Radiation Fluence for TOF

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ROOT files

We studied the radiation dose and neutron fluence distributions on EIC TOF, which raise requirements on the detector design

- root file for radiation doses (collision events):

  bryceCanyon_radDose_pythia_crossing_angle_10x275_central_7_6_2023.root (22.9 MB)

- root file for neutron fluence (collision events):

  MEQ_ONLY_bryceCanyon_fluences_pythia_crossing_angle_10x275_central_7_6_2023.root (13 MB)

- root file for radiation doses (beam+gas):

  bryceCanyon_radDose_beamGas_275_central_7_8_2023.root (22.1 MB)

- root file for neutron fluence (beam+gas):

  MEQ_ONLY_bryceCanyon_fluences_beamGas_275_central_7_8_2023.root (12.7 MB)

`https://wiki.bnl.gov/EPIC/index.php?title=Radiation_Doses`

TOF geometry

- Forward TOF Geometry:

Component	Sub-Component	WBS	Length (cm)	Inner Radius (cm)	Outer Radius (cm)	Offset from Center (cm)	Physical Start (cm)	Physical End (cm)	Volume (m^3)	Weight (kg)	Technology	Notes
HD Time of Flight/Tracker		6.10.03	15	8	60	180	180	195	0.17	33	AC/LGAD	Offset: measured from face nearest to interaction point Weight: based on parametric estimate from SBS Gem

- Barrel TOF Geometry:

Component	Sub-Component	WBS	Length (cm)	Inner Radius (cm)	Outer Radius (cm)	Offset from Center (cm)	Physical Start (cm)	Physical End (cm)	Volume (m^3)	Weight (kg)	Technology	Notes
Barrel Time of Flight/Tracker		6.10.03	289	56	63	27	-117.5	171.5	0.76	151	AC/LGAD	Weight: based on parametric estimate from SBS Gem Length in z needs to be determined

`https://eic.jlab.org/Geometry/Detector/Detector-20231031150001.html`

TOF positions

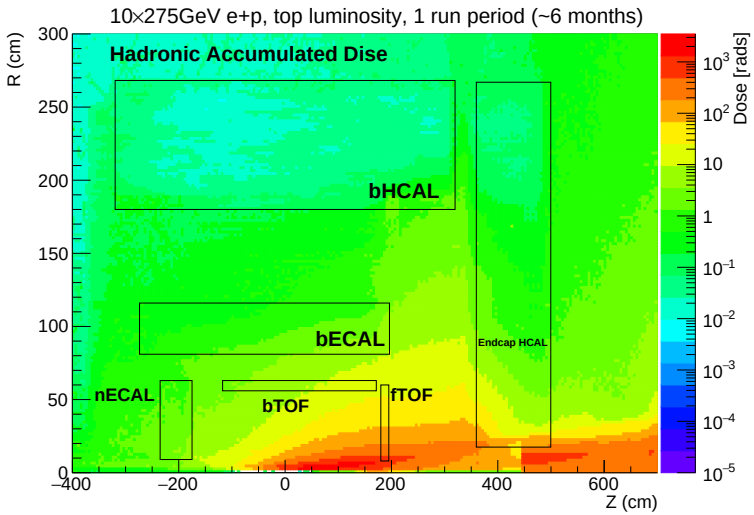

Figure 1: hadronic radiation (collision events)

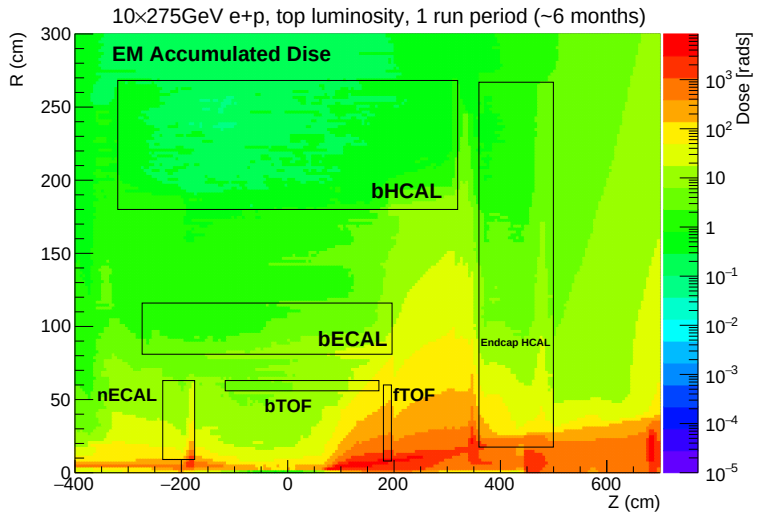

Figure 2: electromagnetic radiation (collision events)

Positions of Forward TOF and Barrel TOF are shown on the plots.

