

Radiation effects in state-of-the art CMOS image sensors

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Overview

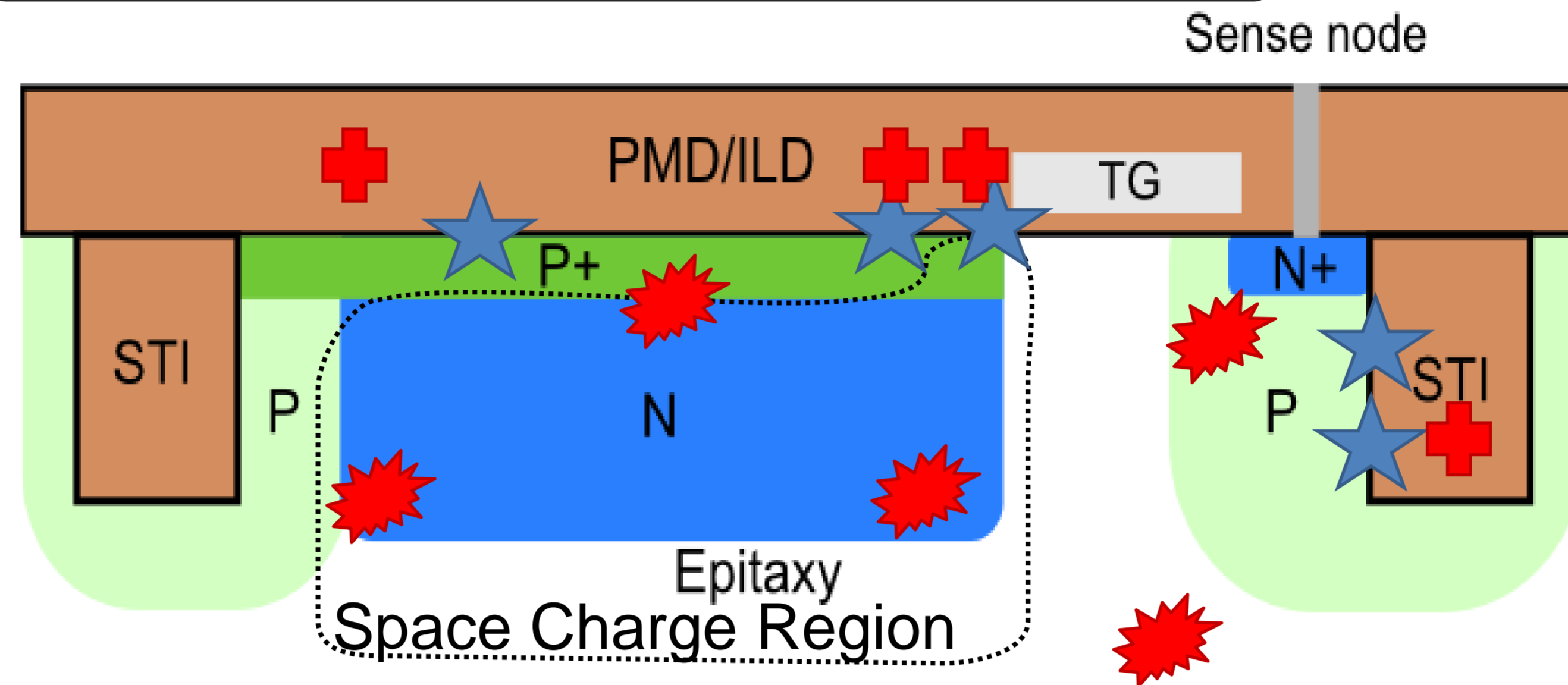
Goal: Study **radiation hardness** of recent **CMOS Image Sensors (CIS)**

DUT: Sony IMX219, commercial device (smartphone)

Main result:

