
BROOKHAVEN NATIONAL LABORATORY

# New Baseline for a Neutrino Factory Front-End

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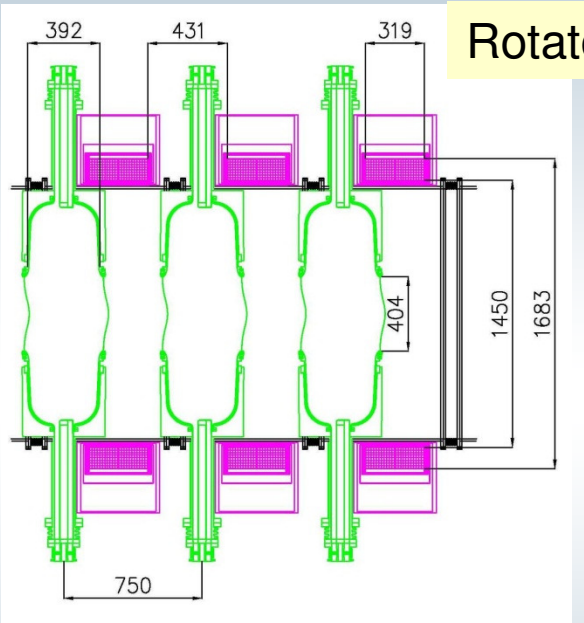
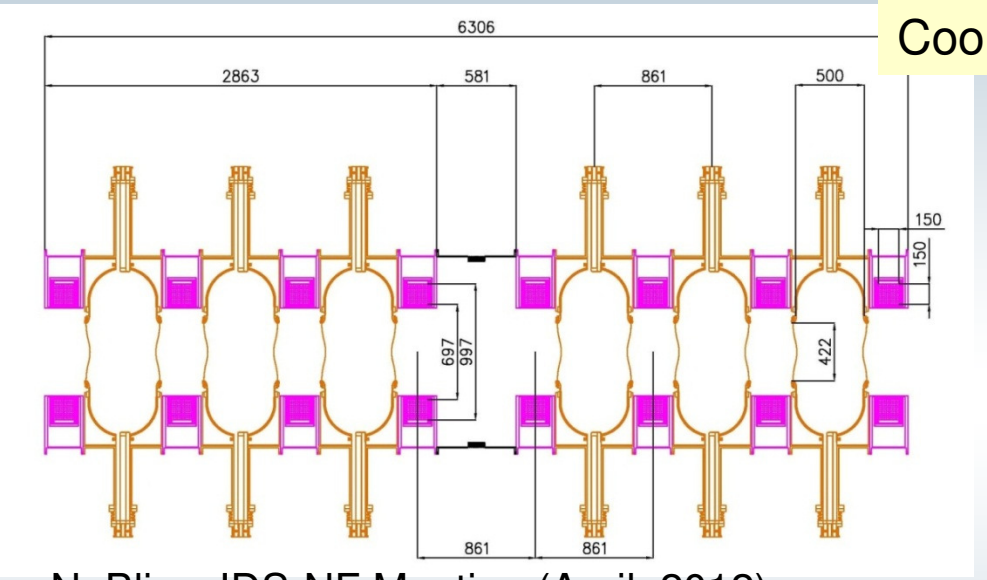
# Outline

- Define new baseline parameters for a NF Front-End
  - Include engineering constrains
- Simulate & benchmark the concept:
  - G4Beamline and ICOOL
- Study low B-Field options
  - Two options: (1) Radial, (2) Longitudinal bucked coils
- Conclusion & Outlook

