



FLEET

ARC CENTRE OF EXCELLENCE IN
FUTURE LOW-ENERGY
ELECTRONICS TECHNOLOGIES

FLEET News: December 2021

We've come to the end of another tumultuous year. I am sure everyone is as exhausted as I am. But it is good to take a moment to reflect on all we've accomplished.

Together we've built a strong collaborative team, and a great place to do science. FLEET truly shone during the 2021 mid-term review, impressing the panel and the ARC. The quantity and quality of science on display at the annual workshop amazed me. FLEET's success allows us to do more, but it also enriches us all, broadening our horizons and boosting our capabilities for the rest of our careers.



Four years in now, I've now seen students who started their studies in FLEET submit their theses and graduate, and postdocs land their first permanent positions. It's bittersweet to see FLEET members moving on, but I am glad we've made their experiences better. I hope they'll take a bit of FLEET with them when they leave, and make the place they *go* better as well. (And to any alums reading this, we'd love to hear from you!)

Lastly, as much as we'd like it to be, the pandemic isn't over, and once again the future looks uncertain. Don't forget that we have many of the tools to stay safe in our own hands. Consider reducing social interactions when you can, meeting outdoors when you can, wearing a mask when you're around other people, especially over the next few weeks, which look to be critical.

Stay safe, have a relaxing holiday break, and best wishes for next year!

Michael Fuhrer
Director, FLEET

In this edition:

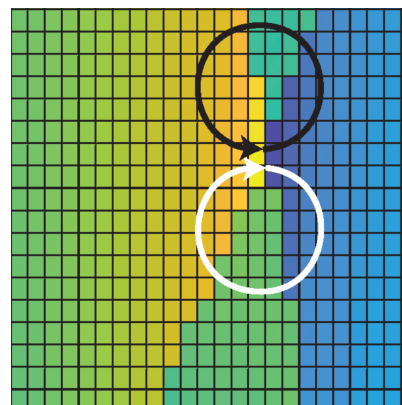
- **FLEET2021**
- **Generating topology from loss** (ANU)
- **Negative capacitance in topological transistors** (Monash, UOW, UNSW, RMIT)
- **Ultracold quantum review** (Swinburne)
- **New translation program at FLEET**
- **Congratulations Bao Yue Zhang** (RMIT)
- **Congratulations to our ECR authors**
- **FLEET physics at AIP summer meeting**
- **Have your say on Australia's research roadmap**
- **Semiconductors and xmas**
- **2022 conferences and other opportunities**

FLEET held our cut-back end-of year meeting this week, with 136 attendees over the three days, 5 theme updates, 79 posters and 21 awards (see the list of recipients online). The physical catch-ups at Sydney and Melbourne were also a welcome chance for some to reconnect face-to-face. [More details and images online.](#)



Generating topology from loss

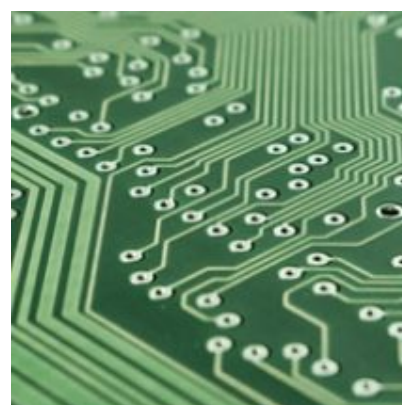
Losses—eg friction/electrical resistance—are generally detrimental. For example electrical resistance causes heat, limits efficiency. But a study led by Eliezer Estrecho (ANU) with Rui Su (NTU Singapore) shows that non-Hermitian physics can lead to striking effects, with novel topology arising from losses in hybrid exciton-polaritons introducing a new avenue to topology. [Read the article online.](#)