TOF positions

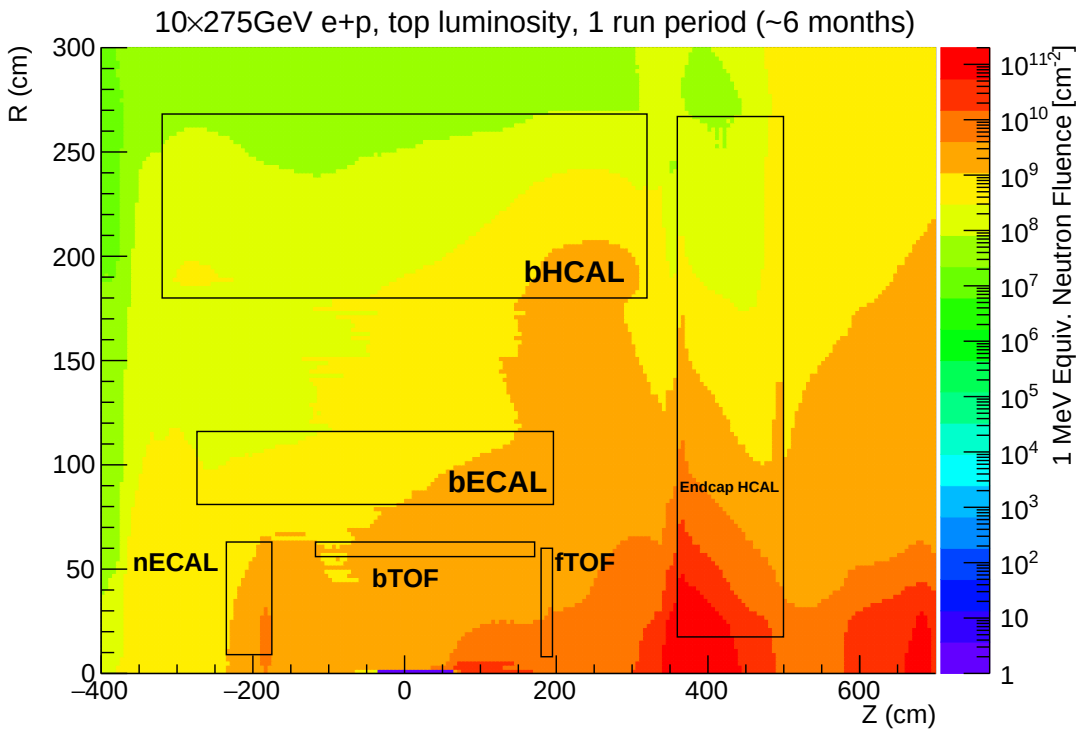

Figure 3: 1 MeV equivalent neutron fluence (collision events)

Radiation dose distributions

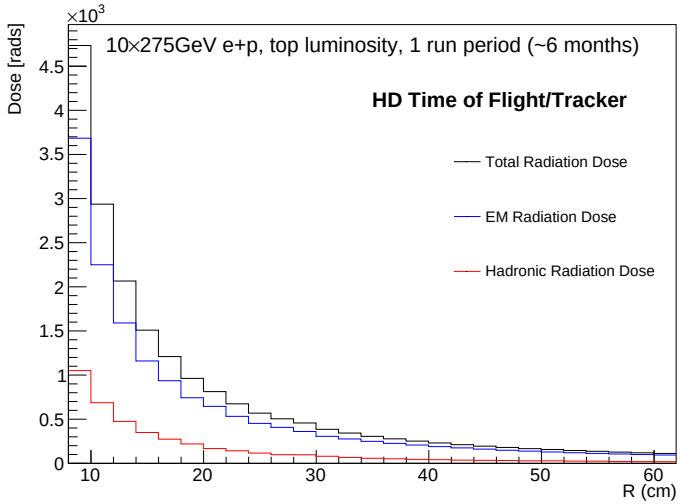

Figure 4: Doses vs R for Forward TOF. The maximum value within each given R is taken (collision events)

