**WP7: R&D on micro-RWELL detector**

**Activity Report for 2017 and Program for 2018**

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The µ-RWELL has been introduced as a thin, simple and robust gas detector for very large area applications requiring the operation in a harsh environment. The detector is composed of two elements: the cathode and the µ-RWELL-PCB, the core of the detector. The µ-RWELL-PCB, realized as a multi-layer circuit by means of standard photolithography technology, is composed of three different elements: a suitable patterned kapton foil that acts as amplification stage of the detector, a grounded resistive layer as discharge limitation element and a standard segmented PCB for readout purposes.

At the moment two different schemes have been studied for the resistive stage: the simplest layout, based on a **single-resistive layer with edge grounding (2D - current evacuation) has been designed for low-rate applications (<=100 kHz/cm2)**; a more sophisticated one, based on a **double-resistive layer with a proper density of through-vias between the two layers with the grounding done by means of the readout electrodes (3D - current evacuation) is under study for high-rate purposes (> 1 MHz/cm2).**

The **proof of concept of the two detector schemes** has been successfully performed in the framework of the R&D activity of the MPGD\_NEXT (WP1) financed by the ***Commissione Nazionale V*.**

**The engineering and industrialization of the detector based on the single-resistive layer scheme**, through a Technology Transfer (TT) to Companies working in the field of rigid (standard PCB) and flexible (kapton circuits) photolithography, has been performed in in the framework of the activities (CMS, RD\_FA) financed by ***Commissione Nazionale I.***

During 2016 and the first months of 2017 a TT work has been done with the **ELTOS-SpA** for the coupling of the PCB with the DLCed-kapton foil, that represents the first step of the manufacturing of µ-RWELL\_PCB, while the final kapton etching, the second part of the manufacturing, has been still accomplished at the PCB – Workshop at CERN (R. de Oliveira).

For the technology transfer **of the kapton etching of the µ-RWELL amplification stage we contacted the Polish Company TECHTRA Sp. z.o.o.,** already involved in the GEM foil production for CERN. We estimate to achieve the first results of the DLCed kapton etching from TECHTRA by the end of 2017 (the etching of the base material for µ-RWELLs requires some adjustments with respect to the GEM etching procedure).

**The objective of 2018 would be to integrate the skills of both Companies to reach a fully operational single-resistive layer detector completely manufactured outside CERN as a product on the shelf of ELTOS/TECTHRA. To fulfil this milestone an intense fine tuning of all manufacturing steps must be scheduled, requiring several iterations and strict interactions with both Companies.**

*The high-rate version of the detector based on the double-resistive layer layout, perfectly working from the point view of the performance in high-rate environment, seems to be not easy to be engineered/industrialized for large area detectors mass-production. For this reason a* ***new simplified version*** *of the high-rate detector scheme will be studied during 2018 in the framework of the MPGD\_NEXT R&D activity (financed by Commissione V). The new high-rate version (HR-v2.0) will be based on a “single-resistive layer” layout coupled with a suitable “ground-network”, whose parameters must be clearly optimized. Very preliminary tests of the HR-v2.0 show very promising results and of course after the proof of concept the engineering of the HR-v2.0 could be performed in the framework of RD\_FA (2019 ?).* **The 2018 program will follow the following scheme and task sharing:**

1. Single-resistive layer (SRL) micro-RWELL prototypes design with strips and pad readout: **LNF**
2. optimization and industrialization of the production processes (for SRL scheme) at ELTOS/TECHTRA: **LNF**
3. prototype construction and QC/QA with X-rays (gain, uniformity, rate capability): **LNF**
4. integration of the front-end electronics and DAQ: **INFN-Fe**
5. DAQ and reconstruction software **INFN-Fe**
6. prototype characterization with pion/muon beam

 at H4/H8-SPS-CERN (efficiency, spatial resolution): **INFN-Bo, INFN-Fe, LNF**

**Costs – 2018:**

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**ANAGRAFICA – WP7 - 2018:**

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| --- | --- | --- | --- |
| **nominativo** | **qualifica** | **RD\_FA** | **sezione** |
| **bencivenni** | I-RIC | **20** | LNF |
| **poli lener** | Art 36 | **10** | LNF |
| **morello** | ass.ricerca | **10** | LNF |
| **cibinetto** | ricercatore | **20** | FERRARA |
| **giacomelli** | I-RIC | **10** | BOLOGNA |
| **braibant** | prof. Associato | **10** | BOLOGNA |
| **boscherini** | I-RIC | **10** | BOLOGNA |
| **bellagamba** | I-RIC | **10** | BOLOGNA |
| **polini** | ricercatore | **10** | BOLOGNA |