UNIVERSITY OF THE WEST of SCOTLAND

UWS

Supporting Scotland's Energy Transition Journey

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World-leading energy research and innovation

University of the West of Scotland has three centres of excellence that play a key role in tackling current and future global engineering and energy challenges:

Institute for Sustainable Engineering and Energy (ISEE)

ISEE tackles current and future global engineering and energy challenges, providing new knowledge, technology and practice needed for the sustainable and just development of engineering and energy generation and distribution.

Institute of Thin Films, Sensors and Imaging (ITFSI)

ITFSI specialises in thin films for a wide range of applications, including thin film energy harvesting devices, for energy systems and self-powered sensors and thin film-based energy storage devices based on supercapacitors.

Artificial Intelligence, Visual Communications and Networks (AVCN)

AVCN is a hub for cutting-edge research in the field of AI, IoT and Big Data, 5G Networks and visual communications, developing smart energy environments and grids through machine/deep learning, blockchain technology, cyber and network security, and intelligent decision support systems.

Artificial Intelligence, Visual Communications and Networks (AVCN) Research Institute

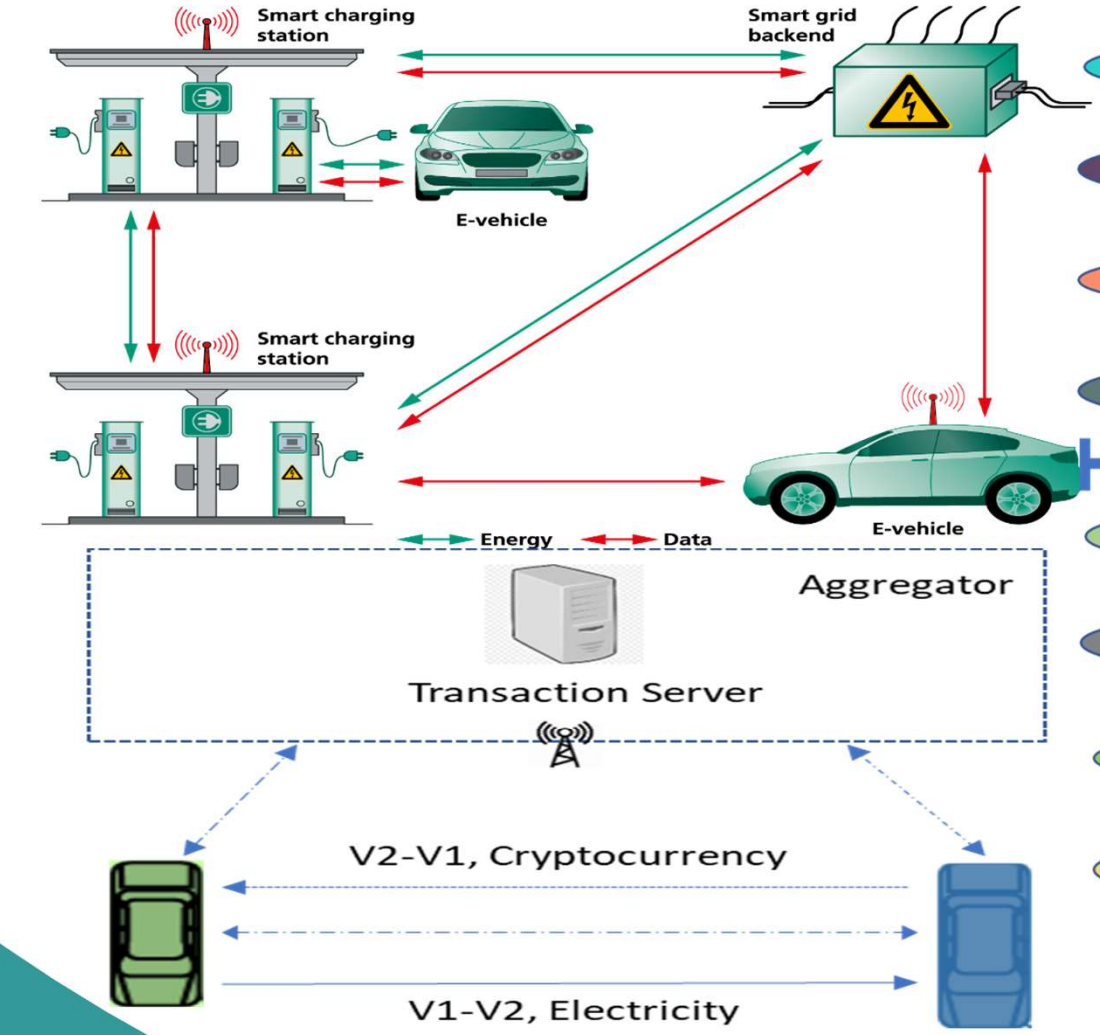
Main research areas

- AI for UN SDGs
- Wireless/mobile/5G/6G networking
- Cyber and network security
- Machine learning (ML) and intelligent decision support systems
- Big data and data analytics
- IoTs, sensor network, Cloud computing
- Blockchain technology
- Video and image compression and transmission
- Scheduling, optimization an logistics management
- Connected and remote health

Track record

- Over 700 peer reviewed publication (over 250 Publications in last 5 years with 10 best paper awards)
- Coordinator and partner in big externally funded research (total worth over £25m) projects

