Muon Collider Workshop -BNL

Front End Studies
International Design Study &
Muon Collider

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FNAL

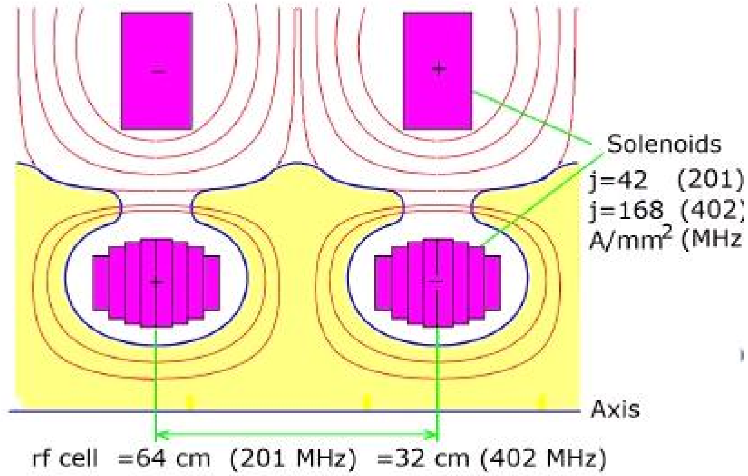
(December 8, 2009)

Outline

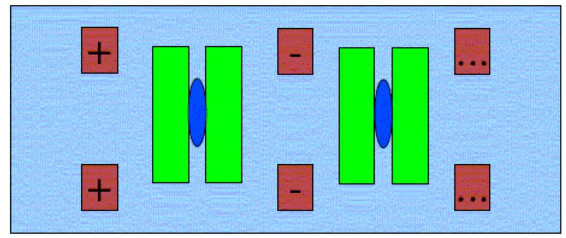
- **Front End for the Neutrino Factory/MC**
  - Concepts developed during study 2A
- **Concern on V_{rf}' as function of B_{sol}**
- **Need baseline design for IDS**
  - need baseline for engineering study
    - ~lower fields; medium bunch length

New Results

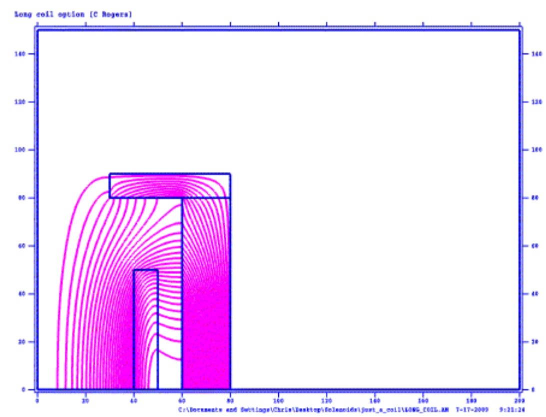
- Insulated rf lattice
  - recent results show similar insulated/uninsulated simulation results



- Shielded rf cooling channel



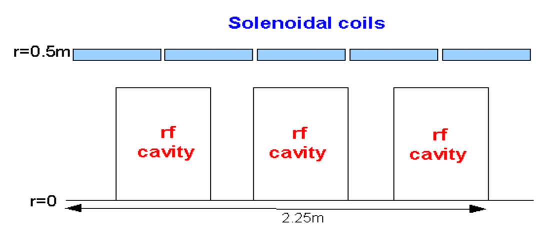
- Front End with reduced rf/B requirements
- Front End Cooling
  - "snake"
  - match into HCC

