Front-end lattice starting after the target area (update II)

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Idea

- Make a front-end lattice that starts at z > 6 m in order to:
  - be able to load a beam file that has included the pions/muons phase space after interaction in the target surrounding material (including the Be window at z = 6m).
  - be independent on the target area designs changes that may/will occur in the future (taper change, magnet arrangements, shielding)
  - be independent on the taper profile (choose an area where is constant)
- Doing the exercise on the ISS lattice (aka ST2a for test purpose):
  - MARS and ICOOL field profile matches
  - choose z = 50 m as place to hand off the beam file (also where the figure of merit is computed).
  - allow to compare MARS and ICOOL particles yield where we hand off the beam file.

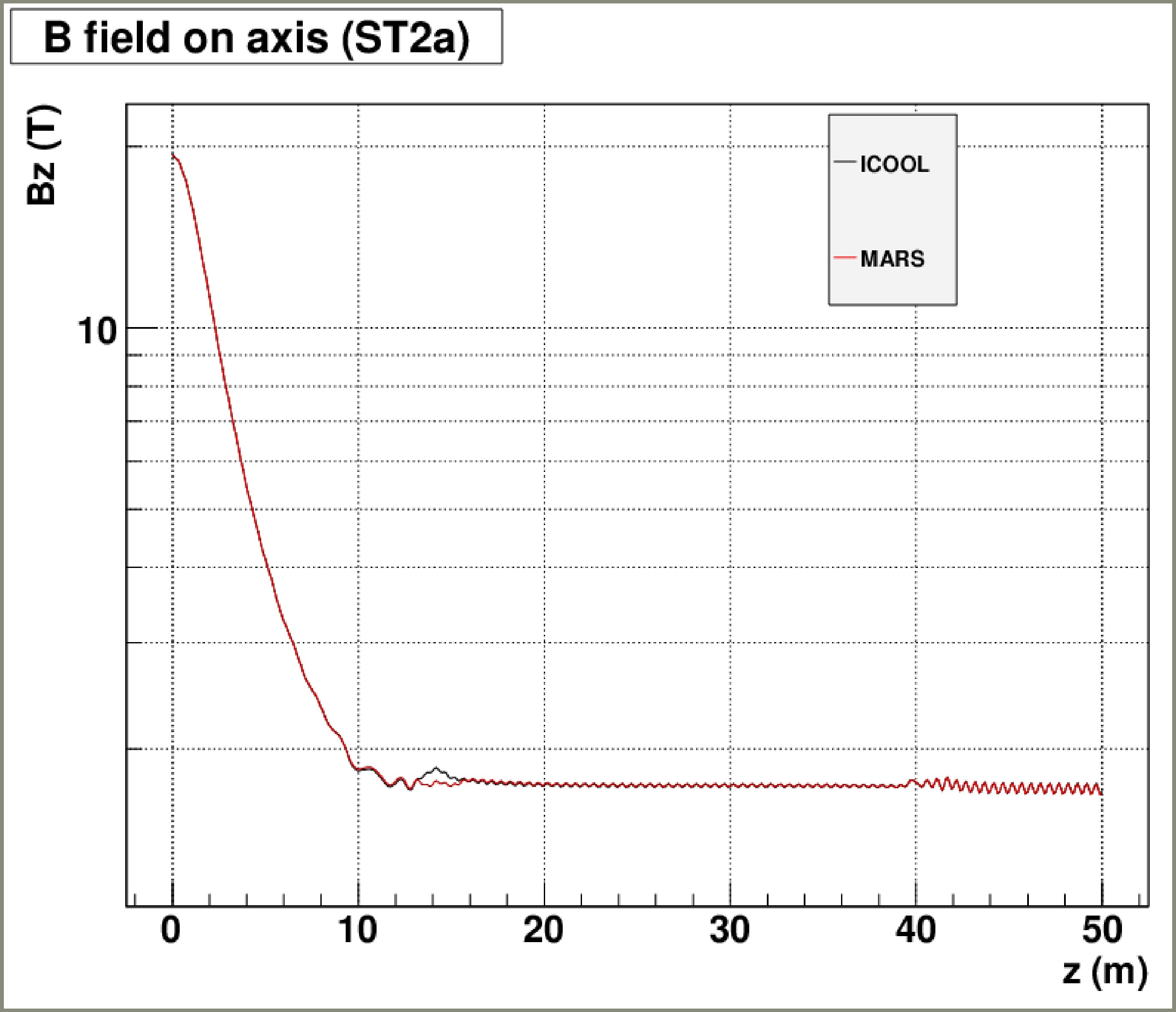
Technicality

- ICOOL:
  - create a shorter lattice which contains only the front-end elements from z = 50 m to end of the lattice (it cuts part of the drift section).

