FLEET
ARC CENTRE OF EXCELLENCE IN FUTURE LOW-ENERGY ELECTRONICS TECHNOLOGIES

FLEET News: November 2021

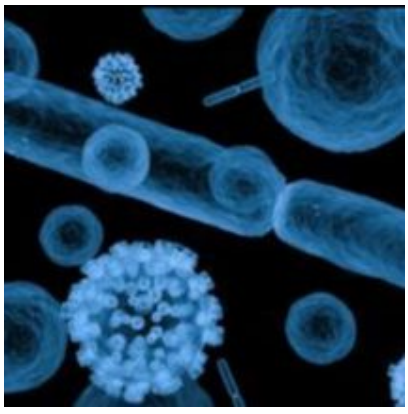
Here at FLEET we are gearing up for our short end-of-year meeting, and celebrating surviving what has been a pretty difficult year for many.

However the production of wonderful science continues, including the world's thinnest X-ray detector, double-dosed semiconductors, liquid-metal pumps and spintronics advances. Please read on for these and other news from around the Centre.

Regards,
Prof Michael Fuhrer
Director, FLEET

In this edition:

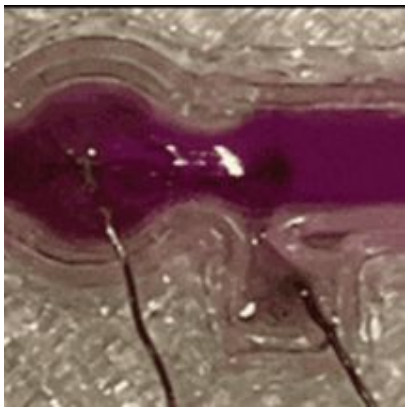
World record: thinnest X-ray detector



A highly sensitive and responsive new X-ray detector is less than 10 nanometres thick and could potentially lead to real-time imaging of cellular biology. FLEET alum Babar Shabbir (Monash) led this study with the ARC Centre for Exciton Science, working alongside FLEET alum Hareem Khan and AI Michelle Spencer (RMIT). **Read more online**.

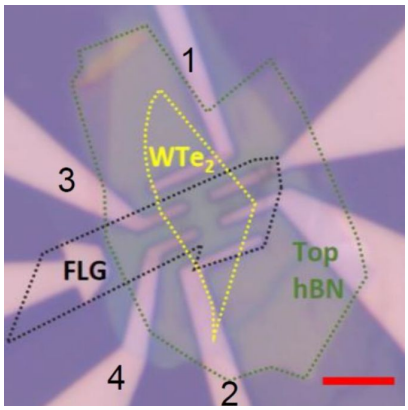
A UNSW-led team across three FLEET nodes has combined two traditional semiconductor doping methods to achieve new efficiencies in the topological insulator bismuth-selenide. With the study led by FLEET Research Fellow Dr Weiyao Zhao, the newly-proven strategy is viable for the growth of extremely high quality topological insulators with both magnetism and excellent electron mobility, vital for low-energy electronic devices. **Read more online**.

No more moving parts



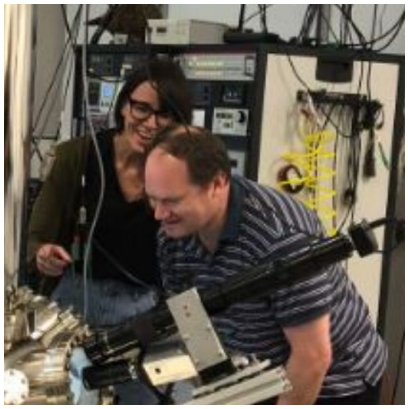
Liquid-metal machines could wipe out maintenance issues for continuous flow reactors. Metals that are liquid at room temperature (such as gallium and its alloys) can offer their unique electrical, thermal and fluidic properties to the pharmaceutical and chemical industries with the possible elimination of moving parts in continuous flow reactors providing improved performance and reduced maintenance costs. The study was led by Jialuo Han and Mohannad Mayyas at UNSW. **Read more online**.

Quantifying spin for future spintronics



Cheng Tan (RMIT) led a collaboration quantifying spin in a 2D quantum spin Hall insulator (QSHI), a promising option for future low-energy nano-electronic and spintronic devices, demonstrating both the value of anisotropic magnetoresistance (AMR) and the promising potential of QSHI for novel spintronic devices. **Read more online**.

Welcome new PI Simon Granville



A welcome to FLEET's long-time collaborator Simon Granville, who this month joined the Centre as a new Partner Investigator. Simon is a Principal Investigator at FLEET's NZ partner organisation MacDiarmid, where he leads the Institute's Future Computing project to control electron transport and spin through superconductivity and topology. **Read more online**.

