Front End Studies and Plans

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Outline

- Front End for the Neutrino Factory/MC
  - Shorter front end example-
    - basis for present study

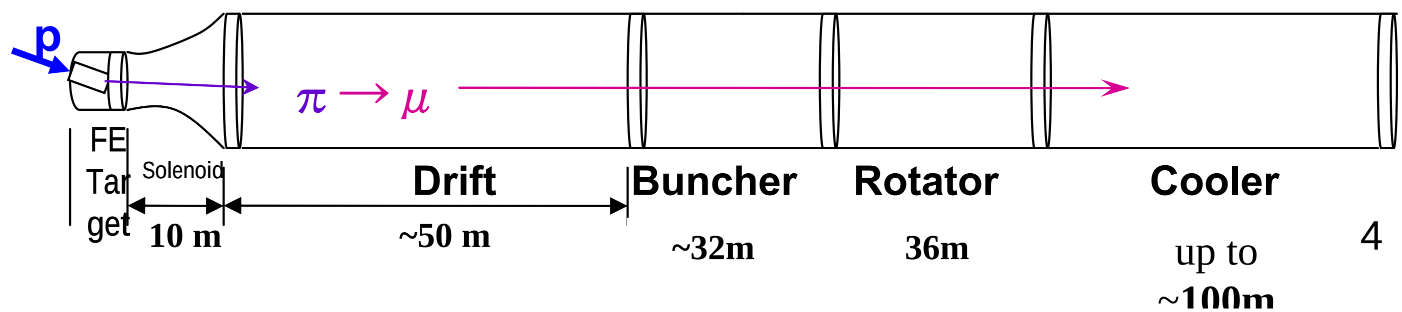
- Need baseline design for IDS
  - need baseline for "5-year Plan"

Plan for IDS

- Need one design likely to work for V_{rf}/B-field
  - rf studies are likely to be inconclusive
  - B=1.25T; V' = 10MV/m is very likely to work
  - B= 2T; V' = 15 MV/m should work with Be
- Hold review to endorse a potential design for IDS
  - – likely to be acceptable (V_{rf}/B-field)
  - April 2010 ?
- Use reviewed design as basis for IDS engineering study