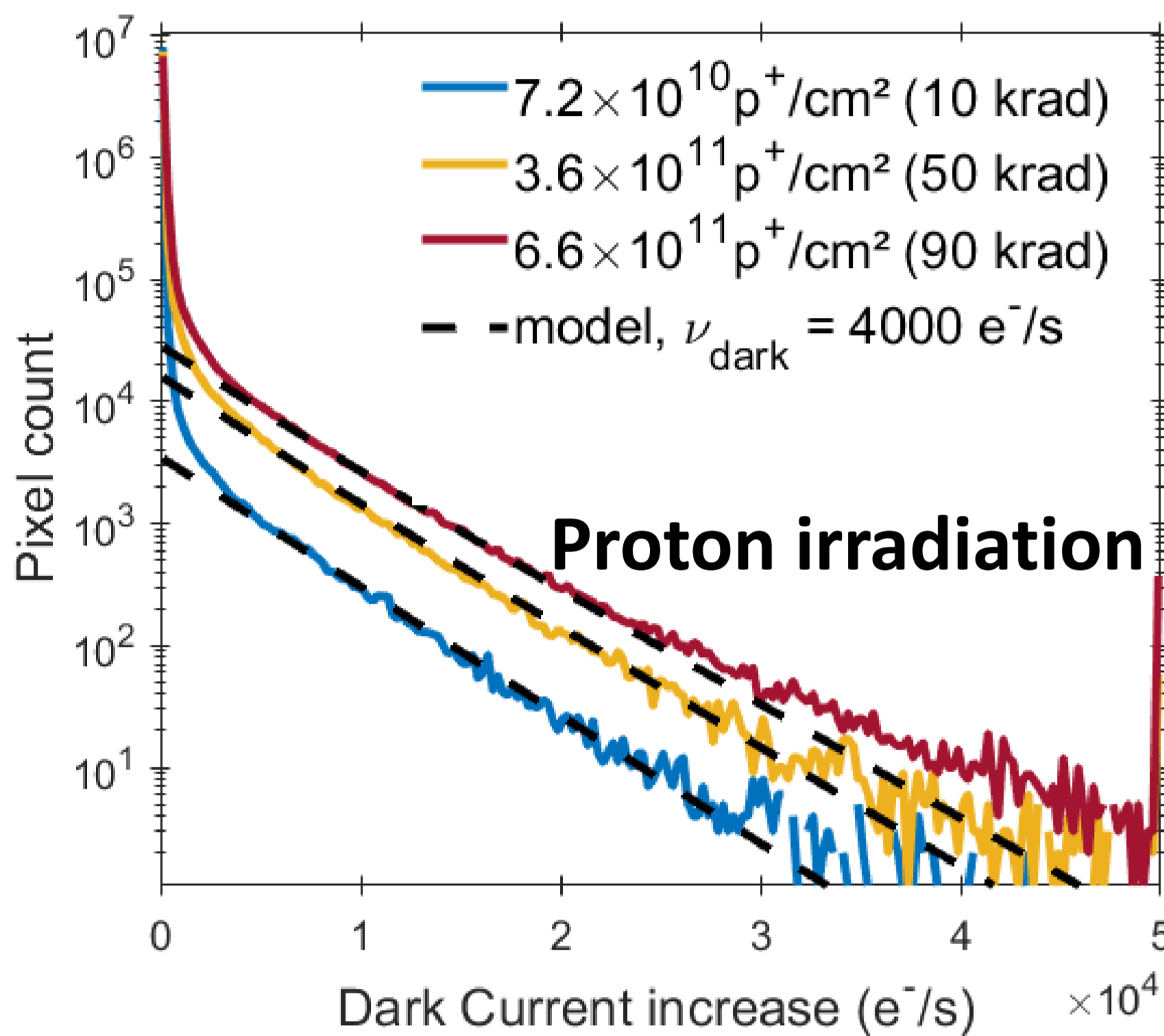
- ✓ Typical CIS degradation trend for displacement damage dose
- ✓ Very good ionizing dose tolerance up to 250 krad

Radiation effects in CIS



-Ionizing dose: Si/SiO₂ Interface States ★
Oxide trapped charges +
homogeneous degradation
-Displacement damage dose: bulk defects ★
exponential tail of hot pixels

