Front-End Alignment and Tolerance

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Summary

- G4BL version 2.0 front-end lattice:
  - bugs correction from the IDR lattice (e.g. Be windows made of Be and not LiH)
  - longer cooling section to accommodate required spacing for RF and magnets
  - no chicane yet

  → version v2.1 available but not tested yet

- Geometry (version 2.0):
  - no physical magnets (G4BL is reading fieldmaps that were produced using ICOOL)
  - fieldmaps for capture, matcher and cooler
  - Constant (B_z = 1.5 T) field for drift, buncher and rotator (fieldexpr command)
  - RF cavities (pillbox) and windows (Be, LiH) volumes defined

- Beam:
  - beam from MARS (ST2a) simulation 8 GeV 4×10^5 pot, negative pions/kaons/muons
  - 2 (or 3 ?) ns smearing (both 2 ns and 3 ns beams are the same)
  - only using the first 10000 particles (a run takes ~20 min)

Lattice description

- Names and lengths (from target to acceleration system):
  - Capture – 18.9 m
  - Drift – 60.7 m
  - Buncher – 33 m
  - Rotator – 42 m
  - Matcher – 6 m
  - Cooler – 105 m (IDR) – 227.04 m (v2.0)

- Cooler length (from discussion with Chris):
  - 30% more cooler in comparison with the IDR version to accommodate the additional RF spacing required
  - rest is additional cooling to test the lattice

$\rightarrow$ ~182 m of cooling (tbc)

- Acceptance criteria:
  - N is the total number of muons at a given z.
  - n_1 is the number of muons that passed the ecalc9f cuts (100 < pz < 300 MeV/c, A_T = 30 mm, A_L = 150 mm at a given z.

Misalignment study

- Changing the magnetic field direction in the drift-buncher-rotator:
  - solenoid symmetry can choose Bx = 0, By= 1.5 x sin ϕ Bz = 1.5 x cos ϕ
  - misalignment in a volume of 1 m length in z
  - choosing different locations in z where to place the misaligned field
  - $\phi = 1^\circ$ (approx. 2 cm vertical tilt for a 1m-long magnet)