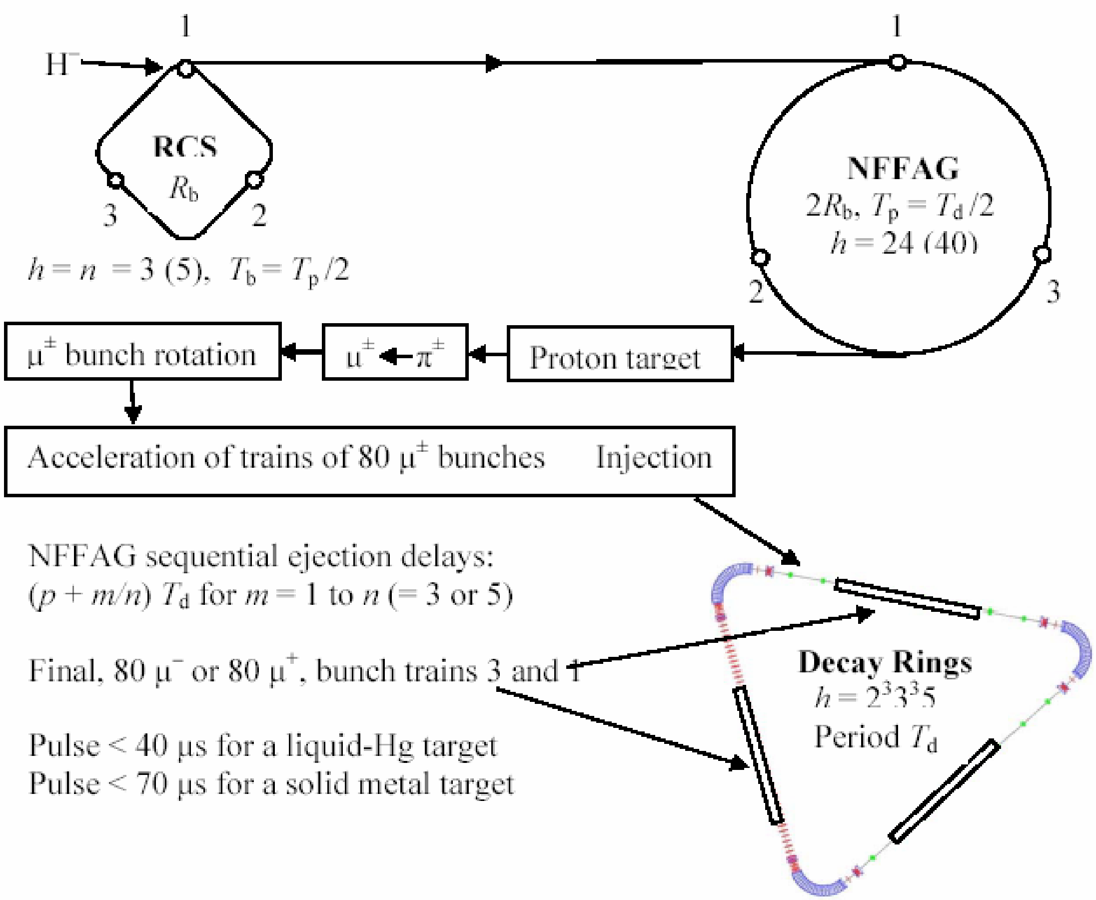
IDS candidate

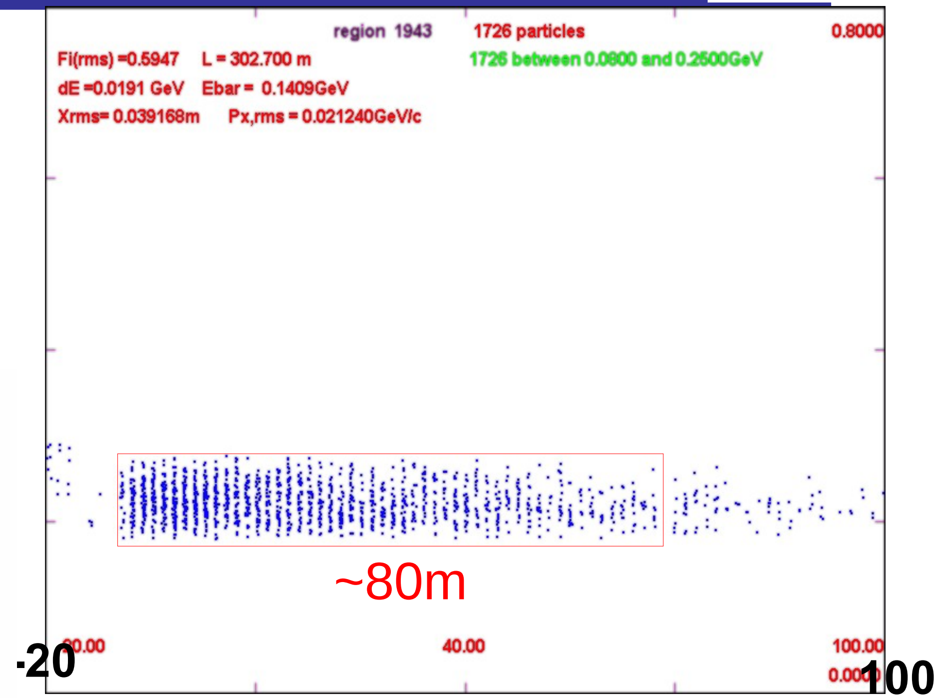
- ISS study based on n_B = 18 (280 MeV/c to 154 MeV/c)
- Reference shorter has n_B = 10 (280 MeV/c to 154 MeV/c)
  - slightly higher fields (2T, 15MV/m)
- Looking for candidate variation for IDS
  - developing intermediate case, with a bit weaker fields

