

# RD50 funding request

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**Title of project:** Design and production of RD50 test structures and devices in L-Foundry 150 nm HV-CMOS technology.

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**Request to RD50:** 45,000 €

**Total project cost:** 90,000 €

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**Project description:**

The HV-CMOS is assuredly emerging as the prime candidate technology for future tracking sensors for ionising radiation for particle physics and numerous other application. The feature of integrating the sensing diode into the CMOS wafer hosting the front-end electronics, allows for reduced noise and therefore higher signal sensitivity. The possibility of applying high voltage and the availability of relatively high resistivity substrates makes these devices also suitable for application where high radiation damage is expected. It is therefore a priority for RD50 to study these type of devices in view of future high luminosity collider applications (HL-LHC and beyond, e.g. FCC). In this emerging technology, a few foundries have emerged as particularly suitable for the needs of tracking sensors. In particular, LFoundry [ref] has several attractive feature in their processing technology, qualifying them as a very strong contender for the production of tracking sensors. The strong points of LFoundry are the small feature size imaging (150 nm), the use of high resistivity wafers, the use of multi-metal stacks (6 metal layers), the 4 well nesting structures and the possibility of reticule stitching.

This project aims to design dedicated test structures for typical RD50 studies and for functional studies that will probe the HV-CMOS sensors performance after a wide range of irradiation fluences with hadrons and compare them with the well-known high resistivity

FZ passive sensors. The production of a radiation model for HV-CMOS devices will be pursued, as well as the study of their functional performance like the signal over noise (S/N) ratio, spatial and time resolution as a function of fluence. The contribution of RD50 in the study of this type of devices is highly valuable to the widening community involved in HV-CMOS sensors and has the perspective of producing a comprehensive parameterisation now missing for drawing their performance scenario as a function of operation in experiments.

The RD50-HV-CMOS design will include several type of test structures, from diode arrays for TCT studies, amplified structures with different pitches for resolution studies and assessment of S/N and other parameters (e.g. cross talk), time resolution enhanced matrices, etc....

The processing will be performed on three different resistivity values for the substrate, in order to study its influence on the performance after irradiation and to test the irradiation models with various starting materials. The tentative values (to be finalised with discussion with the foundry) are 1-10  $\Omega$ , 400-1000  $\Omega$  and  $> 2000 \Omega$ .

The cost of the various processing models offered by L-Foundry are the following (the cost is to be considered approximated):

MPW 100mm<sup>2</sup> : 50000 Euro

Full mask set with 12 engineering wafers : 94120 Euro

MLM 1X3 : 81335 Euro

MLM 1X2 : about 87000 Euro.

MLM is similar to the engineering run (full ownership of the wafer) but the design of the reticule is 1/3 (1/2) of the area, repeated 3 (2) times over the reticule.

The current proposal plans to make use of the MLM 1X3 option, but this could change with the progressing of the design.

### **The project work-plan is as it follows:**

1. Definition of the structures (all)
2. Implementation of the design (Liverpool, Barcelona, FBK, others....)
3. Submission
4. Reception
5. Characterisation/irradiation
6. Back-thinning (there is a cost associated, it can be a second project)
7. Characterisation/irradiation

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### **Project costs, contributions from participating institutes and request to the RD50 common fund.**

The options are as it follows:

MLM 1x3 (one design of 1x2 cm<sup>2</sup> repeated 3 times on a reticule) (12 wafers): 82000€.

The cost estimate for the project is set to 90000€; the exact amount will be determined at the moment of the submission. The cost above could be half met by RD50 contribution, and half to be divided among participants.