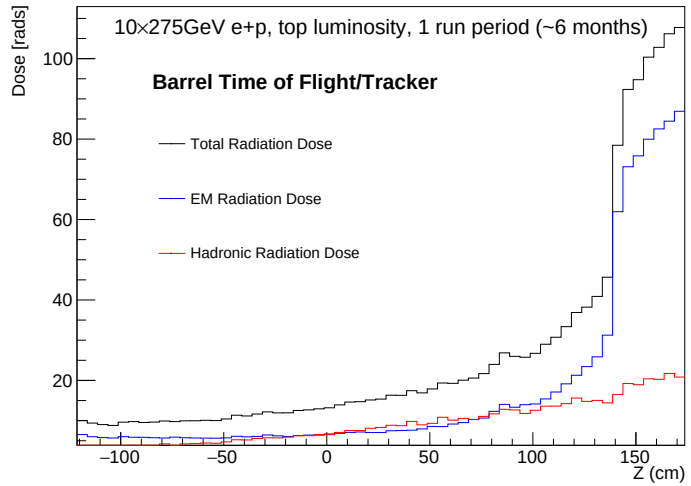

Figure 5: Doses vs Z for Barrel TOF. The maximum value within each given Z is taken (collision events)

- The radiation dose at TOF is dominated by EM radiation
- Reference: radiation dose at CMS inner tracker $\sim$ 1 Grad

1 MeV equivalent neutron fluences distributions

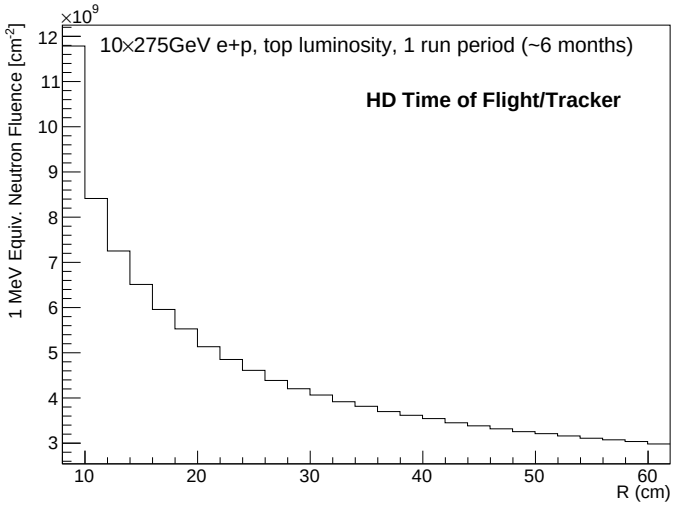

Figure 6: Fluences vs R for Forward TOF. The maximum value within each given R is taken (collision events)

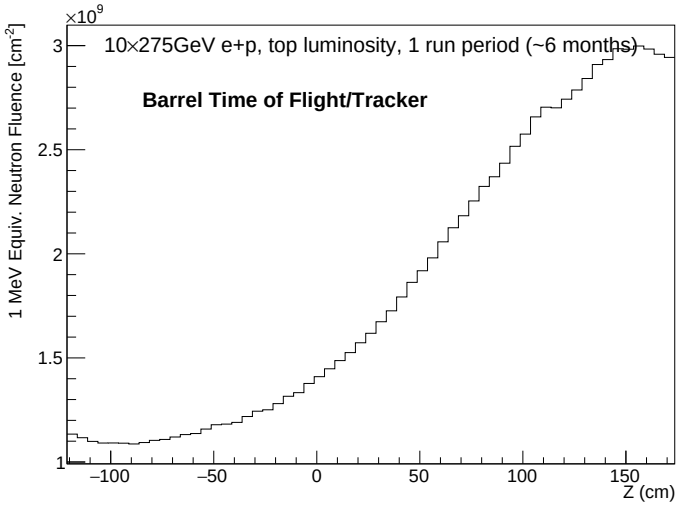

Figure 7: Flences vs Z for Barrel TOF. The maximum value within each given Z is taken (collision events)