Blockchain for smart grid: Exploring applications in energy trading with electric vehicle in V2G Network



Decentralization	Transactions are identically recorded by the participating EVs
Immutability	Uploaded data are unmodifiable or unchangeable so that no one can intrude the system
Anonymity	Anonymous transactions. Users disguise identity (through the clever use of multiple addresses)
Transparency	Transactions are transparent. Participating EVs are aware of transactions happening
Traceability	Identify and trace the information related to the power being purchased and even the supplier's
Visibility	Implies insight into the data blocks making it available to participating EVs
Trust	Allows EVs in the network to be more confident of who is responsible for which activity
Automation	Event triggered automatically upon the occurrence of valid transactions

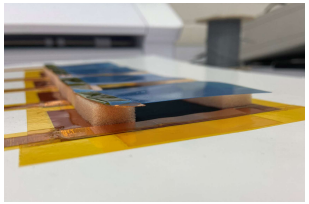
Institute of Thin Films, Sensors and Imaging (ITFSI)

TFSI
Institute of Thin Films, Sensors and Imaging

Centre of excellence and key laboratory in the UK for R&D of functional thin films and applications

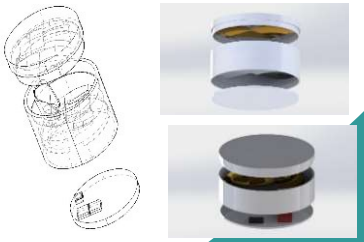
- **Thin film deposition processes**
  - Optical, engineering, bio-medical and MEMS applications

- **Energy Systems and Self-powered Sensors**
  - Development of energy harvesting devices
  - Fabrication of supercapacitors (SC) based on gel electrolytes

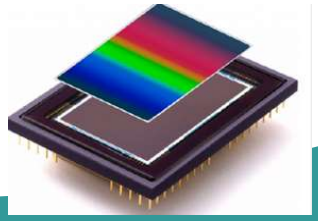


- **Sensors**
  - Miniaturised infrared spectrometry based on non-dispersive infrared or photo-acoustics

- **Imaging**
  - Ultrasonics based on high efficiency piezoelectric thin films. Applications include imaging (medical & dental) and non-destructive testing
  - Linear variable optical filters for multispectral/ hyperspectral imaging



- **Gravitational Wave (GW) Detection**
  - Deposition of ultralow loss optical thin films for use in GW laser interferometric detection



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Commercialisation of Thin Film Technologies