Magnetic field profile matches ISS lattice.

- MARS:
  - translate the MARS beam output at 50 m (fort.82) into an ICOOL file where the z position is shifted by 50 m (z = 0).
  - without smearing the time of the particles by 1-3 ns.

Field profile



Checking particle phase space (1/5)

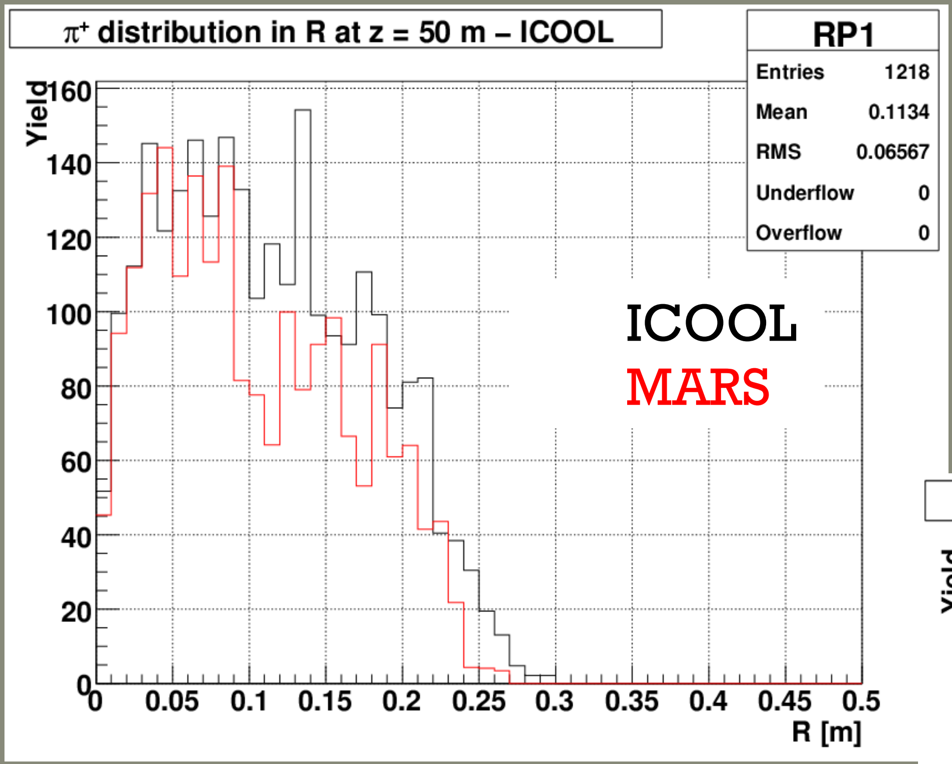
- Previous simulation:
  - error linking to the wrong file, as a result the MARS simulation using ST2 was used instead of ST2a.

