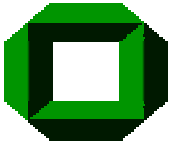
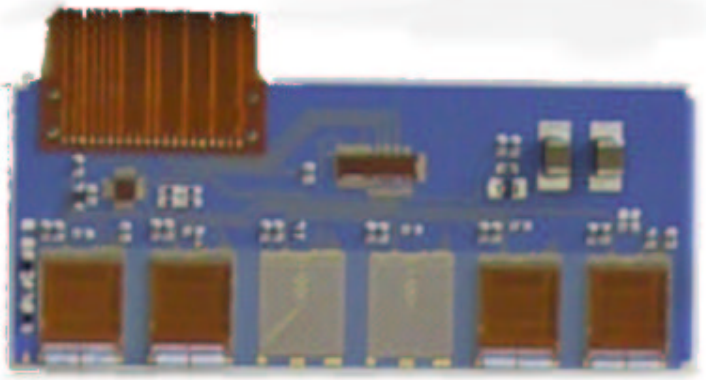


FE-Hybrid Irradiation

Guido Dirkes

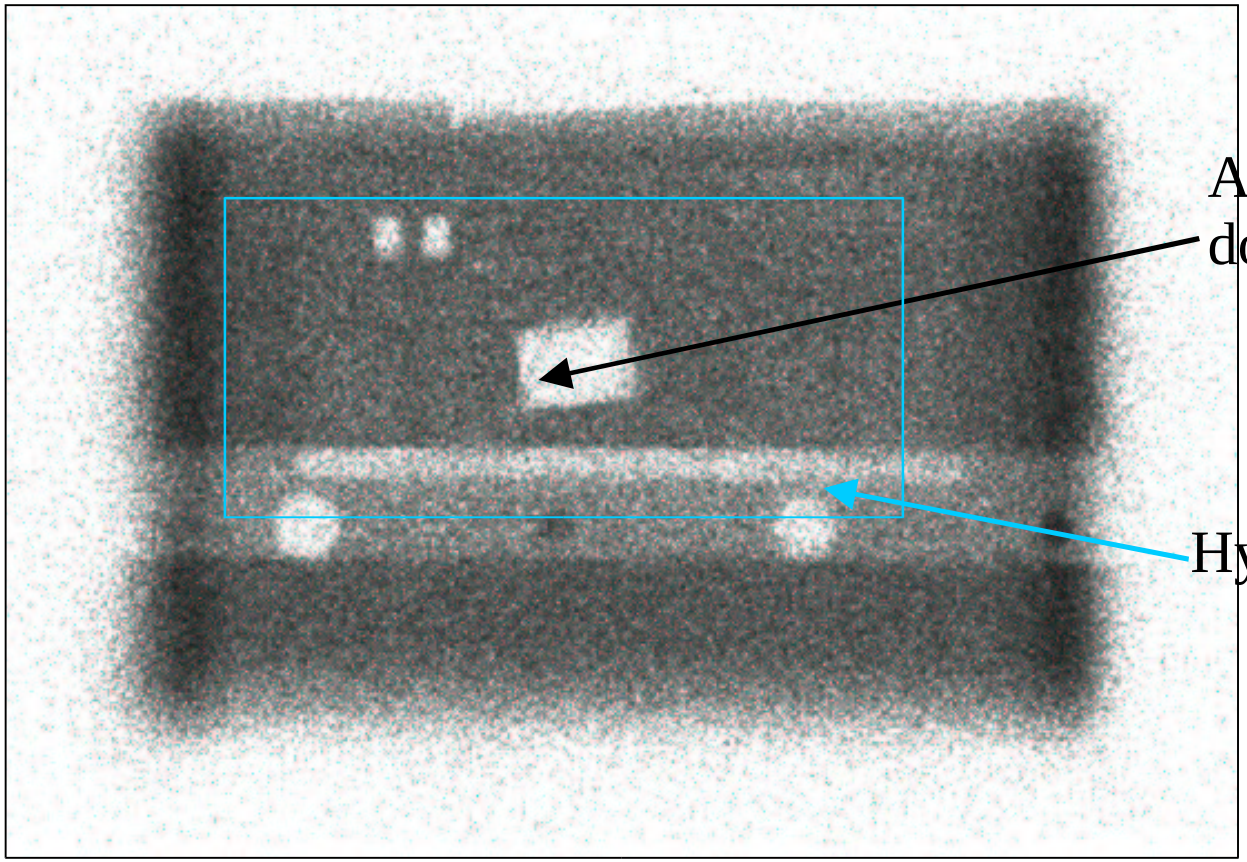
for the Karlsruhe CMS Group

Irradiation of Ceramic Hybrid

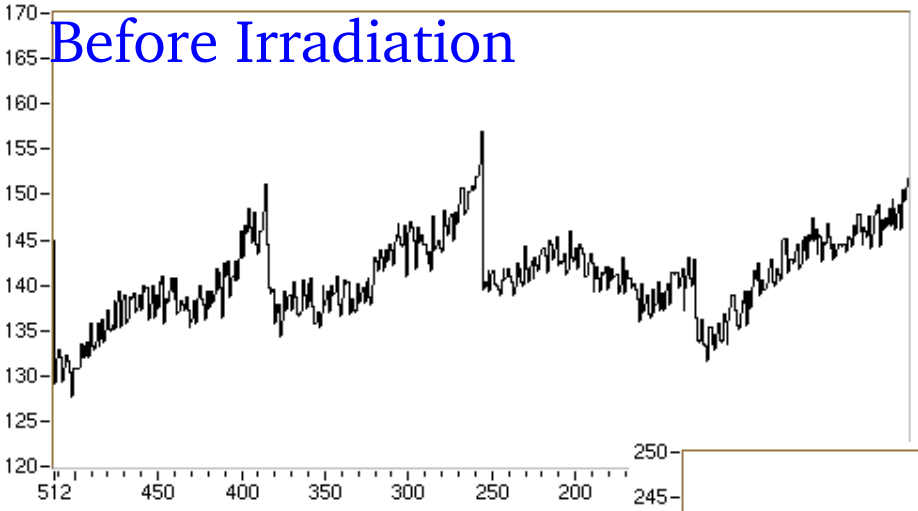


- During irradiation: Clock, Trigger (10Hz), Error Buffer Readout (1Hz), Reset
- Irradiation with 2μA protons up to 2.7e14 p/cm^2 (30 year LHC) at RT
- Result: Hybrid still functional, but ...

