Front-end capture efficiency as function of the beam size in time

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Introduction

- IDS-NF baseline parameter for the proton beam bunch size is 0-3 ns.

- Looking at the front-end capture performance vs beam size in time.

- 8 GeV proton beam 4×10^5 pot from the official FE website: (http://hepunx.rl.ac.uk/uknf/wp1/idsfrontend/Beams_and_Lattices/)

  - G4BL files positives muons/kaons/pions with σ = 2 ns and 3 ns and center of the distribution at t = 0.

  - ICOOL files positive muons/kaons/pions with σ = 2 ns and 3 ns distribution not centered at t = 0. $\rightarrow$ converted into G4BL files

  - G4BL and ICOOL files negative muons/kaons/pions with σ = 2 ns and 3 ns. ! FILES ARE THE SAME FOR 2 NS and 3NS

- Using G4BL and ecalc9f to get muons within the IDR acceptance criteria $100 < pz < 300$ MeV/c, $A_T < 30$ mm and $A_L < 150$ mm.
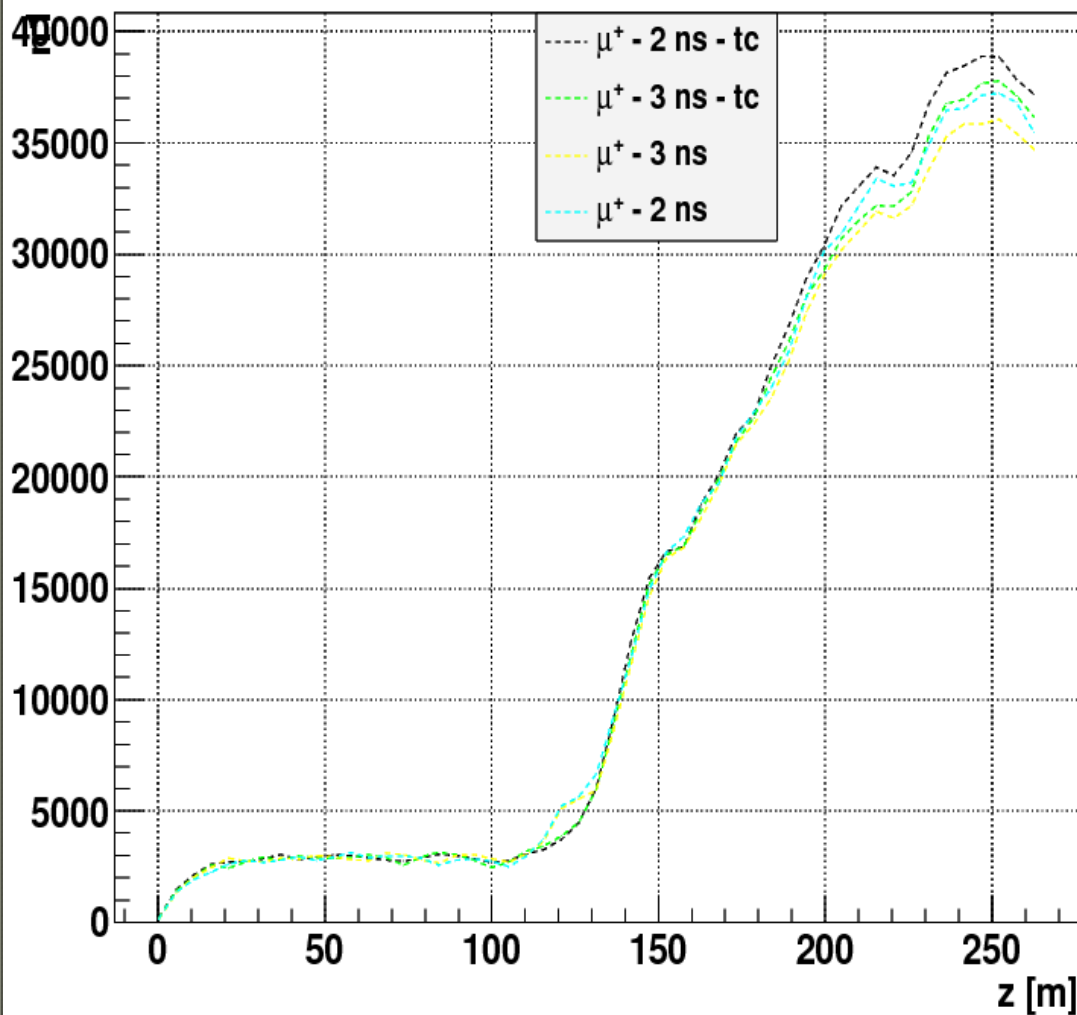
Total number of muons
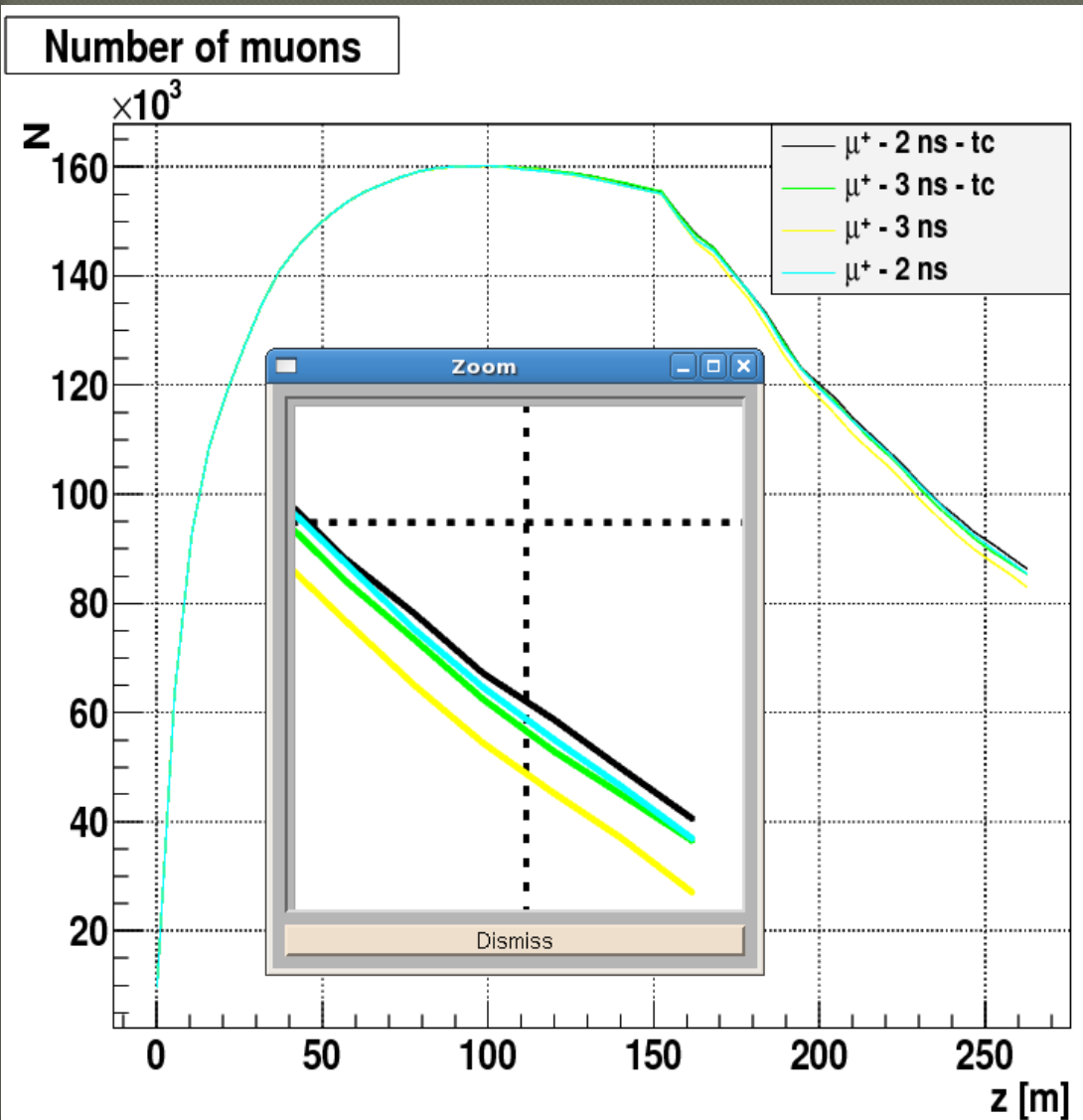
Number of muons

- With 3 ns beam slightly lower number of muons.

- With beam not centered the muons number is lower for the 3 ns case.