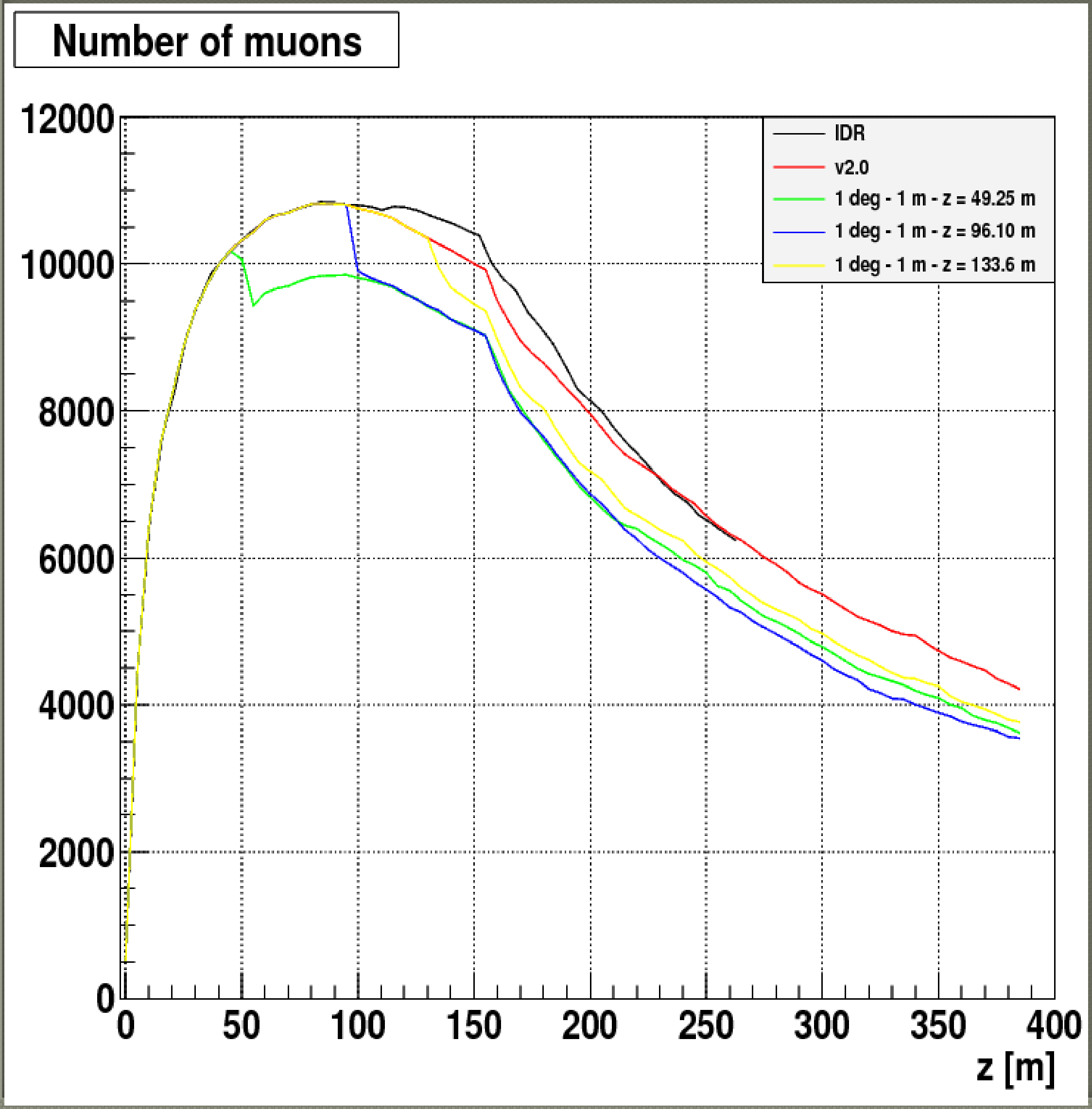
- Maximum tolerance:
  - from previous discussion is was said that 1-5% drop in the number of muons in the acceptance is the maximum tolerance

But:

- need to verify that this is within the uncertainties on the number of muons
- this is within the mechanical tolerance for magnet positioning

$\rightarrow$ Will use real magnets geometry and try other misalignments configuration once the maximum tolerance is defined

