Enabled by ANFF / Webinar Series

Abstracts and information

Contact:

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Starting in October, ANFF is hosting six free webinars to celebrate the exciting science being conducted with the assistance of the network.

We hope that you'll join us to hear about the exciting developments that ANFF has been enabling. Please find the talk abstracts below.

If you have not yet registered for the webinar series, please do so by clicking **this link**. This will ensure you receive the relevant information.

This webinar series has been introduced due to the situation in Melbourne making it unsafe for us to proceed in with the ANFF Retreat and Research Showcase in a responsibly safe fashion.

The "in person" part of the event, themed on the title *Enabled by ANFF*, will be held 11-13 May 2021 in Melbourne. More details to come.

If you have any questions, please contact **Tom Eddershaw**.

This event would not be possible without the support of our valued sponsors.

Six webinars will be held, with one focused on each of the following research priority areas.

~~Construction Science (21 October)~~

~~New and novel technologies to enhance construction materials and buildings of the future.~~

~~MedTech (28 October)~~

~~Developments in medical technologies that will help form Australia's economic future.~~

~~Space and Defence (4 November)~~

~~Furthering the technologies designed to aid space exploration, or to view Earth from high above.~~

Comms and Cybersecurity (11 November)

An overview of research that is improving the transmission or security of communication and data.

Energy (18 November)

Improving the energy outlook via new technologies or increasing the efficiencies of established ones.

Food and Agribusiness (25 November)

Uses of technology to improve the quality of food, or to help produce it.

Each online session will be one hour long and will feature two talks.

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Comms and Cybersecurity

Speaker:

Professor Andrew Dzurak
UNSW and ANFF NSW

Silicon-based quantum computing: The path from the laboratory to industrial manufacture

Biography: Andrew Dzurak is one of world's leading experts in silicon-based quantum computing. He is a Scientia Professor at UNSW-Australia, an ARC Laureate Fellow, and is Director of ANFF-NSW (http://www.anff-nsw.org), the NSW node of the Australian National Fabrication Facility. Following a PhD in Cambridge in 1993, Andrew was a key participant in the establishment of the ARC Centre for Quantum Computer Technology by Professor Bob Clark, which now maintains the world's largest focused collaboration on silicon-based quantum computing.

Andrew, with colleague Andrea Morello, demonstrated the world's first silicon quantum bits (qubits) in 2012, and more recently developed a new qubit technology by reconfiguring the ubiquitous CMOS transistors that make up all of today's silicon processor chips. He leads a team at UNSW focused on the development of a quantum processor that can be manufactured using CMOS technology which is funded by the US Army Research Office, the Australian Research Council, and the company Silicon Quantum Computing Pty Ltd. He has published over 200 research papers including 15 papers in Science and Nature group journals, and is co-inventor on 12 patent families. Andrew received the 2011 Eureka Prize for Scientific Research, and his silicon qubit work was selected by Physics World, UK as one of the world's Top Ten Scientific Breakthroughs for 2015.

Abstract: In this talk I will give an overview of the development of silicon-based quantum computing (QC), from the basic science through to its prospects for industrial-scale commercialization based on CMOS manufacturing. I begin with Kane's original proposal [1] for a silicon quantum computer, conceived at UNSW in 1998, based on single donor atoms in silicon, and will review the first demonstrations of such qubits, using both electron spins [2,3] and nuclear spins [4]. I then discuss the development of SiMOS quantum dot qubits, including the demonstration of single-electron occupancy [5], high-fidelity single-qubit gates [6], and the first demonstration of a two-qubit logic gate in silicon [7], together with the most recent assessments of silicon qubit fidelities [9,10]. I will also explore the technical issues related to scaling a silicon-CMOS based quantum processor [8] up to the millions of qubits that will be required for fault-tolerant QC, including the recent demonstration of silicon qubit operation above one kelvin [11].

[1] B. E. Kane, *Nature* 393, 133 (1998).
[2] A. Morello et al., *Nature* 467, 687 (2010).
[3] J.J. Pla et al., *Nature* 489, 541 (2012).
[4] J.J. Pla et al., *Nature* 496, 334 (2013).
[5] C.H. Yang et al., *Nature Communications* 4, 2069 (2013).
[6] M. Veldhorst et al., *Nature Nanotechnology* 9, 981 (2014).
[7] M. Veldhorst et al., *Nature* 526, 410 (2015).
[8] M. Veldhorst et al., *Nature Communications* 8, 1766 (2017).
[9] H. Yang et al., *Nature Electronics* 2, 151 (2019).
[10] W. Huang et al., *Nature* 569, 532 (2019).
[11] H. Yang et al., *Nature* 580, 350 (2020).

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Comms and Cybersecurity

Speaker:

Professor Brett Nener
University of Western Australia

Atmospheric effects on ground/satellite optical communications

Professor Brett Nener
Microelectronics Research Group (MRG)
University of Western Australia

Abstract: Optical propagation through the atmosphere is subject to scattering, scintillation and refraction, all of which are under the control of the weather. These effects are often the limiting factor in the transmission of high data rates and need to be mitigated. We have been working on the modeling of atmospheric scintillation so that system designers can make informed analysis of the transmission channel. I will briefly discuss what we have been doing recently in this area.

Unlike microwave frequencies, light is strongly scattered, particularly by clouds. Multiple ground stations and receiver diversity are used to overcome this limitation. However, system designers need to select optimal locations for their ground stations (OGS) to maximize the likelihood of a clear path to the satellite even over multiple sites. I will describe our 40 year cloud cover study for Australia that can be used to help with the selection of OGS sites.