- Reference: fluence at CMS $\sim 10^{15}$ $neutrons/cm^2$

TOF positions

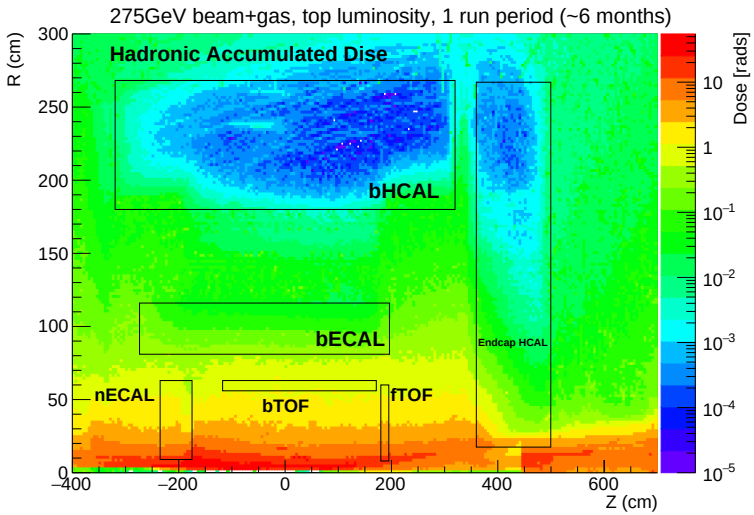

Figure 8: hadronic radiation (beam+gas)

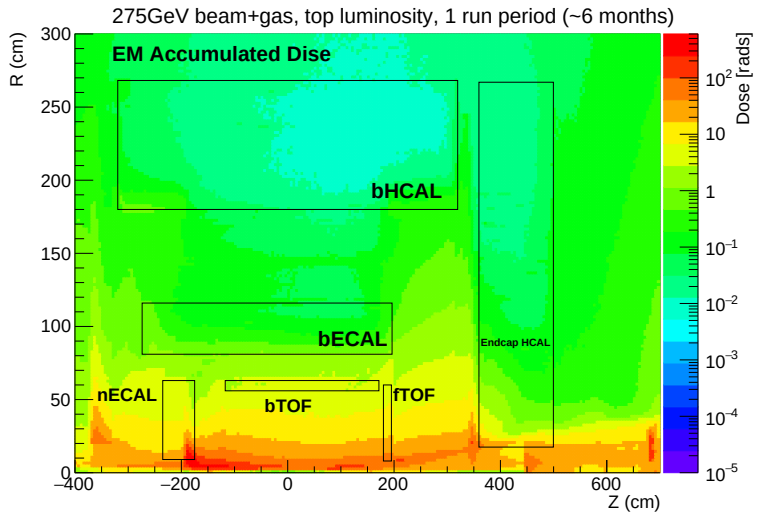

Figure 9: electromagnetic radiation (beam+gas)

Positions of Forward TOF and Barrel TOF are shown on the plots.

