

## FLEET News: September 2020

This week we're very pleased to congratulate FLEET members named as finalists for the Australian Museum Eureka Prize – the country's top science awards: See below for more information about the finalists: the quantum vortex team (UQ and Monash) and Sumeet Walia (RMIT).

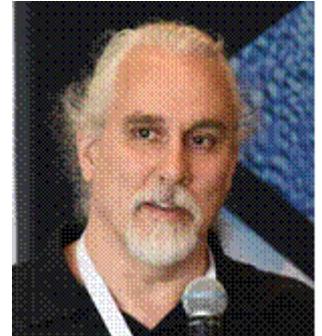
The new series of talks that FLEET is coordinating along with our partners at JQI and Monash has been extremely successful, maintaining cross-Pacific connections while the planes are grounded, allowing partners and colleagues across the globe to 'attend'. See more on this below.

Meanwhile great papers are being published across the Centre, with many being led by our PhD candidates and other ECRs. See below for a selection of recent papers.

Regards,

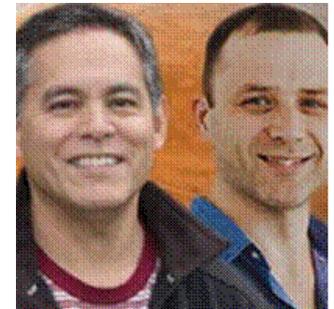
Professor Michael Fuhrer  
FLEET Director

*Catch up on previous editions of FLEET News*



## FLEET's 2020 Eureka Prize finalists

FLEET's Kris Helmerson (Monash) and Matt Davis (UQ) are finalists, named this week, in the Australian Museum Eureka Prizes – the nation's top science awards. The Australian Quantum Vortex team combines 21 theoretical and experimental researchers across three Australian unis and two ARC Centres of Excellence. [Read more online](#)



Congratulations also to FLEET AI Sumeet Walia (RMIT), who is a finalist for the Eureka Prize for an Emerging Leader in Science. [Read more online.](#)

## Growing metallic crystals in liquid metal

A study led by FLEET RF Mohammad Mayyas (UNSW) details a new liquid-metal (gallium) technique with potential for future metal and metal-compound nanostructures.

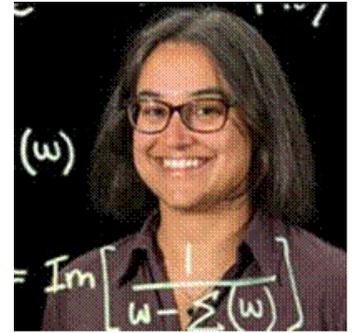
[Read more online.](#)



## Excitons in Nature Physics

FLEET CI Meera Parish has written an explainer on the use of light–matter interactions in quantum material engineering for Nature Physics.

[Read the article online.](#)



## Reviewing QAHE materials at UOW

UOW PhD student Muhammad Nadeem led a collaboration of three FLEET comprehensively reviewing quantum anomalous Hall effect (QAHE) materials, looking at potential enhancements of large spin-orbit coupling and strong intrinsic magnetization (ferromagnetism) in topological insulators and spin gapless semiconductors, to allow function at higher temperatures. [Read more online](#)

## What causes quasiparticle death?

Quasiparticles die young, lasting far, far less than a second. Why? A new Monash study, conducted by FLEET Masters student Haydn Adlong, finds a culprit beyond the usual suspect (decay into lower energy states). The new villain: many-body dephasing.

[Read more online](#)



## What happens between the sheets (of graphene)?

Adding calcium to graphene creates an extremely-promising superconductor, but where does the calcium go? Monash PhD student Jimmy Kotsakidis led a new study for the first time confirming what actually happens to those calcium atoms. Surprising everyone, the calcium goes underneath both the upper graphene sheet and a lower ‘buffer’ sheet, ‘floating’ the graphene on a bed of calcium atoms. [Read more online.](#)

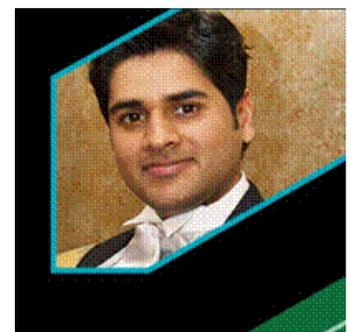
## Diamonds the crown jewel in future electronics

Controlling electric charges spinning on a diamond’s surface could pave the way for a new type of diamond-powered energy efficient electronic devices, new work by FLEET AI Dongchen Qi at QUT. [Read more online.](#)

## FLEET-wide talk coming up: Priyank Kumar on optoelectronics

The next FLEET streamed seminar will be given by FLEET AI Dr Priyank Kumar (UNSW) on design of enhanced optoelectronics using plasmonic nanostructures.

[See details on the FLEET website](#)



## Congratulations to our ECR authors

Congratulations to all the PhD students and other ECRs who are first/second authors in our [recent publications](#): Weizhe Liu, Daisy Wang, David Colas, Weiyao Zhao, Hareem Khan, Zeb Krix and Chang Liu.

The Centre is at 72 out of 100 for our publications KPI, of which 48% have impact factor above 7. [See 2020 performance here.](#)

## US-Australian condensed-matter and cold-atom physics talks maintain international connections

While COVID19 has temporarily halted the visits that traditionally spark and fuel international research collaborations, we continue to find new ways to connect.

FLEET, with partners JQI and Monash University School of Physics and Astronomy, is running a series of talks alternating between US and Australian researchers, presenting developments in condensed-matter and cold atomic physics, enriching connections between the two physics communities.

