Silicon sensors characterisation for the CMS Endcap Calorimeter Upgrade

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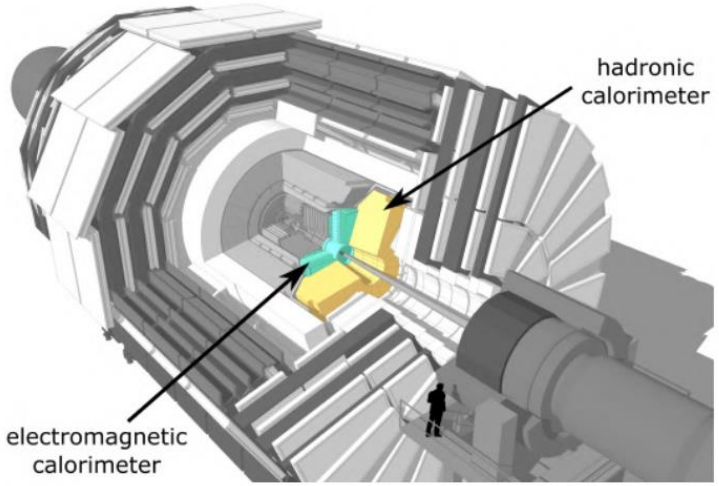
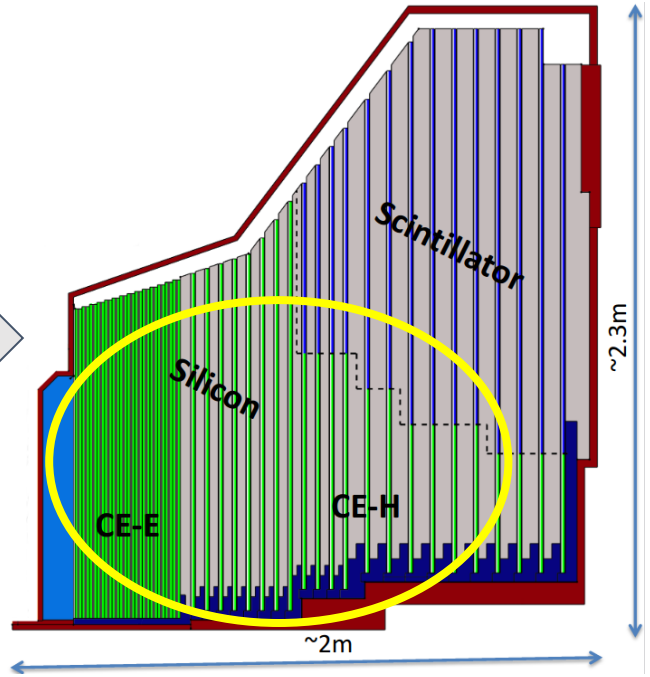
Si sensors play a key role in High Granularity Calorimeter

