

ASX Announcement ([ASX: AXE](#))

12 July 2021

## First indication of on-chip qubit control

### Highlights

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- Significant <sup>12</sup>CQ chip development progress made with the first quantum information signals detected that indicate on-chip qubit control.
  - Quantum control of qubits integrated with miniaturised chip devices under various environment and system conditions is required for <sup>12</sup>CQ chip operation.
  - The progress made is a major technological feat and represents a crucial step towards realising <sup>12</sup>CQ as a viable chip-based qubit architecture<sup>†</sup>.
  - Archer is advancing its world-first technology development with an immediate focus on achieving qubit control.
  - Archer is the only ASX listed company and one of a few players in the world developing a qubit processor chip in the quantum computing industry<sup>‡</sup>.
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Archer Materials Limited (“Archer”, the “Company”, “[ASX:AXE](#)”) is pleased to announce it has an early indication of on-chip qubit control in microscopic-scale qubit material, which marks significant progress as part of the Company’s <sup>12</sup>CQ quantum computing chip development.

Archer recently characterised optimised and unoptimised custom-built quantum control devices (ASX ann. 19 Nov 2020) for initial qubit control measurements, and also developed advanced device designs (ASX ann. 10 May 2021). This ASX announcement reports the first indication of on-chip qubit control in microscopic-scale qubit material.

### On-chip qubit control of few and single qubits would validate <sup>12</sup>CQ chip viability

With the early indication of on-chip qubit control the Company’s <sup>12</sup>CQ quantum computing chip technology development continues and is on track towards achieving ‘*qubit control*’ under various qubit environments, including few and single qubits. Device fabrication and characterisation measurements are being performed by Archer staff at various lab facilities.

For the first time, Archer has recorded the Continuous Wave Electron Spin Resonance (“cw-ESR”) signals arising from a specially fabricated superconducting on-chip resonator semiconductor device integrating *microscopic* quantities of qubits (Image 1). Initial results indicate the obtained on-chip cw-ESR signal signature is characteristic of the qubit material.

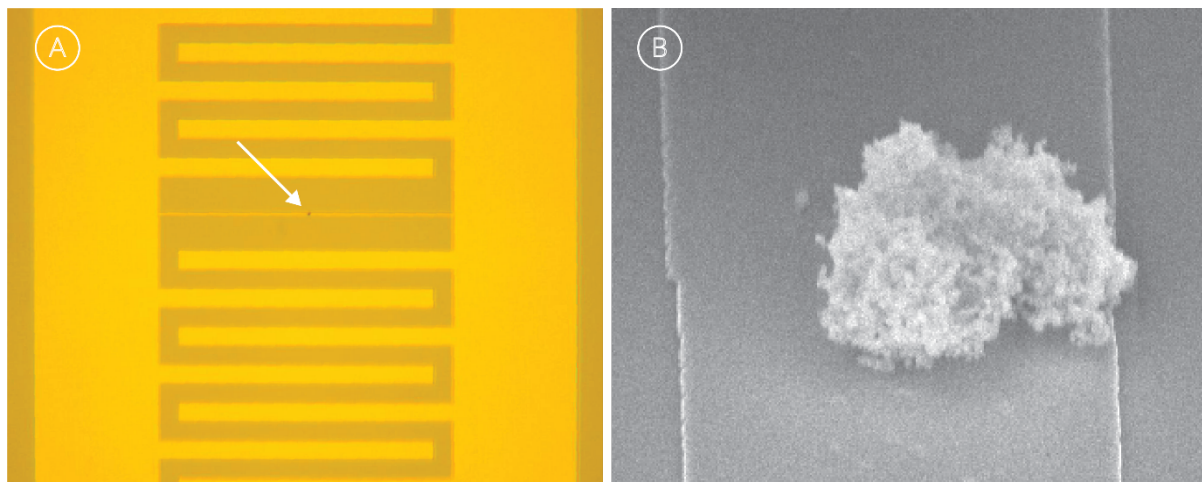
Importantly, the on-chip cw-ESR signal signature was found to be in excellent agreement with the well-studied, repeatable, and scientifically published signal obtained from room-temperature measurements performed on *macroscopic* (‘bulk’) quantity qubits using cw-ESR instruments<sup>†</sup>.

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<sup>†</sup> <https://www.nature.com/articles/ncomms12232>

<sup>‡</sup> <https://www.nature.com/articles/s42254-020-00247-5>; also <https://www.ibm.com/quantum-computing/network/members/>

**Commenting on the recent progress in qubit control, Archer CEO Dr Mohammad Choucair said,** “Archer is making significant progress towards on-chip qubit control as part of its <sup>12</sup>CQ chip development. We have the strongest indication yet that on-chip control of quantum information in our qubit material is within reach and entirely possible under miniaturisation conditions required for any future chip operation.”



**Image 1. Measuring quantum information residing on qubit materials using chip devices.** **A** An example of a specially fabricated superconducting on-chip resonator semiconductor device. Arrow points to a dark spot indicative of a microscopic qubit cluster quantity (magnified in **B**) ten times smaller than the width of a human hair. The superconducting operating temperatures of the device are unrelated to Archer’s qubits’ potential to operate at room temperature. **B** The ultraprecise placement of a microscopic cluster of qubit material on a cw-ESR signal detection area. Individual qubits are not visible at the image magnification.

## About Archer

Archer is a technology company that builds advanced semiconductor devices, including processor chips that are relevant to quantum computing. Archer’s <sup>12</sup>CQ is a world-first qubit processor technology that would allow for mobile quantum computing powered devices. For more information, please view Archer’s [webinar](#) with IBM.

<sup>12</sup>CQ® is a registered trademark of Archer Materials Limited.

The Board of Archer authorised this announcement to be given to ASX.

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