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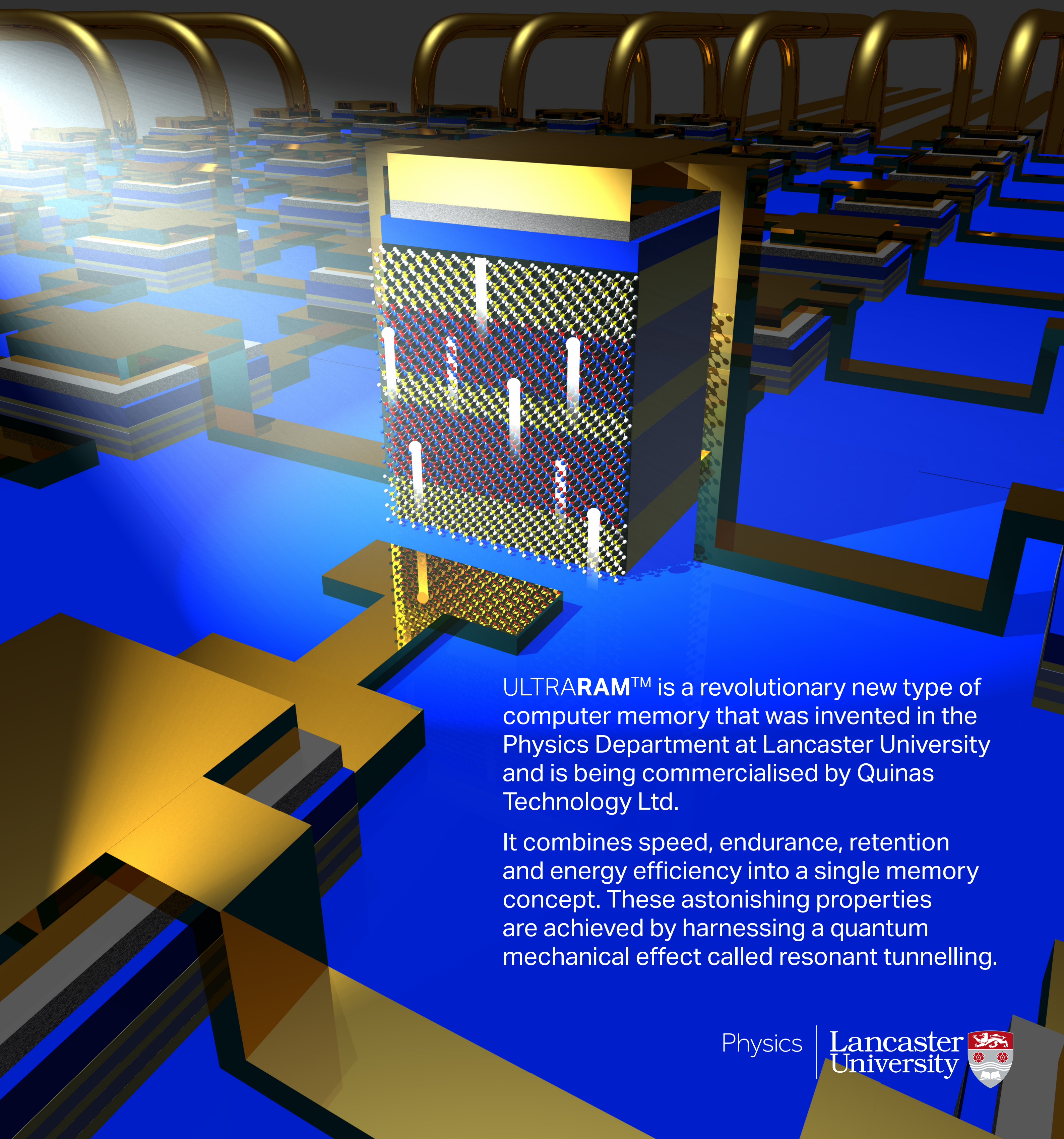
Technology

