Work Plan: New Structures

New structures based on silicon substrates are, possibly together with materials other than silicon, the most promising options to extend radiation tolerance to the region of 7-8×1017 neq/cm2.

- **WP 5.3.1. 3D detectors**
  3D pixel detectors were irradiated and studied in the laboratory and with beam tests up to fluences of 3x1016 neq/cm2 (current world record).
  - Identified milestones for next 5 years:
  - **M1: full radiation tolerance study of 3D pixels connected to the RD53A chip (Q3/2019).**
  - **M2: radiation tolerance studies of 25x250 µm2 pixel cell design and feasibility (yield) studies for the 25x100 µm2 pixel cell layout (Q4/2019).**
  - **M3: final radiation tolerance study of 3D pixels connected to the RD53B chip (Q4/2020)**
  - **M4: Understanding the limit of the radiation hardness of the 3D geometry up to 1017neq/cm2 (Q2/2021)**
  - **M5: Evaluation of the time performances of new 3D geometries (Q3/2020).**
  - **M6: Design and simulation of new 3D detectors geometries for operation at 8x1017neq/cm2 (Q4/2022).**

- **WP 5.3.2. Sensors with intrinsic gain**
  Sensor with intrinsic gain are based on Low-Gain Avalanche Detectors (LGAD) [7] which are thin n-on-p sensors with internal charge multiplication due to the presence of a thin, low-resistivity diffusion layer below the junction. Understanding the radiation effects in LGADs is under intensive investigation within RD50. Different technological solutions are been investigates, such as Carbon or Gallium doping, and new fabrications with thinner sensors with a variety of gain.
  - Identified milestones for next 5 years:
  - **M1: Understand the effect of Carbon and Gallium on gain after irradiation (Q1/2019)**
  - **M2: Model the acceptor removal effect after irradiation (Q3/2019)**
  - **M3: Produce new LGAD design to increase the fill factor (Q2/2020)**
  - **M4: Design and simulate new LGAD geometries for operation at 1×1017neq/cm2 (Q4/2022)**

Work Plan: New Structures

New structures based on silicon substrates are, possibly together with materials other than silicon, the most promising options to extend radiation tolerance to the region of 7-8×1017 neq/cm2.

- **WP 5.3.3. CMOS and monolithic devices**

Identified milestones for next 5 years:

- **M1: Characterization of the diodes and readout electronics of unirradiated and irradiated RD50-MPW1 samples (Q4/2018).**
- **M2: Design and submission for fabrication of RD50-ENGRUN1 (Q4/2018).**
- **M3: Characterization of unirradiated and irradiated RD50-ENGRUN1 samples (Q3/2019, Q3/2020).**
- **M4: Characterization of irradiated backside biased RD50-ENGRUN1 samples for operation beyond 1016 neq/cm2 (Q4/2020).**
- **M5: Studies of stitching process options (Q4/2021).**
- **M6: Characterization of unirradiated and irradiated stitched samples (Q4/2022).**

- **WP 5.3.4. New Materials**

Identified milestones for next 5 years:

- **M1: Fabricate new radiation detectors in different Wide Band Gap (WBG) high quality materials (Q4/2019).**
- **M2: Study the radiation hardness of detectors based on WBG materials (Q2/2020).**
- **M3: Understand the feaibility of large areas detectors based on WBG materials (Q2/2021)**
- **M4: Investigate the fabrication of radiation detectors based on 2D materials (Q3/2021).**
- **M5: Explore operations at 8×1017 neq/cm2 (Q4/2022) using innovative materials.**