Two Company Spin Outs

Total funding - £6.3M

AlbaSense

- Hyperspectral Imaging Cameras
- LVF`s (visible, near infrared, mid infrared, long wave infrared)
- Miniaturised infrared spectrometers (multi & single gas sensors)
- Miniaturised visible spectrometers - spectral discrimination visible light
- Microwave plasma assisted sputtering processes

novosound

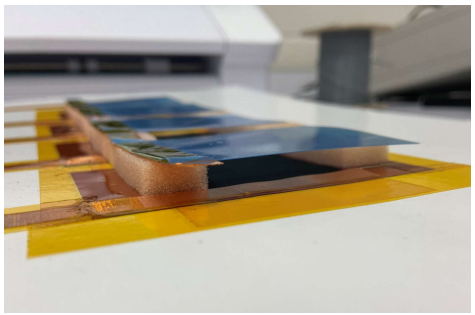
- Dental imaging
- Non-destructive testing
- Medical (vascular imaging – e.g., diabetic foot)

Five patents underpin spinout company activities

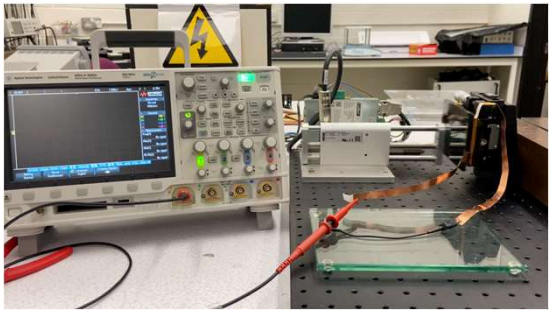
Energy Systems

1. Energy Harvesting Devices – *Triboelectric Nanogenerators (TENG)*

Material Engineering
High surface charge density and controlled electron affinity



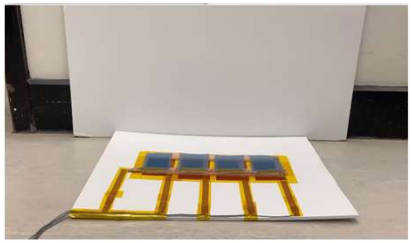
Fabrication
Portable devices for local harvesting of mechanical energy



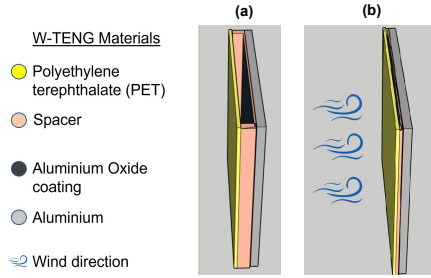
Characterisation
Output power, voltage and current

Posters @ All Energy (meet us at Innovation Zone: L82)

Emma Keel: Triboelectric nanogenerators: A new technology to harvest mechanical energy wasted in the environment.



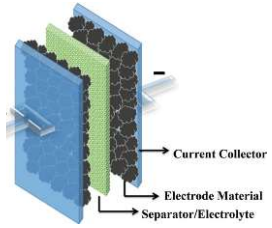
Michael Mckinlay: Wind triboelectric nanogenerator based on anti-corrosive metal oxide nanocoatings.



2. Energy Storing Devices

Gel Electrolyte Supercapacitors (SC)

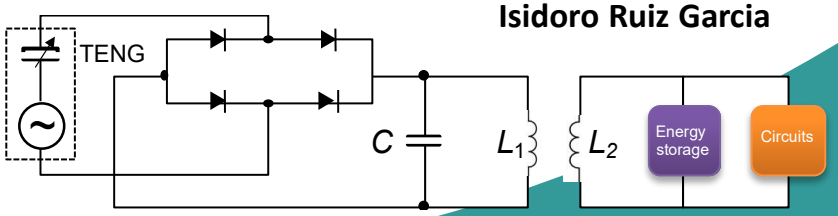
Dr Ammara Ejaz: High power density, i.e., store and release more short-term power.