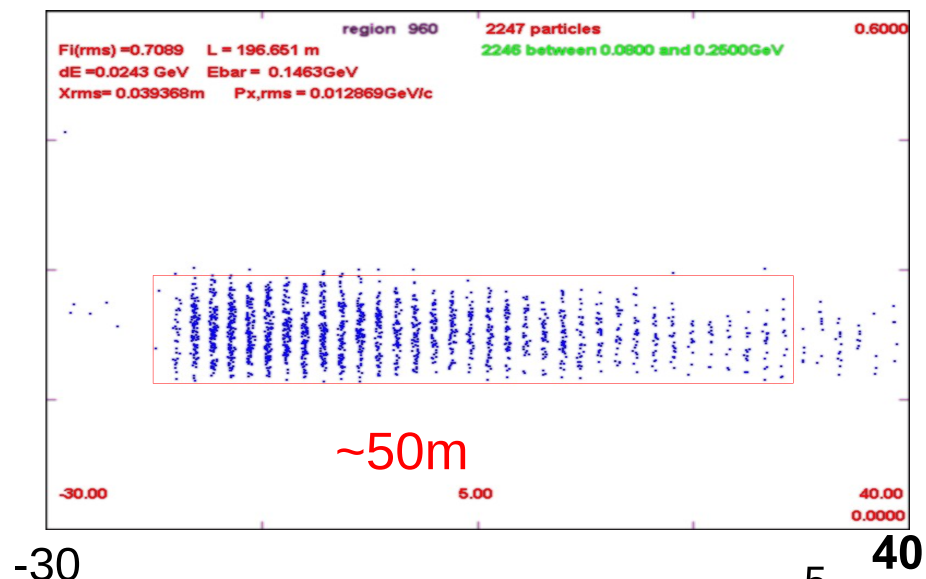


How Long a Bunch Train for IDS?