Picture of Hybrid on Ni foil

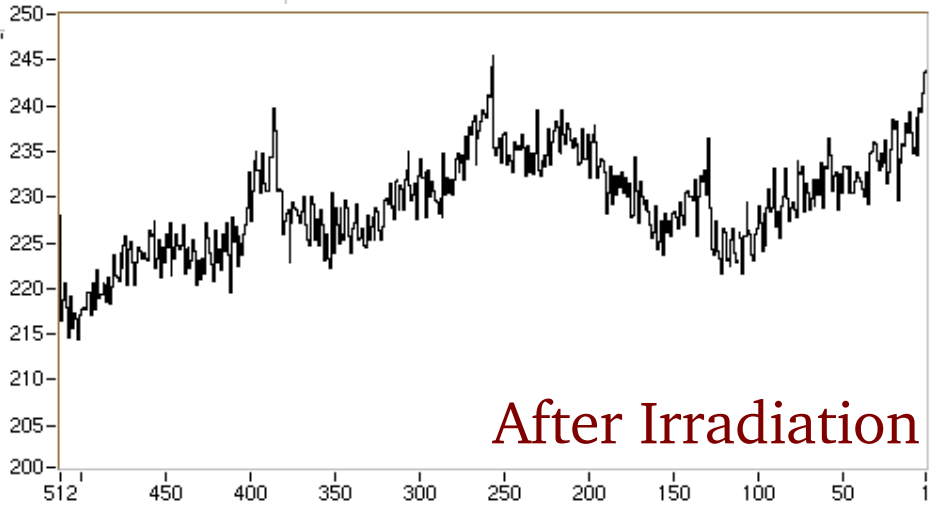


Pedestals

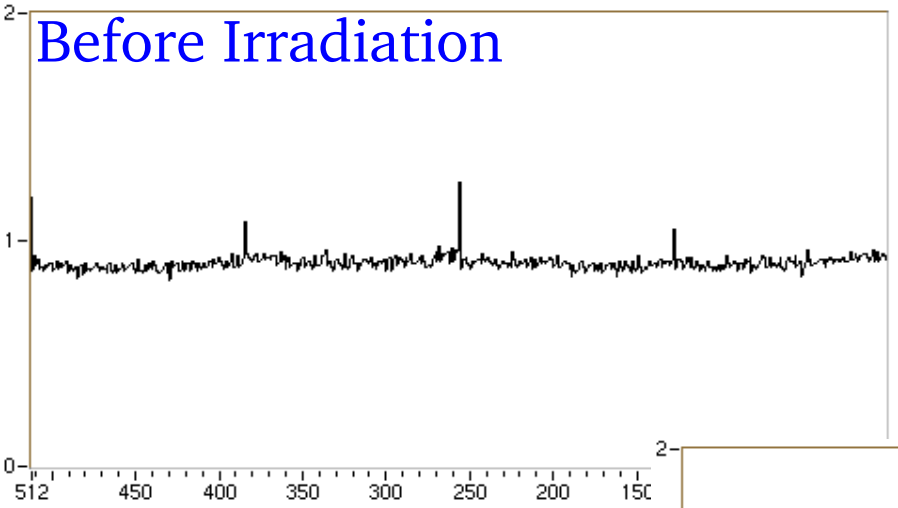


Deconvolution mode
standard settings

- Pedestal increased by a factor of approx 1.6