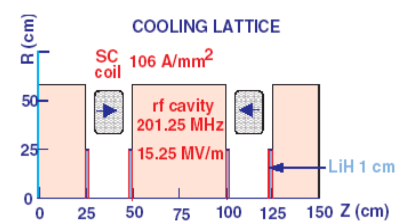


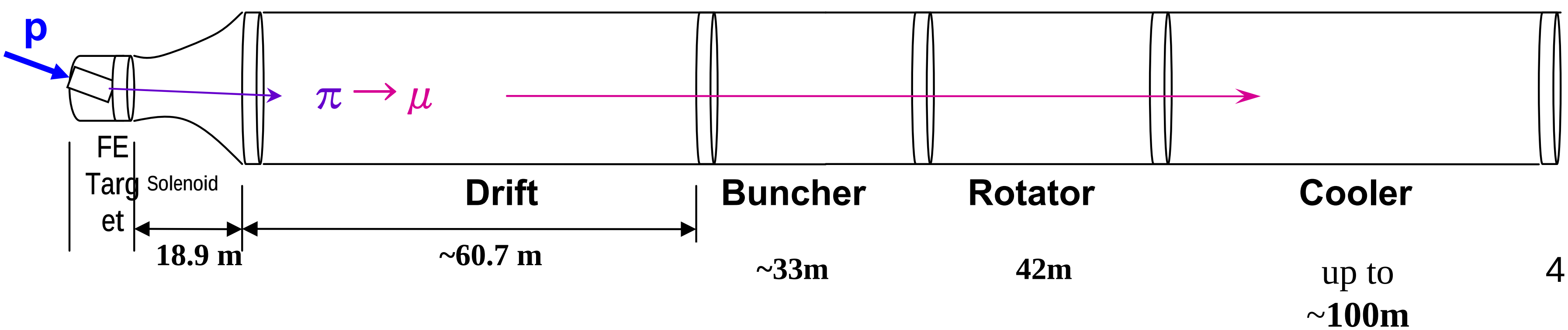
Front End ReOptimization

- Change reference B-field to 1.5T
  - constant B to end of rotator

- changing to n_B ="12" example
  - A bit longer than n_B = 10
  - optimize with lower fields
    - V'_{rf} < 12 MV/m
- Will see if we can get "better" optimum