# Motivation



Rotator

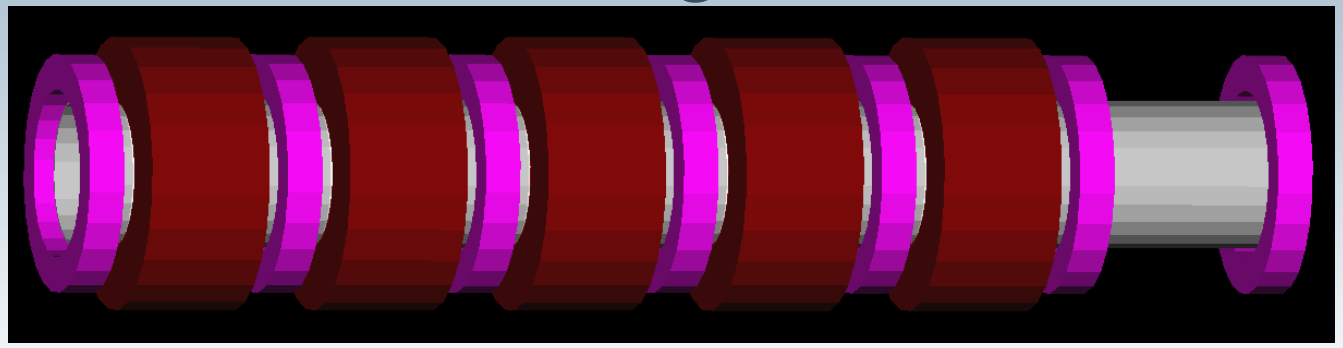


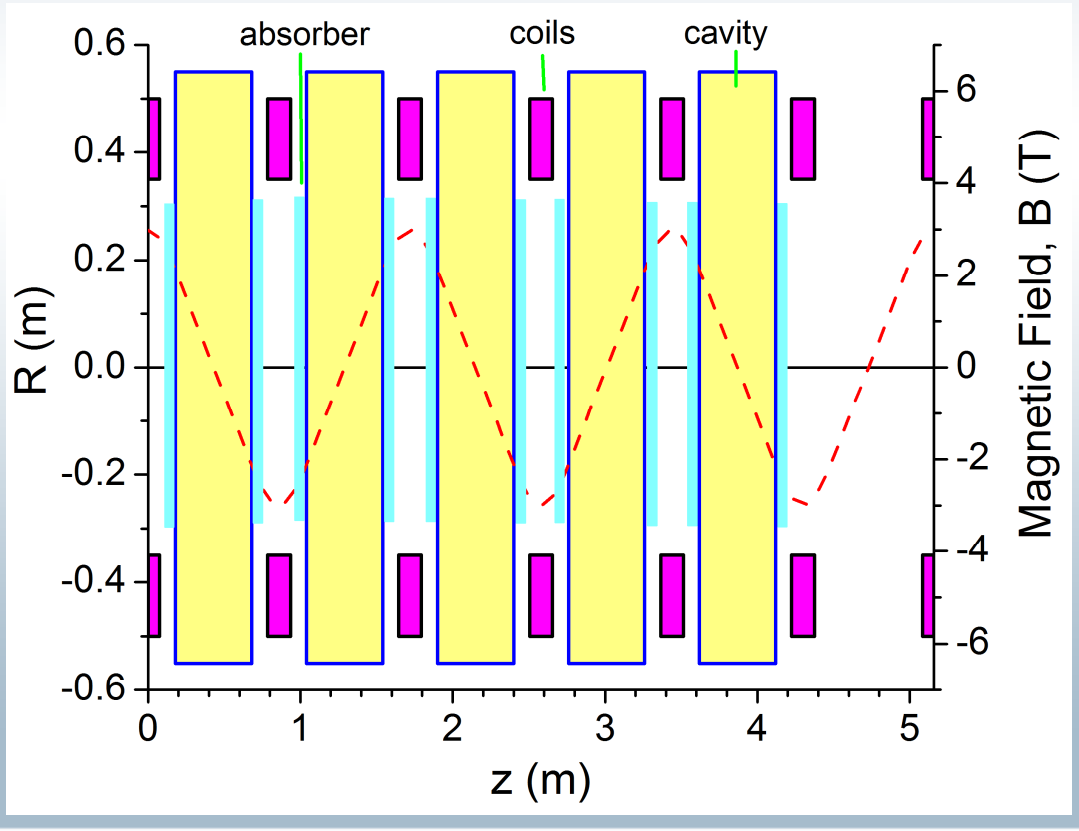
Cooler

N. Bliss, IDS-NF Meeting (April, 2012)

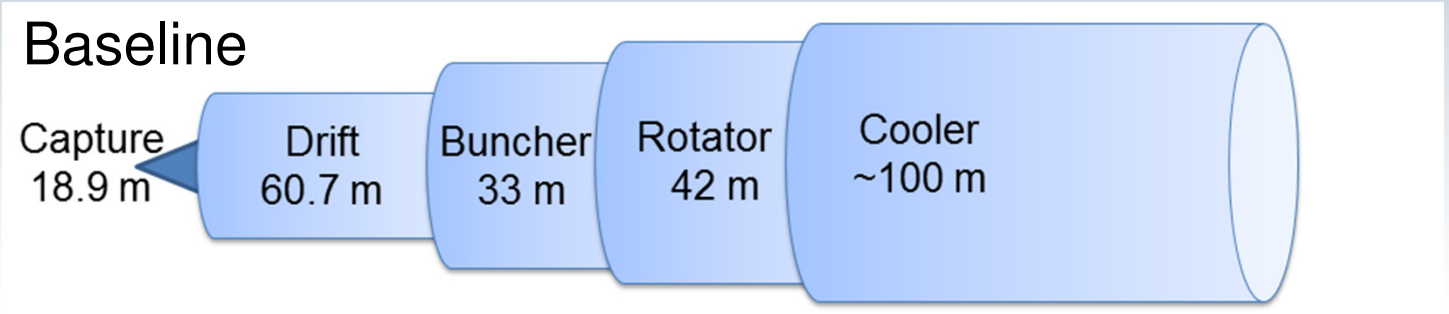
- Recent engineering studies suggest to:
  - Increase the gap between coils in buncher & rotator
  - Increase cooler cell length from 0.75 m to 0.86 m
  - Have one “empty” cell after a series of cavities

