

DRD3 Workshop on 22-23 March 2023

Expression of Interest for participation in DRD3 – R&D on Solid State Detectors

- Name of the institution, full address:

IFIC – Instituto de Física Corpuscular (CSIC-University of Valencia).

Catedrático José Beltrán, 2. E-46980, Paterna

- Country:

Spain

- Contact person:

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- CERN and other experiments:

The institute participates on the following high energy physics experiments as well as R&D initiatives related to the interests of the DRD3 work package: ATLAS, Belle II, LHCb, NA-64, fixed target experiments, Higgs factories, RD50 and AIDAInnova. All the groups listed are interested in R&D activities towards large area, light and highly segmented monolithic pixel sensor developments with specific emphasis on time resolution.

- Size of the group interested in the DRD3 activities:

The final size of the participation will be subject to the funding available. Nevertheless, the principal investigators of the aforementioned groups will ensure proper coverage of the activities we are involved in.

- List of participants:

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Technological areas of interest within the DRD3 collaboration (Financial):

The participation in the research activities described below is funded by a number of regional, national and European research programs. Part of the developments are associated and take place within large detector collaborations but there is also a fraction dedicated to generic R&D.

Technological areas of interest within the DRD3 collaboration (Research):

Our technology choice decision is driven by the physics experiments we're committed to, where excellent position resolution while maintaining good timing properties and minimal material budget is required.

Research interests therefore evolve around three main development lines that may have impact in all the aforementioned experiments.

1) Development of mid-size technology node DMAPS sensors in 150/180 nm. This line would evolve into smaller feature size technologies (65 nm) as soon as they become more accessible.

Goal: Full reticle size demonstrator chip with 30x30 μm^2 pixel pitch, 50 μm thick, 25 ns timing precision. Medium radiation hardness $1 \times 10^{15} \text{ n}_{\text{eq}}/\text{cm}^2$ NIEL, 100 Mrad TID.

2) Development of timing layers based on silicon sensors with internal amplification (SiEM, LGAD, ...).

Goal: Demonstrator development with 100x100 μm^2 pixel pitch, 30 μm thick, 100 ps timing precision.

3) Wafer scale postprocessing, including selective thinning and the deployment of redistribution layers and stitching techniques to increase sensor sizes beyond reticle limits.

Goal: Multi-reticle all-silicon CMOS self-sustained ladder, 0.1% X/X_0 .

→ The ultimate goal, in collaboration with other partners in DRD group, would be to develop a functional large area beam telescope with timing layers as technology demonstrator for current upgrades and future experiments.

Our main activities would include:

- Sensor design, including especially digital periphery.
- Detector electrical characterization, including lab and test beams.
- Detector thermomechanical characterization, including FEM analysis.

- Irradiation campaigns, including TID and NIEL.
- Development of back-end electronics and DAQ systems (hardware, firmware and software).
- Detector integration, including postprocessing at wafer level.

Technological area(s) of interest within the DRD3 collaboration (Tools)

Existing tools:

Clean room: 80 m² clean room class 10000 (ISO7) which includes 25 m² class 1000 (ISO6)

Probe stations (T-controlled down to -20 degC, CV, IV).

Two fully automated wire bonding machines and flip-chip bonder.

Pull and shear testers.

Laser based characterization tools (TCT standard) and radioactive sources.

Fully equipped electronic lab and mechanical workshop.

Electronics workshop with PCB fabrication (multilayer PCB) and assembly capability (SMD/SMT).

Electronics and Microelectronics CAD licenses (Cadence IC, Cadence PCB, Xilinx Vivado Design Suite, etc.) and high-end computing infrastructure.

Technological areas of interest within the DRD3 collaboration (Industry)

We are members of Europractice and working closely with the companies Lab Circuits, UVAX Concepts and Newbury Electronics to produce and assembly electronics hardware.

Further comments:

The budget available and its profile will be finalized once discussed with our funding agency.