microTPC simulation

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for the Belle2 Collaboration

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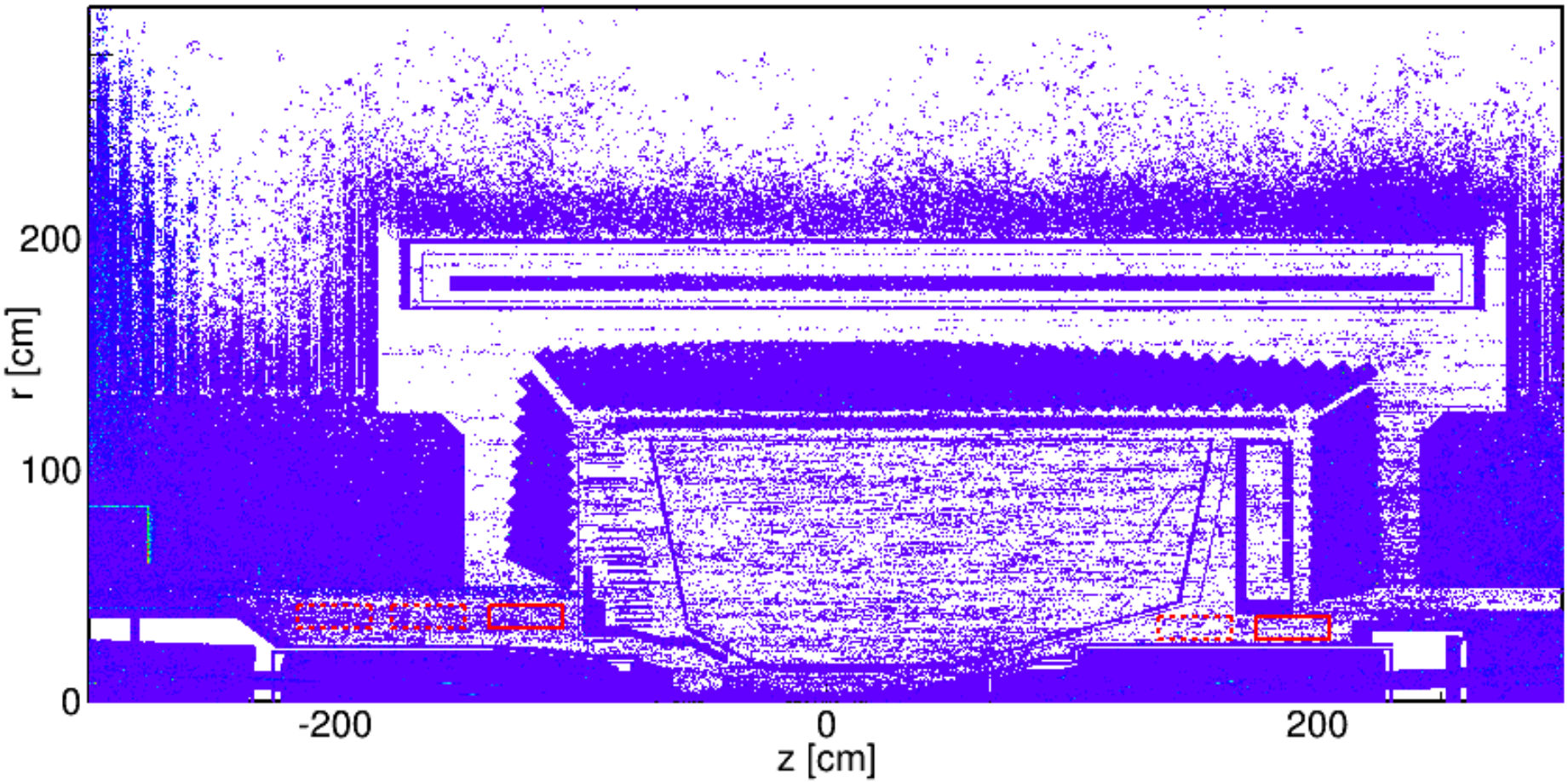
T2 dock spaces / radial view

5th campaign distribution for the particle decay points in the radial plane r = $\sqrt{x^2 + y^2}$ versus z-axis.