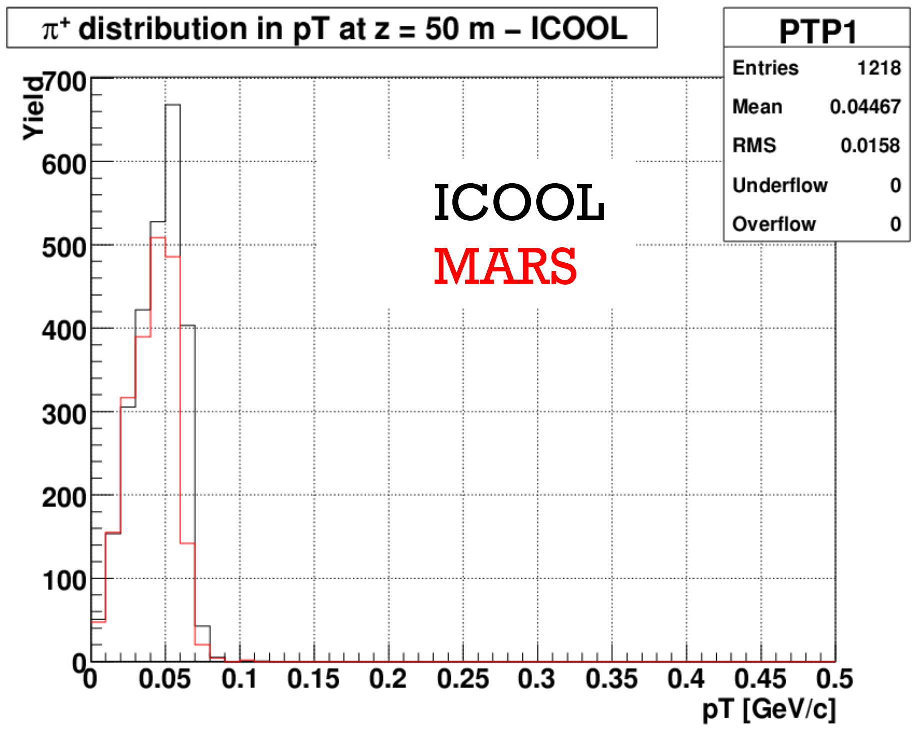
    Explains the difference seen in pT and R (thanks Scott !).

- Particle yields @50 m:
  - π+ - ICOOL = 2579 - MARS = 2072 (~25%).
  - μ+ - ICOOL = 18749 - MARS = 16996 (~10%).
  - π- - ICOOL = 1820 - MARS = 1584 (15%).
  - μ- - ICOOL = 17941 – MARS = 16020 (12%).

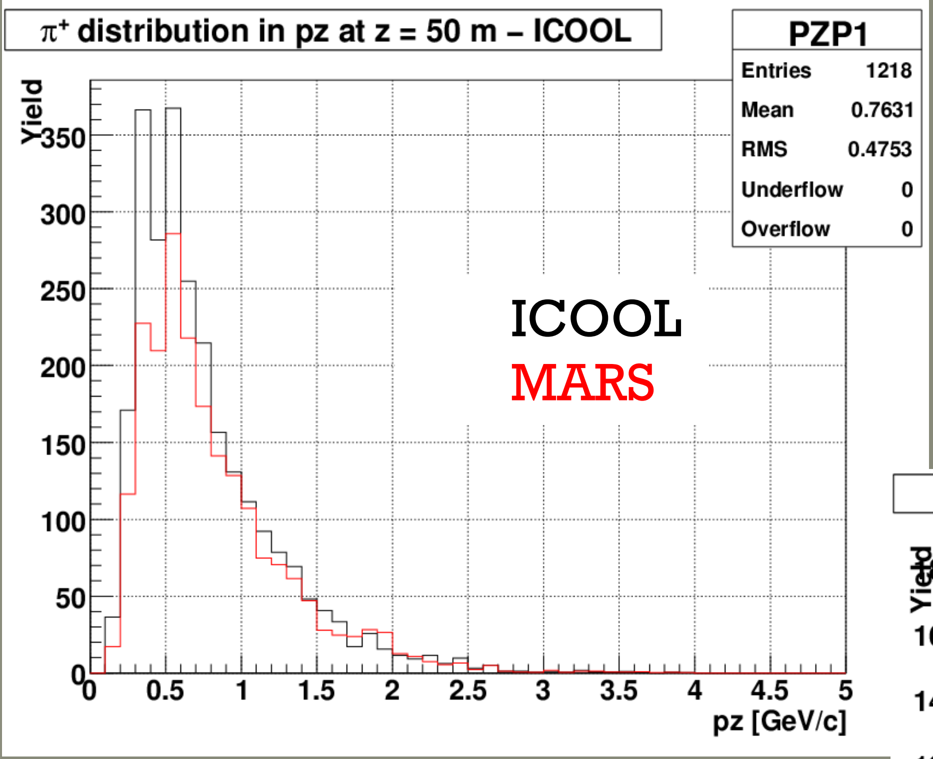
  ICOOl has more optimistic yields (no material in the drift unlike MARS + difference in tracking or other processes ?).