ULTRA**RAM**™

ULTRA-EFFICIENT MEMORY

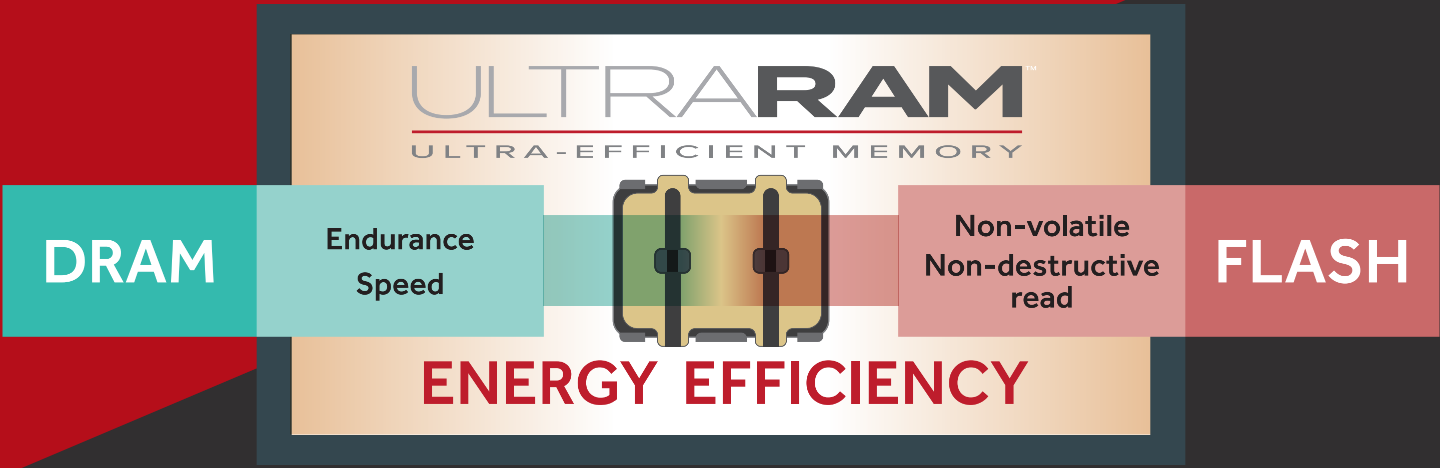


ULTRA**RAM**™ is a revolutionary new type of computer memory that was invented in the Physics Department at Lancaster University and is being commercialised by Quinas Technology Ltd.

It combines speed, endurance, retention and energy efficiency into a single memory concept. These astonishing properties are achieved by harnessing a quantum mechanical effect called resonant tunnelling.

Physics | Lancaster University

Just two complimentary types of memory, **DRAM** and **flash**, represent more than 95% of the >$100bn per year memory market.



DRAM and flash are ubiquitous in digital electronics and computing from internet of things (IoT) devices, through to consumer electronics and appliances, smartphones, personal computers and data centres.

The inherent properties of DRAM (dynamic random access memory) and flash allows them to excel in specific roles, but makes them unsuitable for others. DRAM is fast and can be rewritten almost endlessly (high endurance) so is used as active or working memory, whereas flash is slow and cheap and used for storage.

The conventional view is that these complementary roles are unavoidable, since data that is stored very robustly (non-volatile, like flash) must be difficult to change, while data in a fast memory (like DRAM) that is easily changed has to be somewhat fragile (volatile).

ULTRA**RAM**™ combines the advantageous properties of these two memory types into a single, energy-efficient package, without any of the drawbacks. A major benefit of replacing existing memories with ULTRA**RAM**™ is the reduction in energy consumption. Data centres already consume more electricity then Belgium and The Netherlands combined, and this is only expected to increase, potentially reaching 20% of global electricity by 2030.

A significant amount of this energy is consumed by memories – either in retaining data in active memory, or moving it between active memory and storage. ULTRA**RAM**™'s combination of non-volatility, speed and high efficiency could greatly reduce IT energy consumption, helping to achieve net-zero carbon emissions.

