



Contribution ID: 31

Type: **WG3 Radiation Damage - Extreme Fluence**

Radiation hardness and annealing studies of silicon diodes produced on 8-inch wafers for CMS HGCAL

Tuesday 3 June 2025 15:00 (20 minutes)

To handle the tenfold increase in radiation from the High-Luminosity LHC, CMS will replace its endcap calorimeters with the High-Granularity Calorimeter (HGCAL). Silicon pad sensors, covering an area of 620 m² in the electromagnetic and high-radiation hadronic regions, must withstand fluences of up to 1e16 neq/cm². They are fabricated on 8-inch p-type wafers with thicknesses of 120, 200, and 300 μ m. Each wafer also includes dedicated test structures for quality assurance and radiation hardness evaluation.

These test structure diodes are currently used in four irradiation and annealing campaigns, addressing and going beyond CMS HGCAL radiation hardness qualification needs.

Neutron irradiation campaigns covering both a low fluence range from 1e13 to 2e14 neq/cm² and a high fluences range from 2e15 to 1.5e16 neq/cm² allow to investigate a broad parameter space regarding radiation damage and annealing behaviour at up to five different temperatures (6.5 °C to 60 °C).

To simulate a more realistic operational scenario, one set of diodes was irradiated to fluences ranging from 5e14 to 4e15 neq/cm² and subsequently annealed at three different temperatures within the expected beneficial annealing window. In a second step, these diodes will be further irradiated to end-of-lifetime fluences, consistent with those studied in the high-fluence campaign.

Additionally, a subset of diodes was irradiated with protons (2e15–8e15 neq/cm²), and long-term annealing studies at 20 °C, 40 °C and 60 °C were started in order to specifically investigate potential differences in the annealing behaviour depending on the impact particles.

This talk will present initial results from the low fluence, double irradiation, and proton campaigns, covering observed beneficial annealing effects. Advanced results from the high fluence campaign will be shown in a separate talk by Leena Diehl.

Type of presentation (in-person/online)

in-person presentation

Type of presentation (I. scientific results or II. project proposal)

I. Presentation on scientific results

Authors: DIEHL, Leena (CERN); MUEHLNIKEL, Marie Christin (CERN); ANDERSSON, Max (Uppsala University (SE))

Co-author: MOLL, Michael (CERN)

Presenter: MUEHLNIKEL, Marie Christin (CERN)

Session Classification: WG3/WP3 - Extreme fluence and radiation damage characterization