful quantum-device modeling toolkit. From research to QPU design and engineering education, it helps our users accelerate discovery and turn quantum concepts into reliable device simulations every day

Contact us to test **QTCAD®** and/or **QTCAD® EDU** to get **your free-trial version now!**



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**DESIGN TOOLS FOR
NEXT GEN MATERIALS**

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