3. Power management modules (PMM)

Converting voltage into current

Isidoro Ruiz Garcia



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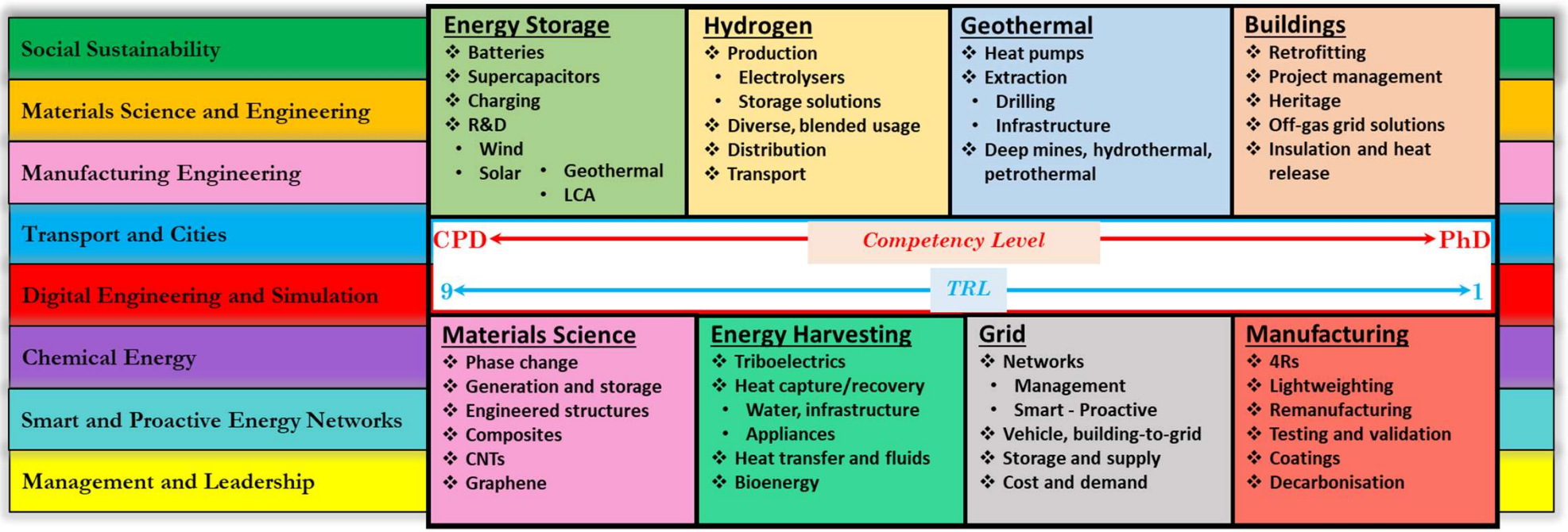
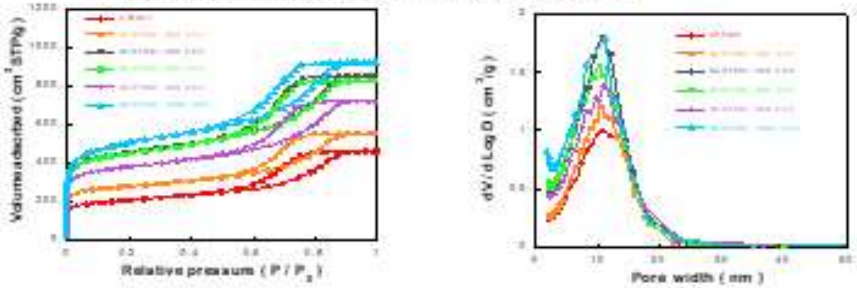
Institute for Sustainable Engineering and Energy (ISEE)