Total number of muons

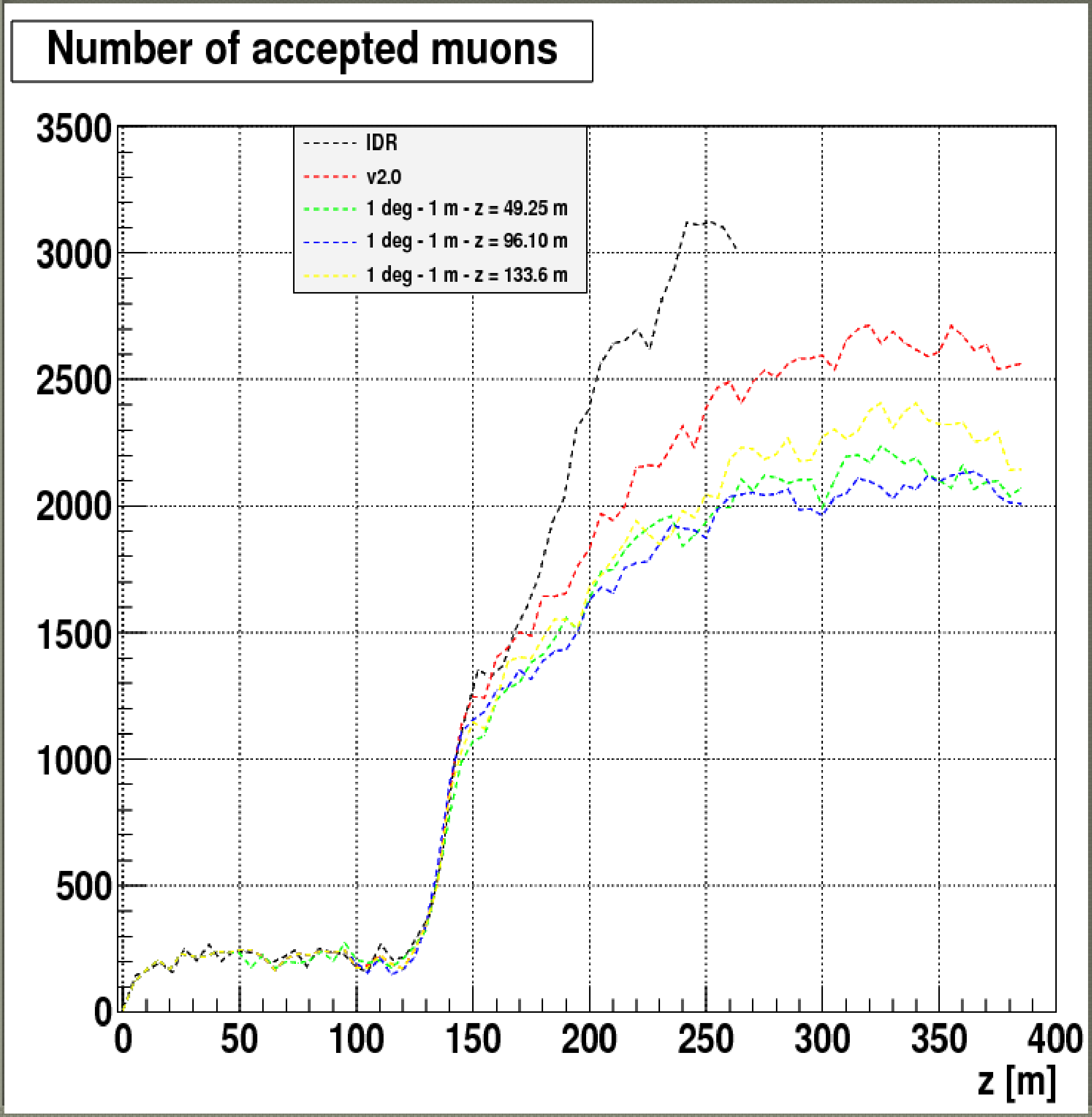


Total number of muons is up to 5% lower in version 2.0 compared to the IDR lattice.

Start to drop at z = 100 m (second half of buncher).

→ Need to find out why.