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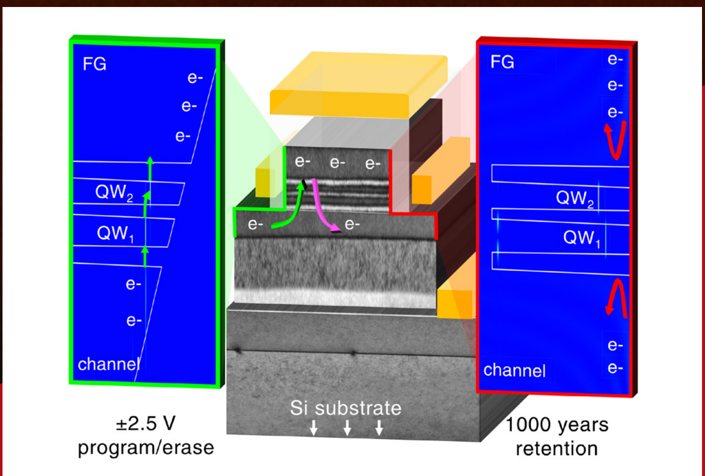
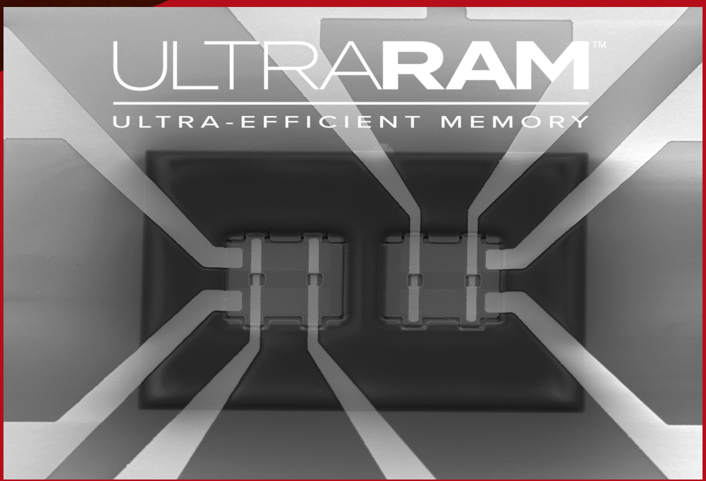
How does it work?

ULTRA**RAM**™ is a charge-based memory that stores data by moving electrons into or out of a so-called 'floating gate'. The charge state of the floating gate is read non-destructively by measuring the conductance of an underlying 'channel'. The final component of the memory is the barrier that acts like a 'lock' to retain electrons in the floating gate during data retention. The barrier is unlocked to allow charge to flow when the memory is being written or erased. In ULTRA**RAM**™, a triple-barrier resonant-tunneling (TBRT) structure is the revolutionary component that give it its remarkable properties.