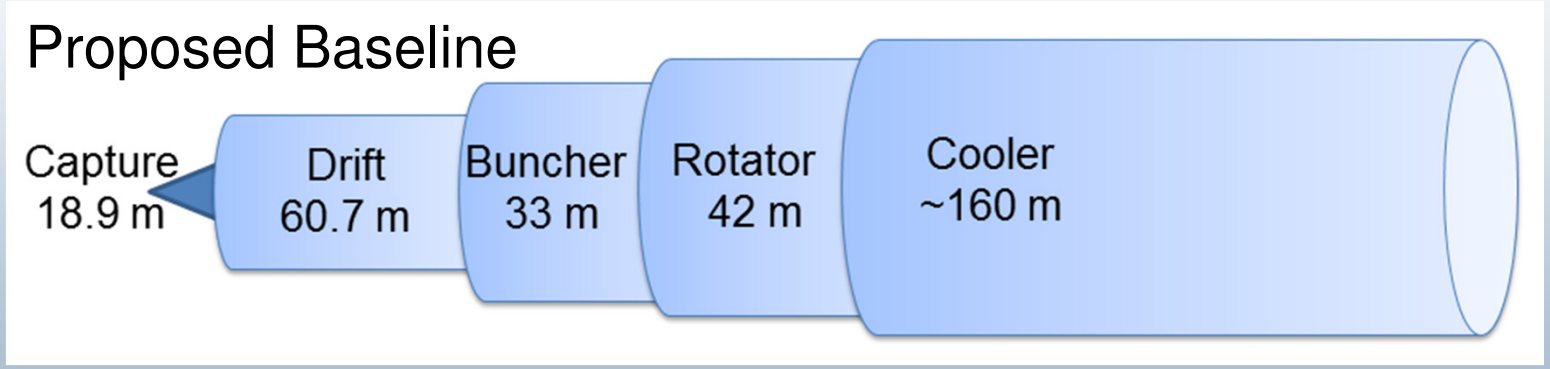
# Solution: Redesign a new cooler





# New Baseline (NBL) Parameters (1)



# New Baseline (NBL) Parameters (2)

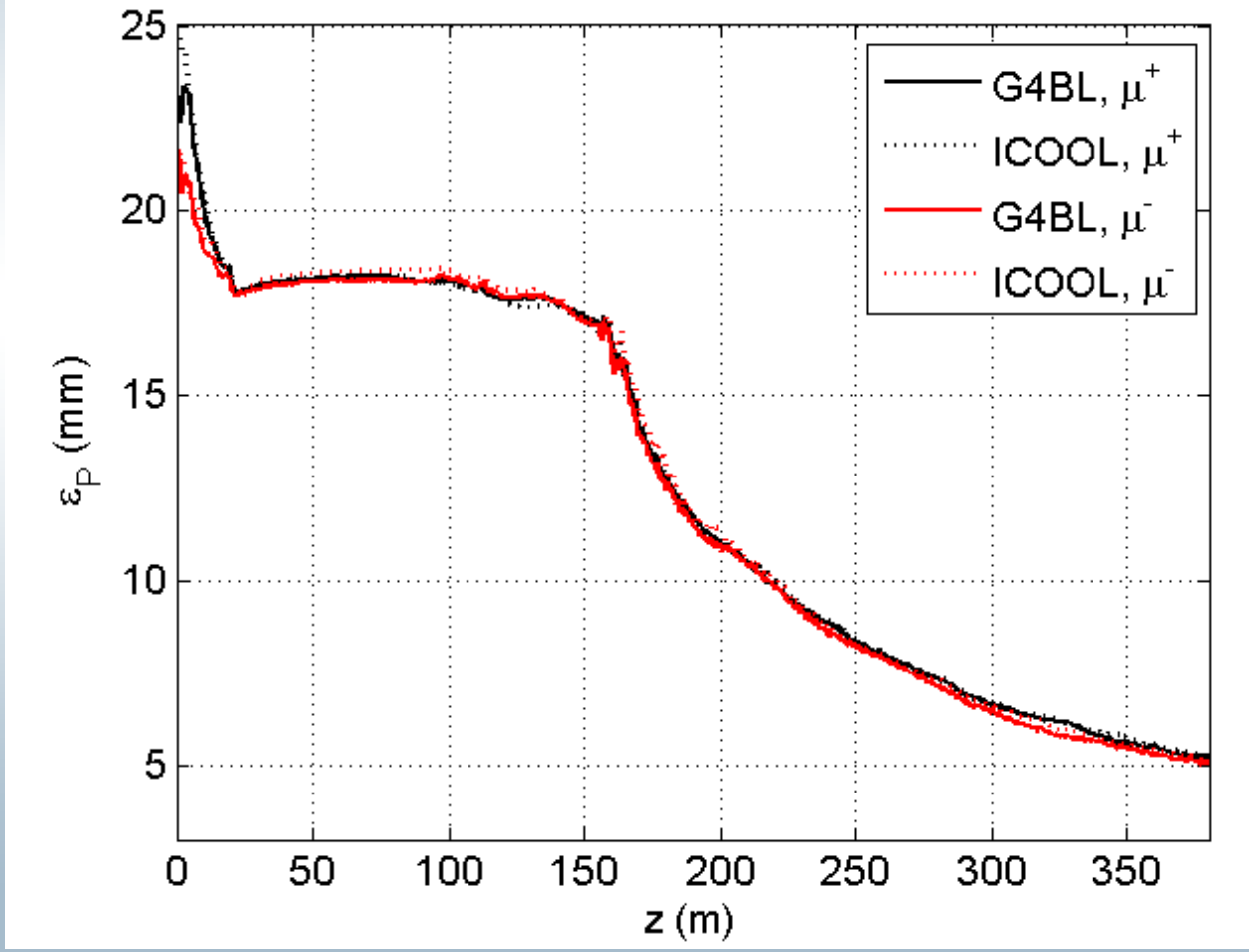
| | Length [m] | Number of cavities | Frequencies [MHz] | Number of frequencies | Peak gradient [MV/m] |
|---|---|---|---|---|---|
| Capture | 18.9 | | | | |
| Drift | 60.7 | | | | |
| Buncher | 33.0 | 33 | 319.6 to 233.6 | 13 | 3.4 to 9.7 |
| Rotator | 42.0 | 56 | 230.2 to 202.3 | 15 | 13 |
| Cooler | >97.5 | 130 | 201.25 | 1 | 16 |
| TOTAL | >252 | 219 | 319.6 to 201.25 | 29 | |