Negative capacitance reduces loss in topological electronics

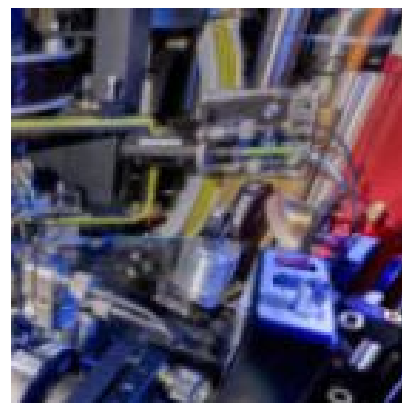
Negative-capacitance ferroelectrics could lower the switching energy of future topological electronics. A FLEET study spanning Monash, UNSW, RMIT and UOW shows that using a ferroelectric material to act as a negative capacitor can make topological transistors switch at lower voltage, potentially reducing energy losses by a factor of ten or more, with the results revealed this week at the IEEE International Electron Devices Meeting in San Francisco.

[Read the article \(and watch Michael's presentation\) online.](#)



Ultracold quantum review

December's edition of *Nature Physics* is dedicated to ultracold quantum technologies, including a review of spectroscopic probes of quantum gases by FLEET's Chris Vale (Swinburne), with Martin Zwierlein (MIT). Ultracold gases are a laboratory for precision, many-body physics – delivering a wealth of insights into collective quantum phenomena, with direct implications for nuclear and condensed-matter physics. [Read the article online.](#)



FLEET's new translation program to help accelerate members' research towards wider impact

A new FLEET program, with expert advice, resources and industry connections aims to develop Centre research into prototypes and technical demonstrations, helping translate FLEET

Program Manager Dr Michael Harvey (right) explained at this week's workshop how the new program will guide FLEET members through the process of identifying promising projects for translation to industry, and shepherding them through the process of establishing linkages. See [FLEET.org.au/translation](https://fleet.org.au/translation) for more.



Congratulations Bao Yue

Congratulations to FLEET Research Fellow Bao Yue Zhang, who received the prestigious 2021 RMIT Vice-Chancellor's Prize for Research Excellence-HDR, recognised for outstanding research and contributions to novel sensing materials and applications in early cancer diagnosis.



Congratulations to our 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**: Jiong Yang, Matt Reeves, Mohannad Mayyas, Oliver Stockdale and Yifang Wang.



A feast of FLEET physics at the AIP summer meeting

A feast of FLEET physics was on show at the Australian Institute of Physics Summer Meeting this month, held at QUT in Brisbane with parallel online delivery. As well as plenary and keynote talks by FLEET's Michael Fuhrer, Dimi Culcer and Kirrily Rule, a total of 36 FLEET members presented talks and posters. FLEET sponsored the meeting's poster session. **See the full list of FLEET speakers online.** Congratulations to Karen Bayros (RMIT University) who won best poster (online) for 'Modelling Josephson effects in superconducting nanoscale devices'.



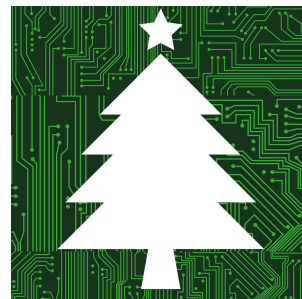
Have your say on Australia's research roadmap

After significant input from the Australian research community over the year, the **draft 2021 National Research Infrastructure Roadmap** is now available for review and feedback, with targeted questions. The Exposure Draft will be open for feedback until 5pm 22 December.



Semiconductors changing the nature of Xmas

How technology has changed Christmas, celebrations, and human communication: from personal, hand-crafted Christmas cards to telegrams to mass-mailed ecards, online shopping and video messaging. Wishing you #happyholidays @yournamehere. [Read more online.](#)



Quantum Australia 2022

Quantum Australia Conference and Careers Fair 2022 Feb 23-25 will bring together world-leading quantum researchers, businesses, government decision-makers, start-ups, and big tech. FLEET is co-sponsoring the event.



Wagga 2022

Also coming in February will be the welcome return of the **Condensed-Matter and Materials Meeting, Wagga 2022** (in Wagga, NSW). [See details online.](#) Today is the deadline for abstracts and registration payments.

FLEET is sponsoring child-care bursaries at Wagga 2022 to assist attendees with carer responsibilities needing additional child care, including either bringing an additional family member to Wagga to help care for the kids, or additional before/after school care during the conference.

