DRD-1 eco-gas submission

Funding opportunity

Early stage research and development scheme 2024

Opportunity status:	Open
Funders:	Science and Technology Facilities Council (STFC)
Funding type:	Grant
Maximum award:	£600,000
Publication date:	4 April 2024
Opening date:	9 April 2024 9:00am UK time
Closing date:	17 July 2024 5:00pm UK time

Timeline

4 April 2024 2:00pm
Webinar

9 April 2024 9:00am
Opening date Intention to submit

30 April 2024 5:00pm
Closing date Intention to submit

List of institutes: Birmingham, Cambridge, Imperial, Liverpool, Manchester, RHUL, Warwick, York, STFC ISIS, STFC PPD

Please provide a brief (less than 300 words) overview of the project, including high level aims and objectives

Gaseous detectors are indispensable as they serve a multitude of diverse applications in particle and nuclear physics, but also in industry, e.g., in the national security domain. To stay at the forefront of rapidly changing particle detector technologies for future detector applications, gaseous detectors must face a critical global challenge: sustainability. Today's gaseous detectors utilise highly potent greenhouse gas mixtures including CF4, SF6, and C2H2F4 with Global Warming Potentials (GWP) of 6630, 23500, and 1300 higher than CO2. The UK DRD1 community will take the lead in a systematic study towards identifying suitable eco-friendly gas mixtures. This development is indispensable and hence imperative to enable future gaseous detectors, both for scientific applications and in industry. The project currently is at TRL2 (potential applications are known/exist and the key challenges are identified): low environmental impact (minimising GWP), safety (non-flammability and low-toxicity), high detector performance (detection efficiency, timing precision, ageing resistance, good quenching capabilities, and radiation-hardness). The proposed effort is fully supported by the UK DRD1.

Obtaining a detailed understanding of properties of ecogases and their impact on the

detector performance for representative technologies like RPCs or GEMs is at the core of our proposal. For this, we will focus on modelling the detector response using simulations. Key parameters to be considered are the primary ionisation rate, charge transport coefficients including electron drift velocity, diffusion and charge multiplication and also scintillation light emission both in low and high-pressure detectors across all of the gaseous detector technologies used in DRD-1 UK. An integral part of this effort is to validate the key simulation input parameters using measurements utilising our DRD1 labs at Cambridge, Liverpool, RAL, Warwick, etc. In addition to obtaining crucial and timely results, this effort will work towards a common infrastructure for the development of the next generation of gas detectors. This future infrastructure will enable us to try new ideas quickly and effectively, maximising the research output and securing a leading role in the international DRD1 effort.
[327 words]

Beneficiaries

The effort is crucial to support future gaseous detectors for scientific applications like ANUBIS (HL-LHC), DUNE, gaseous DM detectors, and detectors at future facilities like the FCC. Securing the construction of major components of such future gaseous detectors will secure a leading role for the UK manufactruing industry for the relevant detector components. Moreover, the effort will generate significant benefit for the UK industry involved in the detector construction for national security applications or muon tomography. Another beneficiary is Linde/BOC, as our project would provide future-directed guidance for gases (and gas mixtures) relevant for the future generation of gaseous detectors.
[101 words]

How the project has been developed from STFC science and technology

A siginifanct number of institutes across the UK STFC community are carrying out research projects using gaseous detectors and/or developing the next generation of gaseous detectors. The detector technologies range from time projection chambers with optical and electronic readouts, over micropattern detectors like GEMs, to RPCs for large-area applications. The active gas is a crucial component of these detector technolgies that drives their ultimate performance. Based on these past developments/applications, the UK DRD1 community is very interested in developing the next generation of gaseous detectors using on eco-gases.
[88 words]