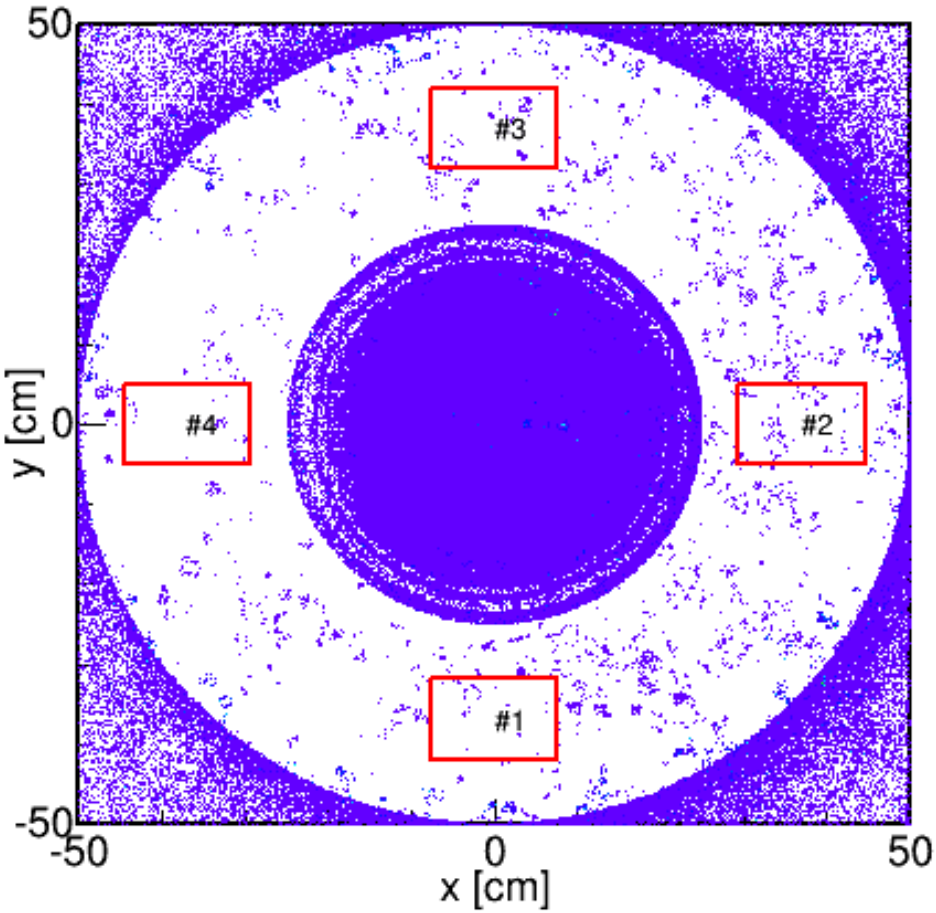
- 4 x 6 inch box

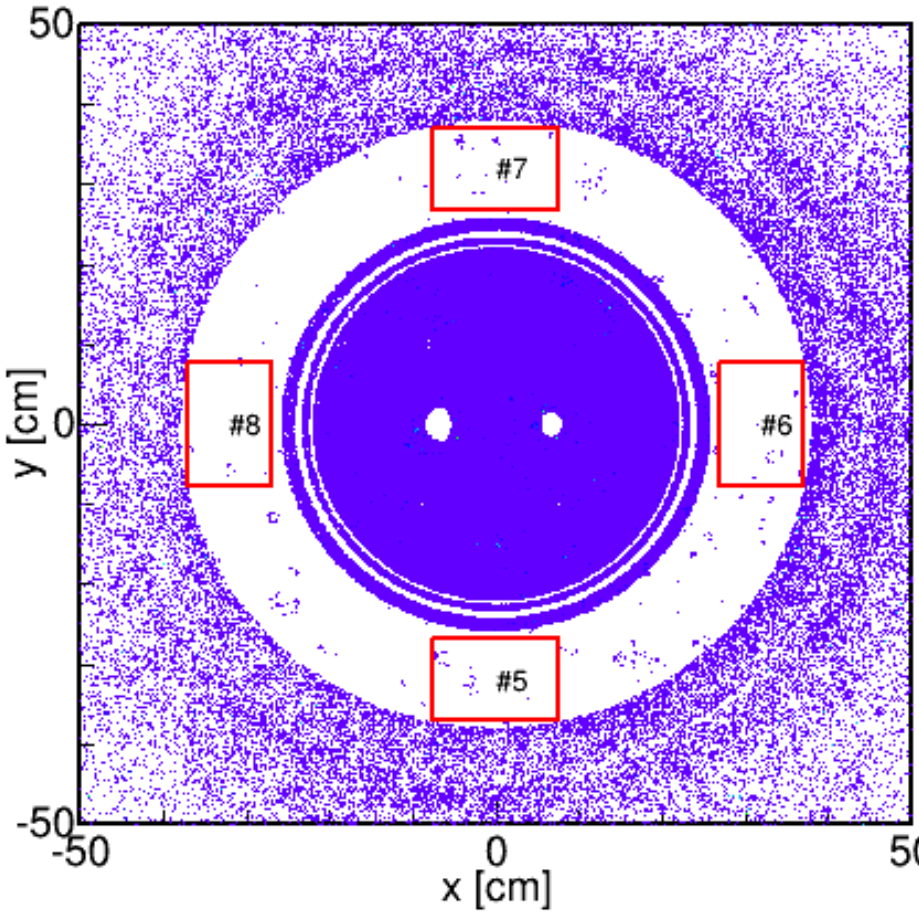


T2 dock spaces / transverse view

5th campaign distribution for the particle decay points in the plane perpendicular to the z-axis.

- Left: for -210 $\leq$ z $\leq$ -105 cm ie backward dock space.
- Right: for 155 $\leq$ z $\leq$ 212 cm ie forward dock space.
