An update on charge collection and E-TCT measurements with CHESS-1 chip

I. Mandić et al., Jožef Stefan Institute, Ljubljana, Slovenia New results:

- CCE with Sr-90 at new fluence step:
 2e15 (Device 1), 5e14 (Device 2), before irradiation (Device 3)
- 2. E-TCT measurements: 5e14 (Device 2) and before irradiation (Device 3)

Sr-90 electrons, mean charge, 25 ns shaping



- Charge after irradiation with 2e15 n/cm2 larger than after 1e15 n/cm2
 → compatible with E-TCT measurements with HV2FEI4 chip)
- good agreement between devices: Dev1 (full line), Dev2 (dashed) and Dev 3 (dotted)

Sr-90 electrons, mean charge, 25 ns shaping



• good agreement between devices

 \rightarrow largest discrepancy at 500 ns shaping at 5e14 but not dramatic, wait for more measurements

•Consistent with measurement with E-TCT measurements on HVCMOS2FEI4 chip by G.Kramberger (more info in https://indico.cern.ch/event/334251/session/1/contribution/15/material/slides/0.pdf)



Charge collection region measured with E-TCT on HVCMOS2FEI4 chip

- effective acceptor removal: depletion region increases with fluence
- collected charge first drops with fluence because of reduced diffusion

- new device (Device 3) measured before irradiation
- charge collection profile across pixel centre: good agreement Dev2/Dev3





Charge collection profile (depth), device 2, different fluences:





large difference in charge collection width between 2e14 and 5e14 measured with E-TCT on PPA11
 → on Sr90 setup almost no difference between 2e14 and 5e14 (large passive array, see slide 3)

ightarrow not understood

ightarrow there are differences between devices:

- PPA11 (E-TCT): 45 μm x 100 $\mu m\,$ pixels, 30% diode fraction
- large passive array (Sr90): 45 μm x 200 $\mu m\,$ pixels, 40% diode fraction



Profile along the pixel length at 35 μ m depth:

• charge collection region larger after 5e14 (blue)

x (µm)

(LTL) 100 A (LTL)

> 20



• gaps between pixels of the PA11 array can be seen before irradiation

- \rightarrow much smaller after 5e14
- ightarrow charge collection region larger after 5e14

Summary:

- charge measured with Sr90 setup after irradiation with 2e15 neutrons /cm2 larger than after 1e15
- consistent with measurements on HVCMOS2FEI4 chip by G. Kramberger
 - → depleted region increases because effective doping concentration is reduced by irradiation

• E-TCT

- \rightarrow large increase of charge collection depth after 5e14 neutrons compared to 2e14
- → small difference of collected charge measured with Sr90 with between 2e14 and 5e14
 → from E-TCT would expect significantly more charge with Sr90 after 5e14
 → no explanation, wait to see the results with other devices and at higher fluences

• next fluence steps:

- \rightarrow device 1: 5e15, device 2: 1e15 and device 3: 2e14, already irradiated
- \rightarrow start measurements next week