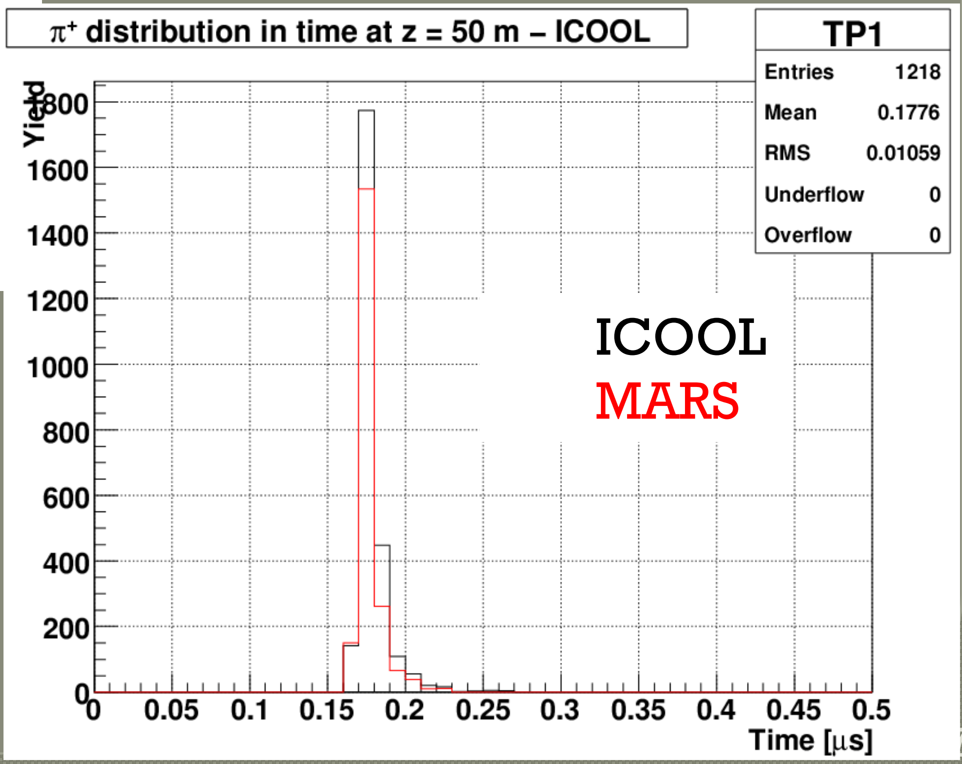
Checking particle phase space (2/5)