Dark current increase

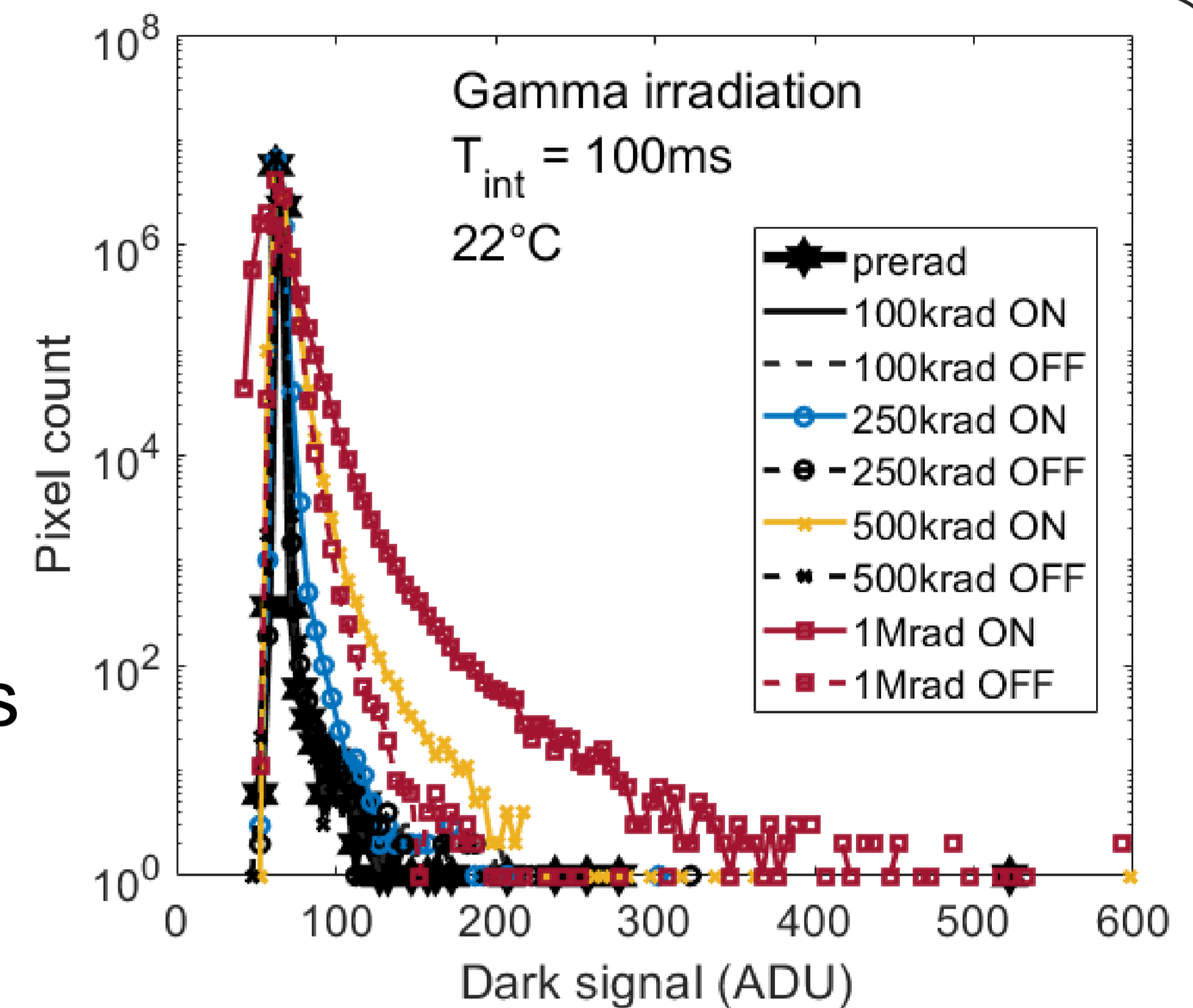


Ionizing dose (gamma irradiation):