Catch up on past talks

- Michael Fuhrer (FLEET Monash) **Negative capacitance in topological transistors**
- David Snoko (Pittsburgh) **Superfluids of light**
- Michael Fuhrer (FLEET Monash) **Topological transistors**
- Ceri Brenner (ANSTO) **ANSTO-FLEET seminar on accelerator science**
- Susan Coppersmith (FLEET UNSW) **Quantum stochastic resonance**

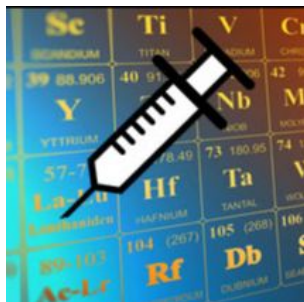
Grants and opportunities

For outreach/development opportunities see **In2science** mentoring, and **CSIRO STEM Professionals in Schools**. Also see active **industry internship** positions at **APR Interns**.

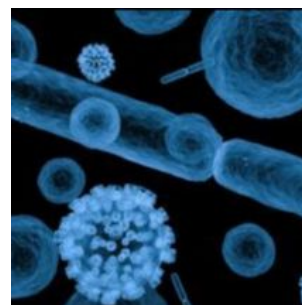
- **Women in FLEET Scholarships** are open to students who identify as female and are accepted into an Honours or PhD program to work with any one of FLEET's investigators. Considered twice a year in June and November. Submit applications anytime.

Previous news

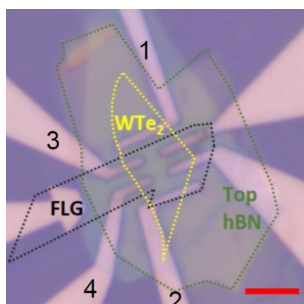
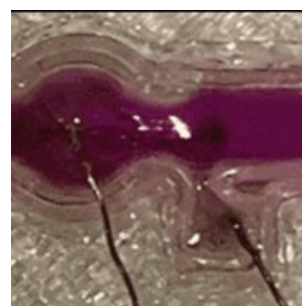
World record: thinnest X-ray detector A highly sensitive and responsive new X-ray detector is less than 10 nanometres thick and could potentially lead to real-time imaging of cellular biology. [Read more online.](#)



Double dosing does the trick A UOW-led team across three FLEET nodes combined two traditional semiconductor doping methods to achieve new efficiencies in the topological insulator bismuth-selenide. 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.](#)

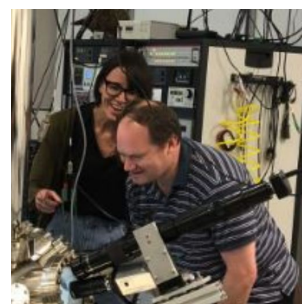


No more moving parts Liquid-metal machines could wipe out maintenance issues for continuous flow reactors. Metals that are liquid at room temperature (such as gallium and its alloys) can offer their unique electrical, thermal and fluidic properties to the pharmaceutical and chemical industries with the possible elimination of moving parts in continuous flow reactors providing improved performance and reduced maintenance costs. [Read more online.](#)



Quantifying spin for future spintronics A FLEET collaboration has quantified 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 FLEET's long-time collaborator Simon Granville joins 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.](#)



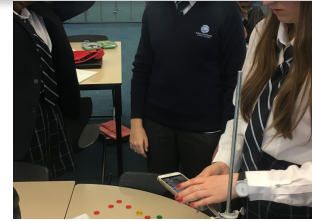
FLEET Chief Investigator Prof Kourosh

Kalantar-zadeh was been named in the top 1% by citations in his field (cross field) for the fourth year running. [Read more.](#) **Congratulations to FLEET AI Torben Daeneke**, whose appointment to Associate Professor at RMIT has just been announced. **And also to UOW's Zengji Yue** who had been appointed an Associate Investigator within

FLEET. **And finally to FLEET AI 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

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.](#)



Multiferroics conference Around 150 researchers from across the Asia-Pacific region joined FLEET last 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).



Semiconductor industry news **The new IEEE roadmap** (IRDS) was released last 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.

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 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.](#)



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.



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