- forward dock space seems to be tight ! Is it a problem ?





Optimized gas parameters

Table: Iso-butane optimized drift velocity and field.

chip	time resolution [ns]	pixel size [μm]	v_{drift} [μm/ns]	E [kV/cm]	D_t [$\mu m/\sqrt{cm}$]
FE-I3	25	400	16	0.5	130.5
FE-I4	25	250	10	0.3	148

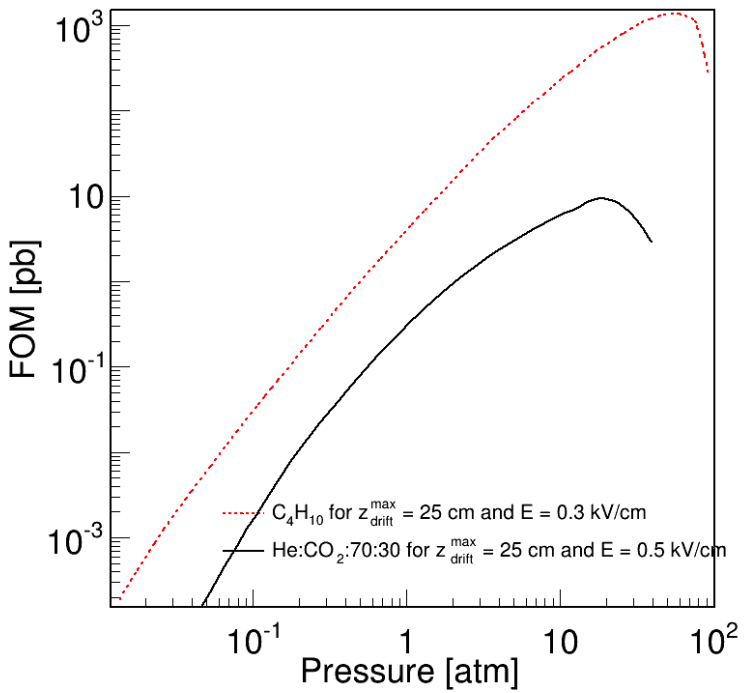
Table: He:CO_2:70:30 optimized drift velocity and field.