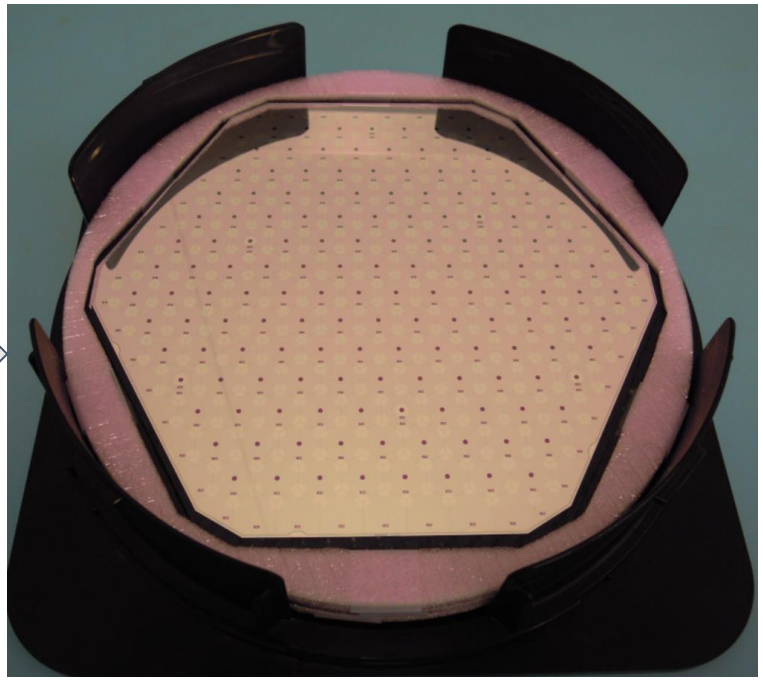
Current CMS Endcap Calorimeter …

… will be replaced by the High Granularity Calorimeter (HGCAL) …

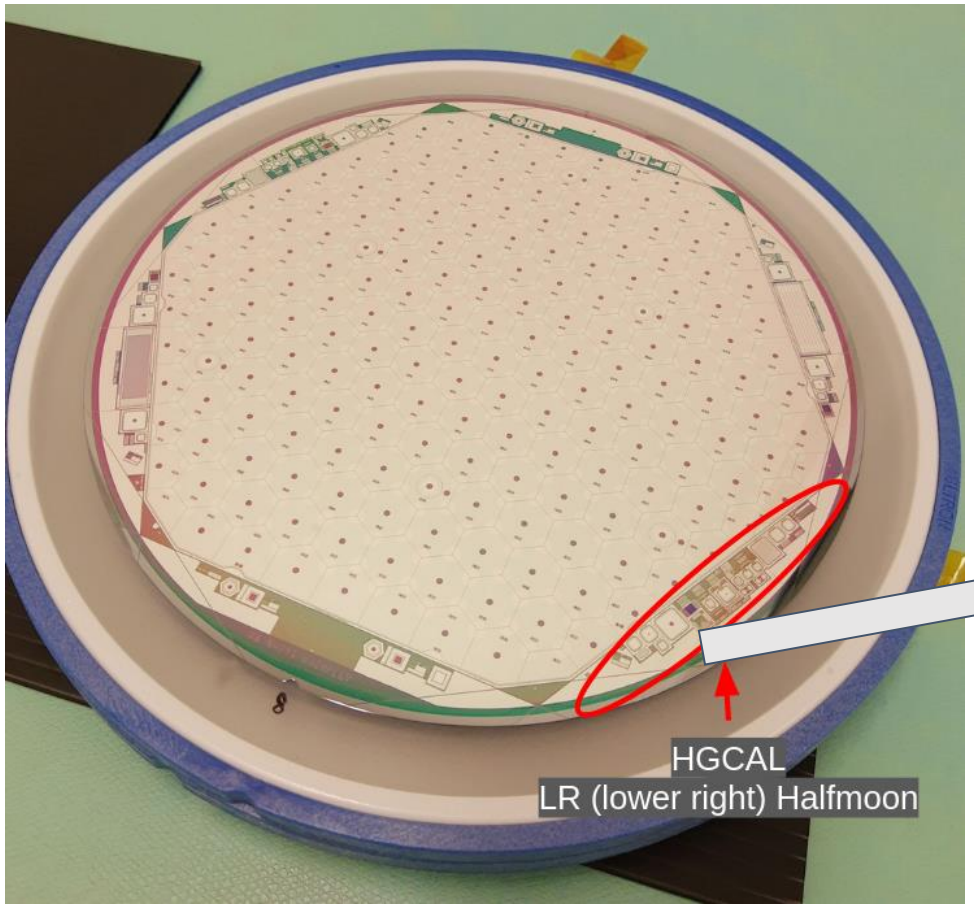
… and in the high radiation region will be based on 8-inch Si sensors