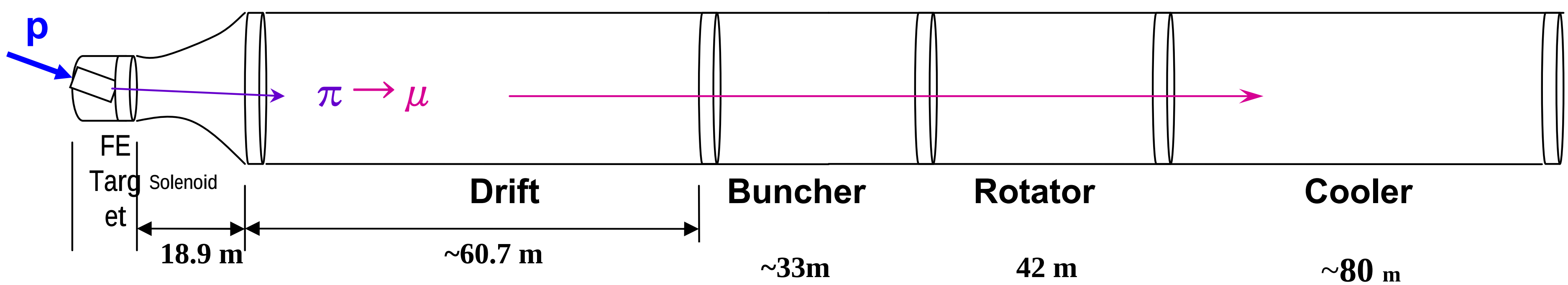






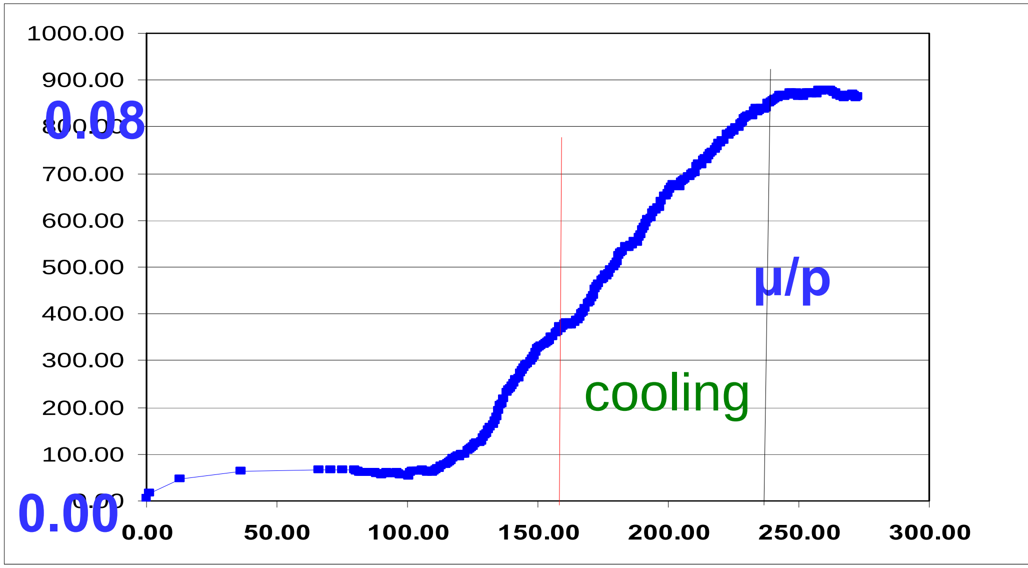
High-frequency Buncher and φ-E Rotator

- Drift (π→μ)
- "Adiabatically" bunch beam first (weak 320 to 232 MHz rf)
- Φ-E rotate bunches – align bunches to ~equal P (233MeV/c)
  - 232 to 202 MHz, 12MV/m
- Cool beam 201.25MHz

