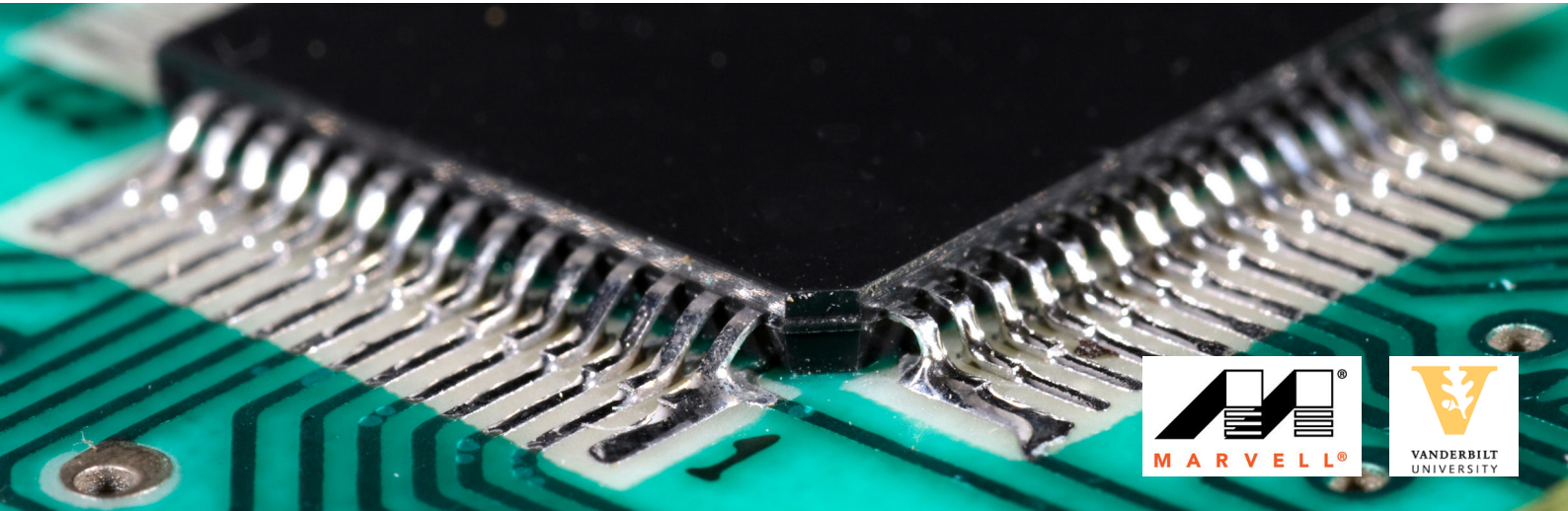


Using muons to simulate damage to microelectronics



Science & Technology
Facilities Council



Vanderbilt University and Marvell Semiconductor have teamed up to investigate the effects of cosmic rays on our modern digital world. They've used the RIKEN-RAL muon facility at STFC's ISIS neutron and muon facility to further their investigation.

The challenge

The microelectronics industry is on the verge of an architectural shift as devices steadily become smaller and smaller in size. The problems however associated with this achievement come in the form of single event upsets (SEUs), which occur when high energy particles such as neutrons and muons hit microelectronics with the potential to cause them to malfunction. Currently, one of the most frequent sources of failure in these components results from cosmic rays in the Earth's atmosphere producing an abundance of neutrons which can bombard microelectronics leading to SEUs. Unfortunately as devices continue to advance, becoming more complex and smaller than 20nm in size they become more susceptible to attack from neutrons and smaller particles such as muons, increasing the risk of failure. Indeed, Ziegler predicted that a watershed event in microelectronic reliability would occur when devices become sensitive to muons.

The solution

Through collaboration with STFC, Vanderbilt University; RIKEN in Japan; Texas Instruments; Cisco and Marvell Semiconductor in the US were able to access Port 4 at RIKEN-RAL muon facility at the ISIS research centre. Here they were able to expose commercially produced Static Random Access Memory (SRAMs) devices with 28 nm nodes to the muon beam. By recording the muon flux and the number of errors that occurred, the probability of muon-induced failures in different microelectronic devices could be calculated, as well as deducing how muons lead to this kind of failure.

The benefits

This project has enabled the organisations involved to understand the mechanisms of failure from a muon SEU, which will help to shape future design and fabrication of microelectronics, enabling manufacturers to develop devices that are less susceptible to muon SEUs. This is the first time this kind of experiment has been attempted at ISIS and is of huge interest to the semiconductor industry. Being able to understand how cosmic rays can interfere with the function of small electronics is of vital importance to numerous manufacturers and will shape the appearance and design of the future digital world.

Work with us

The Science and Technology Facilities Council (STFC) keeps the UK at the forefront of international science and tackles some of the most significant challenges facing society and industry.

We collaborate with industry, the research community and government to develop business opportunities arising from our world-leading science and technology.

With our facilities, capabilities and expertise, we are perfectly placed to solve your high-tech innovation challenges and enhance your competitiveness - whether you are an established global corporation or an entrepreneur with a great business idea.

For more information about how your business could benefit from access to ISIS:

Tel: +44 (0)1925 603708

Email: innovations@stfc.ac.uk

Twitter: [@STFC_B2B](https://twitter.com/STFC_B2B)