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

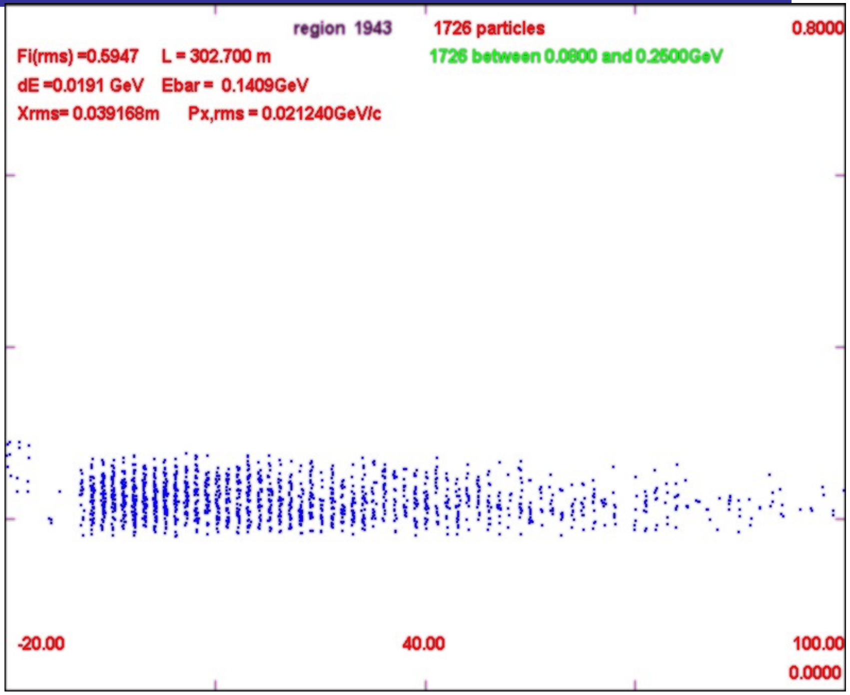


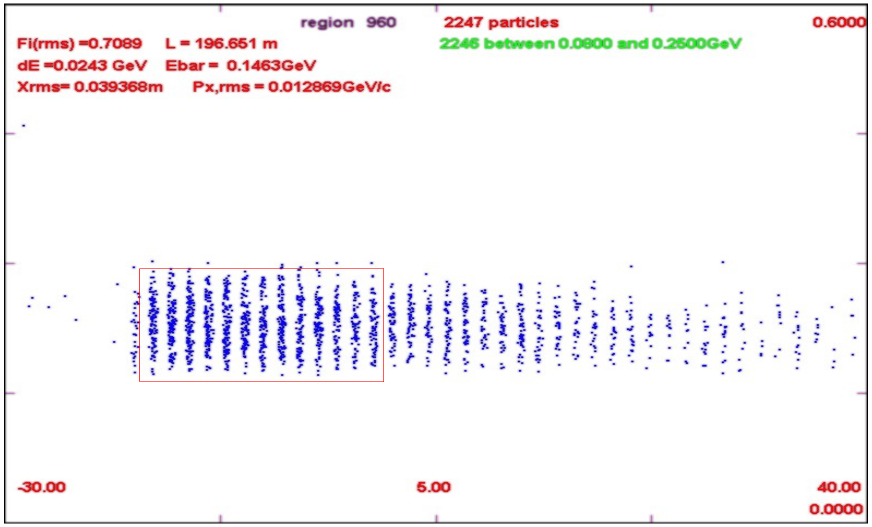




Bunch train length

- **Within IDS design could reduce bunch train to ~80m (52 bunches)**
  - very little mu loss
- **With shorter front end, could reduce that to 50m or less**
  - For Collider scenario ~12 best bunches, (18m) contains ~70% of muons
- **Reserving 80m for bunch trains should be adequate for IDS**