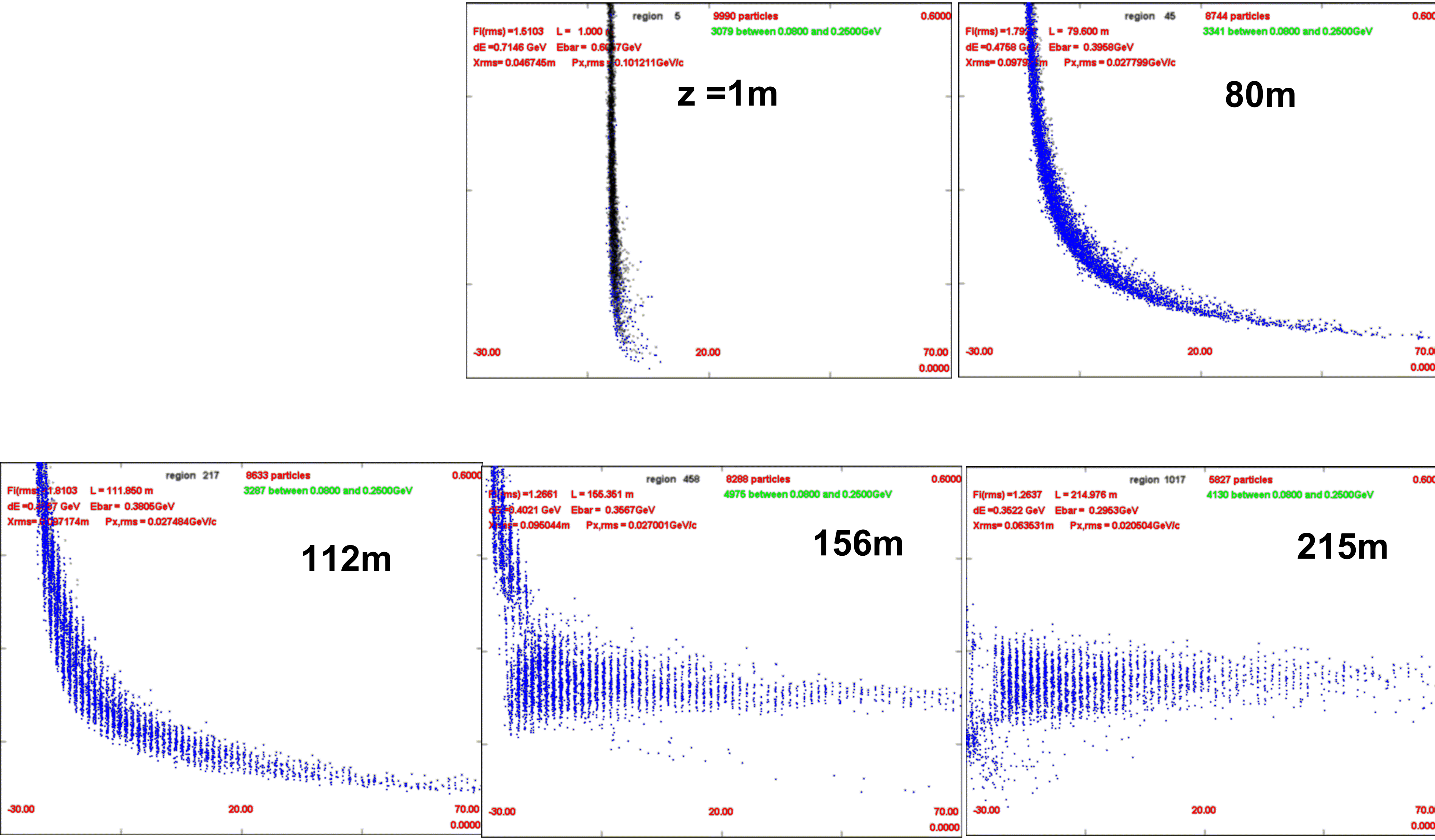


Parameters of candidate release

- Initial drift from target to buncher is 79.6m
  - 18.9m (adiabatic ~20T to ~1.5T solenoid)
  - 60.7m (1.5T solenoid)
- Buncher rf – 33m
  - 320 → 232 MHz
  - 0 → 9 MV/m (2/3 occupancy)
  - B=1.5T
- Rotator rf -42m
  - 232 → 202 MHz
  - 12 MV/m (2/3 occupancy)
  - B=1.5T
- Cooler (50 to 90m)
  - ASOL lattice, P_0 = 232MeV/c,
  - Baseline has 15MV/m, 2 1.1 cm LiH absorbers /cell

