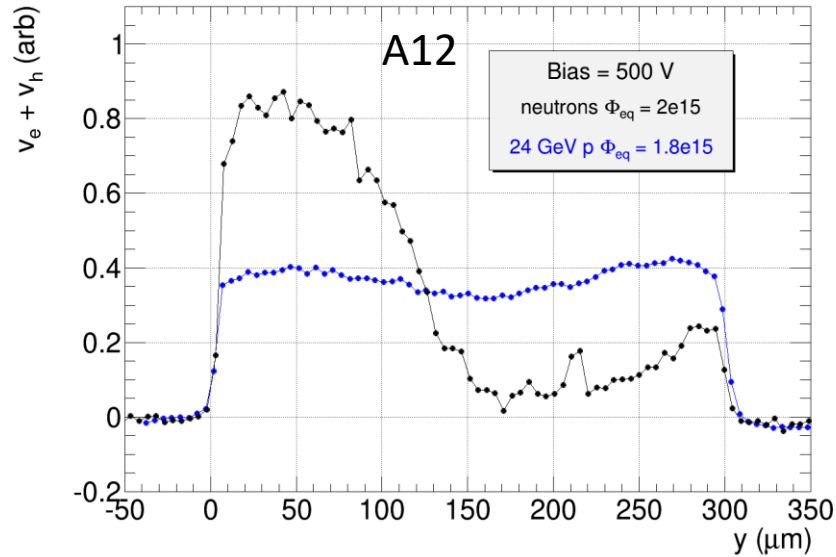Velocity profiles measured with E-TCT give information about electric field in the detectors
- after IRRAD protons or PSI pion irradiation profiles different than after neutron irradiation
 ➔ check the effect of electric field shape on collected charge of a MIP


Proton and neutron profiles normalized to same integral from 0-300 um:
https://indico.cern.ch/event/448475/contributions/1113821/attachments/1174185/1696612/StripSensor_IM_Oct_2015.pdf
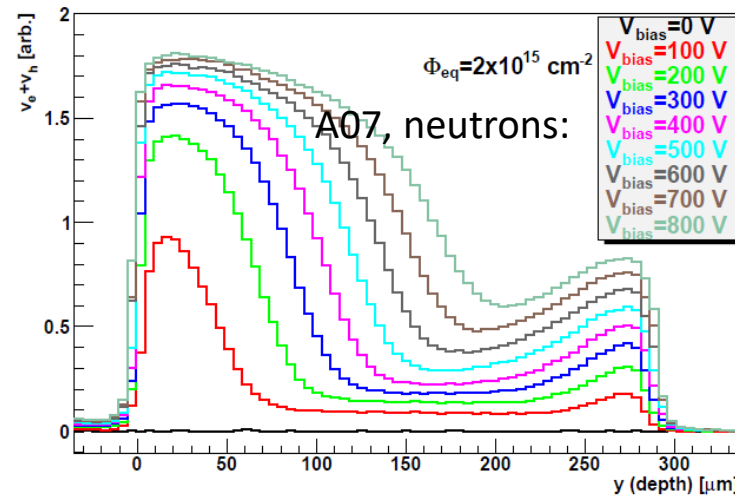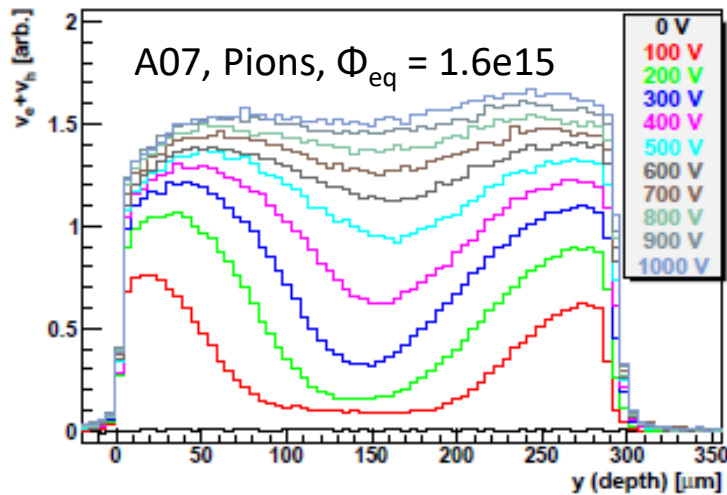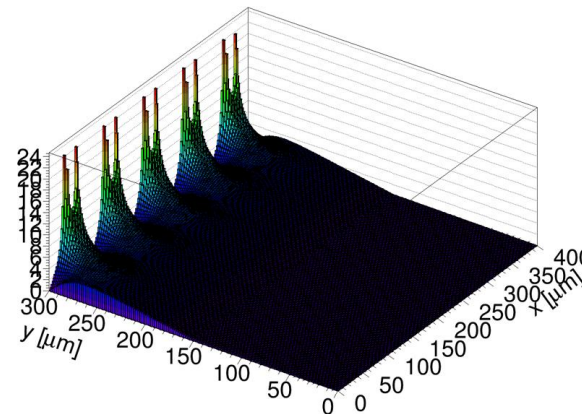