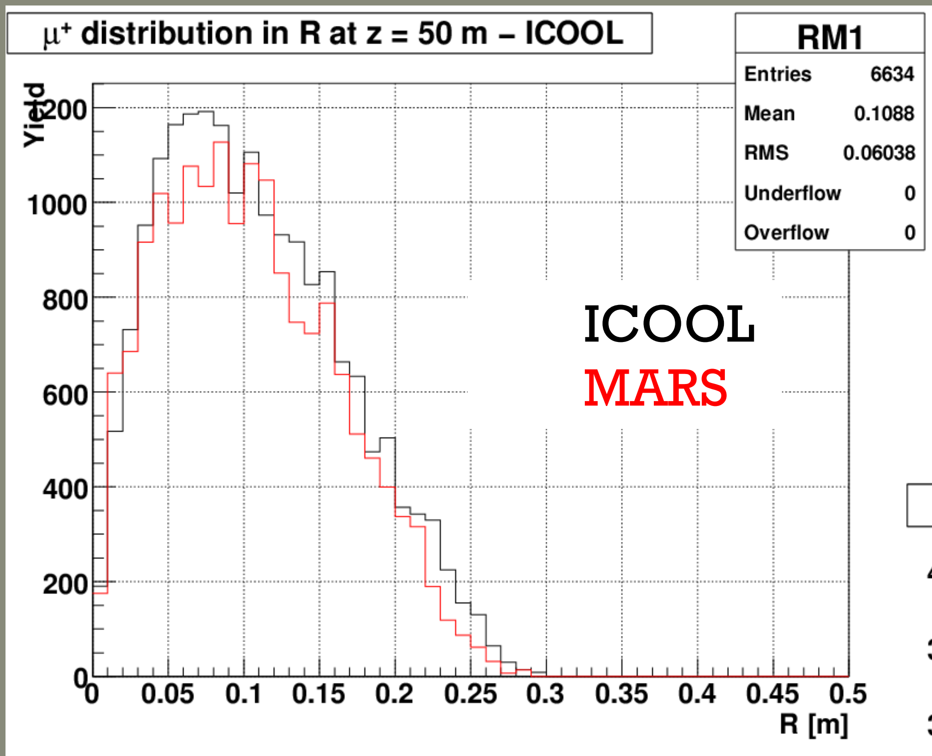


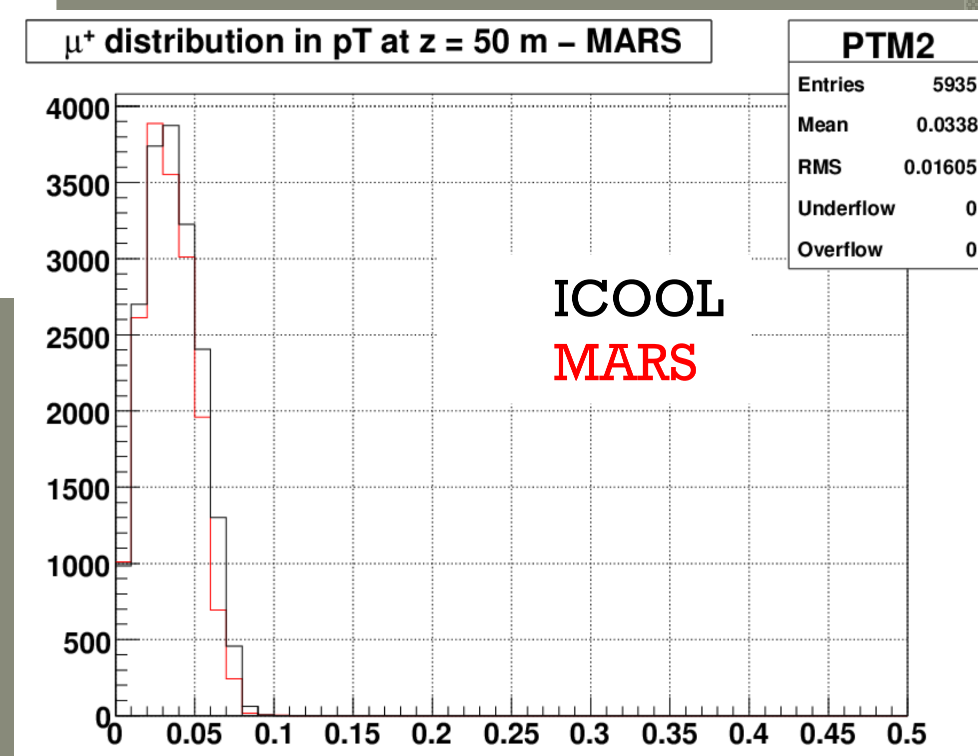
Checking particle phase space (3/5)