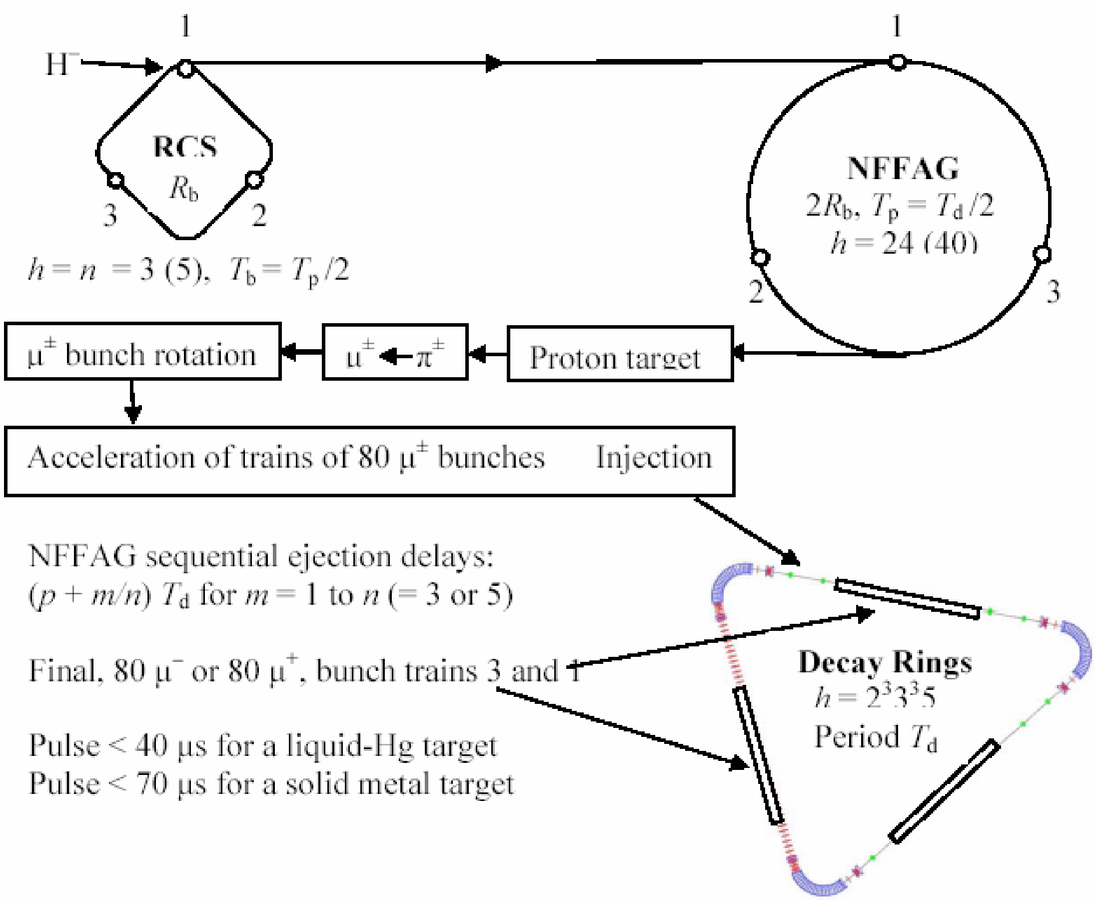


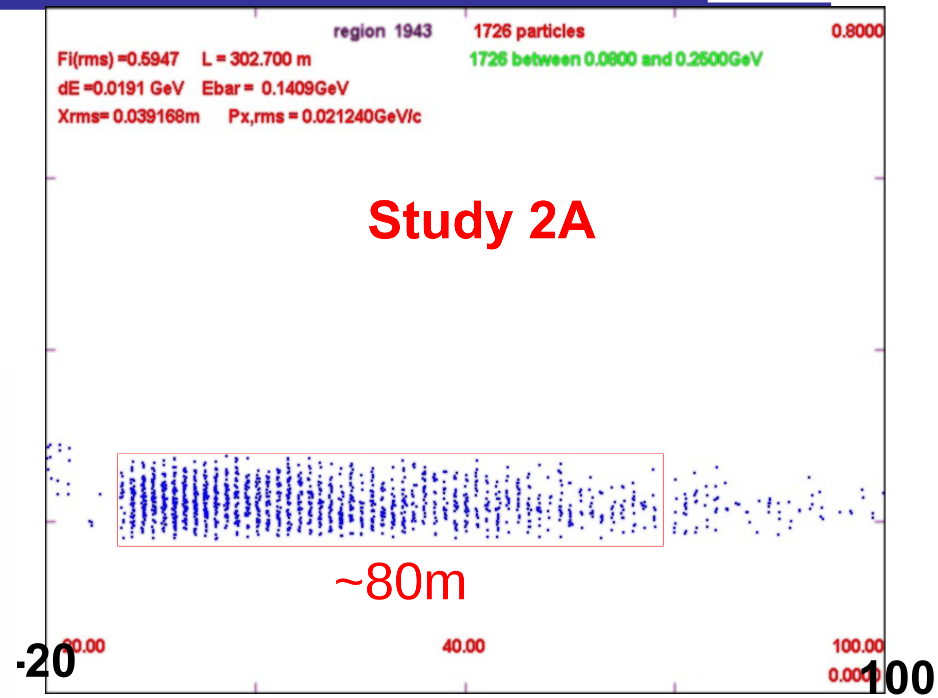
progression through system

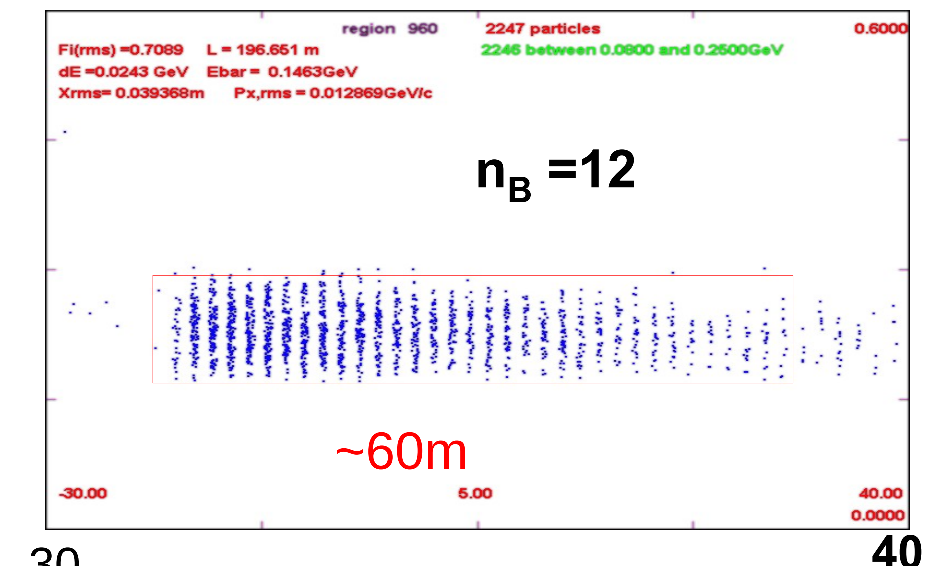


How Long a Bunch Train for IDS?