chip	time resolution [ns]	pixel size [μm]	v_{drift} [μm/ns]	E [kV/cm]	D_t [$\mu m/\sqrt{cm}$]
FE-I3	25	400	16	0.84	124.5
FE-I4	25	250	10	0.53	124.3

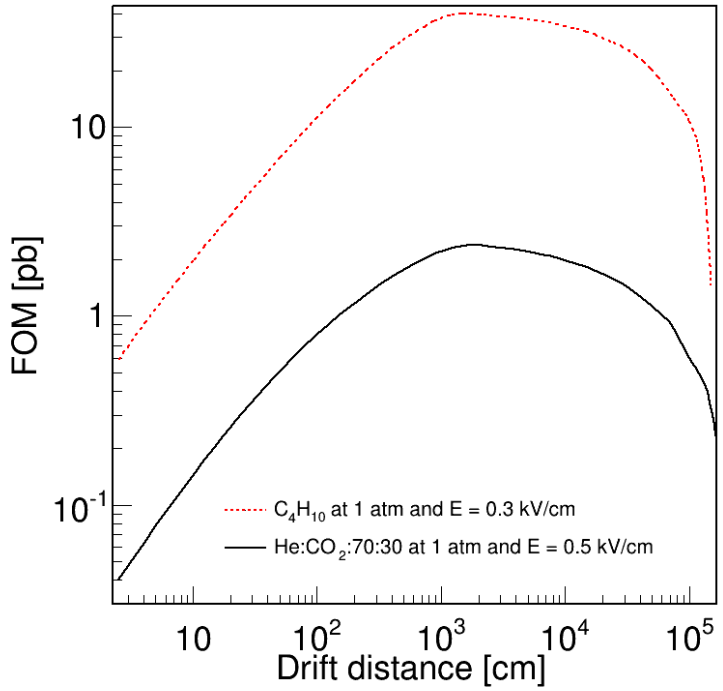
Figure-Of-Merits

- L $>$ 6 x $\sigma_{diffusion}$(z) and L^{max} = 3 cm
- He:CO_2:70:30 at 8 atm FOM = C_4H_{10} at 1 am FOM
  - can we operate with the current prototype He:CO_2:70:30 at 8 atm or pressure above 1 atm ?
- z_{drift}^{max} much higher than designed 25 cm because no hard cut off in the recoil energy spectrum