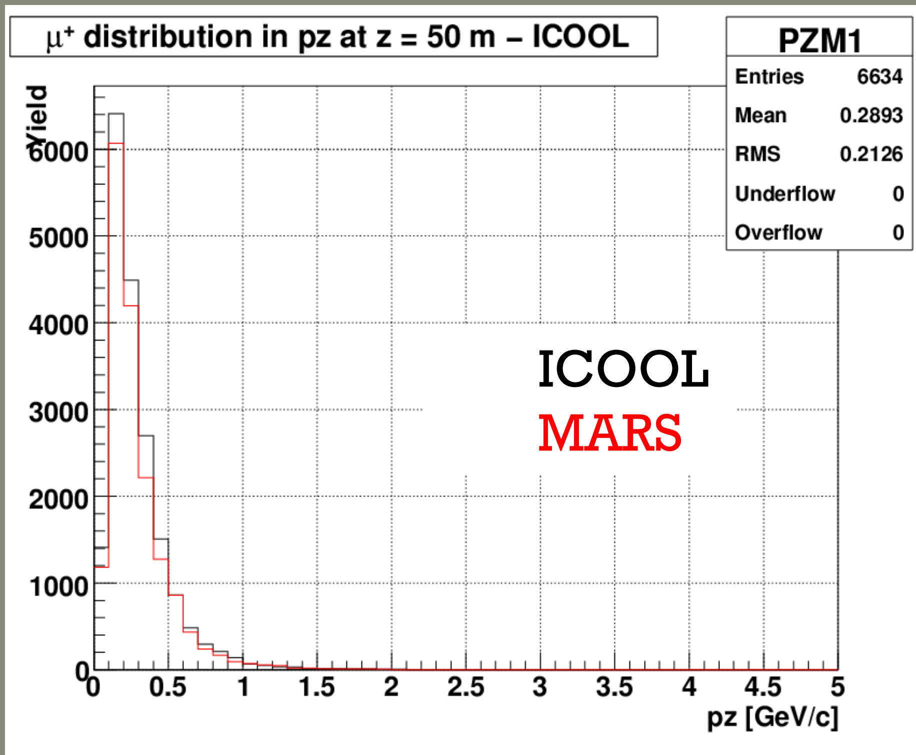


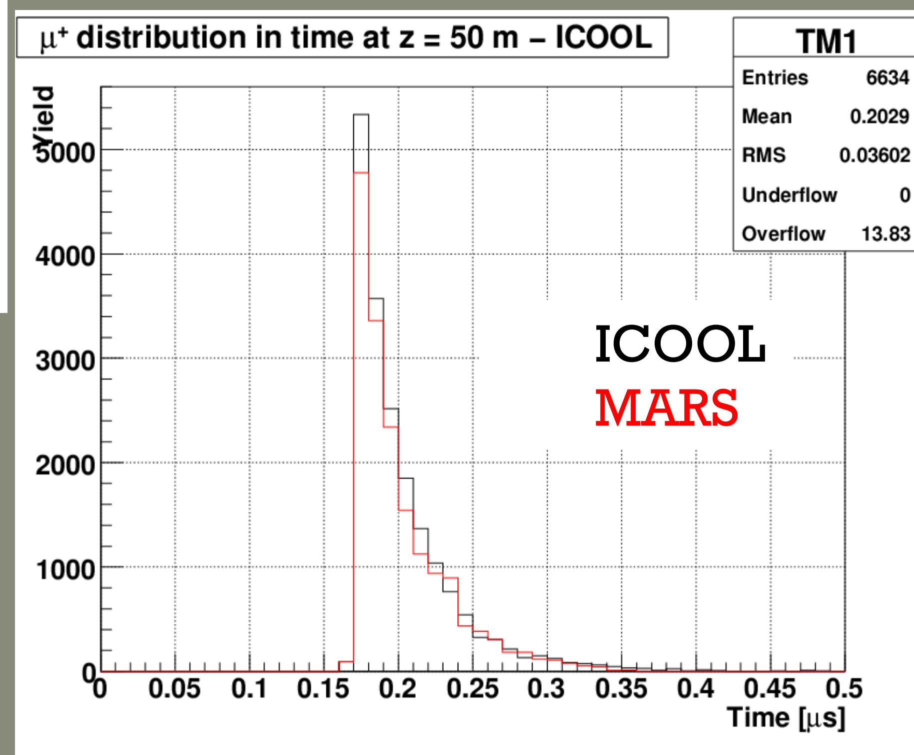
Checking particle phase space (4/5)





Checking particle phase space (5/5)





First attempt (1/2)

- $t_{ref} = 0$:
  - don't set particle reference time. Normally ICOOL should assign to the reference particle <t>. ICOOL knows how to do it since in for009.dat, at z = 0,
    $t_{ref} = \langle t \rangle$.

    Only a 1/10 of the particles remaining.
  - Tallies:
    - 19069 weighted $\pi/K/\mu$ at start
    - 709 weighted $\pi/K/\mu$ lost with flag -23 (particle radius not defined in r-region).
    - 914 weighted $\pi/K/\mu$ lost with flag -43 (pz < PZMINTRK).
    - 327 weighted $\pi/K/\mu$ lost with flag -76 (stepping gave results with r > 100 m or pT > 1000 GeV/c.
    - 1422 remaining particles at the end of the front-end with 187 of them passing the ecalc9f acceptance cuts.

Where did all the other particles go ?

