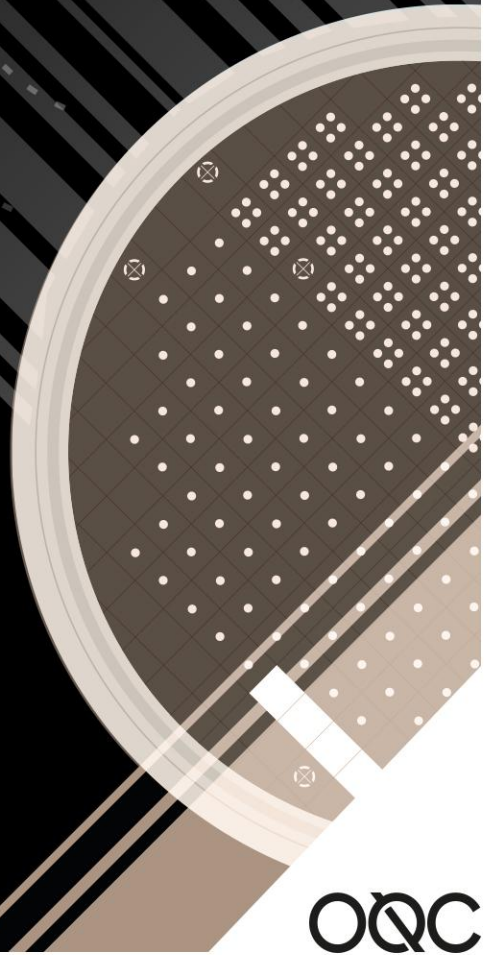
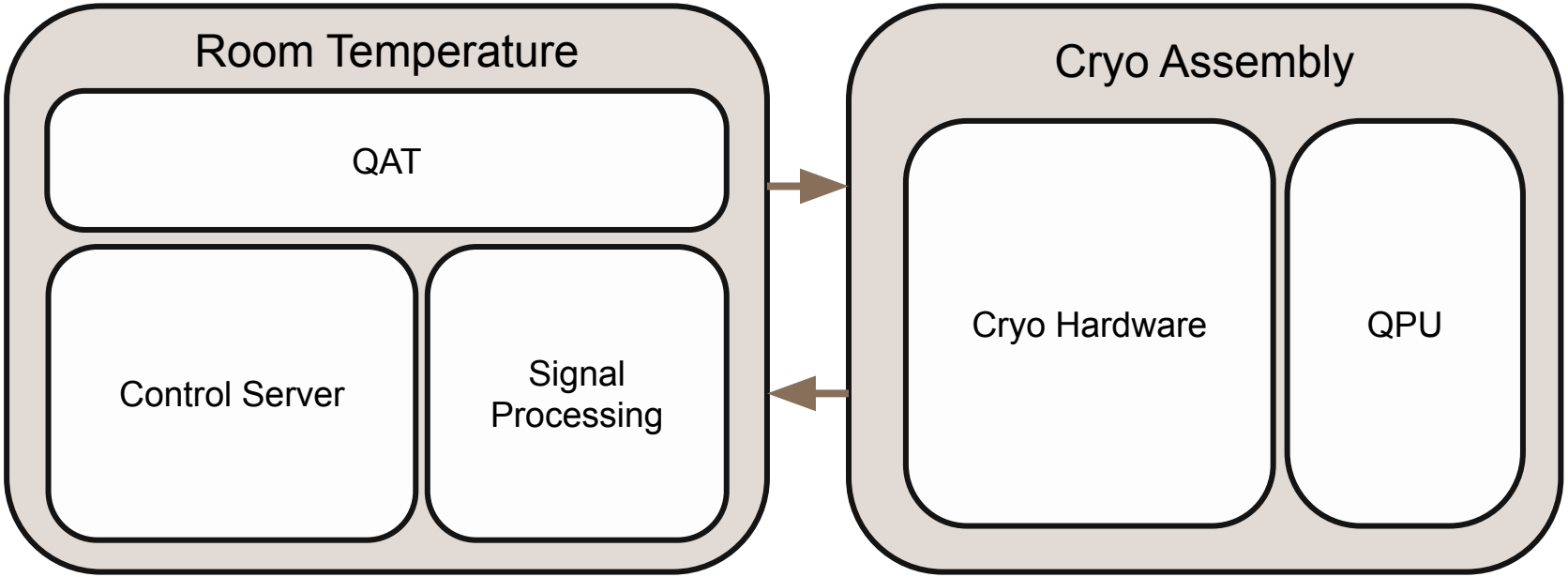
# QPU overview