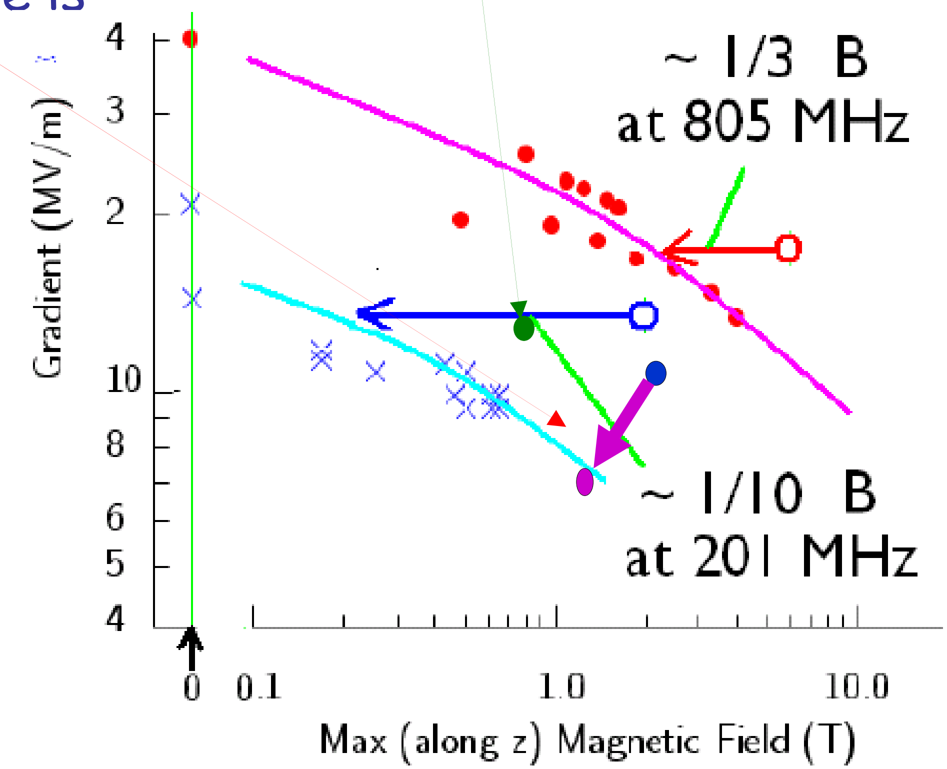




Recent Studies on Lower Fields

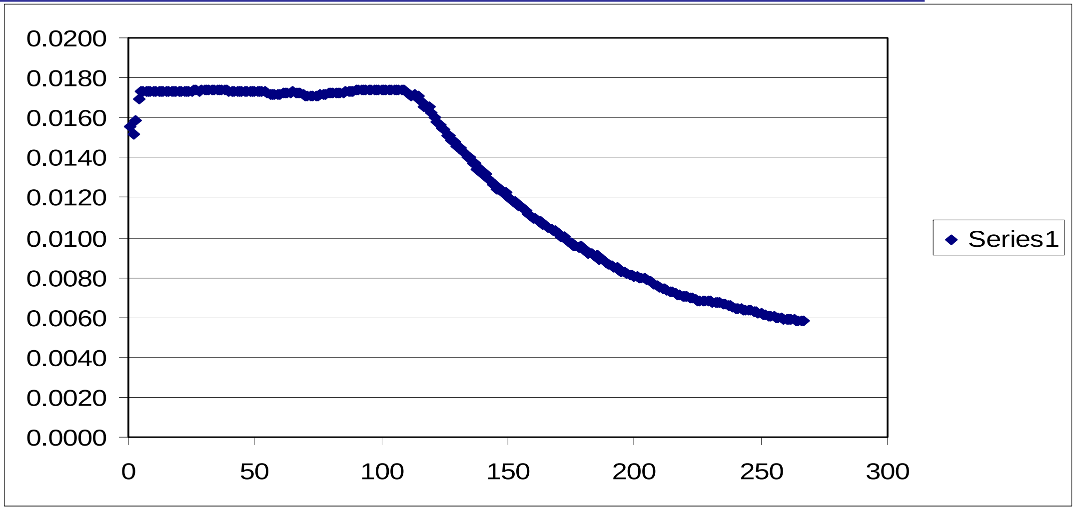
- Adequate acceptance can be obtained by reducing magnetic fields and gradients
- B -> 1.25T, V' -> 10 MV/m ??
  - (10MV/m is 7MV/m real estate gradient; could use 7MV/m if space is filled.)
- Reduced B, V' are relatively certain to work.
- Cost optimum?
  - B=1.5T ?, 12MV/m

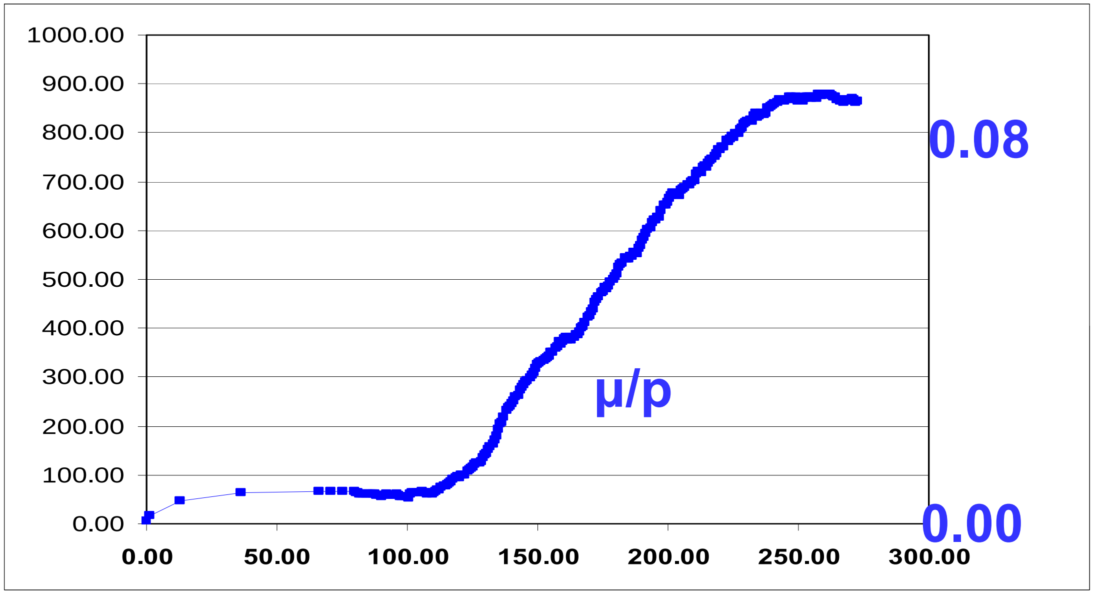
0.75T, 14MV/m

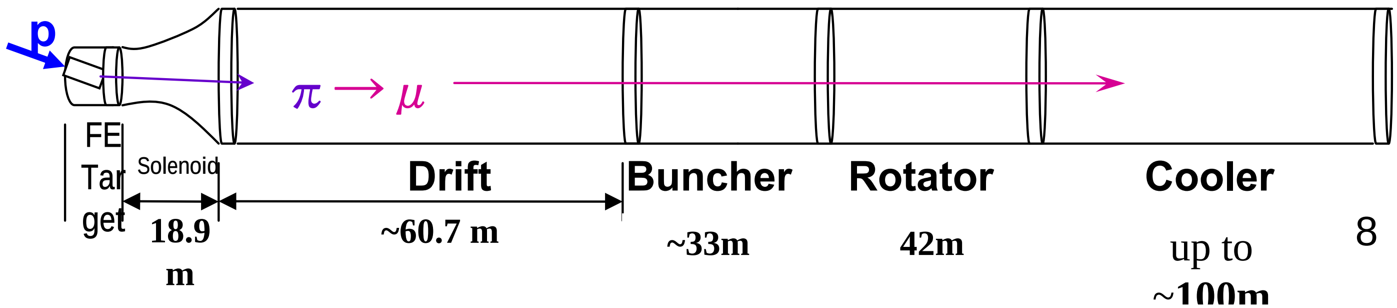


Front end Optimization

- Change reference B-field to 1.5T
  - constant B to end of rotator
  - As good as 2.0T case
- Redoing n_B ="12" example
  - A bit longer than n_B = 10
  - optimize with lower fields
- Will see if we get "better" optimum





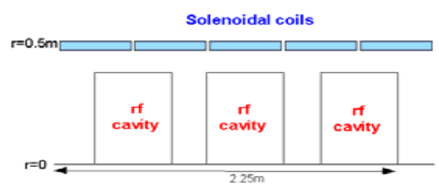


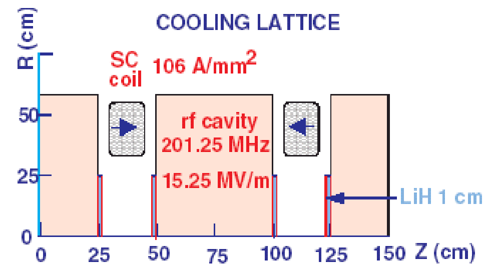
Parameters of candidate release

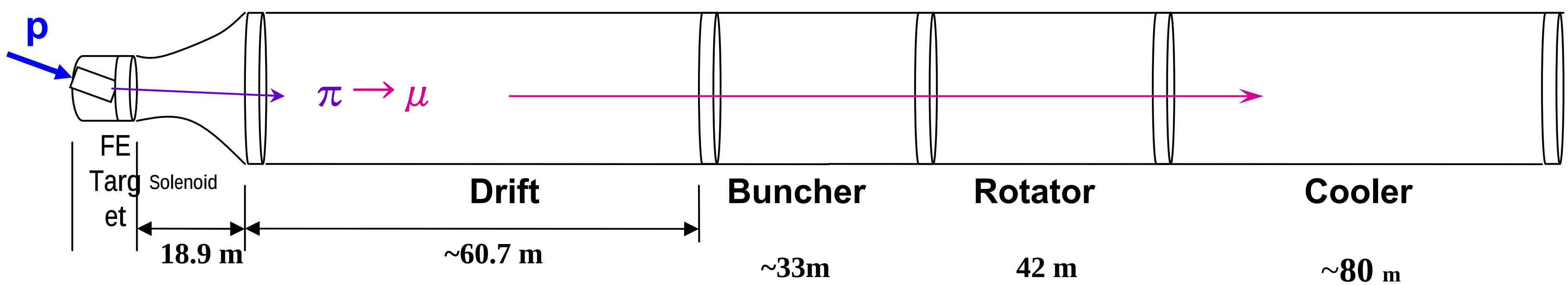
- Initial drift from target to buncher is 79.6m
  - 18.9m (adiabatic ~20T to ~1.5T solenoid)
  - 60.7m (1.5T solenoid)
- Buncher rf – 33m
  - 320 → 232 MHz
  - 0 → 9 MV/m (2/3 occupancy)
  - B=1.5T
- Rotator rf -42m
  - 232 → 202 MHz
  - 12 MV/m (2/3 occupancy)
  - B=1.5T
- Cooler (50 to 90m)
  - ASOL lattice, P_0 = 230MeV/c,
  - Baseline has 15MV/m, 2 1.1 cm LiH absorbers /cell

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 energies
  - 232 to 202 MHz, 12MV/m
- Cool beam 201.25MHz