TOF positions

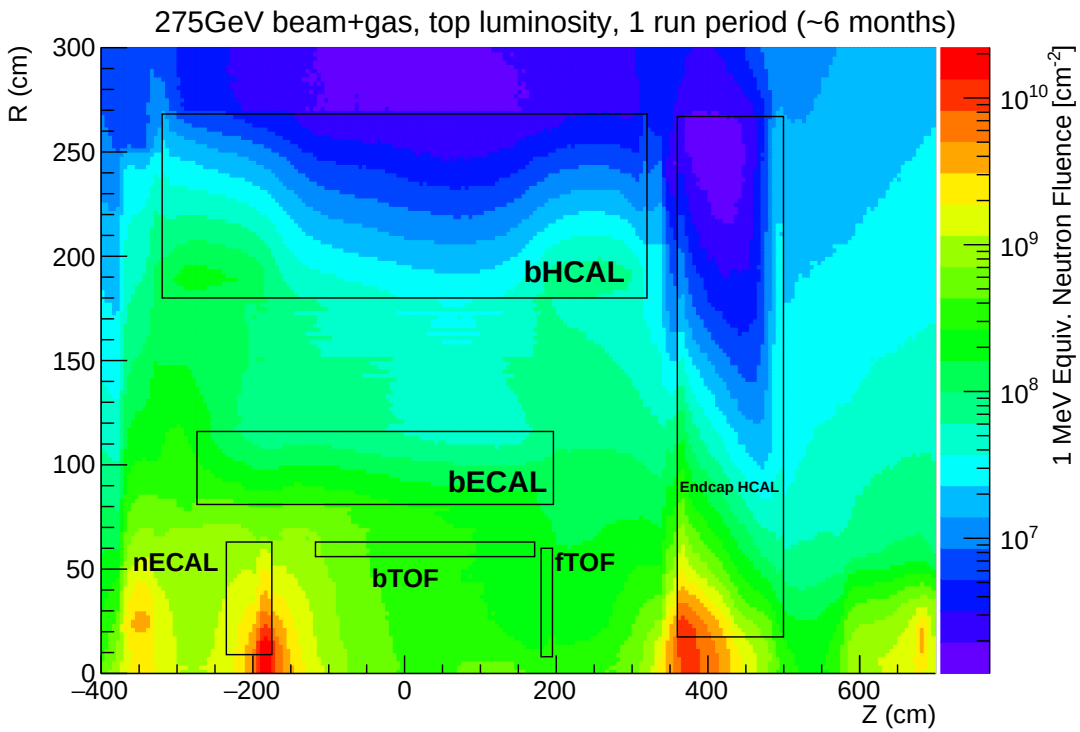

Figure 10: 1 MeV equivalent neutron fluence (beam+gas)

Radiation dose distributions

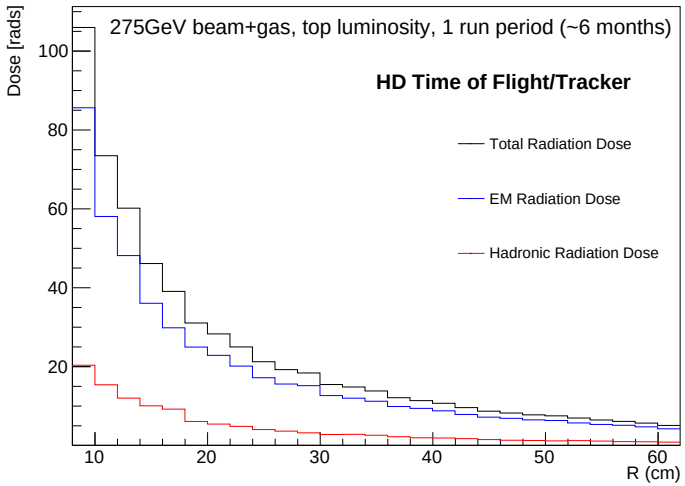

Figure 11: Doses vs R for Forward TOF. The maximum value within each given R is taken (beam+gas)

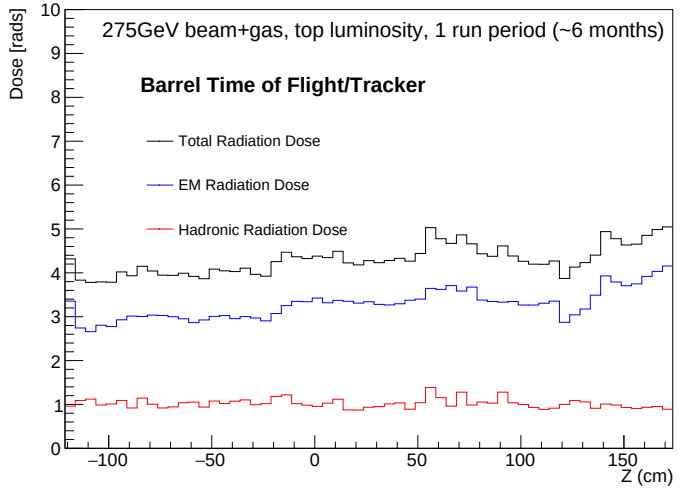

Figure 12: Doses vs Z for Barrel TOF. The maximum value within each given Z is taken (beam+gas)

- The radiation dose at TOF is dominated by EM radiation
- Reference: radiation dose at CMS inner tracker $\sim$ 1 Grad