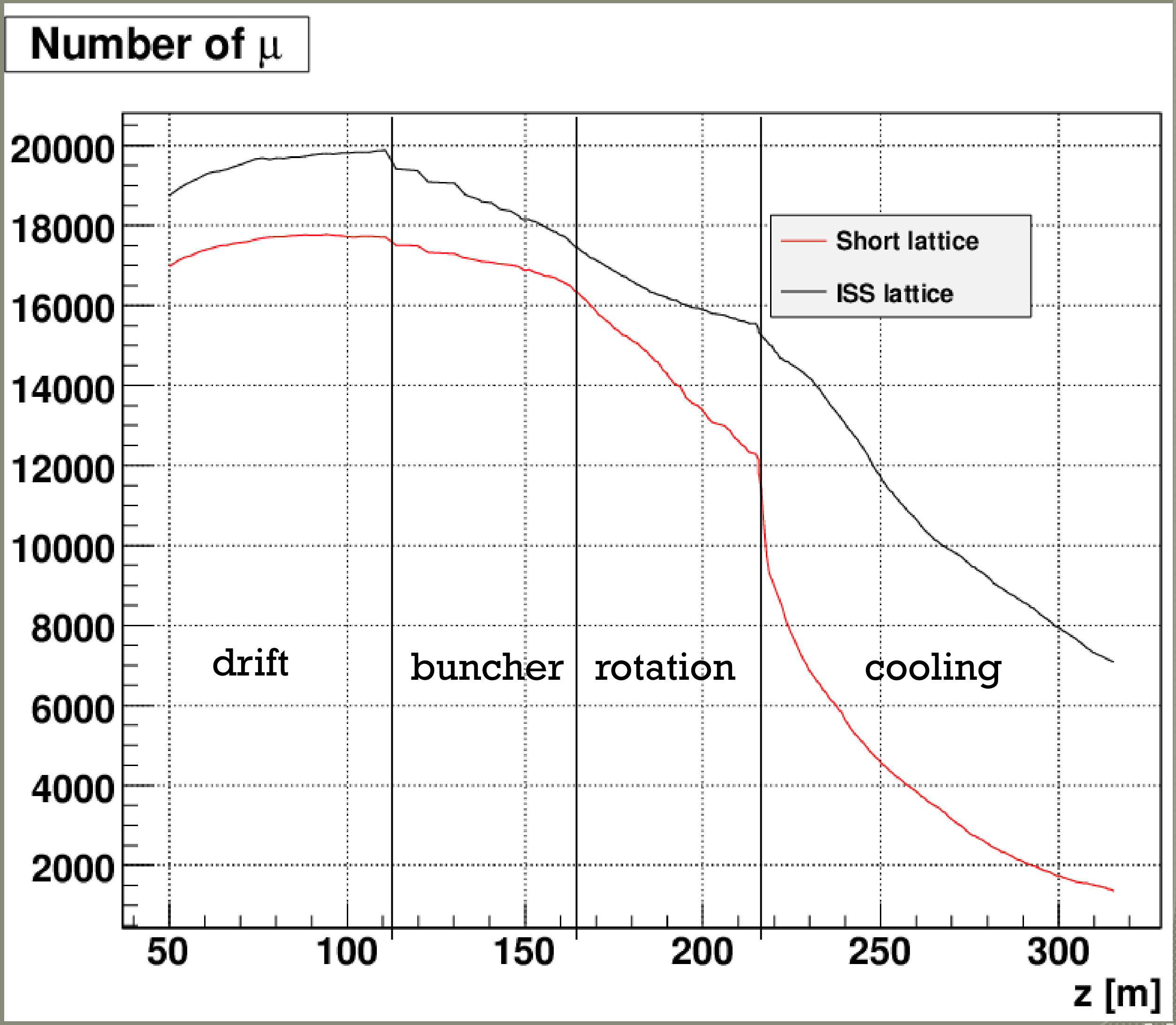
First attempt (2/2)

- Starting to loose muons when entering the rotation section .

- Problem with PHASEMODEL (use model 4 for rotator and model 3 everywhere else) ?

- Problem with tref ?

Why the RF phase is not adjusted in the rotator but the buncher seems ok ?