Russell Rundle



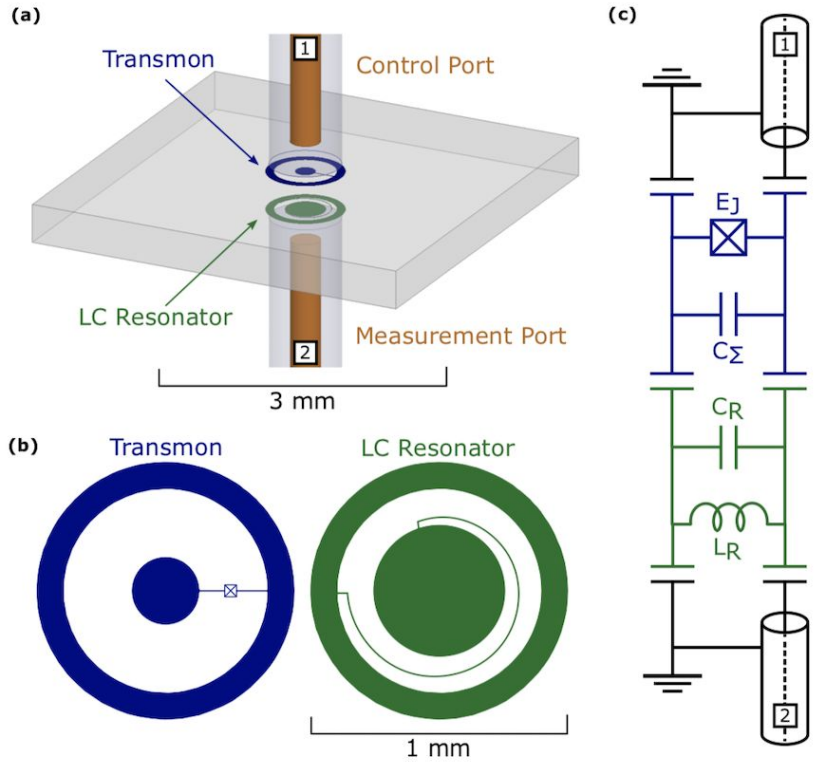


# System overview



# Cryo hardware

# Qubit and Resonator




Our qubits and resonators are coaxial.

The qubit sits on the top of the substrate and the resonator on the bottom.

This placement allows a capacitive coupling between the qubit and the resonator.

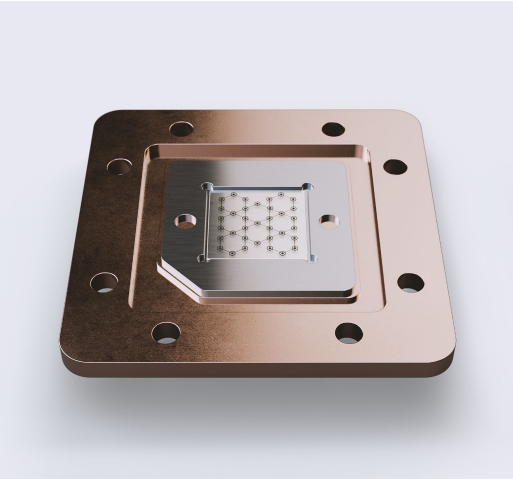
We then control the qubit and resonator by coaxial control lines go out of plane.

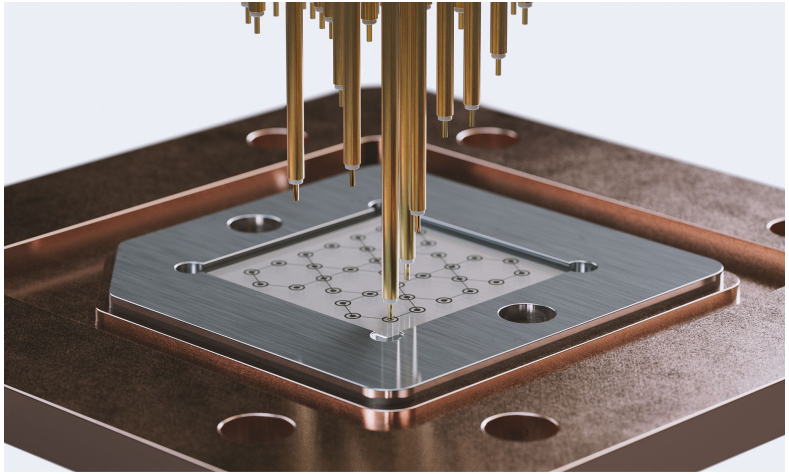
We can perform gate operations and measure by sending microwave pulses down the cables

