WP7: Advanced hybrid pixel detectors

Third Annual Workshop, Bologna.

Anna Macchiolo and Iván Vila

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Overview: Tasks

Device Simulation
- Layout optimization.
- Radiation damage modeling
- Optimization signal multiplication structures.

Sensor manufacturing
- Development & improvement of manufacturing processes for planar, 3D and LGAD devices.
- MPWR for thinned 3D and slim/active edge planar.

Detector performance assessment
- Hybrid thin planar & 3D pixels for HL-LHC environment.
- Very small size and thin pixel sensors for CLIC.
- Low Gain Avalanche Detectors for timing and tracking.
We are in month 36 of 48 = 3/4 of the total (initial) duration of the project. Expect now (3/5 of execution) assuming the one-year extension is approved.
• D7.4 TCAD model radiation damage
  M46  postpone to M52
• D7.7 Final pixel characterisation
  M46  postpone to M52
• D7.8 LGAD characterisation
  M46  postpone to M52

• While the production of pixel and LGAD devices is on schedule, the availability of irradiation facilities will be reduced due to the shutdown of CERN accelerators from December 2018, which was not foreseen and which will likely lead to delays in irradiation and subsequent characterisation (D7.7, D7.8). D7.4 requires the results of D7.7 and D7.8 for model validation.
### WP7 Milestones

<table>
<thead>
<tr>
<th>Milestones</th>
<th>Responsible Group</th>
<th>Month due</th>
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<tbody>
<tr>
<td>MS29 Validation and release of TCAD simulation ✔</td>
<td>INFN</td>
<td>M16 (AUG 2016)</td>
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<tr>
<td>MS49 Workshop on 3D and planar sensors ✔</td>
<td>FBK</td>
<td>M24 (APR 2017)</td>
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<tr>
<td>MS51 Workshop on LGAD characterization ✔</td>
<td>INFN</td>
<td>M24 (APR 2017)</td>
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<tr>
<td>MS50 Technological choice on LGAD sensor thickness ✔</td>
<td>CSIC</td>
<td>M24 (APR 2017)</td>
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<tr>
<td>MS81 Test beam campaign for 3D and planar sensors ✔</td>
<td>MPG-MPP</td>
<td>M36 (APR 2018)</td>
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<td>MS87 Common MPW runs completion</td>
<td>CSIC</td>
<td>M42 (DEC 2018)</td>
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<tr>
<td>MS97 Validation TCAD radiation damage model with data comparison</td>
<td>INFN</td>
<td>M46 (MAR 2019)</td>
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three common productions foreseen in WP7, one for each technology

- Thin 3D and planar pixel sensors, compatible with the RD53A chip.
- **FBK 3D run delivered (ready for flip-chipping at IZM)**, CSIC-CNM 3D run under process (next slide), FBK-Planar to be started in June. Expect no delay on MS87 (all run completed in M42)
- LGAD run being processed, thin sensors, down to an active thickness of 35 μm, expected availability July-September 2018 before MS87.
Currently two 3D productions with RD53A layout in parallel at IMB-CNMs: double-sided technology and single-sided technology.

**Initial approach:** double-side run as AIDA-2020.

Post Atlas & CMS TDR approach: single-sided as preferred technology.

**Re-align AIDA-2020 WP7 with Atlas and CMS choices:** Single-Sided run

150 um active thickness SiSi tech.

8 wafers, DRIE of first holes

- 9 RD53 50x50um² (1-x)
- 9 RD53 25x100um² 2E (2-x)
- 2 RD53 25x100um² 1E (3-x)

Diodes
- 5-x 50x50um² 100x100 electrodes
- 6-x 50x50um² 50x50 electrodes
- 7-x 25x50um² 50x50 electrodes
- 8-x 25x100um² 50x50 electrodes
- 64 test structures 3x3 matrix

MOS
- 9-x 3500x3500 um²
- Polysilicon test structures
<table>
<thead>
<tr>
<th>Time</th>
<th>Session</th>
<th>Speaker</th>
<th>Room</th>
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<tbody>
<tr>
<td>14:30</td>
<td>Welcome and Introduction</td>
<td>Anna Macchiolo et al.</td>
<td>Aula 7</td>
</tr>
<tr>
<td>14:40</td>
<td>Characterization and simulation of small-pitch 3D diodes irradiated to HL-LHC fluences</td>
<td>Roberto Mendicino et al.</td>
<td>Aula 7</td>
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<tr>
<td>15:00</td>
<td>Update on TCAD surface radiation damage modelling in silicon detectors</td>
<td>Francesco Moscatelli</td>
<td>Aula 7</td>
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<tr>
<td>15:20</td>
<td>Update on activities at MPP</td>
<td>Anna Macchiolo</td>
<td>Aula 7</td>
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<tr>
<td>15:40</td>
<td>Update on activities at Santander: Characterization of small-cell 3D pixels and LGADs</td>
<td>Ivan Vila Alvarez</td>
<td>Aula 7</td>
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<td>16:00</td>
<td>Coffee break</td>
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<td>Sala della Trasazione</td>
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<td>16:30</td>
<td>Update on LPNHE activities</td>
<td>Giovanni Calderini et al.</td>
<td>Aula 7</td>
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<td>16:50</td>
<td>Update on Florence activities</td>
<td>Marco Meschini</td>
<td>Aula 7</td>
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<td>17:10</td>
<td>Update on activities related to assembly and measurements of modules in Milan</td>
<td>Simone Monzani</td>
<td>Aula 7</td>
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<td>17:30</td>
<td>Common discussion</td>
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<td>Aula 7</td>
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A. Macchiolo, I. Vila, AIDA-2020 3th Annual workshop, WP7 Parallel meeting
Moving from design and manufacturing to the testing of the first AIDA-2020 RD53A devices.

• Discuss and (if possible) agree on:
  • **Testing strategy** (SPS test beams slots in 2018):
    • 13-20 June (with CMS outer tracker, parasitic) In two months from now!
    • 3-10 October (main users)
    • ... + about 4 Atlas and CMS specific test beam time-slots.
  • **Common planning** Atlas-CMS for testing first AIDA-2020 3D pixels. See Marco Meschini talk.