- pressure FOM



- drift distance FOM



Gain Figure-Of-Merits I

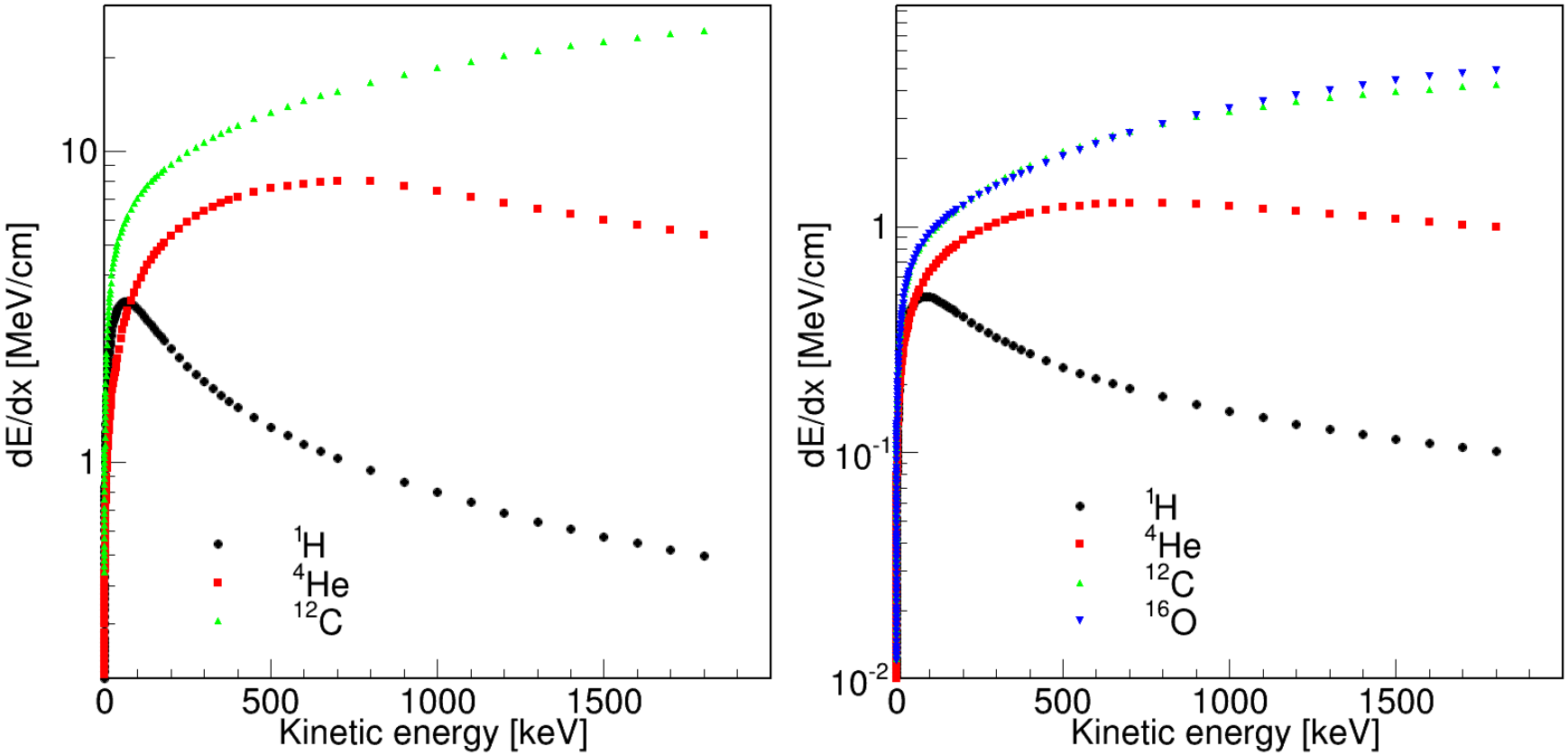


Figure: SRIM calculation of electronic energy loss to the gas electron per centimeter versus recoil kinetic energy. Left: Black point H. Red square He, Green triangle C in C_4H_{10} at 1 atm. Right: Black point H. Red square He, Green triangle C and Blue triangle down O in He:CO_2:70:30 at 1 atm.