G. Kramberger et al., 2014 JINST 9 P10016

Try a simple simulation to see the effect of field shape on charge collection
Use KDetSim (http://kdetsim.org/ , written by G. Kramberger
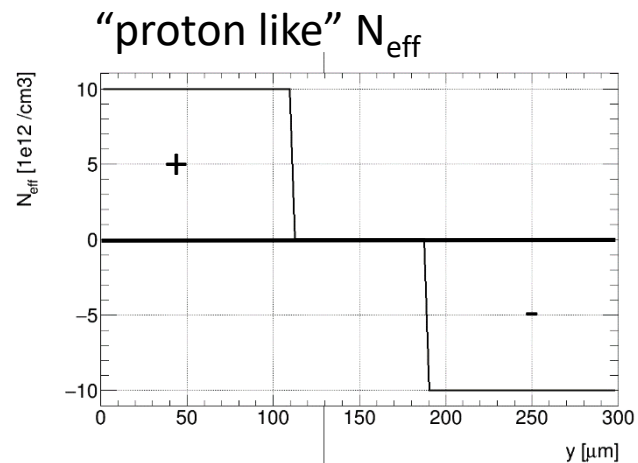

KDetSim

Weighting field
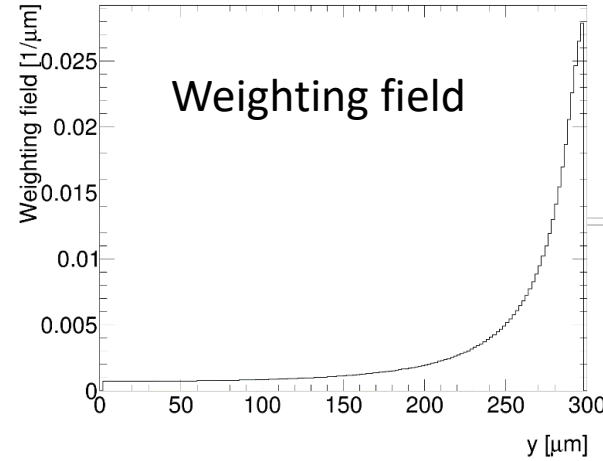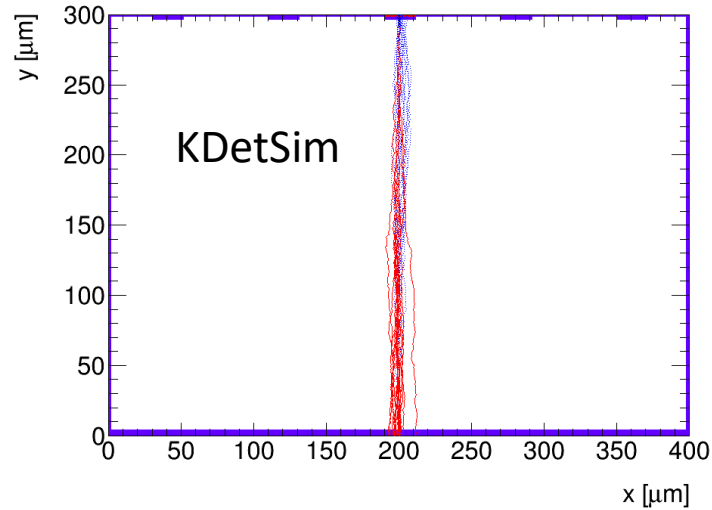
300 um thick strip detector,
Calculate charge collected after passage
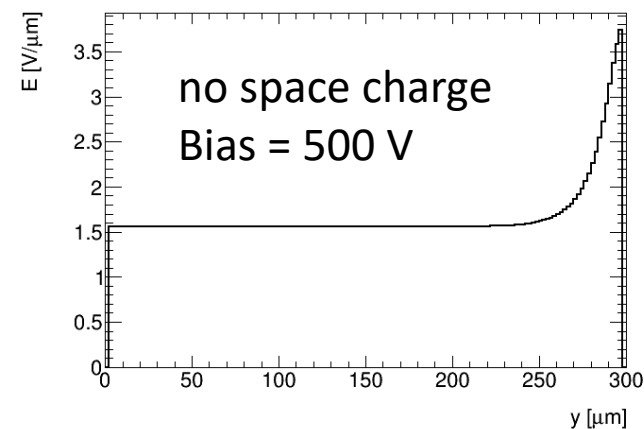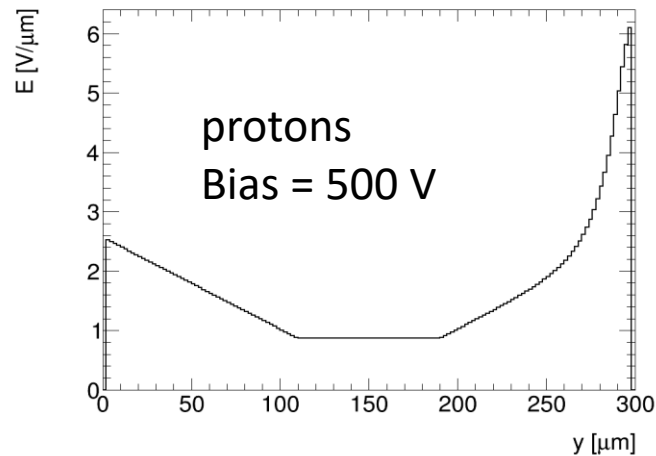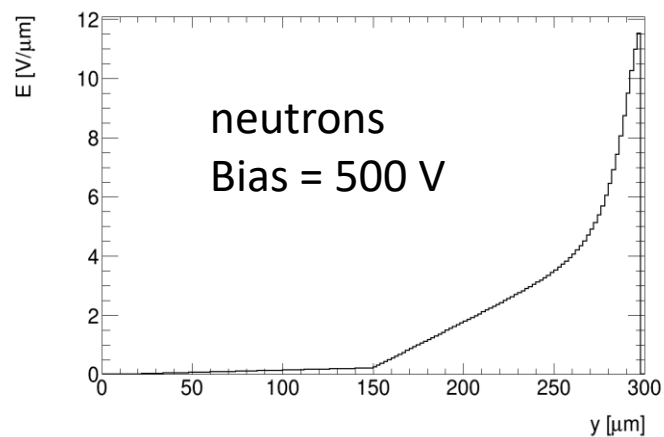of a MIP perpendicular through
the centre of the strip