Muons within acceptance

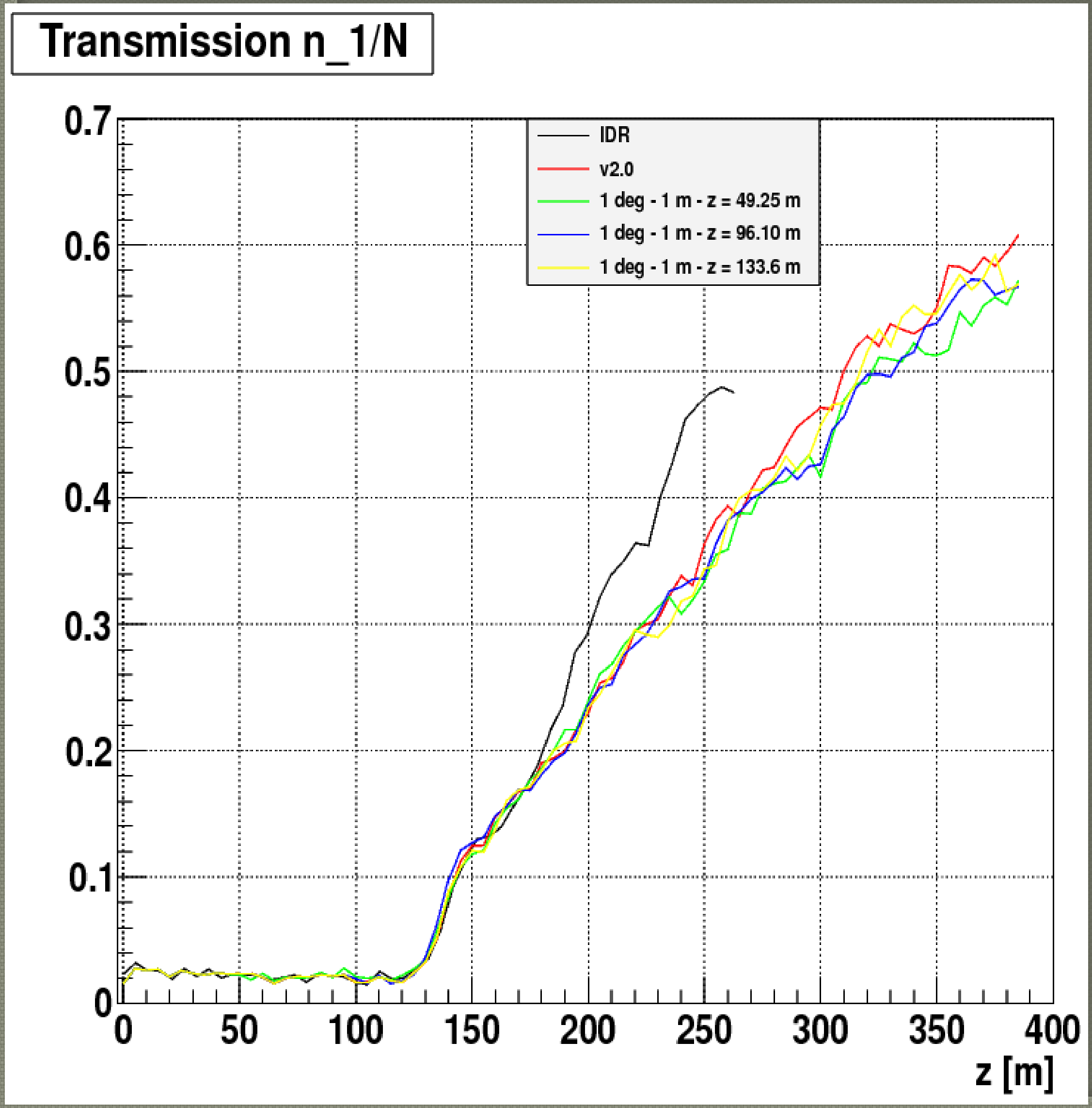


Number of muons in the acceptance is ~20% lower in version 2.0 compared to the IDR lattice.

Start to drop at z = 150 m (second half of rotator).

→Need to find out why.