Full wafers and small “test structures” are characterised

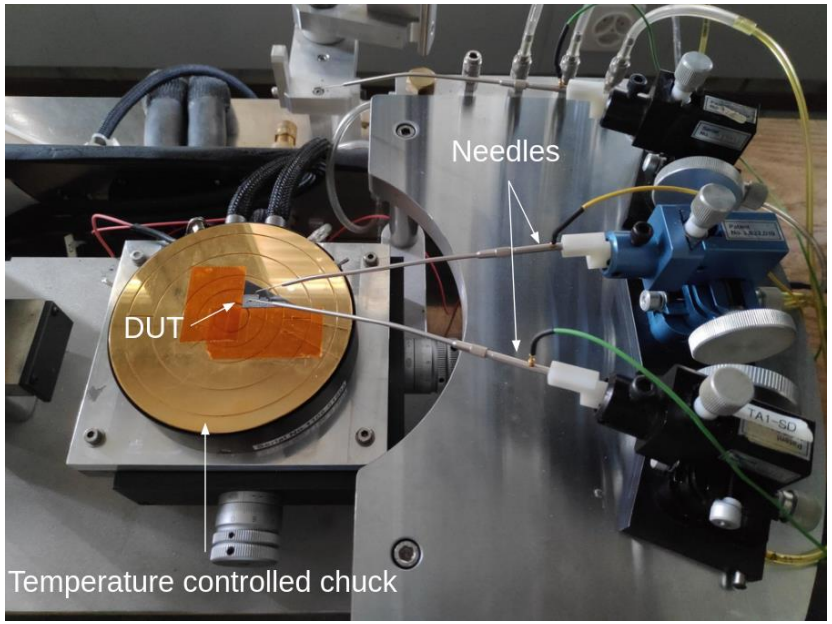


Full wafer hexagonal sensor on circular wafer containing various test structures

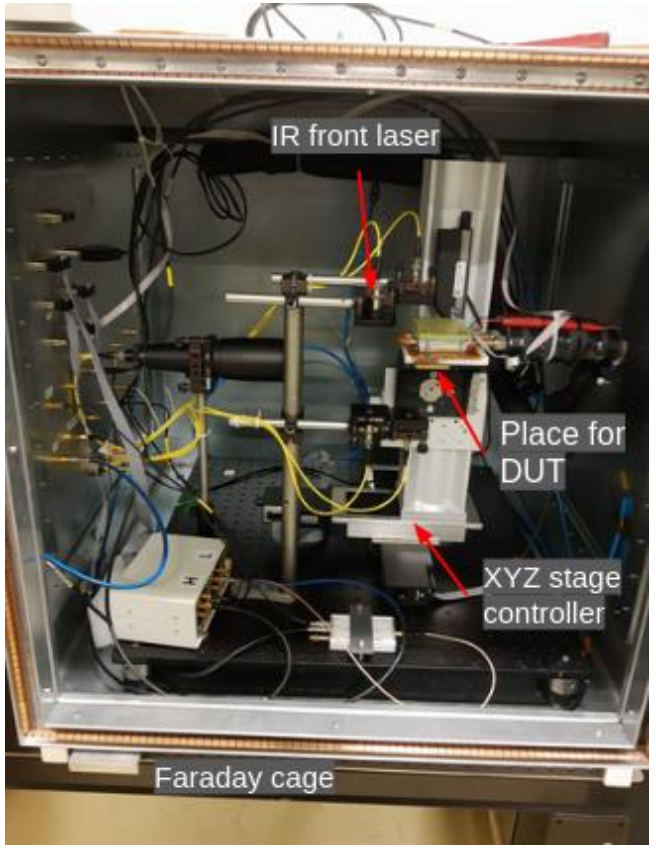
Example test structure diode

Three sensor thicknesses: 300 µm, 200 µm, 120 µm

Neutron-irradiated diodes tested in two setups



Leakage current (IV)
Capacitance (CV) -> full depletion voltage

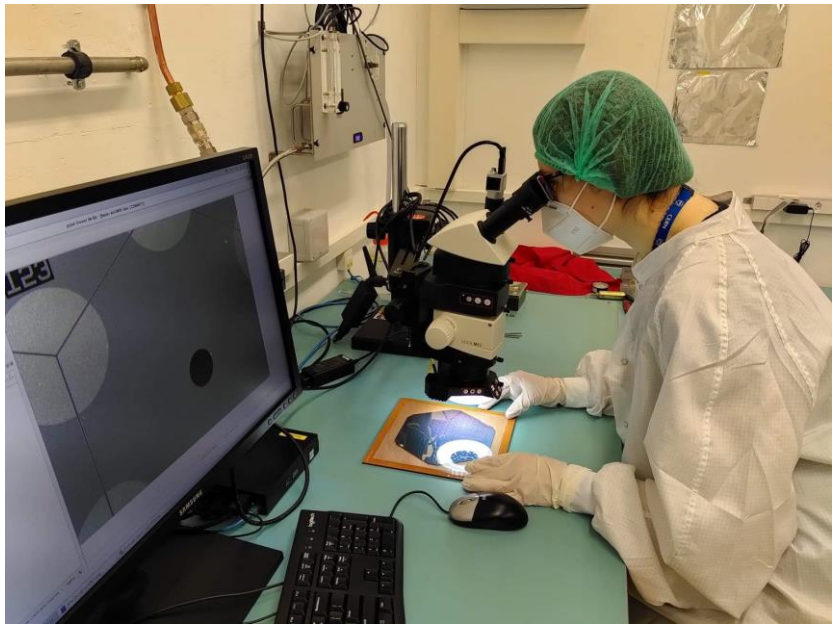


Charge collection studies -> efficiency

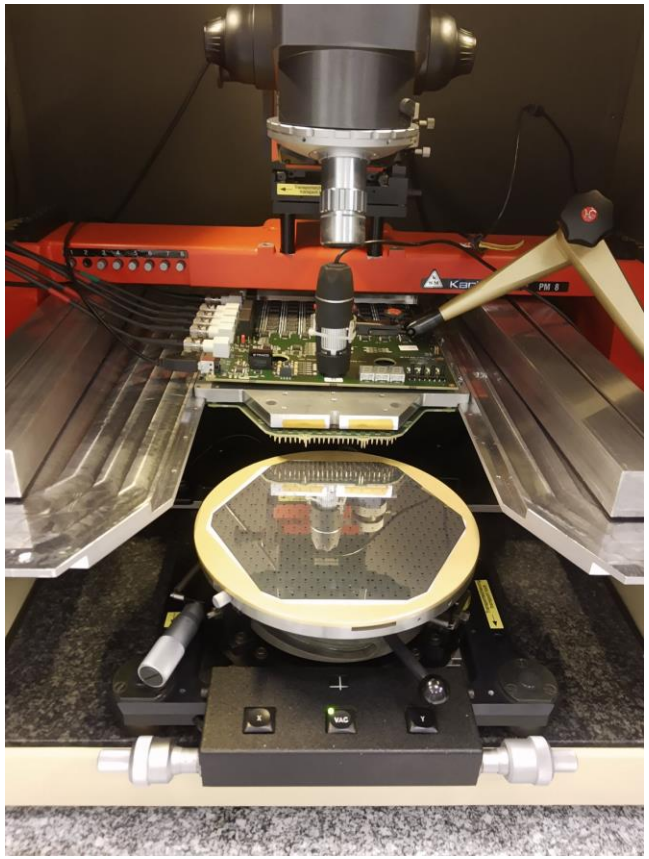
Diodes are annealed in multiple steps and remeasured

Full wafers are electrically characterized in cleanroom conditions

Handling the sensor



Visual inspection of the DUT



DUT placed inside the setup, before contacting

Custom-made system enables automatic testing of the full wafer

Take-home messages

- Radiation-tolerance study of full wafer 8-inch sensors as well as small test structure diodes
- Tests include electrical characterization (IV,CV) and charge collection measurements
- Based on these results, sensors of certain properties (e.g. thickness) will be chosen for respective parts of HGCAL
- Silicon sensors will cover an area of ~620 m^2 of HGCAL (~30 000 8-inch sensors)

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