

## STFC Early stage research and development scheme 2024

### Intention to Submit (ITS)

#### **Title – RAD-PIX: A full-scale RADiation-tolerant monolithic PIXEL detector for physics experiments**

**PI** – Dr. Eva Vilella-Figueras (University of Liverpool)

**Overview** – State-of-the-art silicon tracking detectors, used in the current generation of physics experiments such as the Large Hadron Collider (LHC) at CERN, are not able to meet in a single sensing device the challenging specifications anticipated by future experiments. These specifications include high radiation tolerance ( $\geq 10^{16}$  n<sub>eq</sub>/cm<sup>2</sup>) and low-mass (200 μm), along with high spatial resolution, high data rate and low-power consumption. This proposal will deliver a radiation-tolerant monolithic silicon detector for tracking charged particles in future physics experiments. It will build on existing UK expertise in High Voltage CMOS sensor technology, the most promising route for achieving thin monolithic detectors with excellent radiation tolerance, to deliver a practical full-scale solution that meets the technology specifications for near and midterm future physics experiments in which the UK is involved (e.g. High Luminosity LHC major upgrades and beyond Phase II replacements such as those planned for LHCb and ATLAS). Beyond PPAN it will benefit applications that deploy high-intensity particle beams, such as proton beam therapy for cancer treatment.

The proposal will capitalise on recent advancements achieved within the UK and through the CERN-RD50 collaboration, led by the proposal PI. We will deliver a high radiation-tolerant monolithic High Voltage CMOS demonstrator prototype, RAD-PIX. This will follow a staged approach, delivering first a small pixel chip prototype that will be used as stepping stones to ultimately deliver a full-scale pixel chip. The resource request will be focussed on the necessary chip design effort in institutes where chip design expertise already exists within the UK. A wider community will ensure a detailed evaluation of fabricated prototypes, benefiting from expertise and infrastructure available across the UK (e.g. two-photon absorption, readout electronics, irradiations) and in joint test beams. This proposal is aligned to the priorities of the ECFA DRD3 collaboration addressing several of its stated research aims.

**A statement on the priority for now (i.e. can we delay this to our future year)** – This R&D needs to begin immediately to align with the timeline of upcoming physics experiments that require a silicon tracking detector with the specifications that this proposal will tackle.

**Institutes involved** – Liverpool, Edinburgh, Glasgow, Manchester, Oxford and RAL; others are welcome to join if they wish to do so.