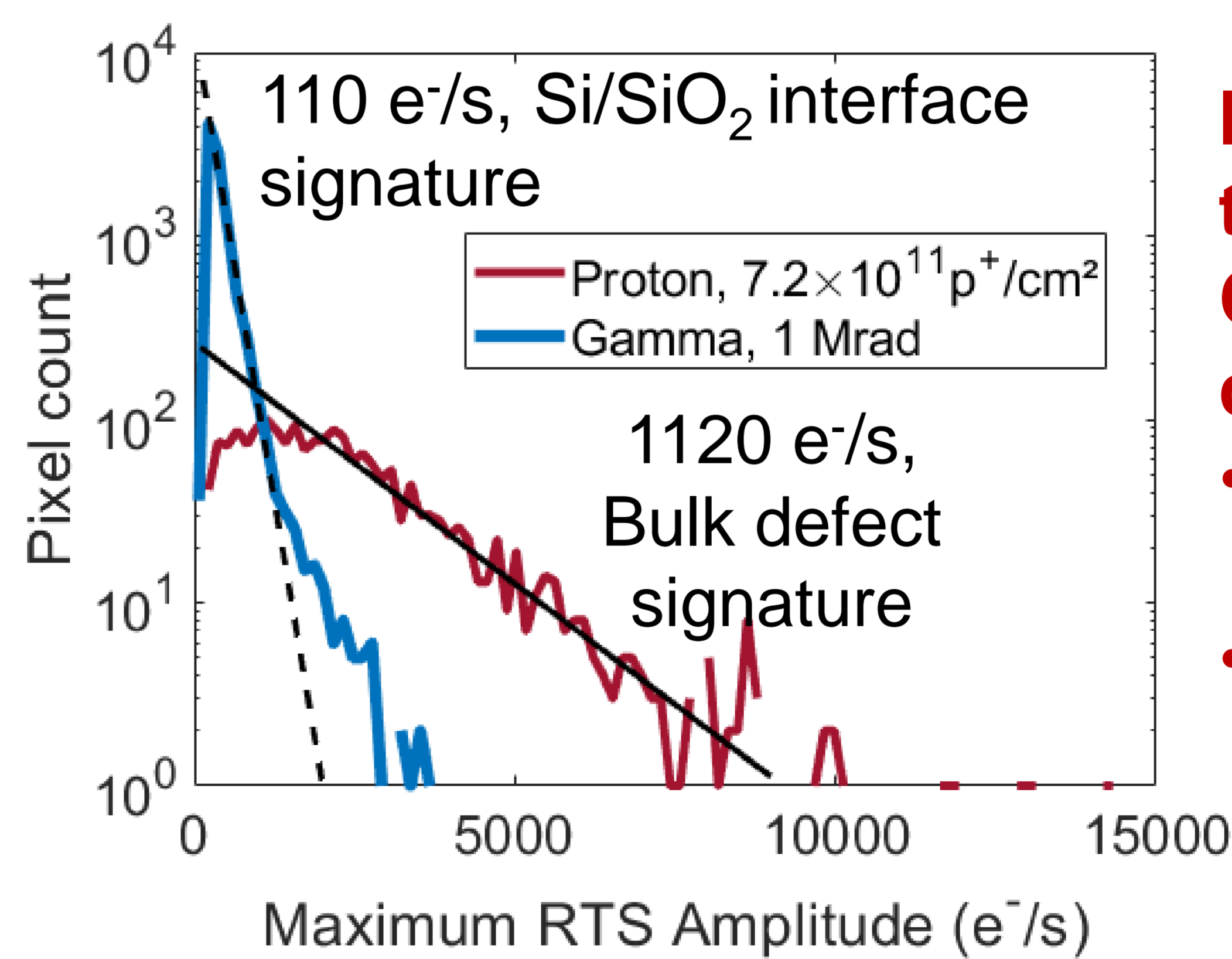
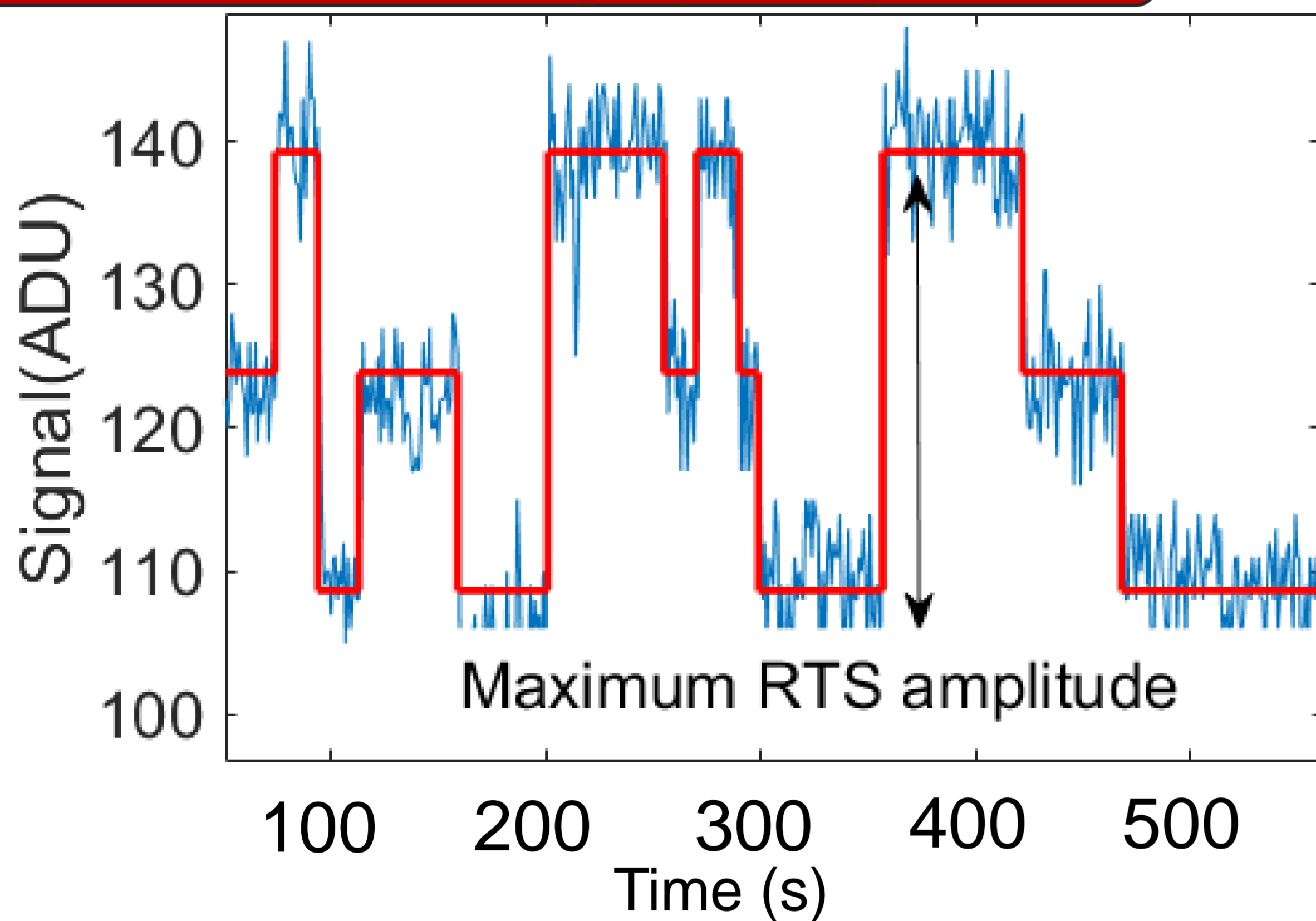
No change in the dark signal histogram up to 100 krad(SiO₂) when biased and up to 500 krad(SiO₂) when grounded