Second attempt (1)

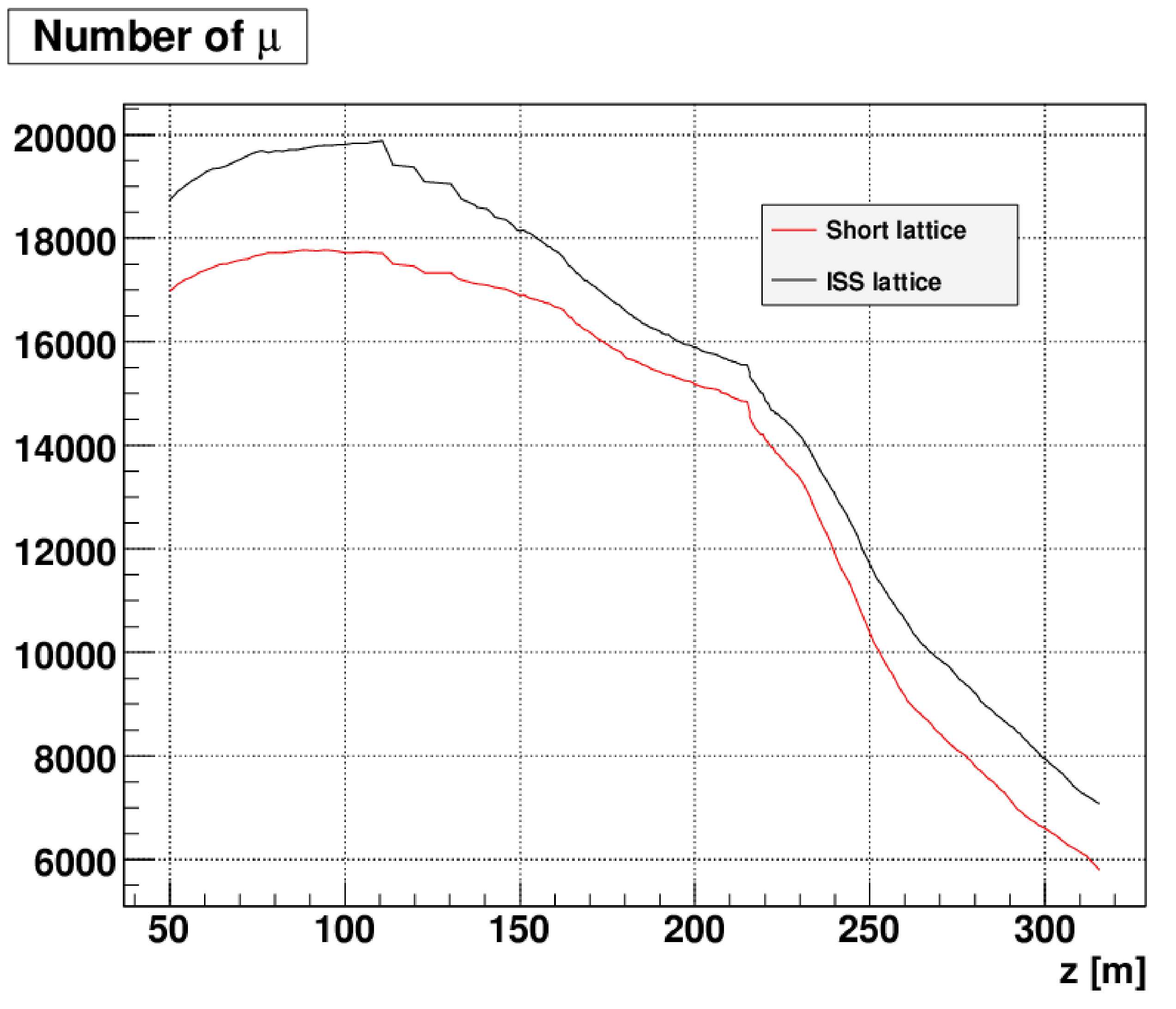
- t_{ref} = <t> ~ 175 ns:

- Assign to the reference particle <t> in the first REFP data card.

- Similar lattice performance.

- 4152 (ISS) and 3253 (short) muons within ecalc9f acceptance.

10% less muons at start come from the difference in tracking using either MARS (short) or ICOOL (ISS).



Conclusion & todo

- Effect on target material (and/or tracking ?) on particles distribution:
  - Loss of particles is up to 12% for muons and up to 25% for pions if using MARS.
  - phase-space distribution remains unchanged.

Important for the FE optimization to hand off the particles beam at a location where the particles loss in material is only driven by the front end design configuration.

- Short ICOOL lattice:
  - Need to set reference particle time to <t> in the first REFP data card.
  - Lattice performance after ecalc9f cuts ~30% less muons compared to the ISS lattice (cannot be solely explained by the 10% difference at input).

Need to check particle phase space in buncher/rotator/cooler.
Is the tref problem a bug of 3.10 (need to check with more recent ICOOL versions) ?