~160 m

~140

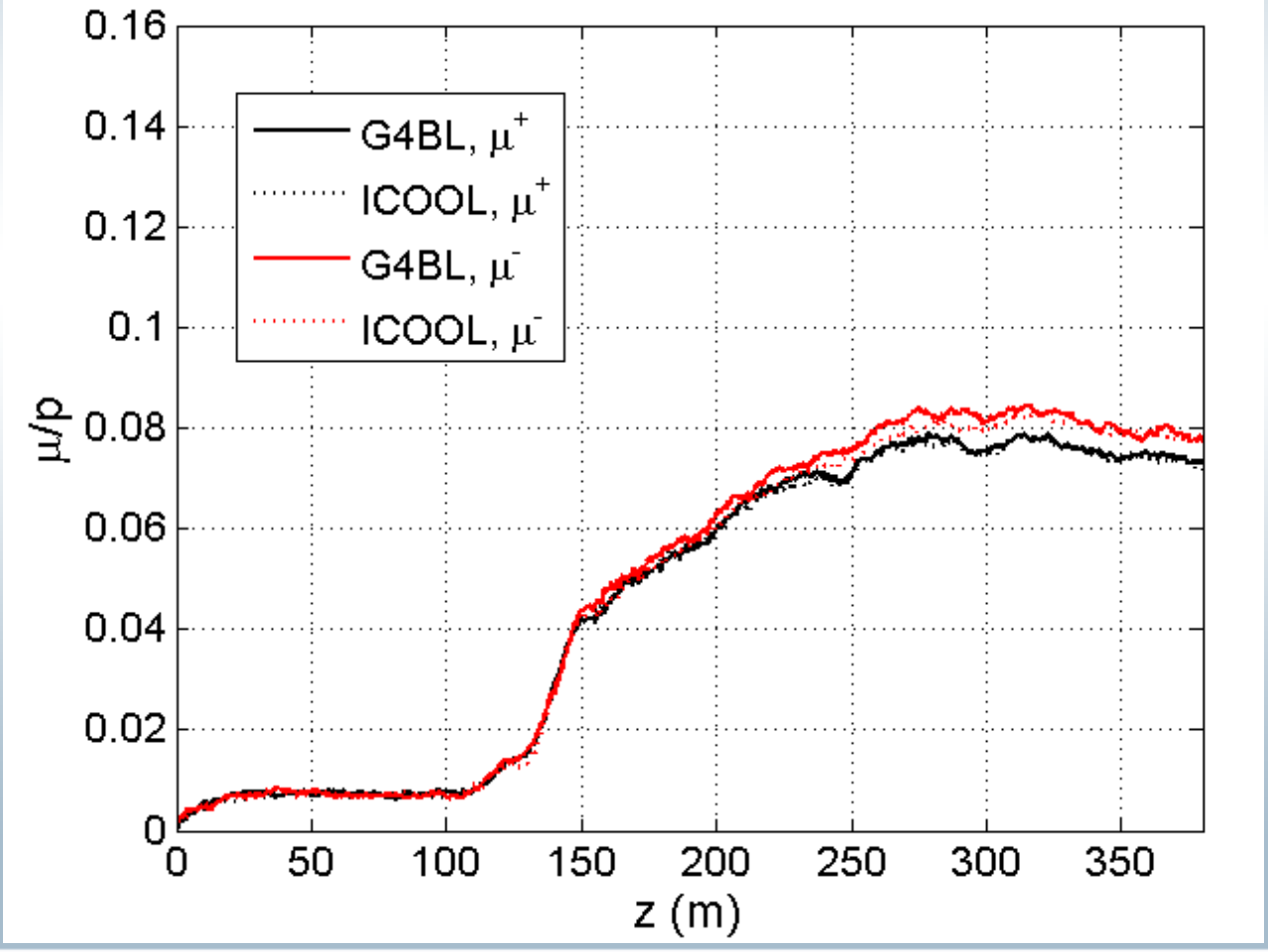
# NF front-end Benchmarking (1)

- Simulation with ICOOL (3.28) and G4BL (2.12) [40K particles]



# NF front-end Benchmarking (2)

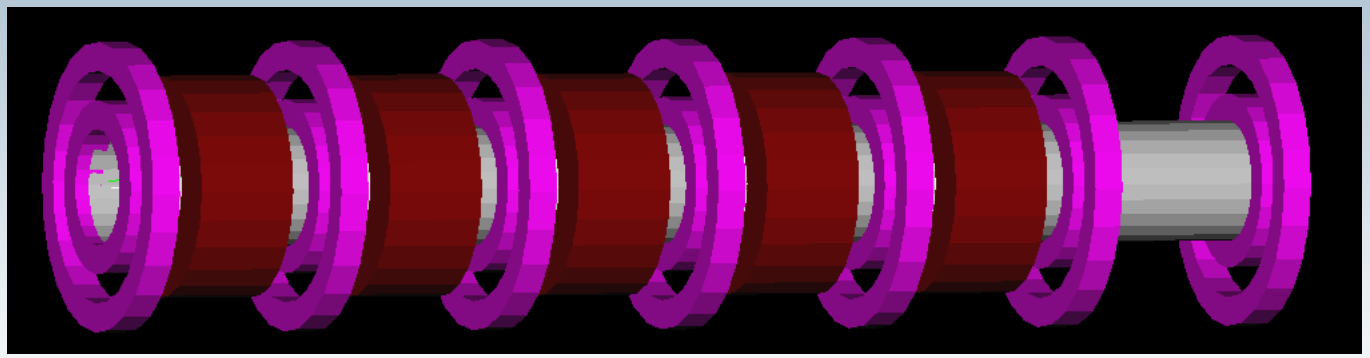
- The μ/p rate is within $A_T$ < 30 mm, $A_L$< 150 mm and cut in momentum 100<Pz<300 MeV/c

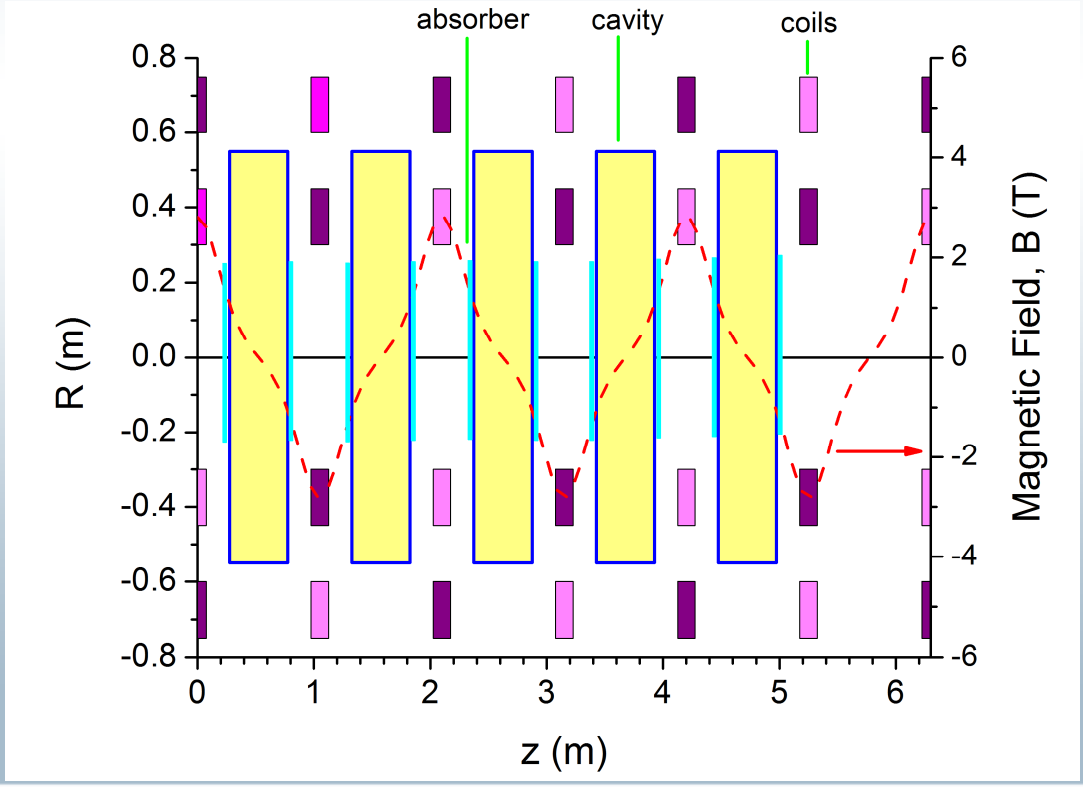


# Alternative Cooling Options

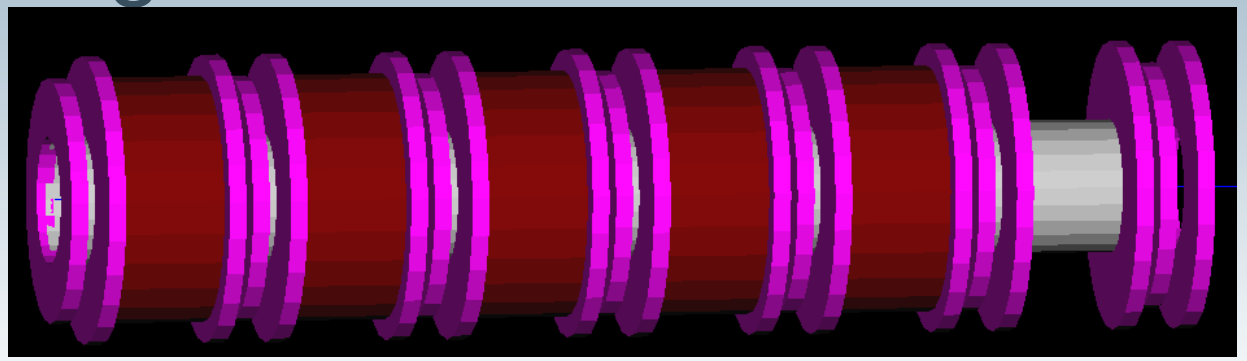
- Two schemes that would lower the field inside the rf cavities are examined
- Case 1: Radial Bucked Coil Scheme (RBC)