Displacement damage dose (proton irradiation):

Follows typical trend for silicon detectors with 10x smaller microvolumes due to small pixel pitch (1.1 μm)

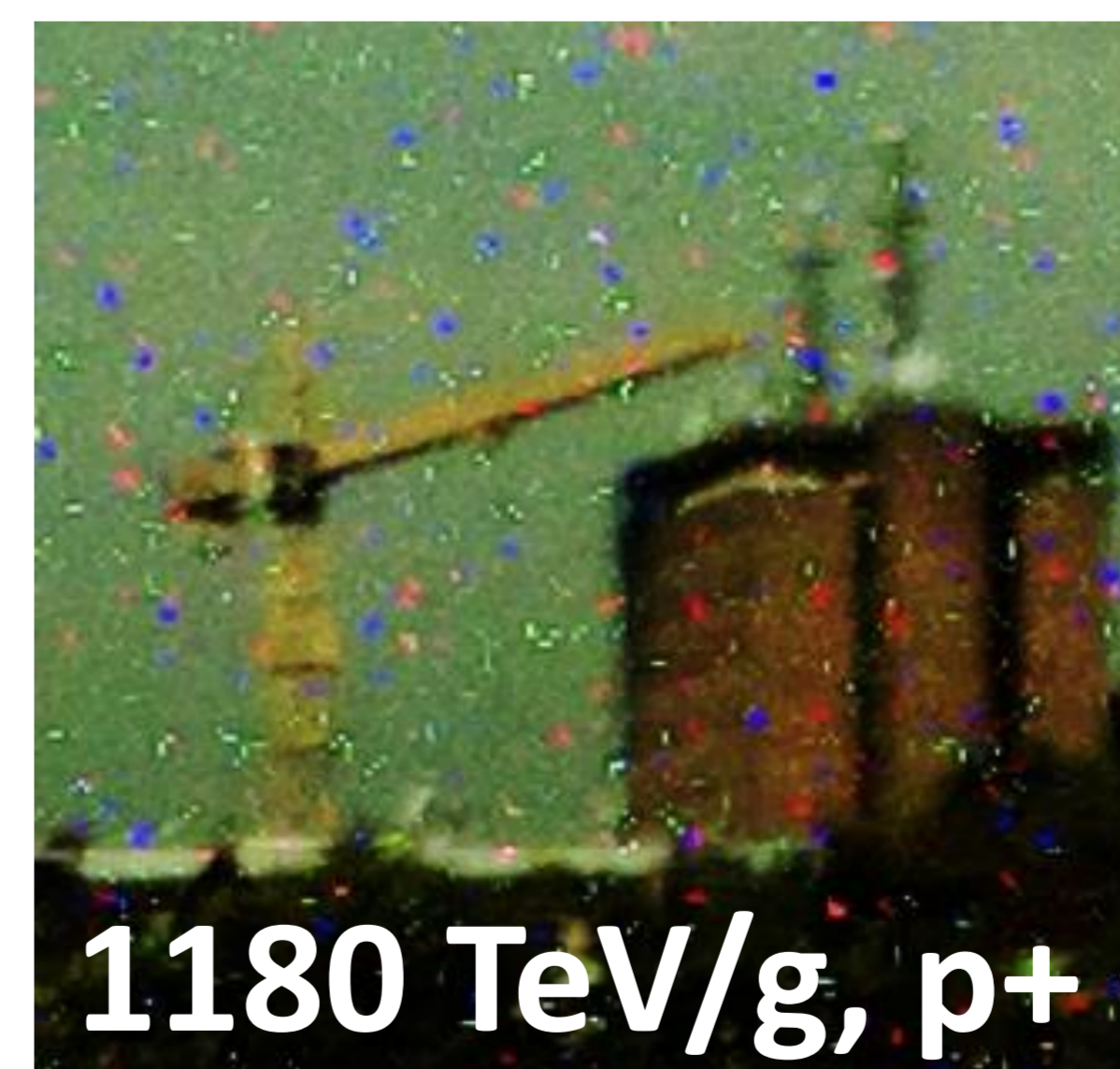
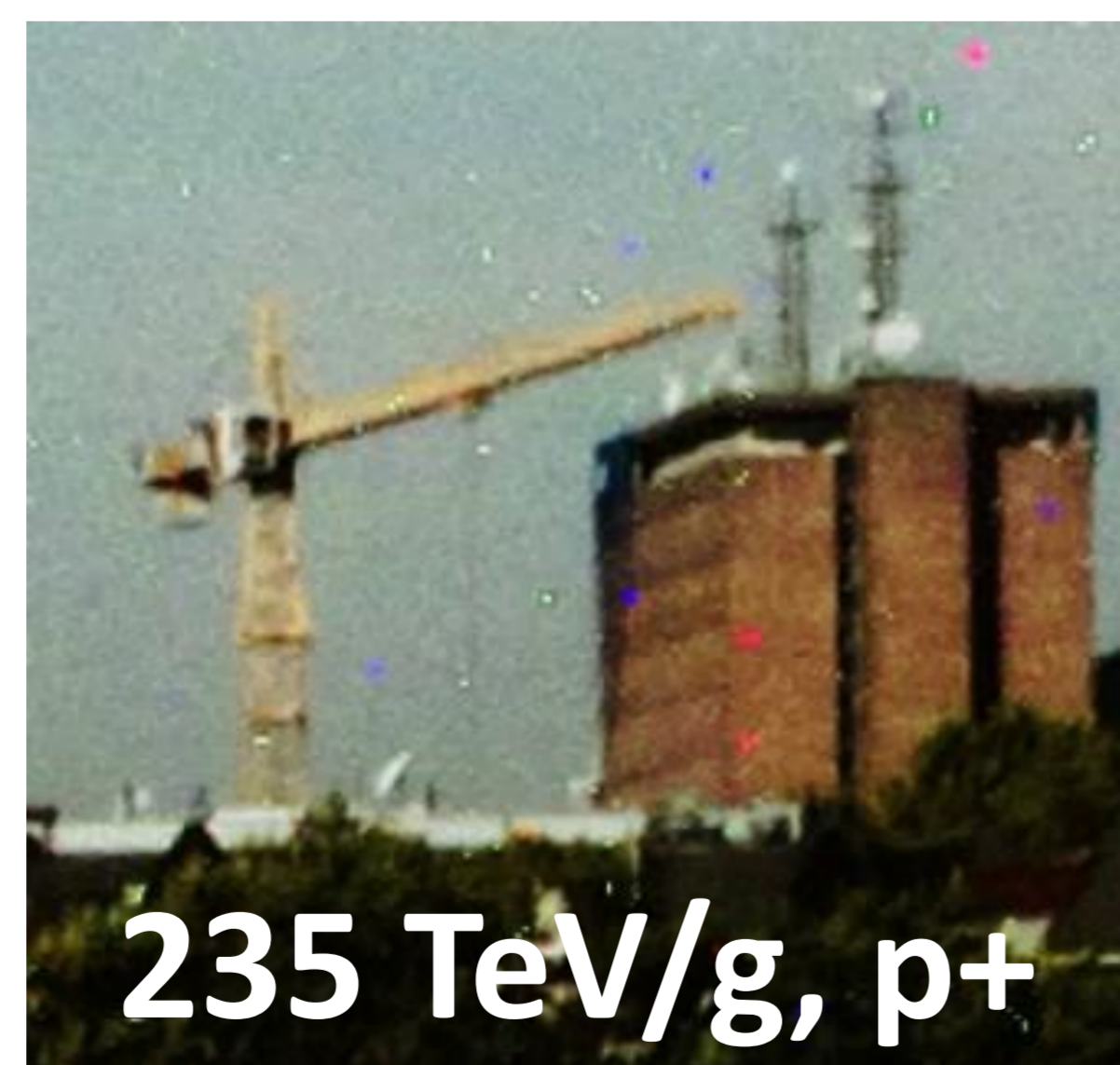