- ISS study alotted space for 80 bunches (120m long train)
  - 80m or 54 bunches is probably plenty







Varying Buncher/Rotator Voltage

- Vary buncher/rotator gradients from baseline to explore sensitivity to gradient limits.
  - same baseline cooling channel (16MV/m, 1.15cm LiH)
    - 15 MV/m -> 1.1cm Li H
- Somewhat less sensitive than previous

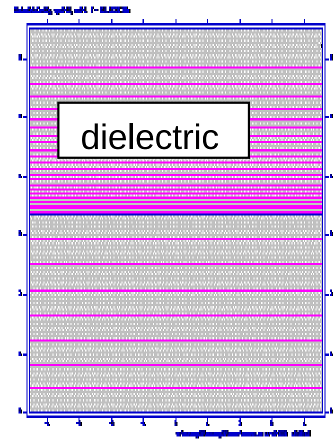
Buncher / Rotator	0/0	3/6	4/7	5/8	6/9	7/10	8/11	9/12	10/ 13	11/ 14
μ/8GeVp at 240m (×10)	.136	.508	.686	.753	.797	.800	.831	.857	.821	.839

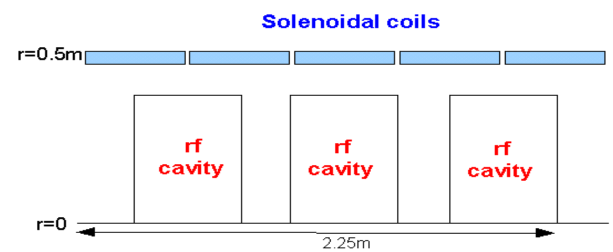
rf requirements

- Buncher
  - 319.63, 305.56, 293.93,285.46, 278.59, 272.05, 265.80, 259.83, 254.13, 248.67, 243.44, 238.42, 233.61 (13 f)
  - ~100MV total
- Rotator
  - 230.19, 226.13, 222.59, 219.48, 216.76, 214.37,212.28, 210.46,208.64, 206.90, 205.49,204.25, 203.26, 202.63,202.33 (15 f)
  - 336MV total
- Cooler
  - 201.25MHz –up to 75m ~750MV

Plans etc.

- Move toward "realistic" configuration
  - More realistic B-field
    - B= 1.5T -> coil-based fields
  - add Be windows
  - smaller number of rf frequencies
- Set up design for cost algorithm
  - rf cavity design (pillbox, dielectric)
  - rf power requirements
  - Magnet design





- Continuing front end IDS design study
  - C. Rogers, G. Prior, D. Neuffer, C. Yoshikawa, K. Yonehara, Y. Alexahin, M. Popovic, Y. Torun, S. Brooks, S. Berg, J. Gallardo …
  - Fermilab meeting (July)
  - ~Biweekly phone Conference
  - Meeting at RAL
    - December 14-18
  - April at Fermilab (IDS meeting)

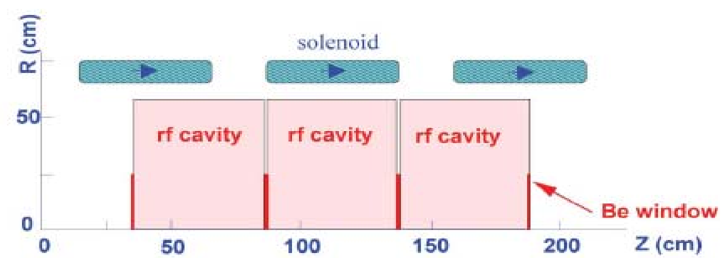


FIG. 9. (Color) Schematic of a cell at the beginning of the phase rotator section.