# QPU

We then arrange the qubits in a lattice.

Pairs of qubits are coupled by coupling arms, allowing entangling operations between the pairs.

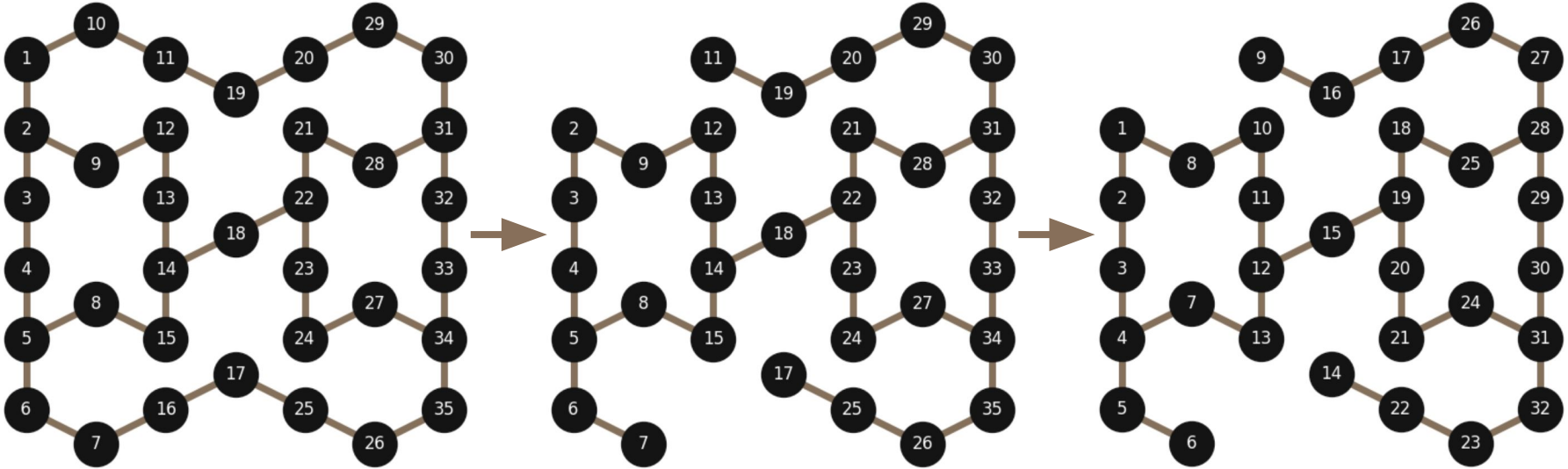




Since the wires go out of plane, we don’t need to worry about control lines on the QPU, allowing us to fully utilise chip space for qubits and resonators.

This also reduces potential crosstalk when scaling to higher numbers of qubits.

# QPU Lattice at CESGA




Initial QPU with 3 redundant qubits

Choose the 32 best qubits

Relabel qubits sequentially

# Room temperature components

**QAT** is our open source software that allows users to build circuits and then send them to a QPU

The user will write a circuit or a sequence of pulse shapes.

These are then sent to the QAT compiler, which are then converted into a series of instructions that can be interpreted by the control hardware.

# Room temperature components

## Control server

Receives instructions from QAT, specifying the pulse lengths and shapes.

Since the operations happen very quickly, the instruction list needs to be synchronised using FPGA cards controlled by precise clocks.

These then get converted into analogue signals and sent to signal processing.

## Signal Processing

After receiving signals from the control servers, the pulses are then mixed with other control signals.

The signals are then sent through the fridge into the QPU to perform operations and measure the qubits.

After measurement, these signals are sent back up the chain and returned to the user.