Gain Figure-Of-Merits II

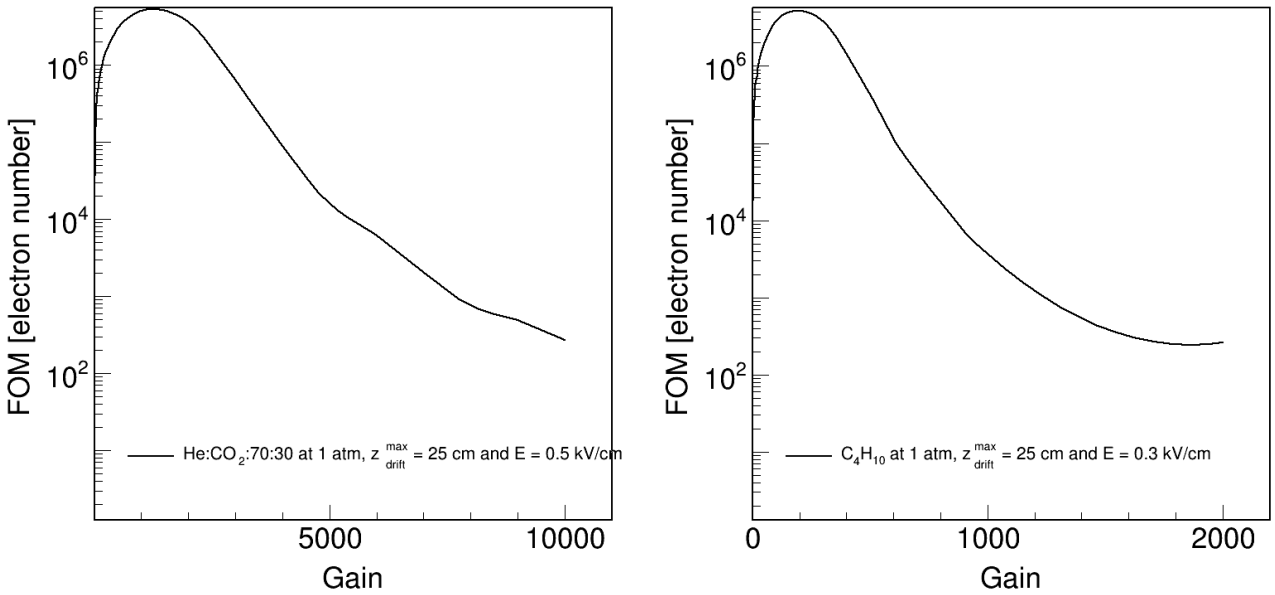


Figure: Gain figure-of-merit for 25 cm drift distance, 1 atm and 200 μm pixel size. Left: for He in He:CO_2:70:30. Right: for H in C_4H_{10}.

Table: Average electron number per pixel and optimal gain for He:CO_2:70:30 and C_4H_{10} at 1 atm.

gas	He in He:CO_2:70:30	H in C_4H_{10}
electron number per pixel	131	940
optimal gain	1300	200

=> at 8 atm, gain(He:CO_2:70:30) = 90 => one GEM !

Field cage

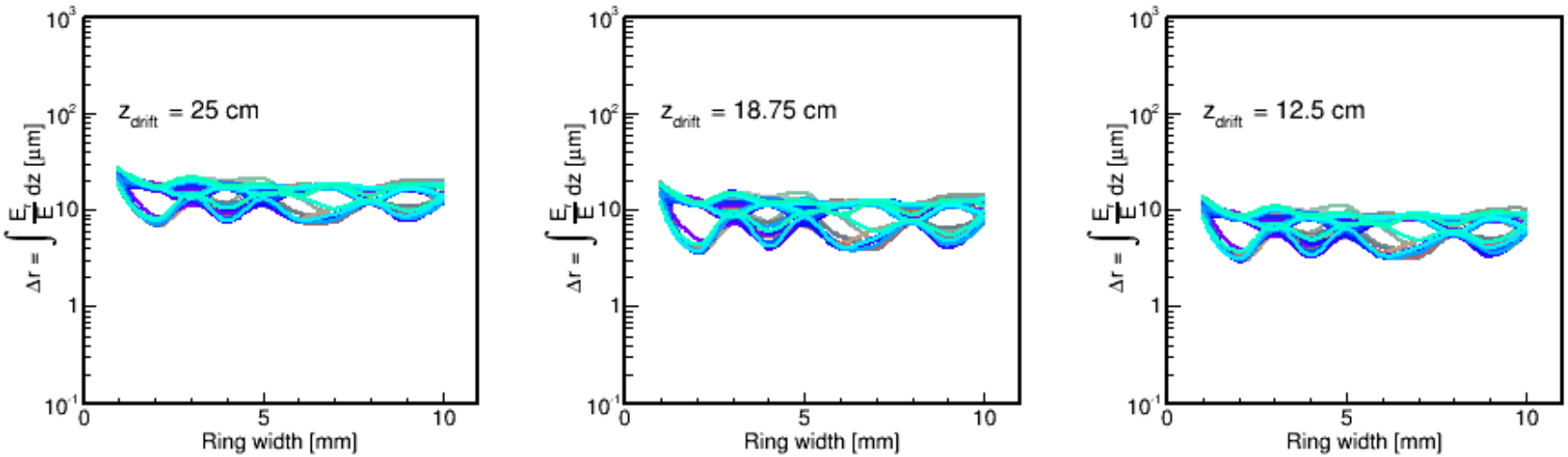


Figure: Radial distance an electron drifts from different drift distance to the bottom of the field cage. Left: from top to bottom. Middle: from 18.75 cm to bottom. Right: from 12.5 cm to bottom.

