# Running Projects

Ioana Pintilie
Jörn Schwandt

*1st DRD3 Workshop*
*Working group 3 (WG3) Session*
*19th June 2024*

# RD50 project

DRD3

## RD50-2023-05: PAB - Partial Activation of Boron to enhance the radiation tolerance of the gain implant

DRD3

- **Title:** "Partial Activation of Boron to enhance the radiation tolerance of the gain implant - PAB"
- **Project Leader:** Valentina Sola (Torino University)
- **Participating institutes: 12** (all RD50 members)
- **Indicated project cost: 52** keuros
- **Request to RD50: 27** keuros
- **Granted RD50 contribution: 27** keuros

**Project description**

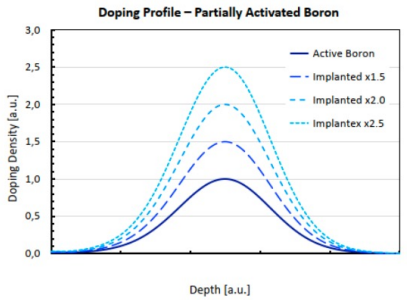


Figure 1: Profile of dopant density forming the gain implant of LGAD sensors exploiting partial activation of boron. Different doses of implanted boron are shown. The goal is to keep a constant dose of active dopant, indicated as dose 1, while studying the effect of different implant concentrations.

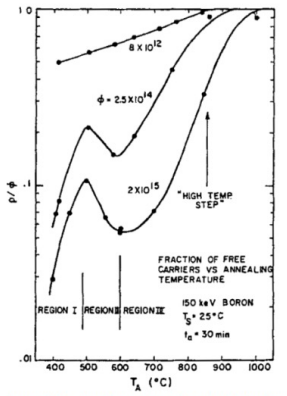


Figure 2: Isochronal annealing of boron. The fraction of activated boron, p/ϕ, is plotted against the annealing temperature, $T_A$, for different implant doses, ϕ. The annealing time is 30 minutes[3].

RD50 funding request

- Date: 15.11.2023 -

**Title of project:** **Partial Activation of Boron to enhance the radiation tolerance of the gain implant – PAB**


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**RD50 Institutes:**

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**Request to RD50: € 27,000**
**Total project cost: € 52,000**

DRD3

# RD50-2023-06: Impact ionization parameterization at extreme fluences

DRD3

- **Title:** "Impact ionization parameterization at extreme fluences"
- **Project Leader: Gregor Kramberger** (Ljubljana)
- **Participating institutes: 5** (all RD50 members)
- **Indicated project cost: 52** keuros
- **Request to RD50: 25** keuros
- **Granted RD50 contribution: 25** keuros

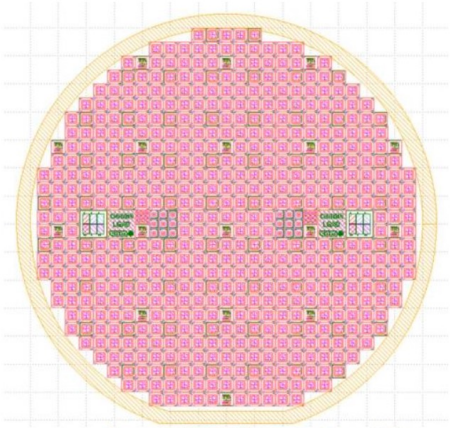

*Figure 1: View of the wafer layout (6").*

- 1, 2, 10, 100 a.u. (B+C LGADs)
- 1, 5, 20, 200 a.u. (B LGADs)
- 1 a.u. (C-implanted PINs)

RD50 funding request

- November, 2023 -

**Title of project:** Impact ionization parametrization at extreme fluences

**Contact person:** *Gregor Kramberger*
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**RD50 Institutes:**

1. CNM, Giulio Pellegrini, giulio.pellegrini@imb-cnm.csic.es
2. JSI Ljubljana, Gregor Kramberger, <Gregor.Kramberger@ijs.si>
3. INFN-Torino, Valentina Sola <Valentina.Sola@cern.ch>
4. UCG, Gordana Medin <gordana.medin@gmail.com>
5. CERN, Michael Moll <Michael.Moll@cern.ch>

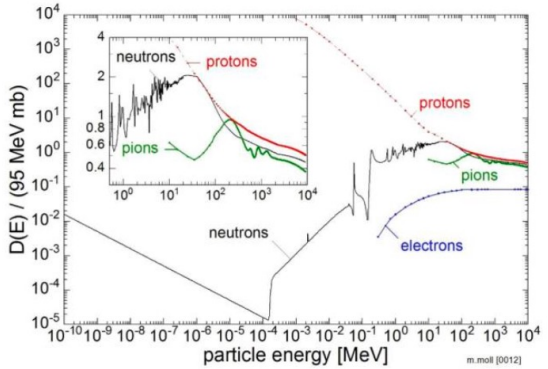
**Request to RD50: 25000 €**
**Total project cost: 52000 €**

We propose processing of several wafers of small size pin and LGAD samples (see Fig. 1) where the doping of the gain layer would be significantly higher than in presently produced LGADs (1e16-1e17 $cm^{-3}$) so that the produced LGADs would not be operational before irradiation, but would be become operational after irradiations when sufficiently large number of initial acceptors were removed to allow depletion of gain layer, establishing electric field in the bulk and not leading to the immediate break-down of the devices. That

# RD50 project

## RD50-2023-07: PIN sensors for dosimetry & NIEL studies DRD3

- **Title:** "PIN sensors for dosimetry and NIEL studies"
- **Project Leader: Michael Moll** (CERN)
- **Participating institutes: 4** (all RD50 members)
- **Indicated project cost: 40** keuros
- **Request to RD50: 20** keuros
- **Granted RD50 contribution: 20** keuros




**Project description:**

The objective of this project is to produce n-in-p diodes in form of simple "pin sensors" that can be used as passive radiation monitoring devices by measuring the radiation induced leakage current in well-defined post-irradiation annealing and operational conditions.