1 MeV equivalent neutron fluences distributions

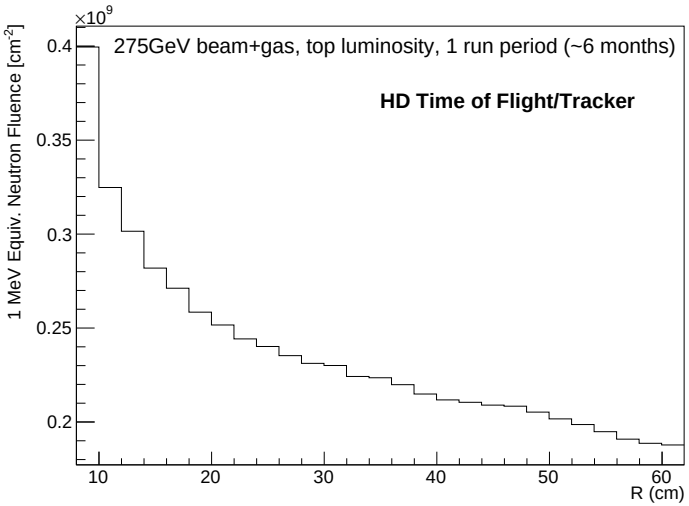

Figure 13: Fluences vs R for Forward TOF. The maximum value within each given R is taken (beam+gas)

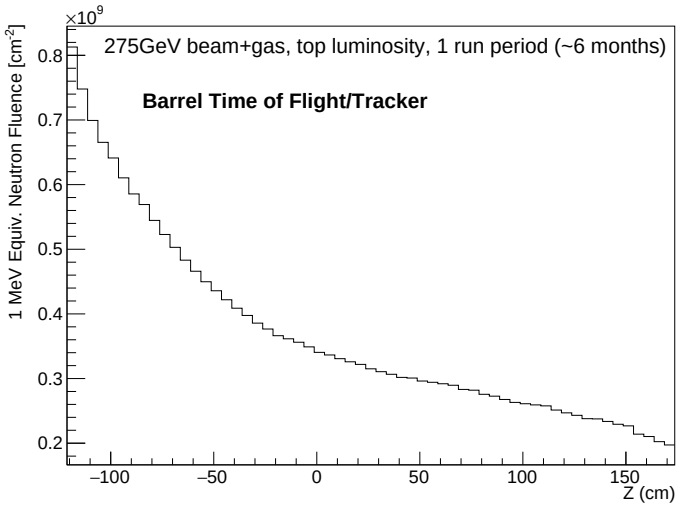

Figure 14: Flences vs Z for Barrel TOF. The maximum value within each given Z is taken (beam+gas)

- Reference: fluence at CMS $\sim 10^{15}$ $neutrons/cm^2$

TOF positions

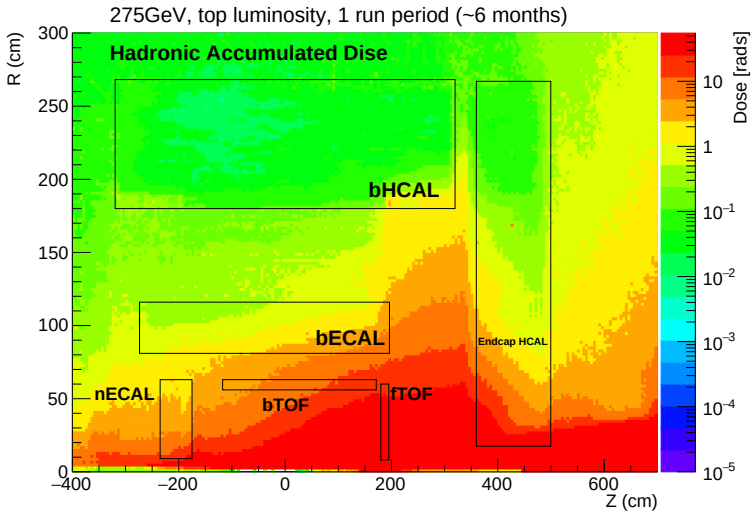

Figure 15: hadronic radiation (sum)

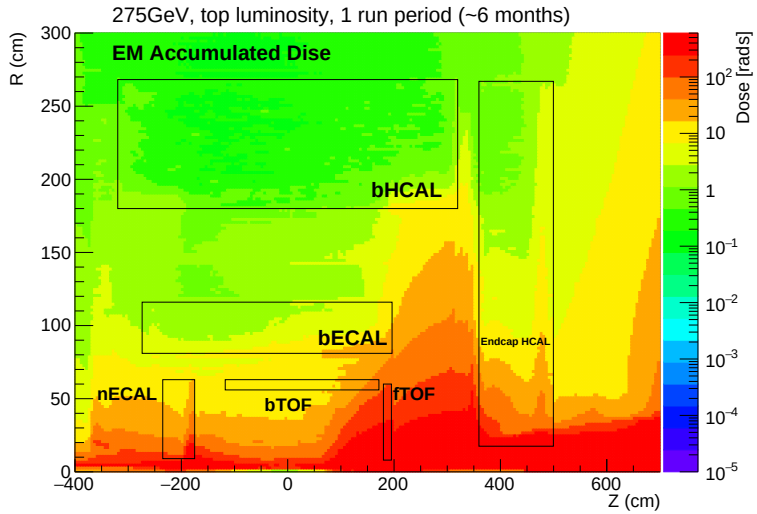

Figure 16: electromagnetic radiation (sum)

Positions of Forward TOF and Barrel TOF are shown on the plots. Collision events and beam+gas distributions are added.