- Shape unchanged

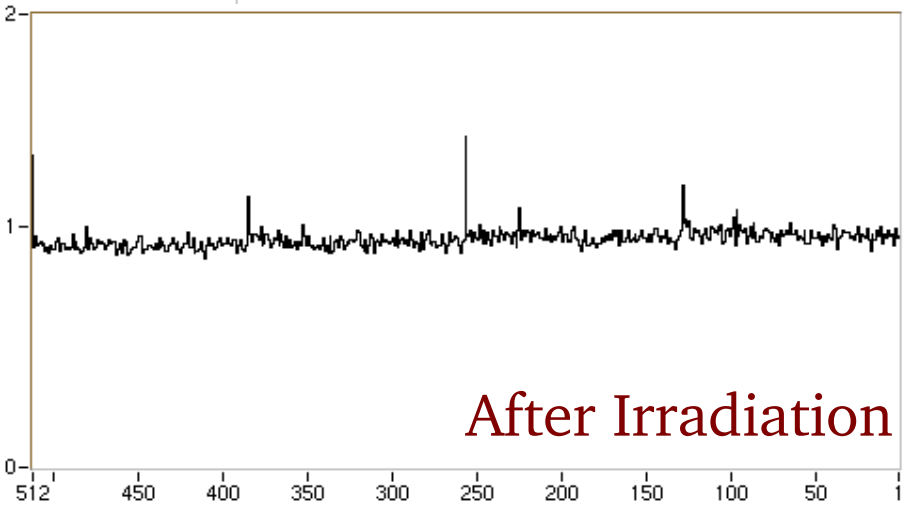


Noise

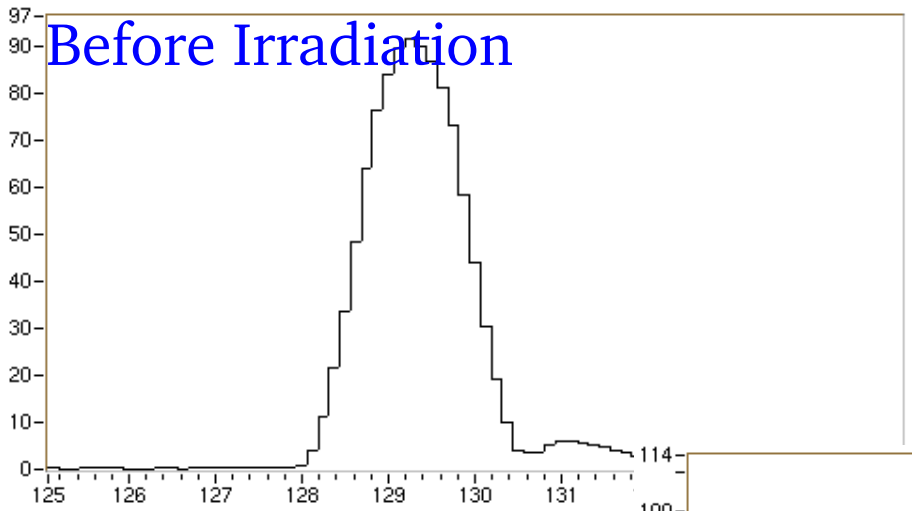


Deconvolution mode
standard settings

Slidly increased
(below 10%)