[See list of future talks and recordings of past talks online.](#)



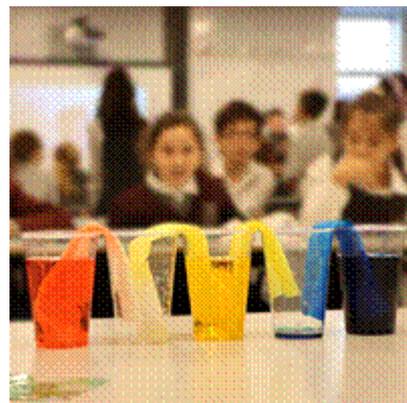
## Virtual and video outreach at UNSW

A team of FLEET PhDs and ECRs at UNSW were able to bridge 2020's COVID restrictions to safely engage a classroom of students with virtual, but hands-on science, this month, with Vivasha Govinden writing that the experience not only had a silver lining in better engagement for the schoolkids, but had unexpected benefits for the scientists too.

[Read about the project online.](#)

A collection of videos produced around FLEET recently put Centre science in the limelight:

- A team of FLEET researchers produced a trio of videos spotlighting the impressive UNSW undergrad lab facilities for the university's virtual open day
- FLEET PhD student Yik Lee (RMIT) gave an excellent explanation of transverse magnetic focusing, which can sort electrons by spin at the university's 3-minute-thesis Science finals
- Agustin Schiffrin (Monash) demonstrated the FLEET levitating superconductor track
- FLEET honours student Coco Kennedy (UNSW) produce a sample using pulsed laser deposition in the lab.



FLEET features next week in the #QandARC series of videos, which is exploring the diversity of scientists and science in Australian Research Council Centres of Excellence. Check out other COEs' videos so far on the [ARC's youtube playlist](#), and keep an eye on FLEET social media next Tuesday for the FLEET edition.

## Topological explainer

A very nice topological materials explainer in September's Physics Today addresses the perennial question "but how are they topological", beyond vague references to coffee cups and donuts—matching 'genus' of 3D shapes to closed surfaces of allowable electron momenta. [Read the article online.](#)



## Quantum materials roadmap

The new IOP quantum materials roadmap explores current research, future challenges, technical applications, underlying physics in topological insulators, multiferroics, twisted-'magic angle' moiré graphene, superconductors (Cu and TMD), topological semimetals, Majorana states and non-equilibrium phenomena (pewh!) [Read the roadmap online](#)

## Maintaining connections: Centre-wide, live-streamed seminars

The next live-streamed talk (8 October ) will be by Priyank Kumar (UNSW).

The November talk will be by Karen Livesy from the University of Newcastle, and December will be Iolanda Di Bernardo (Monash).

## Neutron scattering ANBUG / symposium

The Australian Neutron Beam Users Group (ANBUG) promotes neutron scattering to the community, especially to students and ECRs. The organisation's newly refreshed website has revitalized membership, and all interested researchers are encouraged to join, particularly in 2020 for up-to-date access information and the ongoing series of online seminars available to members.

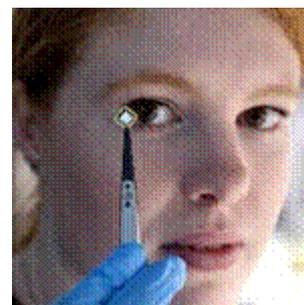
The 2020 virtual Australian Neutron Scattering Symposium will be held 11-13 November

## Previous news

**Congratulations to FLEET CI Meera Parish** (Monash) who received an ARC Future Fellowship, announced this month. The new ARC Fellowship will support Meera's work to unravel the behaviour of novel, complex quantum materials by investigating the nature of quasiparticles beyond the current paradigm. [Read more online.](#)

**Quantum fellowship for FLEET AI Karina Hudson** (UNSW), who has just been awarded a highly-competitive 3 year [Sydney Quantum Academy Fellowship](#) (equivalent to a DECRA). Karina will continue working with FLEET as a Scientific Associate Investigator.

**Using protons to tune inter-layer forces** Guolin Zheng (RMIT), with Centre partner organisation CAS High Magnetic Field Laboratory led a study showing for the first time that interlayer coupling in a vdW material can be largely modulated by a protonic gate, which inject protons to devices from an ionic solid. [Read more online.](#)



**Stacked organic semiconductor development at ANU** We now have the perfect building block to achieve flexible next generation electronics." A 'stacked' organic material developed by FLEET AI Yuerui (Larry) Lu's team at ANU advances future, ultra-fast thin, bendable and more-powerful electronic devices based on photonics. [Read more online.](#)

**Unexpectedly fast conduction electrons** Iolanda Di Bernardo (Monash) led this FLEET study which used a scanning-tunnelling microscope 'trick' to map electronic structure in Na<sub>3</sub>Bi, seeking an answer to that material's extremely high electron mobility. [Read more online.](#)

**Vortex top-hats emerge in superfluids** FLEET's Oliver Stockdale and Reeves (UQ) led a study of rotating superfluids, seeing the emergence of a 'top hat' shaped super-vortex phenomenon. The team demonstrated that during expansion of vortex clusters, for any initial arrangement of quantised vortices, a 'top-hat' shaped super-vortex will form. [Read more online.](#)

**FLEET CI Jan Seidel** (UNSW) is co-editor on a new book on ferroic domain walls, published by Oxford University Press: the first book to cover the emerging field of ferroelectric domain walls in depth, from underlying nanoscale material properties to prototype and emerging nanoelectronics technology and future research concepts. [Read more online.](#)



## Participating organisations

FLEET is the Australian Research Council Centre of Excellence in Future Low-Energy Electronics Technologies.

Participating nodes are:

The Australian National University, Monash University, RMIT University, Swinburne University of Technology, the University of New South Wales, the University of Queensland and the University of Wollongong.