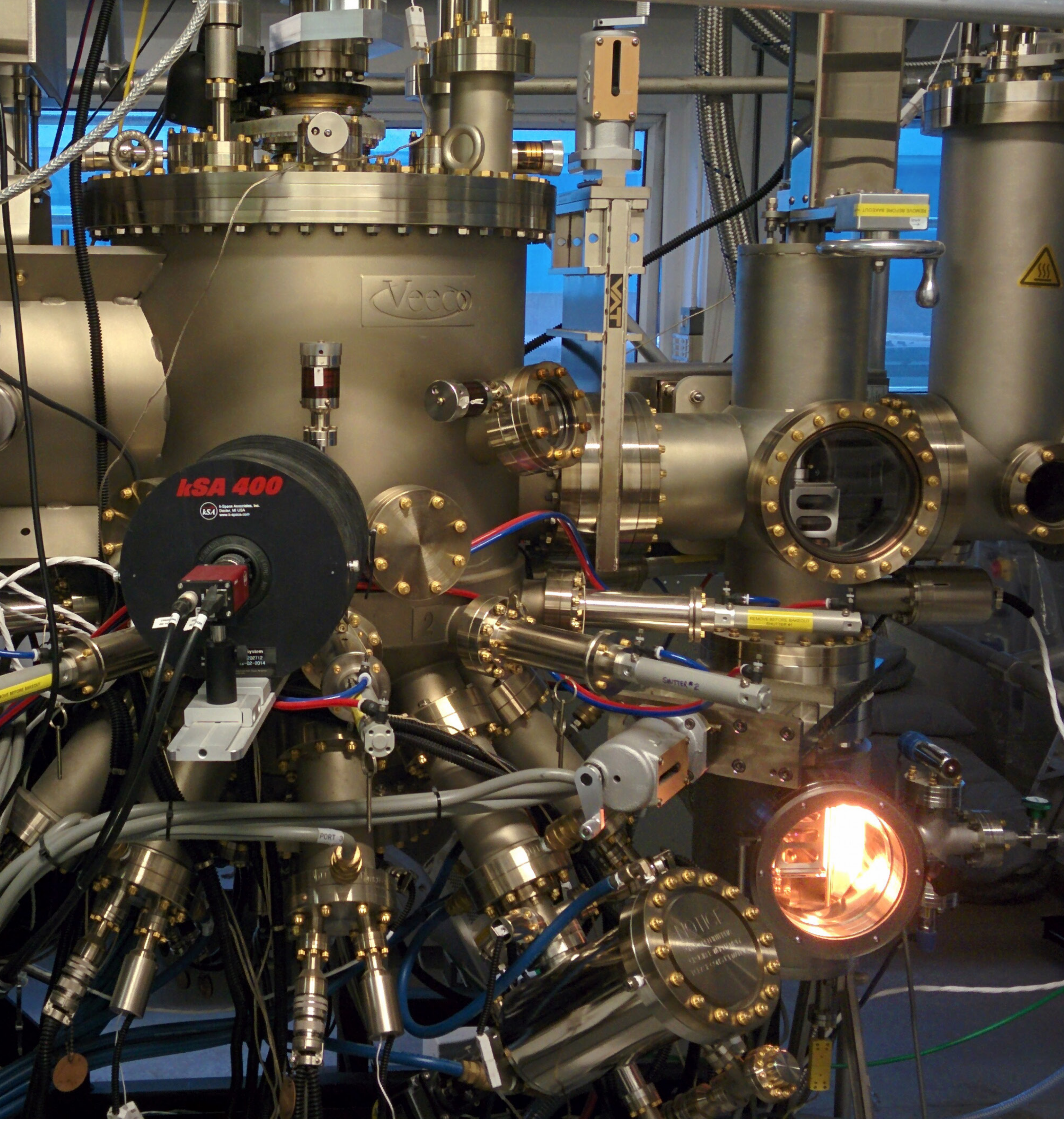
Normally, the TBRT is highly resistive (locked), allowing data to be stored in the memory for over 1,000 years. However, when a small voltage of just ~2.5 V is applied to the device, the barrier is unlocked and electrons can rapidly pass through it. This process occurs by a quantum mechanical phenomenon called resonant tunnelling, and it allows the logic state of the memory to be switched extremely quickly and with very little energy.

The active layers in ULTRA**RAM**™ are made up of compound semiconductors GaSb, InAs and AlSb deposited by a technique called molecular beam epitaxy; in the TBRT they are just a few atomic layers thick! Devices (chips) are then fabricated in Lancaster University's Quantum Technology Centre cleanroom.





Transmission electron microscopy images courtesy of University or Warwick.



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Website: **quinas.tech**

Contact us for further information: **info@quinas.tech**

QUANTIMONY Quantum Semiconductor Technologies exploiting Antimony | ATTRACT | UKRI Engineering and Physical Sciences Research Council | CS Hub | ICURe | UKRI Innovate UK

This work was and is supported by the EPSRC, UK, via the Innovate UK ICURe Explore and Exploit research accelerator programs, the 2017-2020 IAA funding allocation to Lancaster University under grant EP/R511560/1, a scholarship under grant EP/N509504/1, equipment funding under grant EP/T023260/1 and the Future Compound Semiconductor Manufacturing Hub grant EP/P006973/1, and by the European Commission via ATTRACT projects funded under grant agreements 777222 and 101004462 and MSCA-ITN QUANTIMONY under grant agreement 956548.