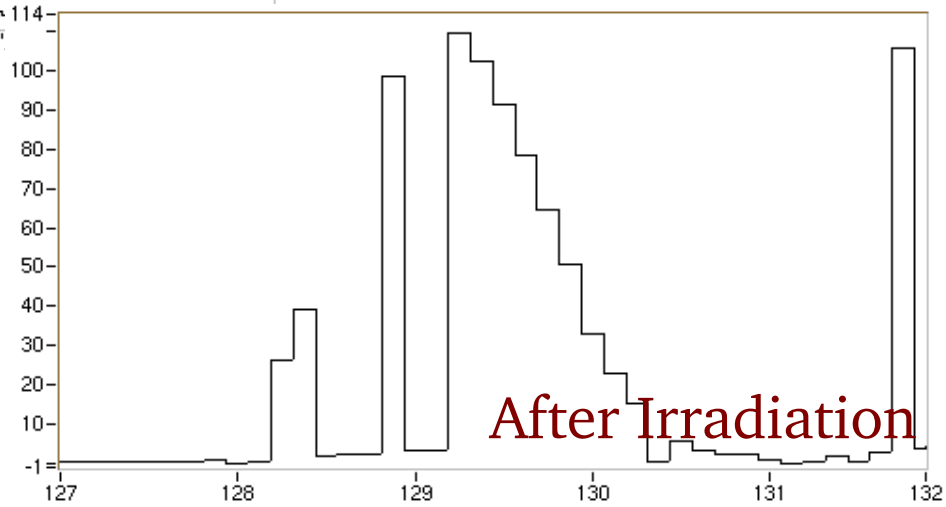


Calibration Pulse Shape



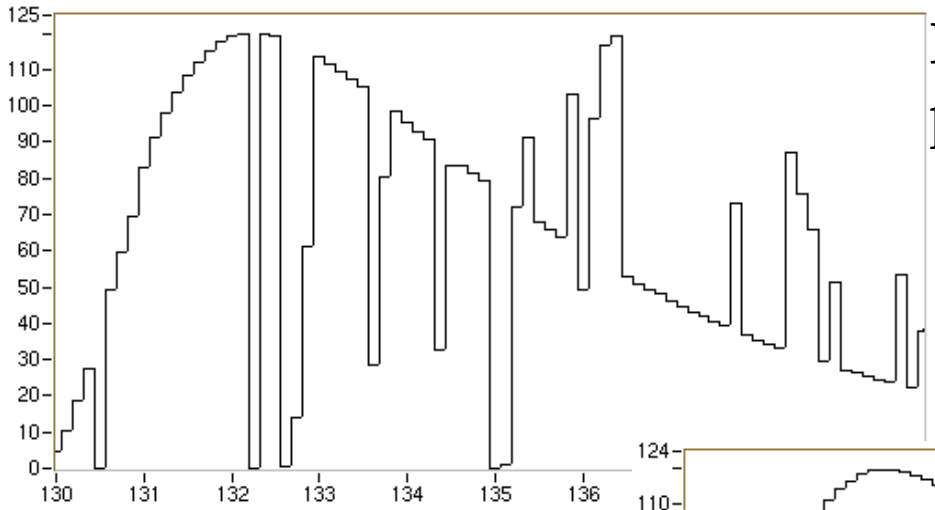
Deconvolution mode
standart settings

What happend ?

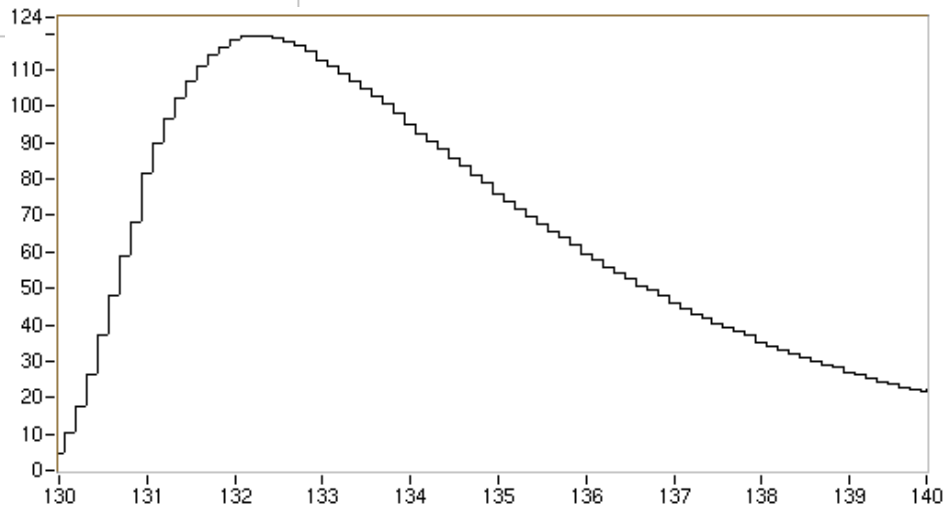


Plots have diffentent binning

Resets and Calibration Pulse Shapes



Resets after each scan point



Resets do influence the pulse shapes

=> Error on Chip !!!

