# Front-End Lattice in G4Beamline (first results)

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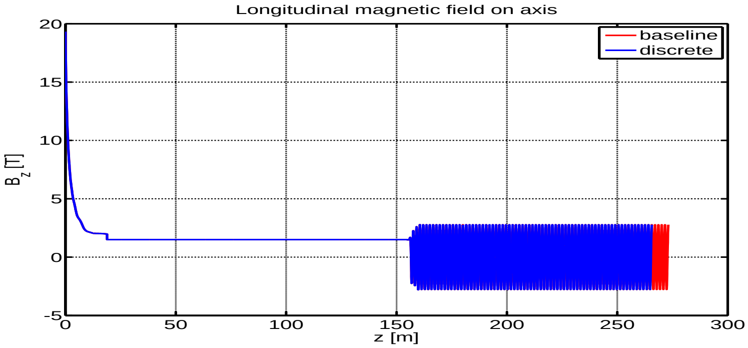
# Lattices

- "Baseline": ACCEL model 10 for RF, continuous change of frequencies, 150 cells (112.5 m) of the cooler section, constant length buncher cells.
- "Discrete": limited number of predefined RF frequencies/gradients, 140 cells (105 m) of the cooler section, variable length buncher cells (1, 2 or 3 RF per cell).

# Magnetic field profile




Magnetic field looks ok (apart from the 2 T to 1.5 T jump between capture and decay sections). Field maps are generated by a separate script.

# Capture and drift

Nothing to report, pions get focused, decay in a 1.5 T solenoid, about 20% loss in “transmission”.

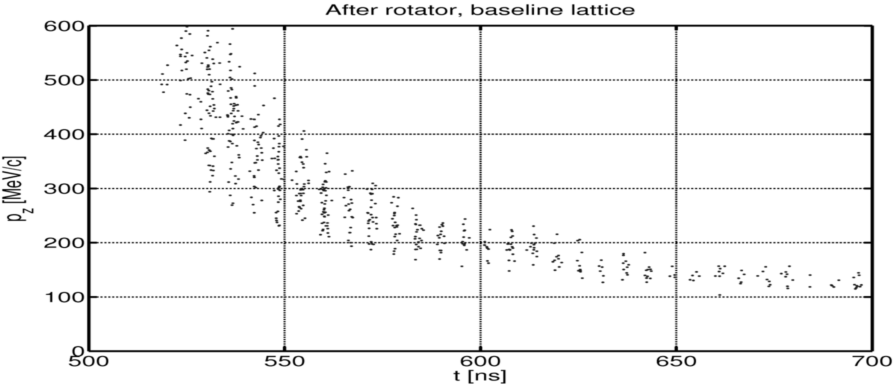
# Buncher and rotator

Model 10 in ICOOL assumes that $G = g_0 + g_1\left(\frac{z}{L}\right) + g_2\left(\frac{z}{L}\right)^2$, where $z$ – longitudinal position, $L$ – buncher length, $g_0$, $g_1$ and $g_2$ are constant coefficients, $G$ – RF gradient.

Also, $\nu_{RF} = \frac{n_b}{|t_{ref1} - t_{ref2}|}$, where $\nu_{RF}$ – RF frequency, $n_b$ – number of bunches separating the two reference particles, $t_{ref\{1,2\}} = \frac{z}{v_{ref\{1,2\}}}$, $v_{ref\{1,2\}} = \frac{p_{ref\{1,2\}}}{\sqrt{p^2_{ref\{1,2\}} + m^2}}$.

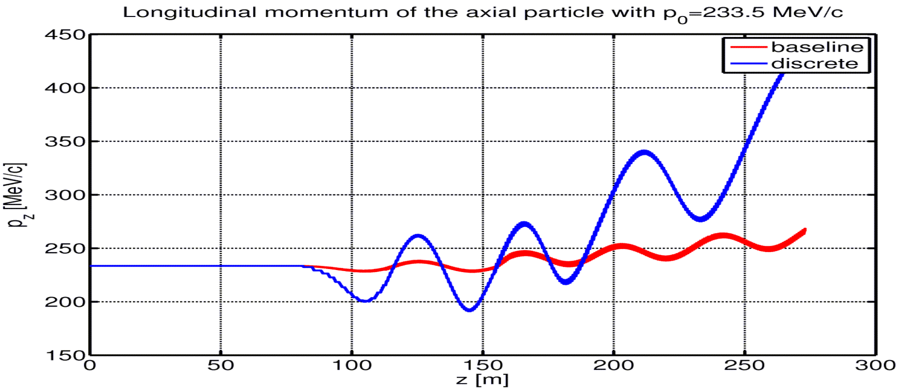
I used these formulas in G4Beamline.

# Rotator issue




Big issue: there is no rotation in the rotator section (RF time offset is not right, I guess).

# Rotator issue continued




Reference particle with $p_0 = 233.5$ MeV/c loses and regains energy in both buncher and rotator, clearly a synchronization issue.

# Matcher and cooler

- In the "discrete" model both gradient and frequency values for RF provided.
- In the "baseline" model used $frfcool, $Vrfcool and $ficool + standard G4Beamline pillbox RF cavity.
- Again, no proper time/phase offset.

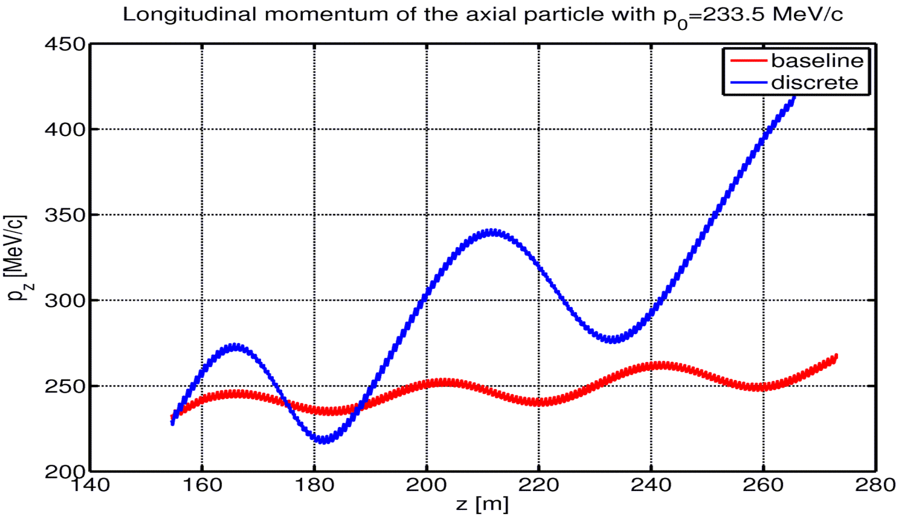
# LiH absorber

LiH absorber between the rotator and matcher sections:

- “Baseline”: $p_{ref}$ goes from 233.5 to 233.0 MeV/c.
- “Discrete”: $p_{ref}$ goes from 233.5 to 230 MeV/c.
- Any comments?

# LiH absorbers in matcher + cooler

- “Baseline”: 10 & 11.5 mm.
- “Discrete”: 11 & 11 mm.
- Results in higher energy gain by ref. particle (next slide).


Longitudinal momentum of the axial particle with p0=233.5 MeV/c
450
400
350
300
250
200
p_z [MeV/c]
140
160
180
200
220
240
260
280
z [m]
baseline
discrete

# TODO:

- Understand & resolve the issue with RF synchronization (quick question: is there a way to trace in ICOOL what RF phase has been set to?).
- Find a way to do it in a (semi-)automatic fashion for future simulations. G4Beamline built-in “tune” command can only tweak RF gradient.
- Achieve proper phase rotation.
- Compare outcome to ICOOL.
- Use happily ever after (hopefully).