Random Telegraph Signal

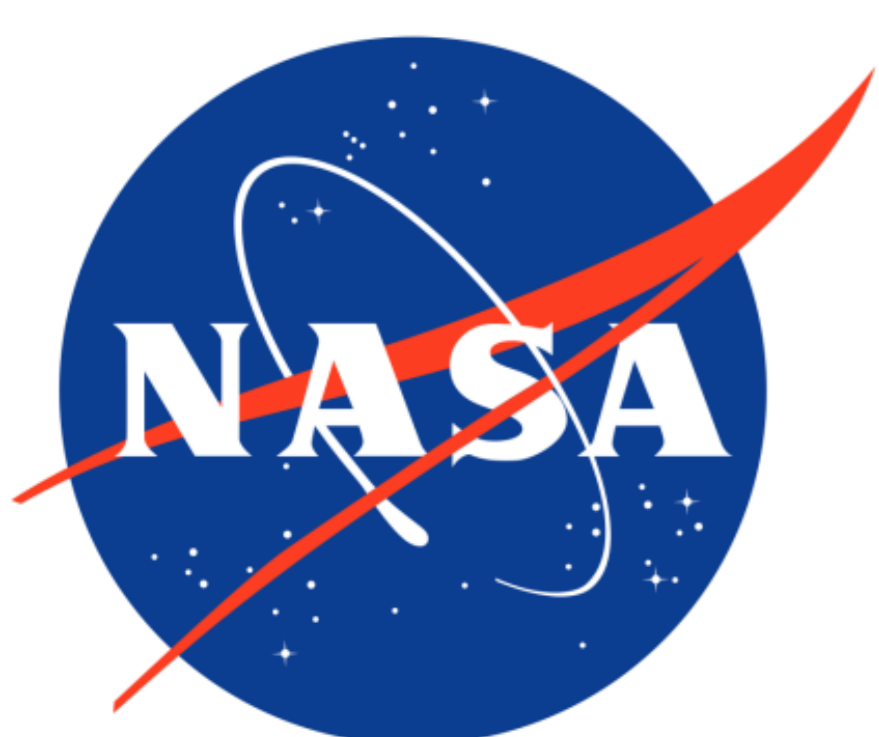


In line with state-of-the-art results for CMOS Image sensors despite:

- smaller pixel pitch than previous work
- pixel design moving away from the planar PPD



- The biasing conditions have a strong impact on the ionizing degradation of the device with the worst-case scenario being when the device is biased and operating during irradiation. The device exhibit a very good tolerance to ionizing dose up to 250 krad.
- Displacement damage induced degradation is in line with state-of-the art trends for CIS both for radiation induced dark current and Random Telegraph Signal.



Conclusions