Transmission

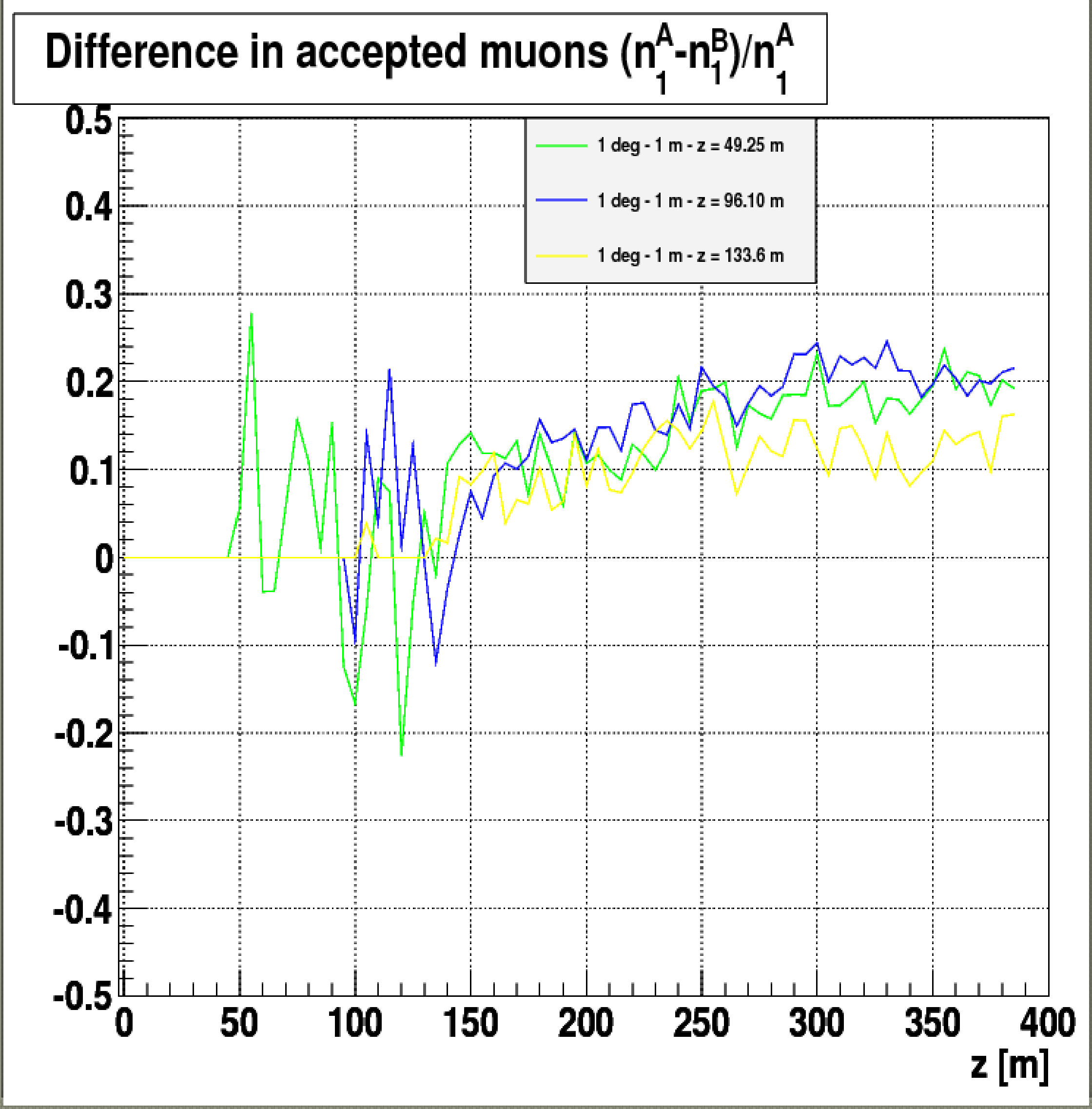


Number of muons "transmitted" is 30% lower in version 2.0 compared to the IDR lattice.

Starts at z ~175 m (beginning of cooler).

→ Need to find out why.

Difference



Comparison between number of muons accepted in version 2.0 and different misalignment configurations .

Misalignment in the drift or the buncher have equivalent results (~20%).

Misalignment in the rotator less dramatic (~10%).

But in all the cases 1° difference in angle (= 2 cm vertical misalignment for a 1 m long magnet) is already way too much.

Todo

- Need to cross-check that the origin of the difference seen between the IDR lattice and version 2.0 is well understood.

- Verify/plot the uncertainties on the number of muons (total/accepted/transmission/difference).

- Get a rough estimate on what a magnet survey accuracy is (depend on magnet size and location).

  will constraint the study to mechanical tolerance and simulation accuracy.

- Use real magnet geometry for the capture, matcher and cooler sections.

- Work on the RF-electric field misalignment.