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# Characterization of GaAs avalanche photodiodes featuring separated absorption and GaAs/AlGaAs superlattices multiplication layers using soft X-rays.

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Sensors based on GaAs are of particular interest as X-ray detectors since they have several advantages over Si, like a wider bandgap (lower dark current) and higher atomic number (higher detection efficiency).
In recent years we have developed and have studied Separate Absorption and Multiplication Avalanche PhotoDiodes in GaAs designed explicitly for synchrotron and free electron laser, featuring multiplication layers based on superlattice with staircase structures.
Effects of doping level of the various layers, the number of multiplication steps and the role of the "separation layer" have been analyzed.
Here we present further studies concerning quantum efficiency and the possibility of working in a "non punch-through" regime.
Devices with different thicknesses of the absorption zone have been studied using synchrotron light, producing electrons in the absorption layer at variable distances from the multiplication zone, and the role of the interfaces in the loss of efficiency has been measured.
Then we analyzed the devices depositing an δ p-doped sub-monolayer of carbon atoms such as to achieve complete depletion of the multiplication region but not punch-through, and thin enough to allow most of the electrons produced in the absorption zone enter the multiplication zone. In this way, the efficiency is high and the absorption zone is never subjected to a field such as to induce unwanted charge multiplication or band-to-band tunneling.

## Collaboration

**Primary authors:** Mr COLJA, Matija (University of Trieste); Mr CAUTERO, Marco (University of Trieste)

**Co-authors:** Dr CAUTERO, Giuseppe (Sincrotrone Elettra Trieste); BONANNI, Valentina (Elettra Sincrotrone Trieste); BIASIOL, Giorgio (Consiglio Nazionale delle Ricerche); MENK, Ralf Hendrik (Elettra Sincrotrone Trieste); Mr DAL ZILIO, Simone (Consiglio Nazionale delle Ricerche); Dr PILOTTO, Alessandro (DPIA, Univ. of Udine); DRIUSSI, Francesco (DPIA, Univ. of Udine); ANTONELLI, Matias (Istituto Nazionale di Fisica Nucleare); PALESTRI, Pierpaolo (DPIA, Univ. of Udine); Dr STEINHARTOVÁ, Tereza; GIANONCELLI, Alessandra (Elettra Sincrotrone Trieste)

**Presenter:** Mr CAUTERO, Marco (University of Trieste)

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