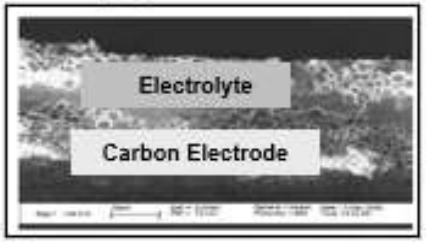
Improved Electrochemical Performance of Li/O_2 Battery Electrode Materials

PREPARATION OF POROUS AIR ELECTRODE

Control of Porosity of Carbons at Nano-Scale

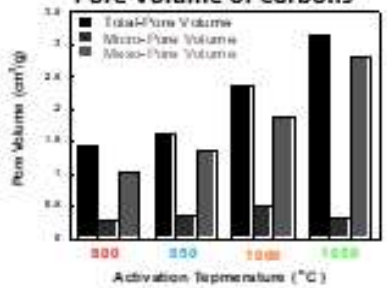


SEM Micrograph of the Cathode Electrode

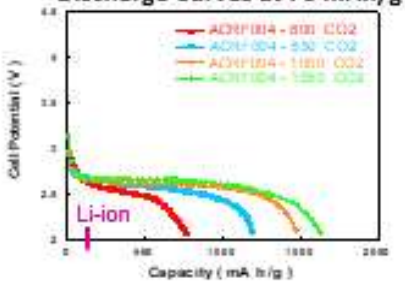


ELECTROCHEMICAL PERFORMANCE OF THE ELECTRODES

Pore Volume of Carbons



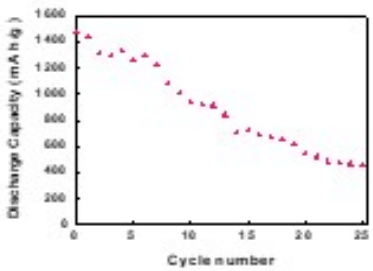
Discharge Curves at 70 mAh/g

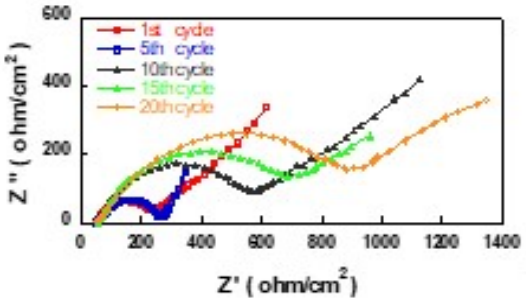


Discharge Capacities at 70 mAh/g

Sample	Cell Voltage (V)	Capacity (mA h / g)
ACRF004 – 800 CO2	2.60	773
ACRF004 – 850 CO2	2.64	1206
ACRF004 – 1000 CO2	1.68	1480
ACRF004 – 1050 CO2	2.70	1682

CYCLEABILITY OF THE ELECTRODES





core

UK Government

AYRSHIRE GROWTH DEAL

East Ayrshire Council
Comhairle Siorrachd Àir an Ear

CLEAN GREEN EAST AYRSHIRE

"The CoRE project will be a critical enabler to the future world, transforming energy production, distribution and storage within Ayrshire and beyond.

The Ayrshire region will become an exemplar for transitioning to a low carbon society by repurposing the area's existing assets (industrial/natural) to create energy self-sufficient communities.

The aspiration is to create equitable communities with a fair and just energy system that boosts their capability, economy and health and wellbeing.

The Cumnock area will be a vibrant place which is carbon neutral, successful and respects our environment."