TOF positions

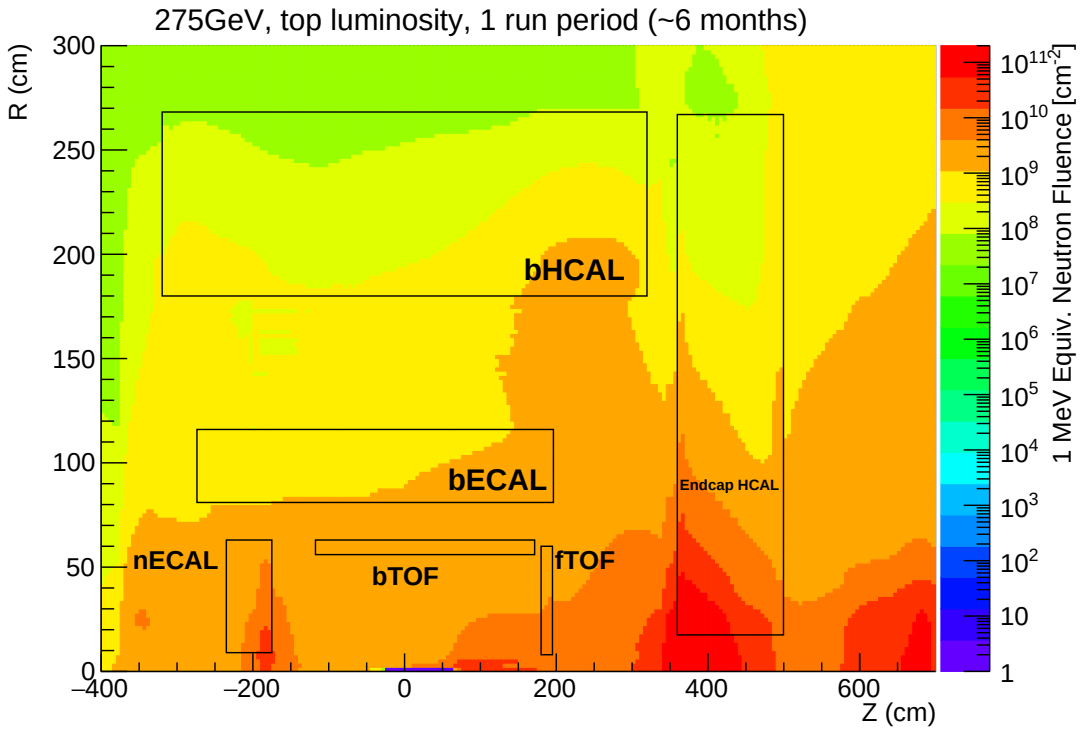

Figure 17: 1 MeV equivalent neutron fluence (sum)

Radiation dose distributions

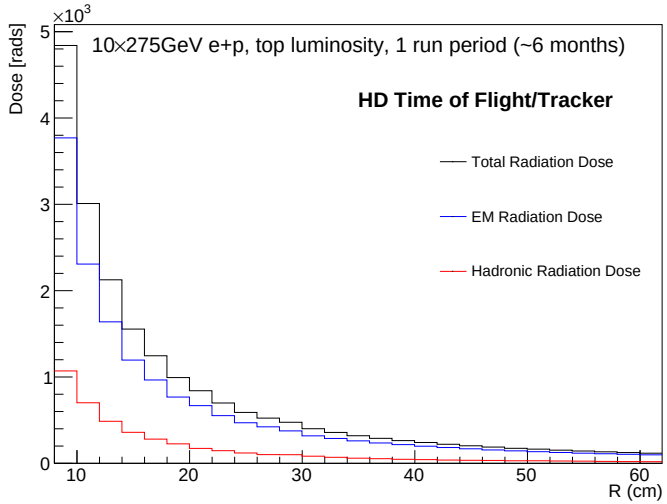

Figure 18: Doses vs R for Forward TOF. The maximum value within each given R is taken (sum)