The purpose of the project is two-fold:
**[1] Dosimetry:** The sensors will serve as dosimetric devices for radiation monitoring in irradiation campaigns at the JSI nuclear reactor and the CERN IRRAD facility in the context of RD50/DRD3 collaboration projects.

**[2] Facility Intercomparison/NIEL study**; The sensors will serve a measurement campaign for the cross-comparison of irradiation facilities. For the intercomparison of irradiation facilities, a set of sensors will be provided free of charge to interested irradiation facilities within the RD50/DRD3 collaboration for exposure at their facility under well controlled dosimetric conditions. After exposure, the sensors will then either be measured at the facility under well defined conditions (after annealing of 80 minutes at 60C at a specified bias voltage to be determined after processing of the sensors, with guard ring connected) or shipped to CERN were the corresponding measurements will be performed. The ultimate scientific goal is to evaluate the validity of the Non-Ionizing Energy Loss (NIEL) hypothesis by means of measuring the leakage current of the sensors after irradiation. This study is accompanied by simulation studies at CERN using FlUKA, GEANT4 and TRIM simulations to evaluate the expected Non-Ionising Energy Loss (NIEL) against the measured leakage current increase.

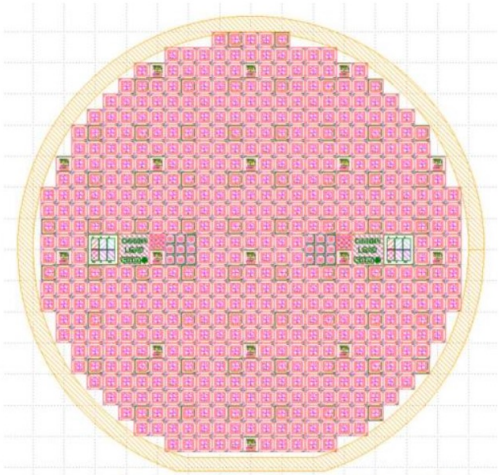


*Figure 1: View of the wafer layout (6").*

RD50-2023-07

RD50 funding request
- November, 2023 -

**Title of project:** PIN sensors for dosimetry and NIEL studies
**Contact person:** *Michael Moll*
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**RD50 Institutes:**

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2. CNM, Giulio Pellegrini, giulio.pellegrini@imb-cnm.csic.es
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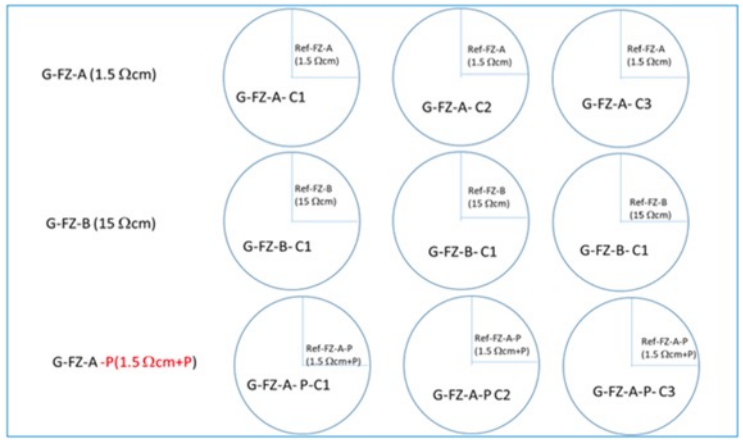
4. NIMP Bucharest, Ioana Pintilie ioana@infim.ro

**Request to RD50: 20000 €**
**Total project cost: 40000 €**

# RD50 project

- **Title:** "Defect engineering in PAD diodes mimicking the gain layer in LGADs "
- **Project Leader:** Ioana Pintilie (NIMP, Bucharest)
- **Participating institutes: 7** (all RD50 members)
- **Indicated project cost:** 51.2 keuros
- **Request to RD50:** 26.7 keuros
- **Granted RD50 contribution: 26.7** keuros




… different Boron doped wafer type with/without Carbon and Phosphorous compensation

**RD50 funding request** **RD50-2022-01**

Date:
17.05.2022

**Title of the project:** *Defect engineering in PAD diodes mimicking the gain layer in LGADs*

**RD50 Institutes:**
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**Request to RD50: 26665 EUR**

**Total project costs: 51165 EUR**

**Project description:**

The proposed project is focusing on the acceptor removal process (ARP) in the irradiated gain layer of LGAD sensors, aiming to understand it and parametrize it for various content of B, C and O impurities and irradiation fluences, in order to find proper defect engineering solutions to maximize the radiation hardness of the gain layers. The studies performed so far on LGAds show that in the $p^+$ layer of LGADs, the ARP can result in a complete disappearance of the gain at 1MeV neutron equivalent fluences higher than $2x10^{15}$ $cm^{-2}$. As major obstacles preventing the achievement of enough knowledge for characterizing and proposing feasible solutions for improving the performance of the gain layers in LGADS are: