Shielded RF Lattice

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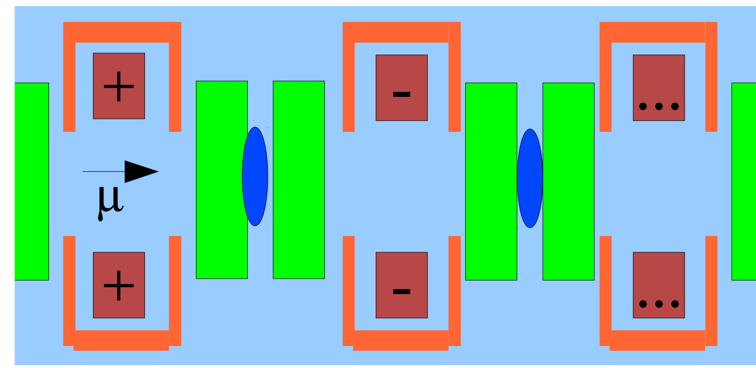
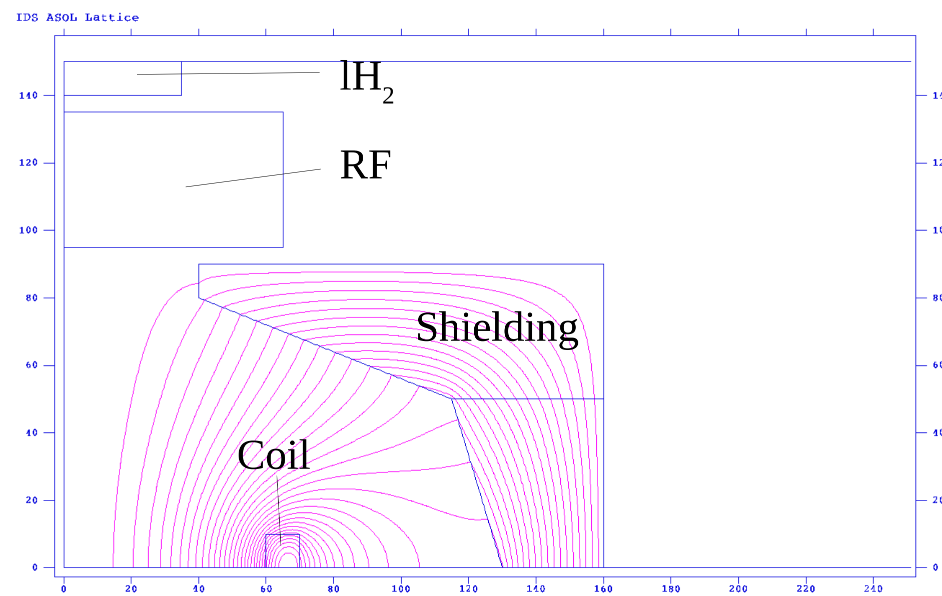
Shielded RF - Reminder

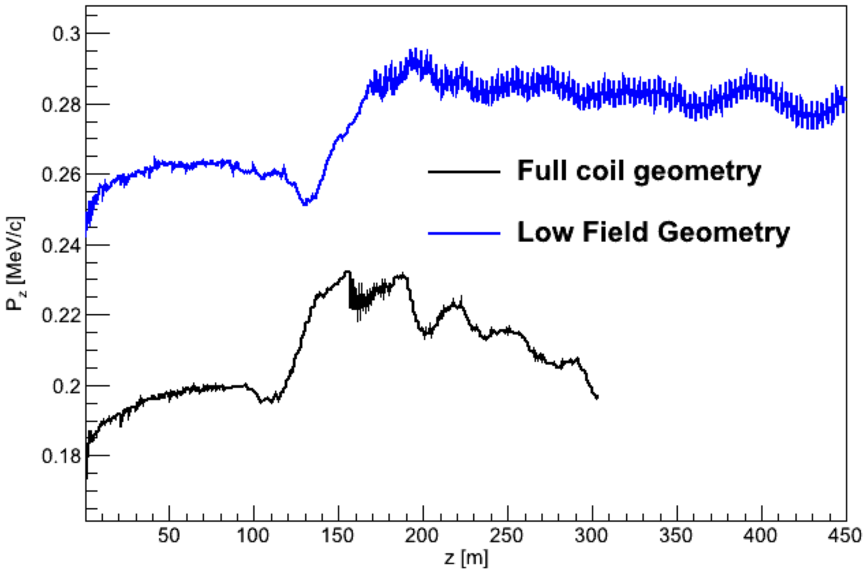
- Increase cell length to remove RF from solenoid fringe fields
  - Add shielding using iron or bucking coils?
  - Try to keep good acceptance and focusing
- Look at cooling section
  - This is where the RF is most limited
  - This is where optics are most demanding
- How well can we cool in this shielded scenario?
- How well can we optimise the cooling lattice?
- Try to keep RF cavities in < ~~0.1~~ 0.5 T fields
- Liquid Hydrogen absorbers



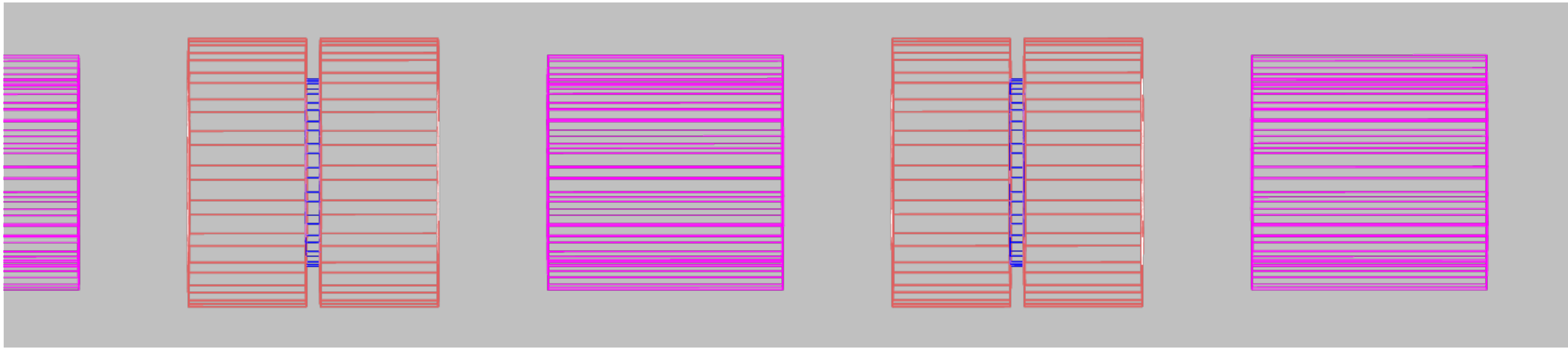


Capture at Higher P

- Work at higher energy to reduce geometric emittance
- Use existing capture scheme for acceleration
- Keep peak field same
  - Change phasing to bring both reference particles in at higher momentum
  - Still phase with 233 MeV/c particle
  - Needs ~ 4-6 degrees phase to bring to 273 MeV/c
- Cut 273 MeV/c < Pz < 373 MeV/c
- All simulations done in g4bl v2.06

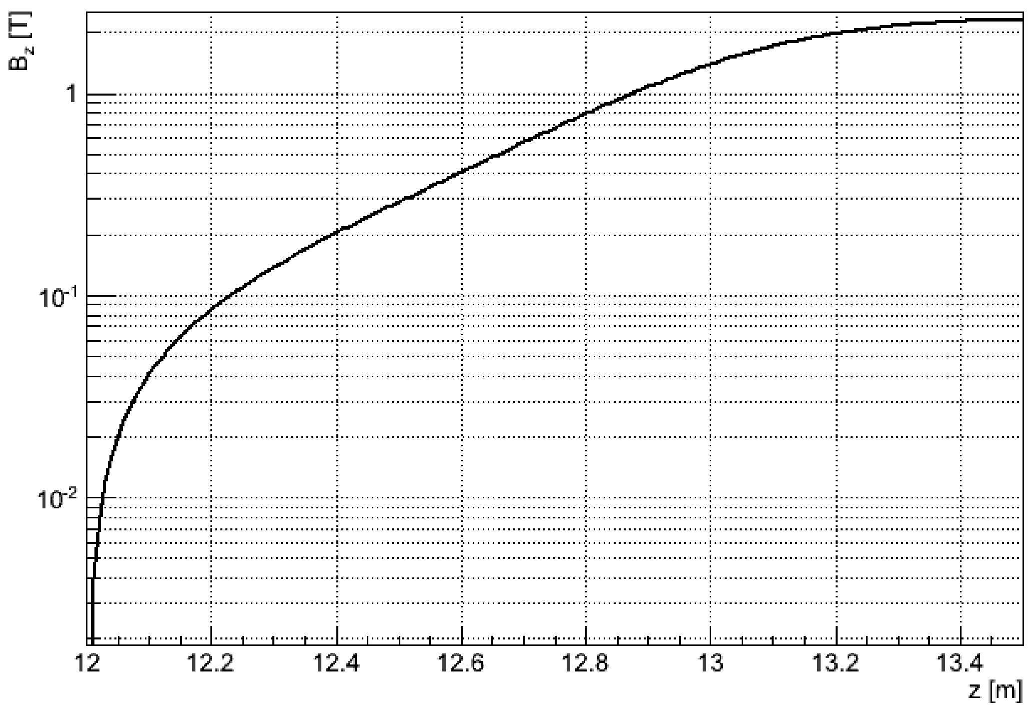


LiH Lattice Schematic

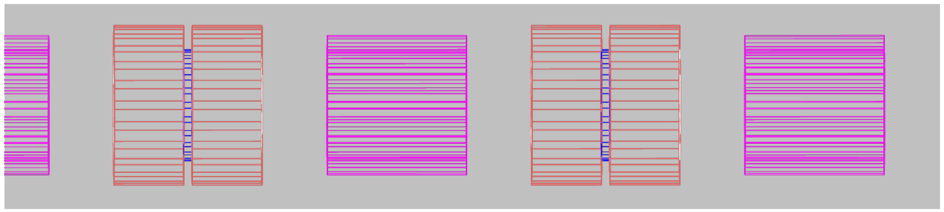


- LiH absorber every cell
  - Much more compact
  - Some compromise in cooling performance
    - LiH makes a bit more scattering

LiH Lattice Schematic



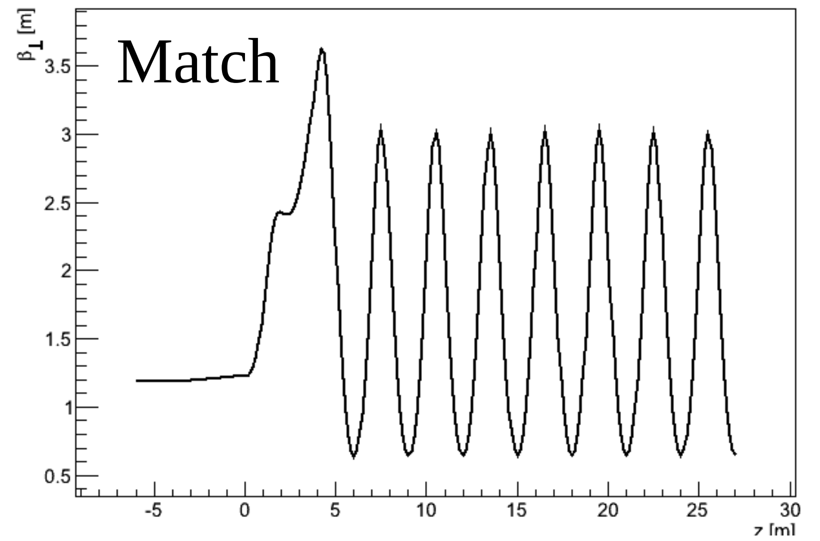
LiH Lattice Schematic

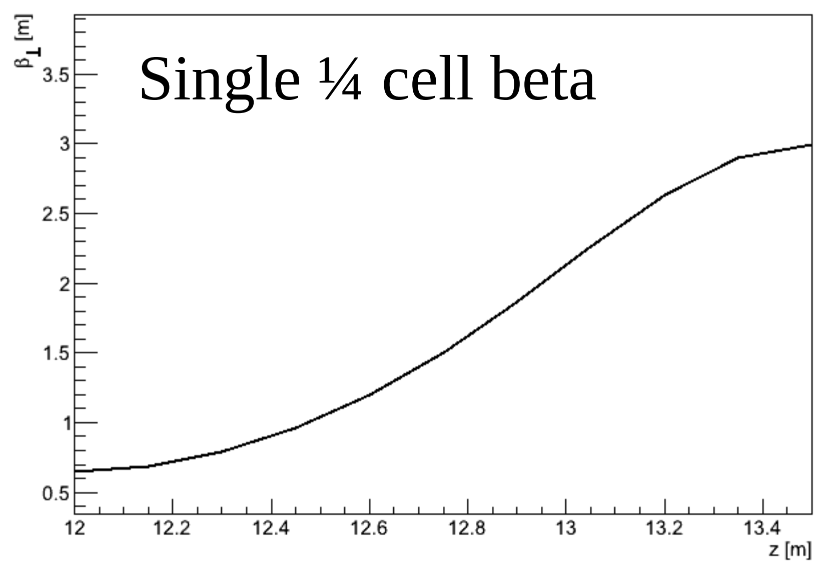


LiH length	46 mm
RF peak field	19 MV/m
RF phase	30 degrees
RF length	500 mm
Be window thickness	0.4 mm
Apertures	400 mm
Coil length	1000 mm
Coil radial thickness	100 mm
Coil inner radius	400 mm
Coil current	22 A/mm^2

Matching from RF Capture

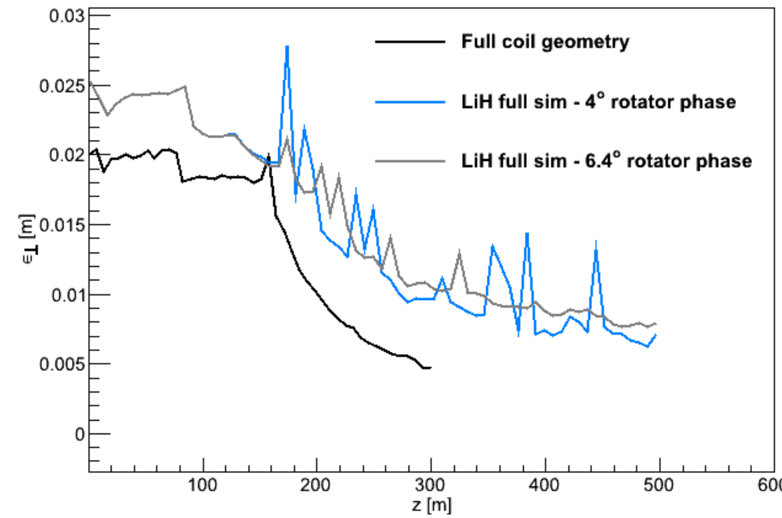
- Bring into flipping lattice
- Note I do fiddle with magnet currents in the cooling lattice
  - I don't always redo the match!
  - Probably good enough

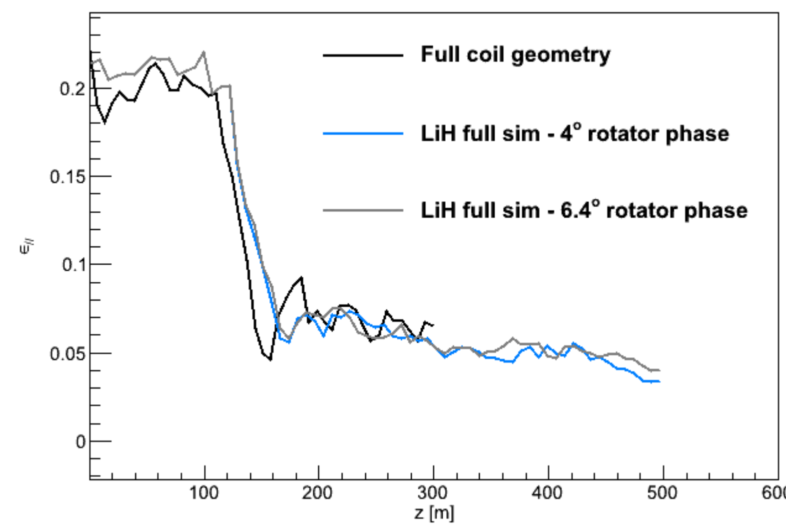




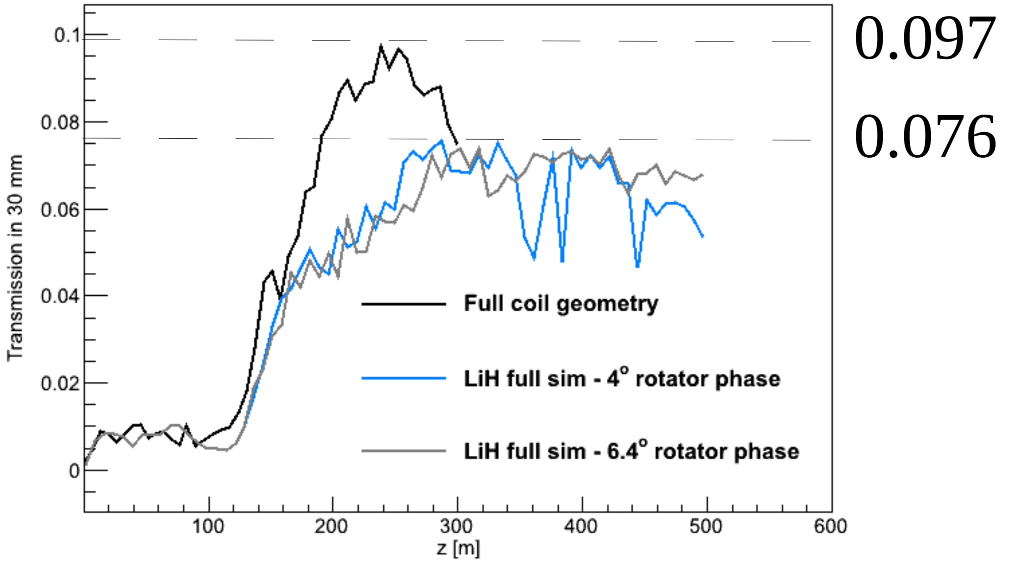
Emittances

- Transverse and longitudinal emittance look good
  - But note mismatch to cooling
  - Worse for 4° case (off-momentum)
- Longitudinal matching is better





Capture Performance



- Transmission inside usual cuts:
  - 30 mm normalised transverse acceptance
  - 150 mm normalised longitudinal acceptance
- Note however momentum cut is
  - 173 < Pz < 373 MeV/c for low field geometry
  - 100 < Pz < 200 MeV/c for baseline

Components

	Baseline	LiH
Tunnel length	75 m	120 m
Number of RF	100	80
RF length	500 mm	500 mm
RF peak field	16* MV/m	19 MV/m
Number of coils	100	40
Coil current	106.66	21
Inner radius	350 mm	400 mm
Outer radius	500 mm	500 mm
Length	150 mm	1000 mm
Coil peak field	2.8 T	1.25 T
Coil current	106.66 A/mm^2	19 A/mm^2

Conclusion

- Full simulation in G4BL
- Includes reoptimisation of phase rotation to capture at higher energy
- Or we use LiH, fields <~ 0.3 T, lose ~ 20% muon rate
- Cooling channel cost ~ same (New!)

Require

- The modified lattice should be fully documented so that a third party could reproduce the lattice.
- The modified baselines should be properly integrated with the muon front end and simulated fully. Any simulation should reproduce the front end baseline performance.
- There should be two codes with simulations showing similar performance.
- There is a fair amount of work involved in changing baseline. The improvement should be shown to be of sufficient magnitude that a rebaseline is worth while, i.e. there is a definable and significant benefit.
- The relative increase in hardware should not be too great (i.e. the cost shouldn't increase by too much, relative to the improvement in performance).