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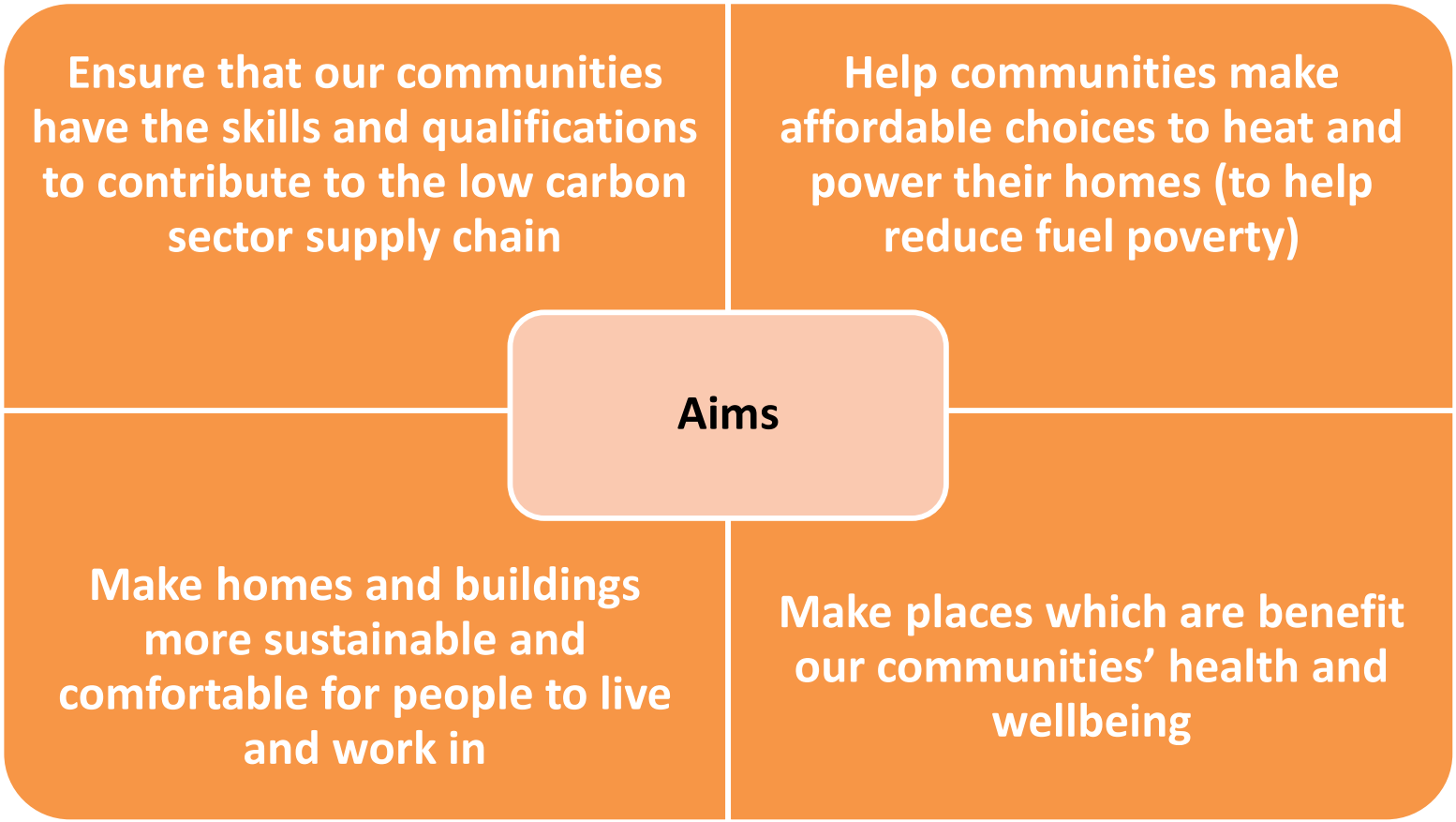
Aims


Ensure that our communities have the skills and qualifications to contribute to the low carbon sector supply chain
Help communities make affordable choices to heat and power their homes (to help reduce fuel poverty)
Aims
Make homes and buildings more sustainable and comfortable for people to live and work in
Make places which are benefit our communities' health and wellbeing

We thank our academic and industrial partners for their support

Scottish Universities Physics Alliance

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Thank you for your time.

I hope this has been helpful and informative.