Resets only after latency change (took several attemps)

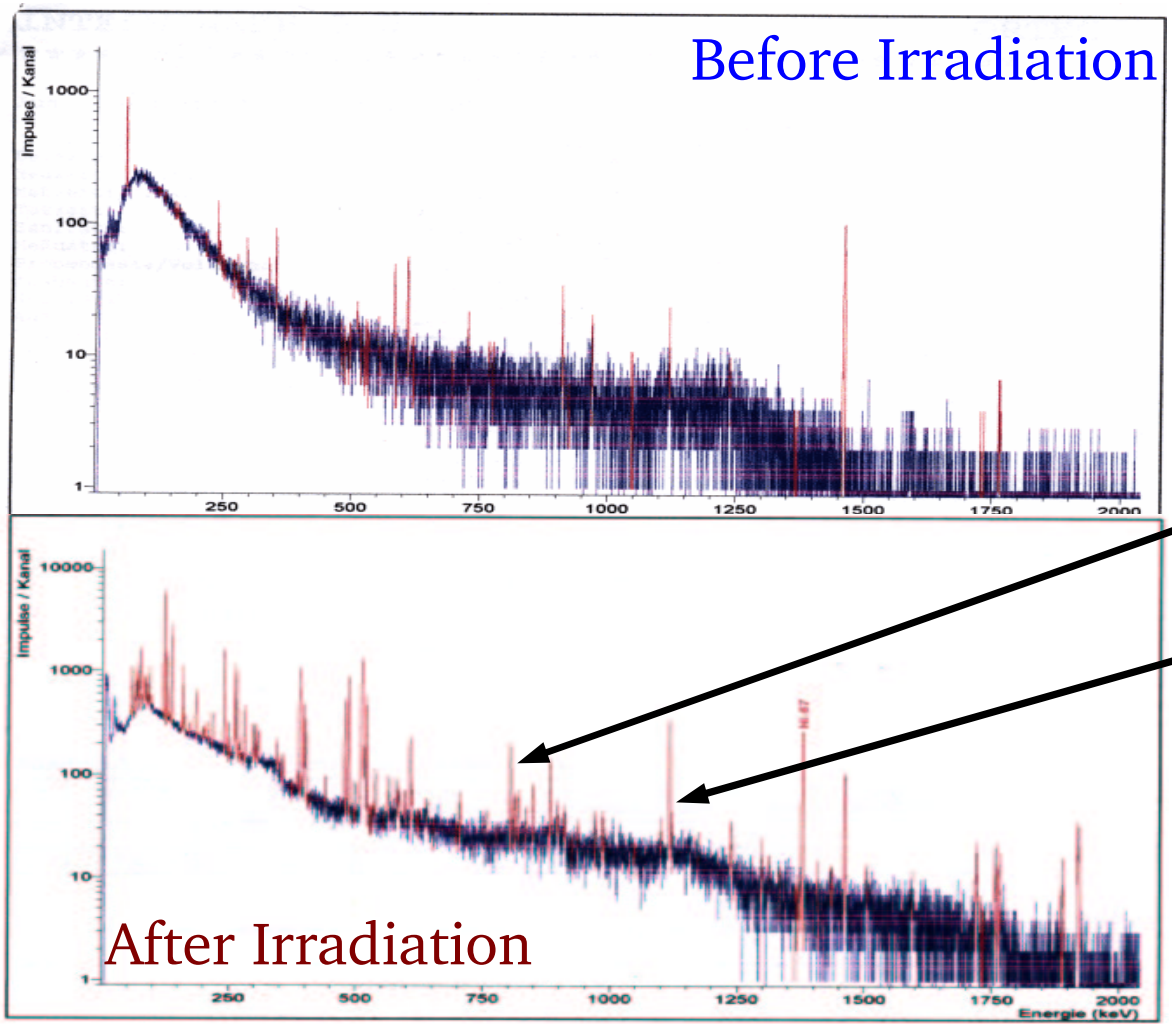
FR4 Irradiation

Bare hybrid without any components mounted

- Irradiation with 2μA protons up to 1.3e14 p/cm^2 (15 years Inner Barrel flux) at RT
- No visible defects
- No signs of delamination
- Activated with approximatly 1Bq/cm^2 (after 1 week)

Isotopic activation

Different scale (logarithmic | factor of 4 difference)



Bi^{206} from Pb

Zn^{56} from Cu

+ lines from Ni (contermination by dosemetry)

Conclusions

- Hybrid still functional after 30 years of LHC, but
  - Minor (?) error in the calibration curcuit
  - Increase of pedestal values

- FR4 Hybrid irradiated with 15 year of Inner Barrel Flux
  - No signs of delamination
  - Investigate activation sources (conterminations)