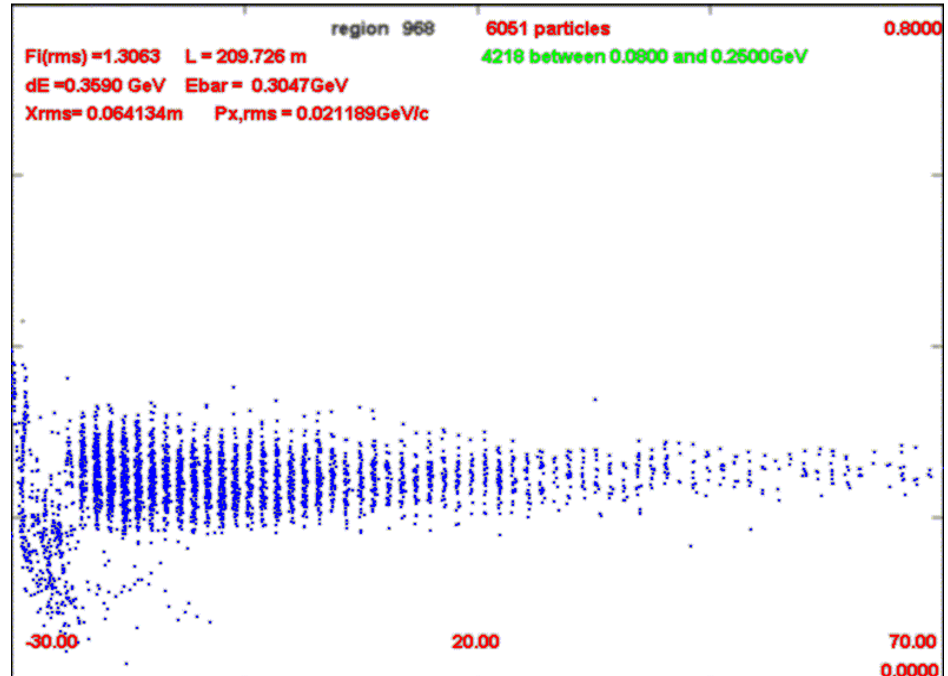


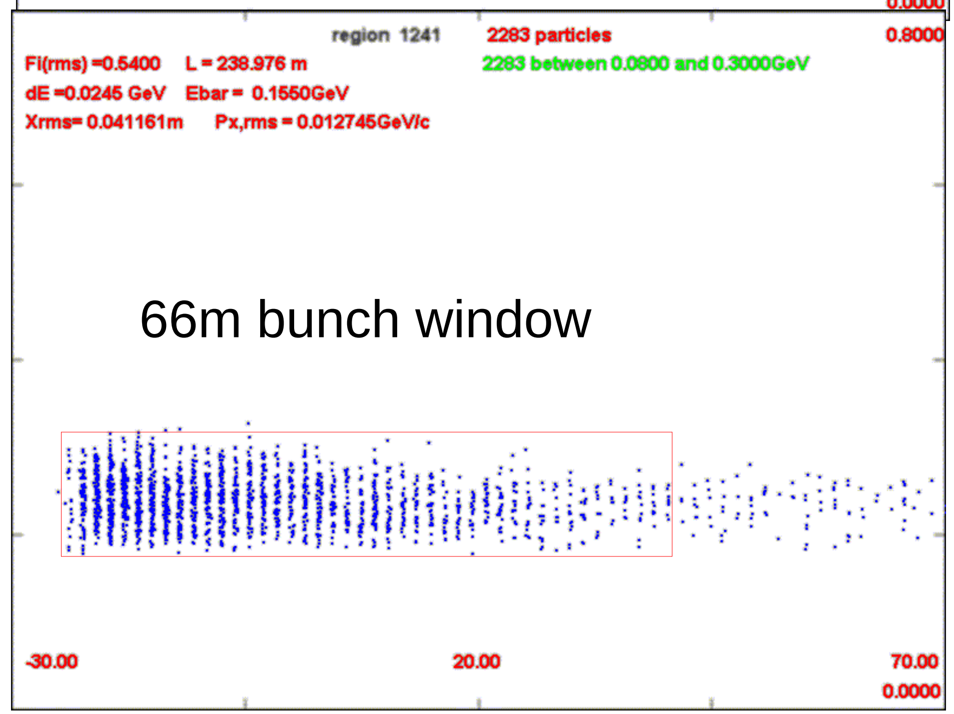




Newer NF Release Candidate

- Front End a bit longer than "short" example
- ~50m shorter than ISS, however
- gradients no greater than ISS baseline
- slightly better "performance"





B_0 = 1.5T, n_B = 12 RC

- Muons per 10 8-GeV protons

Cooler/ Rotator	10	12	14	15	16	18 MV/m
10	0.35 (0.63)	0.55 (0.67)	0.66	0.73		
12		0.57 (0.72)	0.754 0.84	0.77 0.856	0.88	0.80
14			0.776	0.80	0.84	
15				0.81	0.85	0.84
	(0.65cm)	(0.8cm)	1.0cm	1.1cm	1.15	

Black are old n_B = 10 example; new version is Green

- **New version has "better" performance than old**
  - more μ/p
  - weaker fields
  - But not quite at "certain to be safe" values

- **Shorter than IDS but ~20% longer than n_B =10 example**

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

Study2B June 2004 scenario (ISS)

- Drift –110.7m
- Bunch -51m
  - 12 rf freq., 110MV
  - 330 MHz → 230MHz
- ϕ-E Rotate – 54m – (416MV total)
  - 15 rf freq. 230→ 202 MHz
  - P_1=280 , P_2=154 δN_v = 18.032
- Match and cool (80m)
  - 0.75 m cells, 0.02m LiH
- Captures both μ^+ and μ^-
  - ~0.2 μ/(24 GeV p)