ASX Announcement (ASX:**AXE**) 26 August 2019

Qubit component positioned with nanoscale precision

Highlights

- Archer team assembles the first qubit material component ("qubit") of the ^{12}CQ room-temperature qubit processor ("chip") with nanometre precision.
- The ability to directly position individual qubits is a key requirement for building a scalable chip and derisks Archer's chip technology development.
- The achievement is definitive proof for addressing a global quantum computing industry key success driver for early-stage quantum computing technology development related to scalability, practicality and use[1].
- NSW Government funding received to support continued prototype facilities access and chip development.
- Chip commercialisation to continue through the prototyping of hardware componentry into a proof-of-concept minimum viable chip product for room-temperature quantum computing technology directly onboard modern devices.

Archer Exploration Limited ("Archer", the "Company") (ASX:**AXE**) is pleased to announce that the Company has assembled the first qubit component of a prototype room-temperature operation quantum computing qubit processor ("chip"), as part of its pioneering quantum technology project ^{12}CQ (pronounced "one two cee cue").

Commenting on the Company's ^{12}CQ developments, Archer CEO, Dr Mohammad Choucair, said: "This outstanding achievement further strengthens our commercial readiness, as we've met a key milestone in derisking and progressing the chip technology development, while demonstrating a key success factor [of a scalable qubit architecture] the quantum computing community commonly uses to qualify the most promising early-stage, long-term potential solutions to practical quantum computing."

^{12}CQ Qubit Componentry Assembly

To assemble the first qubit component of Archer's chip, a single qubit was isolated and precisely positioned on a silicon wafer (**Fig. 1**) ("Process"), with the Process being performed at room-temperature. The Process overcomes the key technological barrier of demonstrating the possibility of qubit scalability in the fabrication of a working chip prototype, representing a minimum viable product: a product chip at a commercial readiness that can validate solutions to direct consumer ownership of quantum computing powered technology.

The ability to directly position individual qubits is a key requirement for building a scalable chip. To achieve this, Archer uses a unique carbon-based qubit that has the potential to enable chip operation at room-temperature and integration onboard modern devices (see *Quantum Technology & Archer's ^{12}CQ Advantage*). The qubit is the fundamental component of Archer's ^{12}CQ prototype chip, as without the qubit, quantum computing cannot be performed.

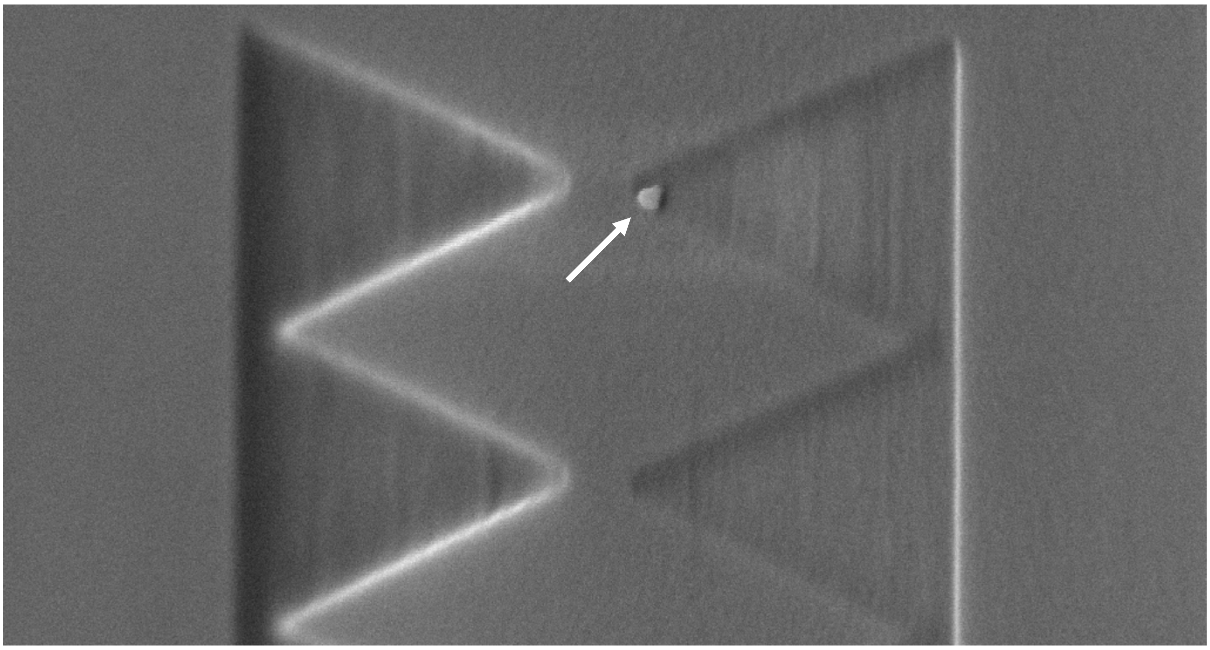

Fig. 1. Electron microscopy image of a single qubit of about 50 nanometre size (indicated by the arrow) positioned with nanometre-scale precision on a silicon wafer surface.