Rates measured at T2

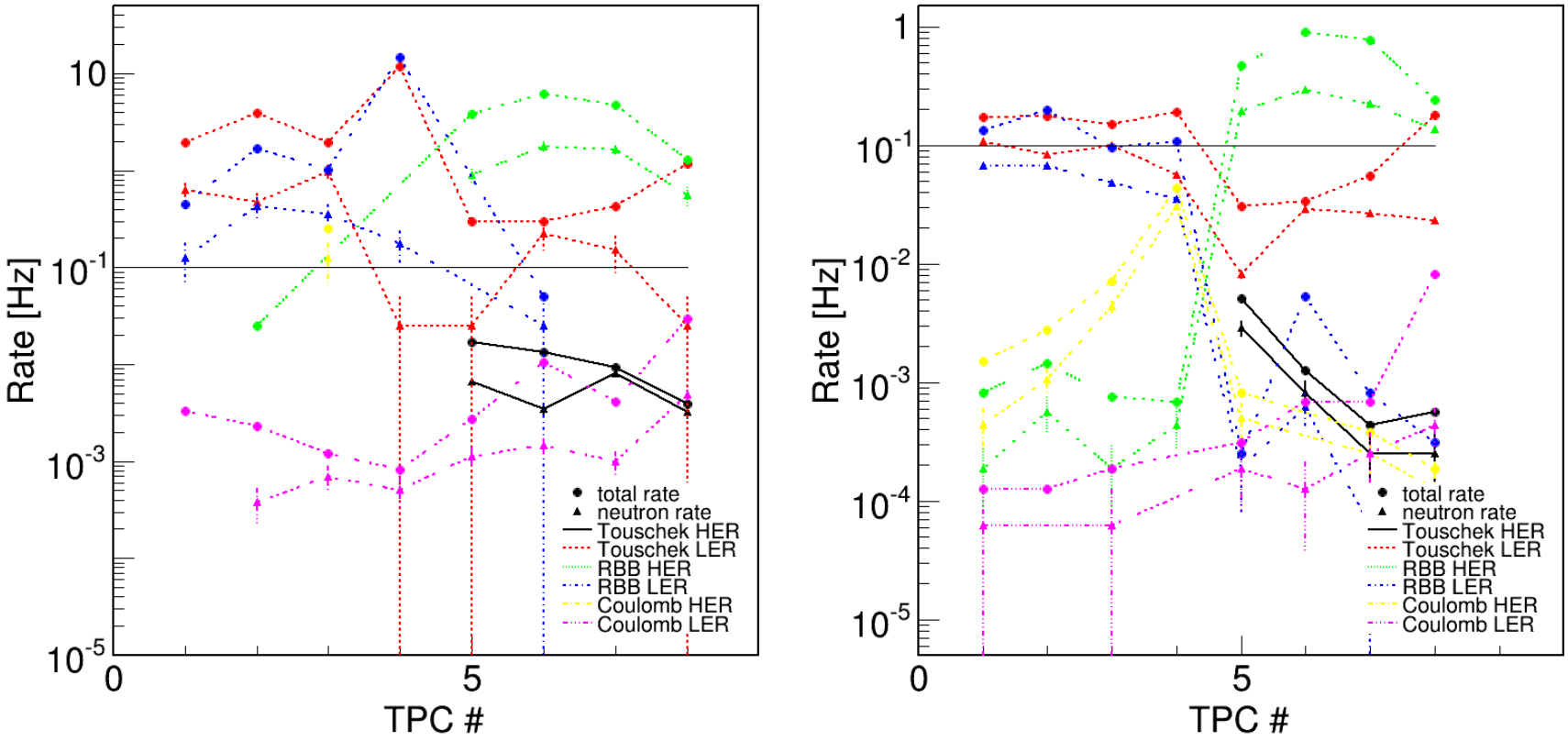


Figure: Rate at T2 phase recorded by four FE-I4 pixle chips in each TPC for the different beam-induced backgrounds. Left for C_4H_{10} at 1 atm. Right for He:CO_2:70:30 at 1 atm. The neutron rates correspond to the rate of recoil with directionality and edge cut. The total rates include neutron with and with out directionality and electrogmatic particles. The black line represents the irreductible background expected.