Congratulations

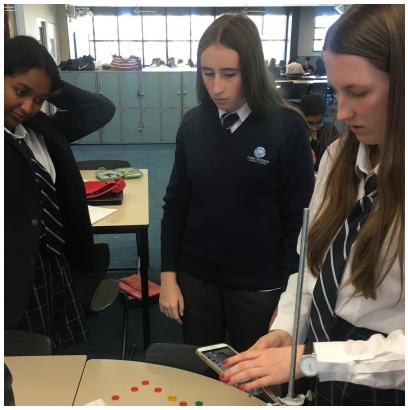
FLEET Chief Investigator Prof Kourosh Kalantar-zadeh has been named in the top 1% by citations in his field (cross field) for the fourth year running. **Read more**.

announced.

And also to UOW's Zengji Yue who had been appointed an Associate Investigator within FLEET.

And finally to FLEET Al Zhi Li (UOW), who has been promoted to Senior Research Fellow at the university.

FLEET unit encourages girls/students to consider physics



Surveying and student interviews confirms success of the ongoing FLEET–JMSS future-computing unit in encouraging girls/other students to consider a future in physics. In addition to students finding the unit interesting and enjoyable, the unit revealed a breadth and depth to the discipline of physics that students were previously unaware of, and meeting FLEET researchers made physics real, palpable and inclusive for students, who got immense value from researchers' raw, unfiltered stories about their research and its application to real-world problems. **Read more online**.

Help us improve Centre diversity

With a deadline this Friday, we'd appreciate your help to share advertising for **FLEET's Diversity and Women in FLEET fellowships**, encouraging applications from all underrepresented groups in Australian STEM. **Click and share FLEET's LinkedIn post**.

Multiferroics conference this month

Around 150 researchers from across the Asia-Pacific region joined FLEET this month for the **12th APTC Workshop on Multiferroics**, hosting 27 talks and a dozen posters covering materials exhibiting more than one type of built-in order (eg, magnetism and ferroelectricity). Thanks to FLEET CI Jan Seidel (UNSW) for co-hosting and Cecilia Bloise for coordinating support.

Congratulations to FLEET ECR authors this month

Congratulations to the following FLEET students and ECRs who are the first, second or third author in our **most recent publications**: Haydn Adlong, Weizhe Liu, Pankaj Bhalla, Maciej Pieczarka, Andrew Goszek, Mohannad Mayyas, Pankaj Sharma, Eliezer Estrecho, Cheng Tan and Bao-Yue Zhang.

Semiconductor industry news

The new IEEE roadmap (IRDS) was released this month, with the updated **Beyond CMOS chapter** outlining progress and plans in new memory technologies based on ferroelectric materials, topological transistors (**newly added to the roadmap last year**), excitonic systems (such as studied in FLEET's research theme 2), domain-wall logic, and neuromorphic computing. The **More than Moore chapter** includes energy harvesting technologies (piezoelectric, thermoelectric) and novel memory systems.

Quantum in the news

The Australian government announced $111m investment this month to support commercialisation, adoption and use of quantum technologies, including $70m for a new Quantum Commercialisation Hub to include industry stakeholders and experts, led by Chief Scientist (and previous FLEET Advisory Committee member) Dr Cathy Foley.

In addition a new partnership between the US and Australia will encourage exchange of quantum knowledge and skill between the two research communities.

Trans-pacific CM/cold-atoms talks in 2020

Meanwhile, FLEET continues to maintain US-Australian physics connections, with the ongoing trans-pacific talks on condensed matter and cold-atom physics. The first talks in 2022 are already confirmed and will cover quantum matter at UC Berkley, low-dimensional correlated materials at U. Illinois, strongly-correlated many-body systems at Minnesota, and controlled quantum systems at Colorado. **See the updated list of 2022 talks online**.

Or, catch up on past talks

- David Snoke (Pittsburgh) **Superfluids of light**

- Susan Coppersmith (FLEET UNSW) **Quantum stochastic resonance**
- Mykhailo Klymenko (Exciton Science RMIT) **Optical response of 2D semiconductors**
- Francesca Iacopi (TMOS/FLEET UTS) **Wafer-scale graphene synthesis**

Lots of FLEET physics at the AIP summer meeting

Registrations are still open for the Australian Institute of Physics Summer Meeting (next week, 6–9 December) at QUT in Brisbane, with parallel online delivery for those of us south of the wall. The summer meeting will see plenary and keynote talks by FLEET's Michael Fuhrer, Dimi Culcer and Kirrily Rule, as well as many other Centre speakers. FLEET is sponsoring this year's poster session. **Details online**.

Conferences in 2022

Abstracts are being accepted now for the Quantum Australia 2022 conference and careers fair in February 2022, bringing together world-leading quantum researchers, businesses, government decision-makers, start-ups, and big tech. For information about presenters, networking, posters and the careers fair (entry is free for students) **see the website**. FLEET is co-sponsoring the event.