The Process was performed with nanometre scale accuracy on silicon substrates (however the Process was not limited to silicon) and was repeatable and reproducible. This level of positional accuracy and control is required to build a working prototype, and the Process allows Archer to quickly build and test quantum information processing devices incorporating a number of qubits; individual qubits; or a combination of both, which is necessary to meet Archer's aim of building a chip for a practical quantum computer. Further improvements and optimisation to the Process are likely to reduce the time required to build a working chip prototype.

Commenting on the qubit componentry assembly, Archer CEO, Dr Mohammad Choucair, said: "The qubits are only a few tens of nanometres in size and this means we need to have a high level of accuracy in physically positioning our qubits to successfully build a working device. It is incredibly difficult to apply such a high of degree precision in controlling qubit location; however, we have unambiguously achieved this, making it possible to scale our chip qubits."

NSW TechVoucher Funding

The Archer team is building chip prototypes at the Research and Prototype Foundry within the world-class, $150 million purpose-built Sydney Nanoscience Hub facility, at the University of Sydney ("Sydney"). The Facilities Access Agreement with Sydney (ASX Announcement 3 April 2019) was varied to account for the awarding of competitive NSW TechVoucher funding ("Funding") to Archer's wholly owned subsidiary, Carbon Allotropes Pty Limited. The maximum Funding amount of $15,000 was awarded and will be used to continue accessing facilities at the Research and Prototype Foundry to build chip prototypes.

Next Steps

The technical development at the heart of ^{12}CQ is a world-first. Archer intends to continue technology de-risking value-added development of the ^{12}CQ qubit processor chip by completing the next stages of component assembly towards a proof-of-concept prototype chip. The prototype chip validation is required to establish a minimum viable product.

Archer intends to commercialise chip products through licencing and direct sales (ASX Announcement 29 May 2019) by seeking to establish commercial partnerships with highly resourced and skilled organisations including software developers and hardware manufacturers, that could allow for product scale, IP transfer, and distribution channels.

Background and Market Summary

Quantum Technology & Archer's ^{12}CQ Advantage

Quantum computers represent the next generation of powerful computing[1]. They consist of a core device (a chip) made from materials capable of processing quantum information (often called qubits) necessary to solve complex calculations. One of the biggest challenges to wide-spread use by consumers and businesses involves keeping the qubit stable at room-temperature while integrating into electronic componentry. The development of quantum computers is envisioned to impact industries reliant on computational power, including finance, cryptocurrency and blockchain.

During his previous employment at Sydney, Archer CEO, Dr Mohammad Choucair, invented the first material known to overcome both the limitations of sub-zero (cryogenic) operating temperatures and electronic device integration for qubits. The conducting carbon material was able to process qubits at room temperature[2] and offered the potential for scalability: a solid-state material of workable dimensions for nanofabrication (less than 100 nanometres in size), easily processed and handled, and produced in quantities useful for quantum computing.

This unique combination of physical, chemical, and structural properties has the potential to reduce commercial barriers to quantum computing and make it globally accessible. The patented device incorporating these materials forms the subject of IP that was exclusively licenced from Sydney by Archer (ASX Announcement 12 December 2018), and the materials are available in Archer's wholly owned subsidiary Carbon Allotropes.

Market and Key Growth Catalysts

According to McKinsey[3], currently the highest-value in the quantum computing economy is derived from technology development in the US, EU, and Australia. Morgan Stanley forecasts that quantum technology could double the value of high-end computers to US$10 billion by 2027.[4-5] Investment bank Goldman Sachs predicts that by 2021, quantum computing could become a $US29 billion industry[6], while the Boston Consulting Group[7] highlighted the dependence of the market size on achieving technical milestones over the coming decades.

Globally, quantum computing forms part of the mature semiconductor and electronic parts manufacturing industry (SEPMI)[8]. The SEPMI is a US$500 billion+ revenue market, with approx. 70% of manufacturing concentrated in Asia. Approximately 40% of costs in the market relate to materials, and the industry sees margins of approximately 10-20%. There are few companies with large market share including Samsung, Intel, and Qualcomm, giving rise to potential opportunities for mergers and acquisitions based on disruptive technology integration.

About Archer

Archer provides shareholders exposure to innovative technologies and the materials that underpin them. The Company has a focused strategy targeting globally relevant materials markets of quantum technology, human health, and reliable energy.

Answers to some common questions related to Archer and the ^{12}CQ Project can be found in ASX Announcement 11 June 2019.

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[1] Philipp Gerbert and Frank Rueß. Boston Consulting Group. November 2018. https://www.bcg.com/en-au/publications/2018/next-decade-quantum-computing-how-play.aspx
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[3] Appears in: https://www.economist.com/news/essays/21717782-quantum-technology-beginning-come-its-own
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[5] Quantum Computing – Weird Science or the Next Computing Revolution? Morgan Stanley. August 2017.
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