Building Scalable Quantum Networks *using Magnets*

> *To build powerful quantum computers, their components must be able to communicate across a chip, or between separate processors entirely. Our work explores how magnetic materials can provide that missing link — reliably, in real time, and without destroying quantum information. We're building the communication infrastructure for the quantum age.*

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2026

MISSION

The Quantum Communication Problem

Unlike classical computers, which process information as 0s and 1s, quantum computers harness the laws of quantum physics to explore many solutions simultaneously. This makes them exponentially more powerful for certain problems — modelling complex biological systems for drug discovery, accelerating the clean energy transition by designing more efficient batteries and solar cells, or tackling climate models too complex for any classical machine.

Quantum computers process information using delicate quantum states. But for them to be useful, different parts of the system need to **exchange information reliably** — without destroying those fragile states in the process. **Achieving this across a chip, at scale, is one of the hardest unsolved problems in quantum hardware.**

10^{24}

years it would take a classical supercomputer to solve what Google's quantum chip solved in minutes

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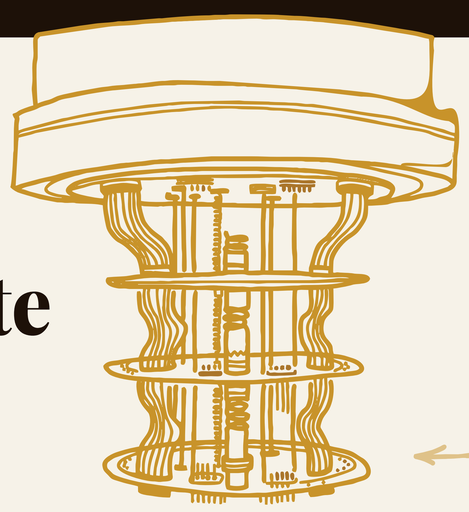
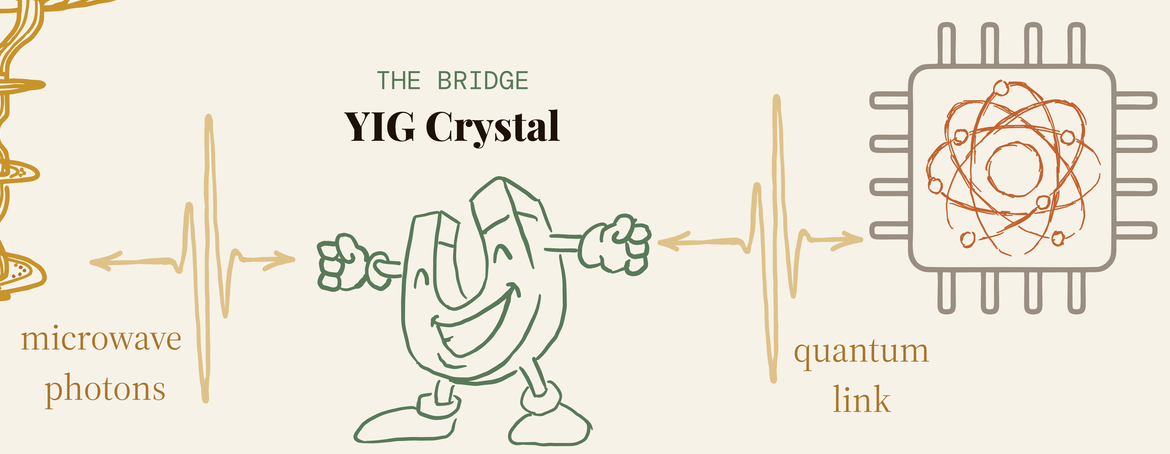
OUR APPROACH

Making Quantum Components Communicate

Magnetic materials show unique promise as quantum interfaces. They couple naturally to the microwave photons that control quantum processors, to spin qubits, and to optical qubits — and crucially, they are so **magnetically quiet** that quantum information can pass through them. This makes them an **ideal medium for transferring quantum information** between components.





By controlling the interaction at the YIG crystal — our magnetic bridge material — we aim to control when and how quantum information flows between processors, without destroying it.

KEY ACHIEVEMENTS

What We Demonstrated

1 Remote Coupling Achieved

We demonstrated that microwave photons and a YIG magnet can strongly interact even when spatially separated over long distances — providing a practical blueprint for connecting separate quantum processors.

2 Electronically Switchable Interaction

Using polarised microwave photons, we showed the interaction can be tuned continuously in real time — from full information exchange to none at all — without any physical reconfiguration of the hardware.

3 First Observation of Quantum Link Dynamics

We observed, for the first time, how these quantum links evolve in real time — opening a window into the dynamics that future engineers will need to understand and control.

IMPACT

Why This Brings Us Closer to Real Quantum Computers

Networked Quantum Processors
Separate quantum processors could be networked together like computers in a data centre, building machines far more powerful than any single chip.

On Demand Control of Quantum Interactions
Precise, real-time control over coupling enables quantum interactions to be switched on and off on demand — allowing processors to exchange quantum information exactly when needed.

The Infrastructure the Quantum Age Needs
Just as the internet required reliable communication infrastructure, quantum computers require reliable quantum links — and this work helps build them.

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