ACN: 123 993 233

ASX Announcement (ASX:**AXE**) 3 April 2019

Archer's ^{12}CQ Project commences

Highlights

- The ^{12}CQ Project commences with the aim of building a carbon-based quantum computing device (chip) capable of room-temperature quantum information processing that would form the future basis of a Universal Quantum Computer.
- Facilities Access Agreement executed with the University of Sydney, providing Archer access to the Research & Prototype Foundry Core Research Facility at the Sydney Nanoscience Hub: world-class infrastructure, equipment, and engineers required to build the chip.
- Dr Martin Fuechsle, Archer's Quantum Technology Manager, is appointed Honorary Associate at the University of Sydney as part of the ^{12}CQ Project, enabling direct access to publicly restricted library resources and chip fabrication instrumentation.
- Successful development of the technology would represent a major global breakthrough in the quantum computing industry, estimated to reach $US29 billion by 2021[1] and linked to the $US500 billion[2] semiconductor market, catalysed by technical advances that allow for practicality, accessibility, and wide-spread consumer adoption[3].
- Archer holds an exclusive international licence to commercialise the technology and owns the critical materials required to build the chip, and intends to licence and directly sell the technology with patents filed protecting the intellectual property (IP) in the US, EU, and Australasia.

Archer Exploration Limited (Archer, Company) is pleased to announce that the Company has commenced its maiden quantum technology project dubbed ^{12}CQ (pronounced "*one two cee cue*") to build a carbon-based quantum computing device (chip). The chip forms the basis of IP exclusively licenced to Archer from the University of Sydney (University) (ASX Announcement 12 December 2018). Archer has begun building chip prototypes at the Research & Prototype Foundry Core Research Facility at the Sydney Nanoscience Hub having executed a Facilities Access Agreement (Agreement) with the University, coinciding with the University's appointment (Honorary Appointment) of Archer's Quantum Technology Manager, Dr Martin Fuechsle, as Honorary Associate.

Commenting on the commencement of ^{12}CQ, Archer CEO Dr Mohammad Choucair said, "We have started building the chip. ^{12}CQ has a simple value proposition, that of realising practical quantum computing. Key components of our commercialisation plan are now in place and we are in a unique position to strengthen quantum computing in Australia. Access to the Research & Prototype Foundry at the Sydney Nanoscience Hub provides us with the specialised world-class infrastructure, facilities, equipment, and personnel we need to successfully build this potentially breakthrough quantum computing technology."

Image 1. Archer's Quantum Technology Manager, Dr Martin Fuechsle, operating the Electron Beam Lithography instrumentation inside the cleanrooms of the Research & Prototype Foundry at the Sydney Nanoscience Hub. The working environment is highly controlled, and access is restricted, requiring specialised control over air quality, temperature, humidity, and lighting (orange) to counter any detrimental effects during chip building and testing.

The success of ^{12}CQ requires building and testing atomic-scale quantum devices using special chip fabrication tools and instruments for patterning and testing materials and quantum logic circuits. The Agreement provides Archer access to over 20 dedicated instruments, specially designed device substrates, and cleanrooms at the Research & Prototype Foundry Core Research Facility in the University's Sydney Nanoscience Hub.

The cleanrooms are available at ISO Class 5 level, defined by a tightly regulated environment (temperature, humidity, and light) and a low level of particulates (Image 1). The cleanrooms mitigate the risk of the external environment destroying the fabricated devices (e.g. dust particles can be thousands of times bigger than the circuitry and can damage the components). They are the flagship facility of the Research & Prototype Foundry and are comparable to production-level cleanrooms found in major international semiconductor chip building foundries.

Next Steps

The technical development defining ^{12}CQ is a world-first, and Archer will begin building prototype devices by assembling atom-scale materials componentry while overcoming technical challenges in controlling, reducing, or eliminating the technical risks associated with realising the 16 claims in the patent application. Dr Fuechsle is internationally recognised in pioneering quantum device fabrication and has been appointed Honorary Associate of the University of Sydney, which allows Archer the direct and expedient access to the cleanrooms and operation of instruments and tools to build the chip. Dr Fuechsle is currently completing mandatory facility induction and instrument certifications at the Research & Prototype Foundry required for performing materials and device testing and characterisation.

About the University of Sydney Research & Prototype Foundry Core Research Facility and Sydney Nanoscience Hub

Image 2. A photograph looking into the restricted cleanroom from the foyer of the University of Sydney Research & Prototype Foundry Core Research Facility at the Sydney Nanoscience Hub.

The Sydney Nanoscience Hub is a $150 million purpose-built facility to explore the nature of matter, design new technologies and engineer them in some of the best cleanroom and nanofabrication facilities in the world and houses the Research and Prototype Foundry Core Research Facility. The state-of-art building, labs and fabrication facilities are designed to enable the precise measurements needed to access quantum phenomena on the nanoscale. The building features more than 25 laboratory modules with different performance grades maintained by specialist engineers. With 60 onsite experts and over 250 Instruments available, the University's Core Research Facilities are some of the world's most comprehensive for making devices in a variety of materials.

Background and Market Summary

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

Quantum computers represent the next generation of powerful computing[3]. They consist of a core device (chip) made from materials capable of processing quantum information (qubits) necessary to solve complex calculations[4]. One of the biggest challenges to wide-spread use 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, cryptography, digital currencies, and AI.

During his previous employment at the University, Archer CEO Dr Mohammad Choucair invented the first material known to overcome both the limitations of sub-zero operating temperatures and electronic device integration for qubits. The conducting carbon material was able to process qubits at room temperature[5]. This has the potential to reduce the 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 the University by Archer (ASX Announcement 12 December 2018), and the materials are available in Archer's wholly owned subsidiary Carbon Allotropes.

Image 3. An entryway to the $150 million Sydney Nanoscience Hub, supported by the National Research Infrastructure for Australia as part of an Australian Government Initiative.

Market and Key Growth Catalysts

According to McKinsey[6], in 2015, Australia (5%), the EU (35%), and North America (30%), made up 70% of A$2.1bn (€1.5bn) world spend on high value quantum computing R&D. Morgan Stanley believes quantum technology could double the value of high-end computers to US$10

billion by 2027.[7-8] Investment bank Goldman Sachs predicts that by 2021, quantum computing could become a $US29 billion industry[1], while the Boston Consulting Group[3] 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)[2]. The SEPMI is a $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 (consolidation) based on disruptive technology integration.

About Archer

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

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Shareholders

For more information about Archer's activities, please visit our:

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