Also in February will be the welcome return of the **Condensed-Matter and Materials Meeting, Wagga 2022** (in Wagga, NSW). **See details online**.

Other grants and opportunities

For outreach/development opportunities see **In2science** mentoring, and **CSIRO STEM Professionals in Schools**.

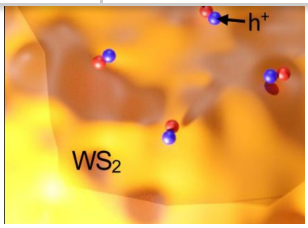
Know anyone interested in an **industry internship**? See active positions at **APR Interns**.

- Applications for **FLEET's PhD writeup scholarships** are accepted monthly.
- **Women in FLEET Scholarships** are open to students who identify as female and are accepted into an Honours or PhD program to work with any one of FLEET's investigators. Considered twice a year in June and November. Submit applications anytime.
- Keep an eye on the **FLEET grants page** for multiple ongoing opportunities.

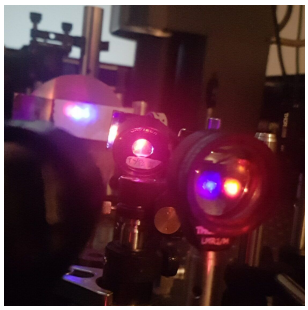
Previous news

New physics prize honours Shaun Johnstone A new Monash award honours the memory of FLEET's Shaun Johnstone, who passed away in December 2019. The Shaun Johnstone Prize will be awarded for the best paper written by a PhD student in experimental physics or astronomy published in the past year. **Read more**.

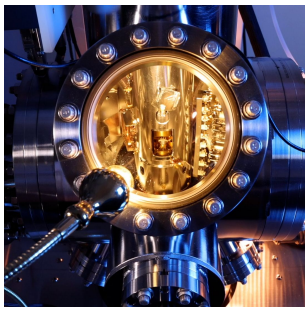
Sandwich-style construction allows step toward exciton electronics A new 'sandwich-style' fabrication process by ANU-Swinburne has enabled an exciton-polariton breakthrough, coupling excitons in 2D material to



step towards ultra-low energy electronics based on light-matter hybrid particles, exciton-polaritons. **Read more**.



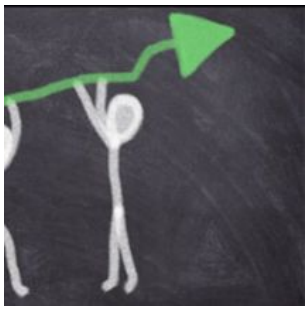
Illuminating the path to topological electronics with ultra-short bursts of light Ultra-short or infinitely long: it all looks the same. FLEET researchers at Swinburne and ANU show that ultra-short pulses of light (34 femtoseconds) elicit the same response as continuous illumination. The experiment harnessed interactions between real and virtual states to 'switch' the electronic state of atomically-thin (2D) WS_2, aiding the search for future low-energy electronics based on exotic topological materials. **Read more**.



Stress can be good for you: enhancing piezoelectric properties under pressure Enhancing piezoelectric properties under pressure at UNSW with Daniel Sando and Oliver Paull discovering a new exotic state of a room-temperature multiferroic, with exciting implications for future technology. **Read more**.

Ask a Physicist **FLEET's new "Ask the physicists" page** encourages schoolkids, parents and others to ask their hardest, most-baffling questions and we'll answer them (or, we'll find a FLEET member who can).

PhDs submitted, new roles Congratulations to a trio of FLEET PhD students who submitted their PhDs last month, the culmination of many years hard work. Congratulations to: Muhammad Nadeem (UOW), Yonatan Ashlea Alava (UNSW) and Tatek Lemma (Swinburne). And congratulations to Dhaneesh Kumar (Monash) for his postdoc role at the Max Planck Institute for Solid State Research in Stuttgart, Germany, and Vivasha Govinden (UNSW) for her postdoc role at the Oak Ridge National Lab in Arkansas, US.



Future leaders FLEET is developing the next generation of science leaders, and fostering equity and diversity in STEM, with career and leadership support for women in FLEET working towards achieving both of these goals. Four FLEET women secured scholarships for the 2022 Leading Edge program. Congratulations to Abigail Goff (RMIT), Maedehsadat Mousavi (UNSW), Nicci Coad (RMIT) and Tenille Ibbotson (Ops Team). **Read more online**.

Participating organisations

FLEET is The Australian Research Council Centre of Excellence in Future Low-Energy Electronics Technologies. Read more about our **participating nodes** and **partners** online.

MONASH University | UNSW Sydney | Australian National University | RMIT University | Swinburne University of Technology | University of Wollongong Australia | The University of Queensland


Australian Government
Australian Research Council