



FLEET

ARC CENTRE OF EXCELLENCE IN
FUTURE LOW-ENERGY
ELECTRONICS TECHNOLOGIES

FLEET News

Welcome to FLEET News. This month we bring a selection of research news from around the Centre – much of it pre-dating the official start date, proving that great science does not wait for ink to dry.

There's also a wrap-up of open day events, outreach past and future, and awards and recognition for FLEET researchers.



Last week I was privileged to present FLEET's mission to a delegation of parliamentarians at Parliament House. It was great to have the opportunity to inform our legislators about the growing use of energy in information technology, and the need for basic science to find new, low-energy technologies to extend the information revolution. I look forward to future opportunities, when I will tell them about our scientific breakthroughs!

The first FLEET Conference is fast approaching, and hopefully you have registered and confirmed accommodation by now, which will help us plan logistics and manage our relationship with the conference venue. I'm looking forward to seeing you all there.

Regards,

Michael Fuhrer

Director

ARC Centre of Excellence in Future Low-Energy Electronics Technologies

FLEET in the news

The annual 'nano' edition of the Australian Manufacturing Tech magazine included a brief introduction to FLEET's nano-scale activities at RMIT, Wollongong, Monash and UNSW, and highlighted our partnership with the ANFF.



Director Michael Fuhrer was interviewed on science show Einstein-a-gogo, discussing global computing energy use, the imminent demise of Moore's Law, and FLEET's search for ultra-low energy electronics. If you missed it, [listen here](#).

Showcasing FLEET at open days

University open days provided an opportunity to present FLEET to the public, road-testing some of our messaging regarding energy use in computing, how traditional transistors function, and the search for dissipationless alternatives.

Swinburne University of Technology was the first cab off the rank, with FLEET CIs Chris Vale and Jeff Davis leading tours of the ultra-fast spectroscopy and ultra-cold atomic gas labs.

Monash University followed, with hands-on demonstrations of traditional and topological transistors, lab tours and a talk by Michael Fuhrer. **RMIT** node leader Kourosch Kalantar-Zadeh hosted a FLEET demonstration including hands-on study of 2D materials under microscope. **ANU** put new FLEET PhD Maryam Boozarjmehr on the Van de Graaff generator and **UNSW** had FLEET demonstrations in both Material Science & Engineering and Physics tents.

The challenge

The big challenge that FLEET is addressing is the increasing energy load of computation, which is currently at least 5% of world electricity use, and doubling each decade.

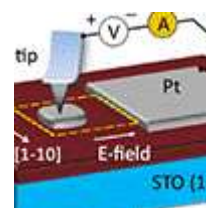
To date, the amount of energy being burned by computing has been kept in check by a phenomenon known as **Moore's Law**, whereby the number of chips in a given area doubles every two years. But we are fast approaching a limit for Moore's Law.



Current computing is based on semiconductor chips that each burn a tiny, tiny amount of power as they 'switch'. FLEET will develop switches that will burn almost zero energy, operating at room temperature.

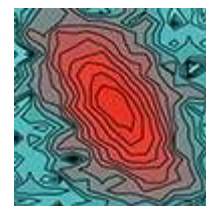
Papers and results from around the Centre

A UNSW study is a step towards **domain-wall electronics**, based on nano-scale, 'disappearing' topological conduction paths that could allow for extremely dense memory storage, with domain walls precisely reconfigured by a controlling voltage.



A UNSW investigation of relationships between **spin-orbit interactions in gallium arsenide quantum point contacts** detected the signatures of two known forms of spin-orbit interaction, and controlled their interplay by changing the orientation of the substrate.

While semiconductor spintronics promise lower switching energy and faster speed, a major limitation on their development is the lack of **room temperature ferromagnetic semiconductor materials**. A University of Wollongong collaboration lowers a barrier to such practical spintronic devices operating at room temperature.



Ultra-low resistance semiconductor junctions studied at Monash University have revealed a more favourable band alignment for the junction than previously assumed, offering great potential as contacts for future thin-film transistors.

FLEET's UNSW researchers studied **spin-orbit interaction at the two-dimensional interface** between common semiconductor materials, developing a new semi-analytical method for analysis, and finding agreement with experimental results.

Recognition

The significant experimental achievements of **Xiaolin Wang** (Australian Institute for Innovative Materials at the University of Wollongong) were recognised with the University's **Vice Chancellor Award for Researcher of the Year**.

Kourosh Kalantar-zadeh's ingestible smart pill, which could revolutionise prevention and diagnosis of gut disorders/disease, was **recognised by the prestigious 2017 IEEE Sensors Council achievement award** in the field of sensors. The pill's physisorptive sensors are based on atomically-thin, two-dimensional materials.

FLEET research was highlighted at an **important light-matter conference in Würzburg, Germany**, with **Eli Esteicho** from Elena Ostrovskaya's group at ANU winning best poster presentation **and David Colas** from Matt Davis' group at UQ winning 3rd prize for poster presentation.

Outreach

As well as talks, demonstrations and lab tours conducted as part of university open days, FLEET sponsored recent **Girls in Physics breakfasts** with the Australian Institute of Physics, and the **battle of the brains** during National Science Week.

Coming up: in November we are very lucky to be hosting **Nobel Laureate Wolfgang Ketterle**, who will be presenting a public talk at Swinburne University of Technology on 30 November. We'd love to see FLEET folk there, and would appreciate your help in sharing [the event](#).



The ARC requires each FLEET member to contribute **20 hours of outreach this year**. A multitude of options should make this easy to achieve, including presenting to schools, running lab tours, or helping develop education resources. See [the intranet for ideas](#), or contact FLEET outreach coordinator [Dianne Ruka](#).

We'll cover 'FLEET Geeks' and other outreach activities in the next edition of this newsletter. Until then, check out [#homescience experiments](#) on FLEET's Twitter feed for inspiration (read more [here](#)).

Nano travel

The [Australian Nanotechnology Network \(ANN\)](#) offers funding for members to travel to Australian National Fabrication Facility (ANFF) nodes – up to \$1000 in travel and accommodation. Open for postgraduate nanotech students and ECRs currently studying/working in Australia who are members of ANN, with support from their supervisor and ANFF node manager.

Eight ANFF nodes across 19 Australian universities house open-access tools and expertise for researchers.

Helping to share FLEET news

If you're on [Facebook](#), [Twitter](#) or [Linkedin](#), we would love it if you followed our accounts and shared our posts, particularly with other colleagues in the field. If a friend or colleague might be interested in our news, [click here to send them an invite](#). Or let us know and we'll invite them.

If you have been forwarded this email, you can subscribe to future editions by [clicking here](#).

Participating organisations

FLEET's 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.



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