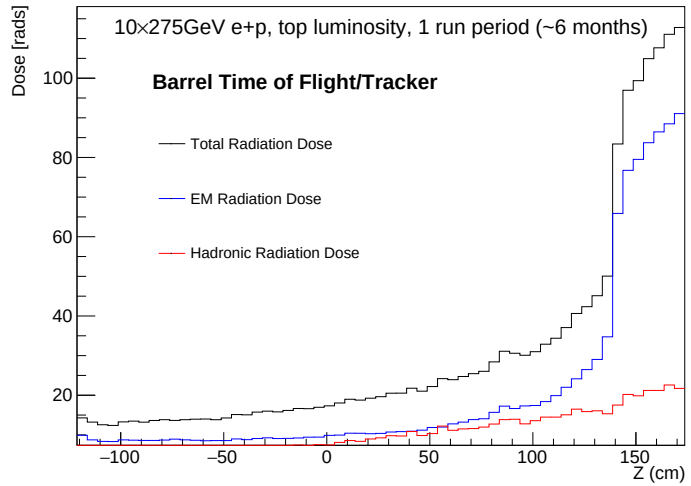

Figure 19: Doses vs Z for Barrel TOF. The maximum value within each given Z is taken (sum)

- The radiation dose at TOF is dominated by EM radiation
- Reference: radiation dose at CMS inner tracker $\sim$ 1 Grad

1 MeV equivalent neutron fluences distributions

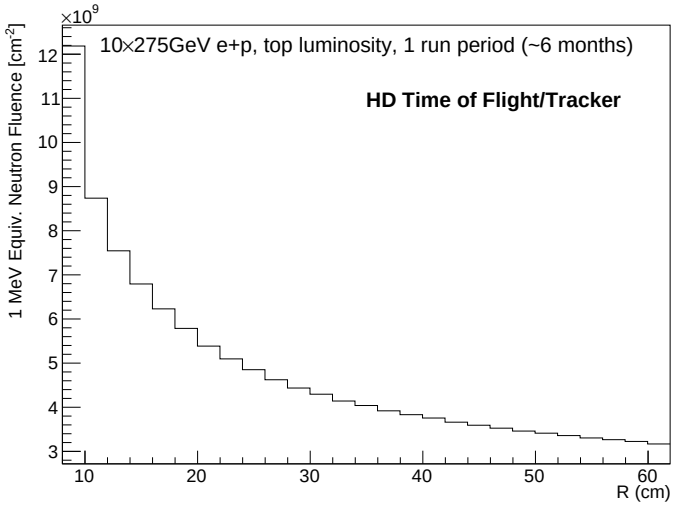

Figure 20: Fluences vs R for Forward TOF. The maximum value within each given R is taken (sum)

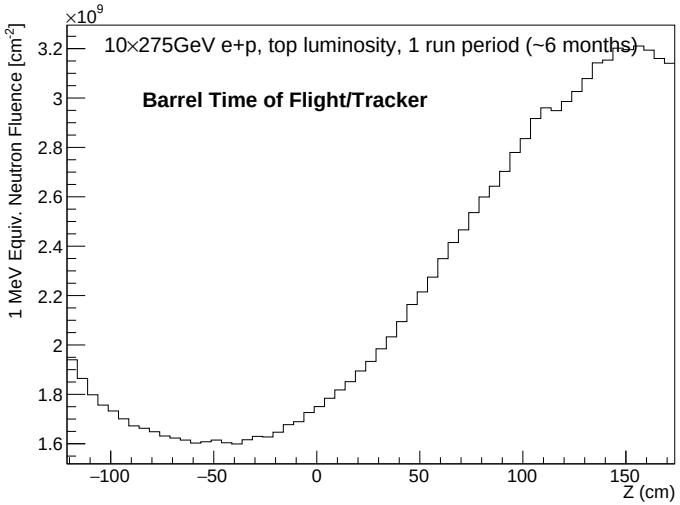

Figure 21: Flences vs Z for Barrel TOF. The maximum value within each given Z is taken (sum)

- Reference: fluence at CMS $\sim 10^{15}$ $neutrons/cm^2$

Thanks