E field
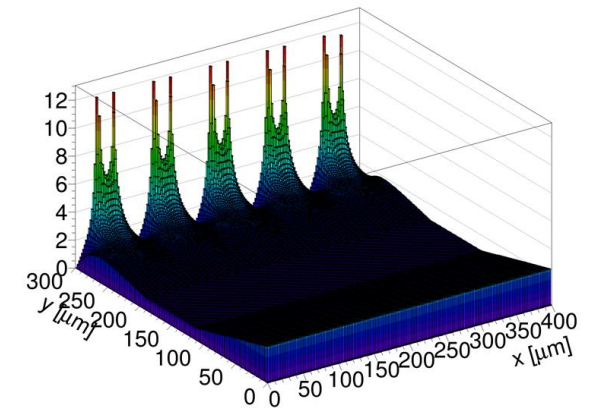
- input to the simulation is the effective space charge concentration
  ➔ chosen to very roughly match measured velocity profiles

"neutron like" N_{eff}

"proton like" N_{eff}
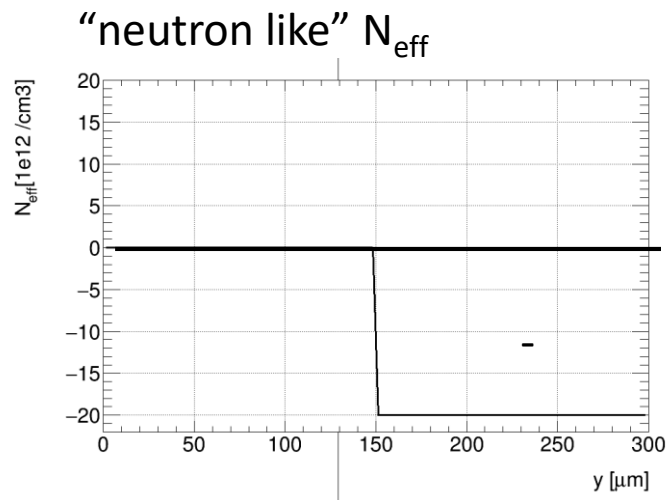
$N_{eff} = 0$

Electric field at x at the middle of the strip

neutrons
Bias = 500 V

protons
Bias = 500 V

no space charge
Bias = 500 V

<u>Charge trapping:</u>

$Q = Q_0 \cdot exp(-t/\tau)$

$1/\tau = \beta \cdot \Phi_{eq}$

Measurements of trapping constant ß with IRRAD protons:

1. *W. Adam et al 2016 JINST 11 P04023,* measured on n-type Si at Φ = 1.5e15 neq/cm2, **ß ~ 3e-16 /ns**
2. *V. Cindro et al., NIMA 599 (2009) 60–65*, measured in p-type DOFZ up to Φ = 3e14 neq/cm2, **ß ~ 4e-16 /ns (similar for neutrons)**
3. G. Kramberger et al., NIMA 481 (2002) 297-305, measured in n-type materials, up to Φ = 3e14 neq/cm2, **ß ~ 7e-16 (ß ~5e16 for neutron irradiation)**

Plot shows collected charge as a function
of trapping constant for electric fields shown on previous slide
(assuming 23050 electron is full charge collection and Φ = 1.6e15)

Phi = 1.6e15

- at same trapping probability larger charge is expected after proton irradiation if electric field from the previous slide is assumed
- same (or smaller) charge after proton irradiation than neutron irradiation indicates larger trapping probability after PS protons
  ➔ seen in G. Kramberger et al., NIMA 481 (2002) 297-305

Warning:
In this example charge is calculated for a perpendicular track through the middle of the strip. In Sr-90 measurements tracks cross at
different points and under different angles and clustering is performed so numbers should not be directly compared to Alibava measurements