NOT SURE WHY
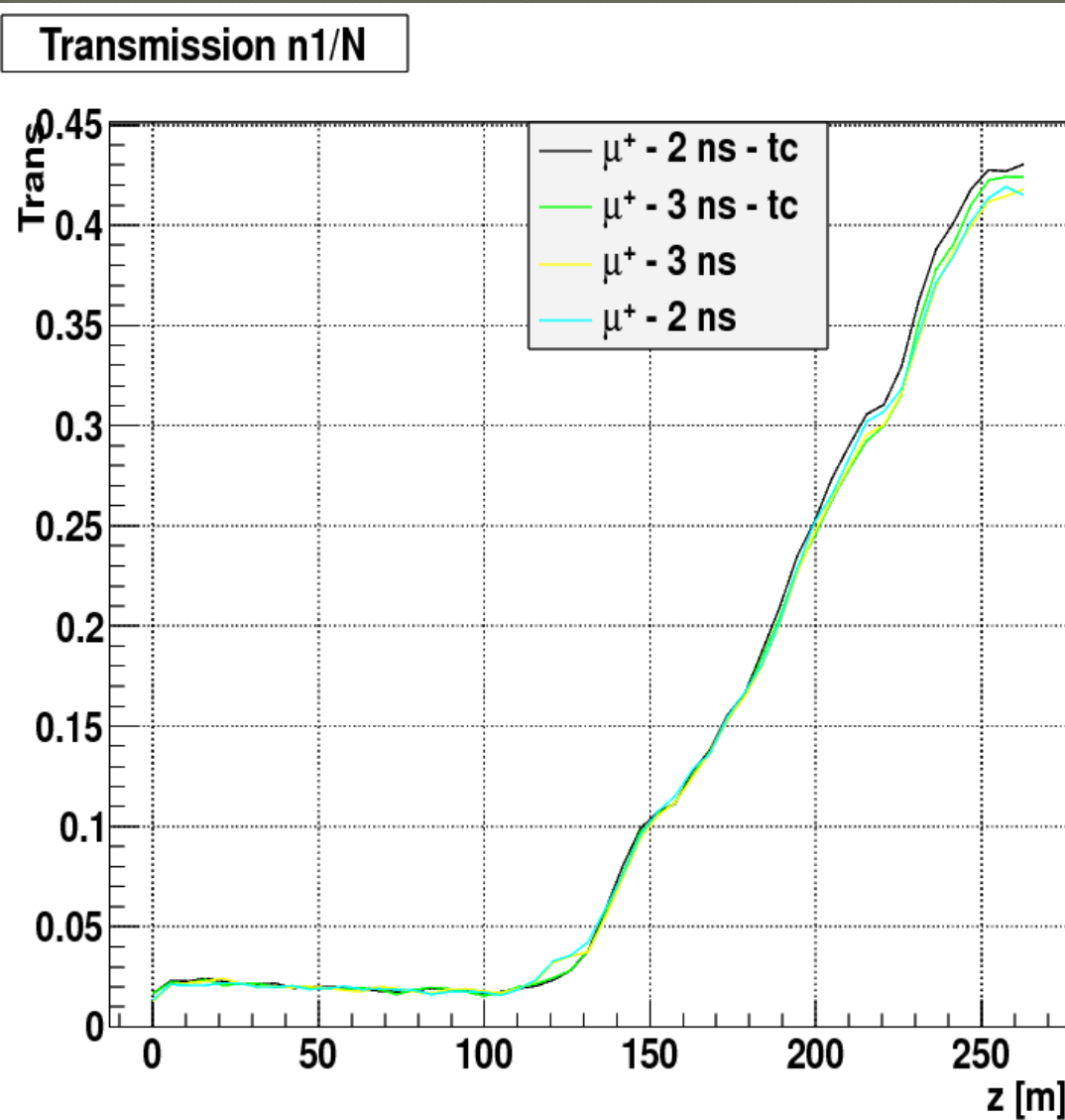(except caused by the RF ?)

Muons within acceptance

Number of accepted muons

Legend:
- μ^+ - 2 ns - tc
- μ^+ - 3 ns - tc
- μ^+ - 3 ns
- μ^+ - 2 ns

z [m]

- Beam size is a ~ 3% (centered beam) and ~2% (not centered beam) effect.

- Beam centered or not is a ~5% (2ns) and ~4% (3 ns) effect.

  Probably worse for bigger beam spread (tbc).

Transmission

Transmission n1/N

- Beam size is a ~1.5% (beam centered) and ~1% (beam not centered) effect.

- Beam centered or not is a ~3.5% (2 ns) and ~1.5% (3ns) effect.

Transmission does not seem to be affected much by beam size.

TODO

- Need to recover 2 ns and 3 ns negative muons/kaons/pions files (Chris is working on it).

- Need to run more beam sizes (0 ns & > 3 ns):

  - Check if can recover the original MARS files used (from Harold)

  - Apply the gasdev routine (ala IDR)

  - Apply Chris Python script to re-center the beam (for consistency purpose)

- Check if results similar with:

  - Applying a spread to the proton beam (instead of gasdev which applies a time shift to each particle)

  - Other beam energies 5-15 GeV