  - Field in rf is less than a Tesla
- Case 2: Longitudinal Bucked Coil Scheme (LBC)
  - Achieves lower B-field than RBC
  - Tight space between coils and rf
  - High hoop stress

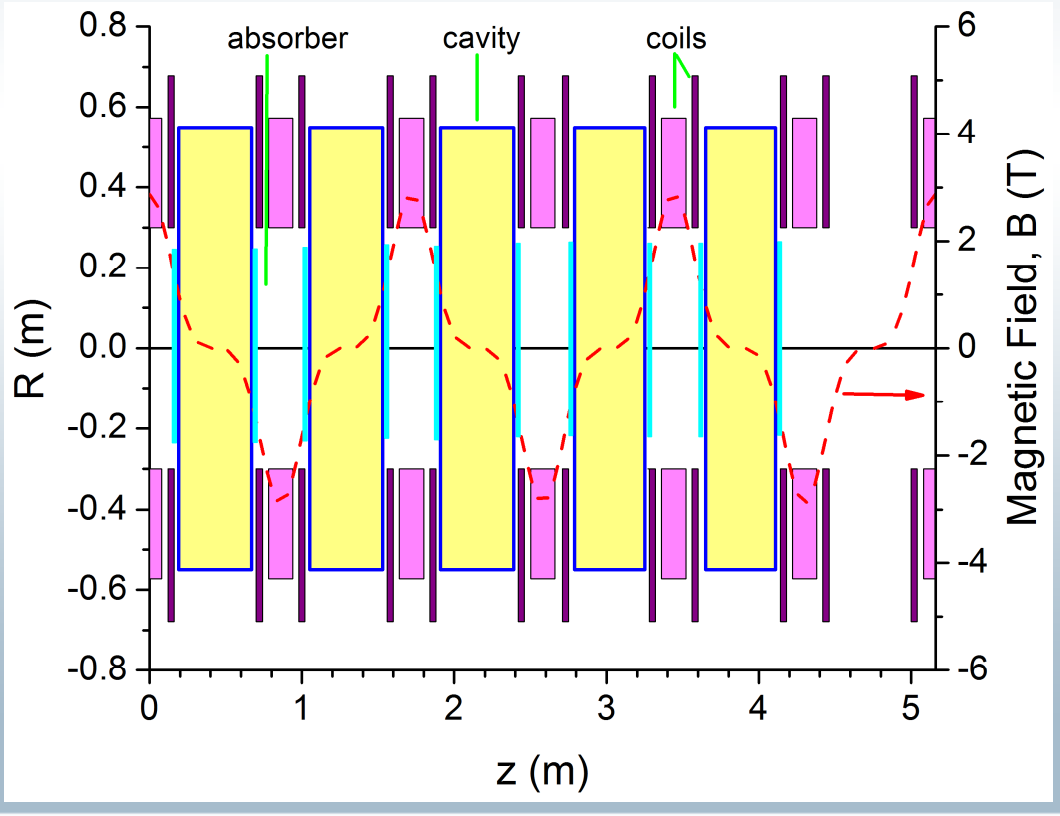
# Radial Bucked Coil Scheme



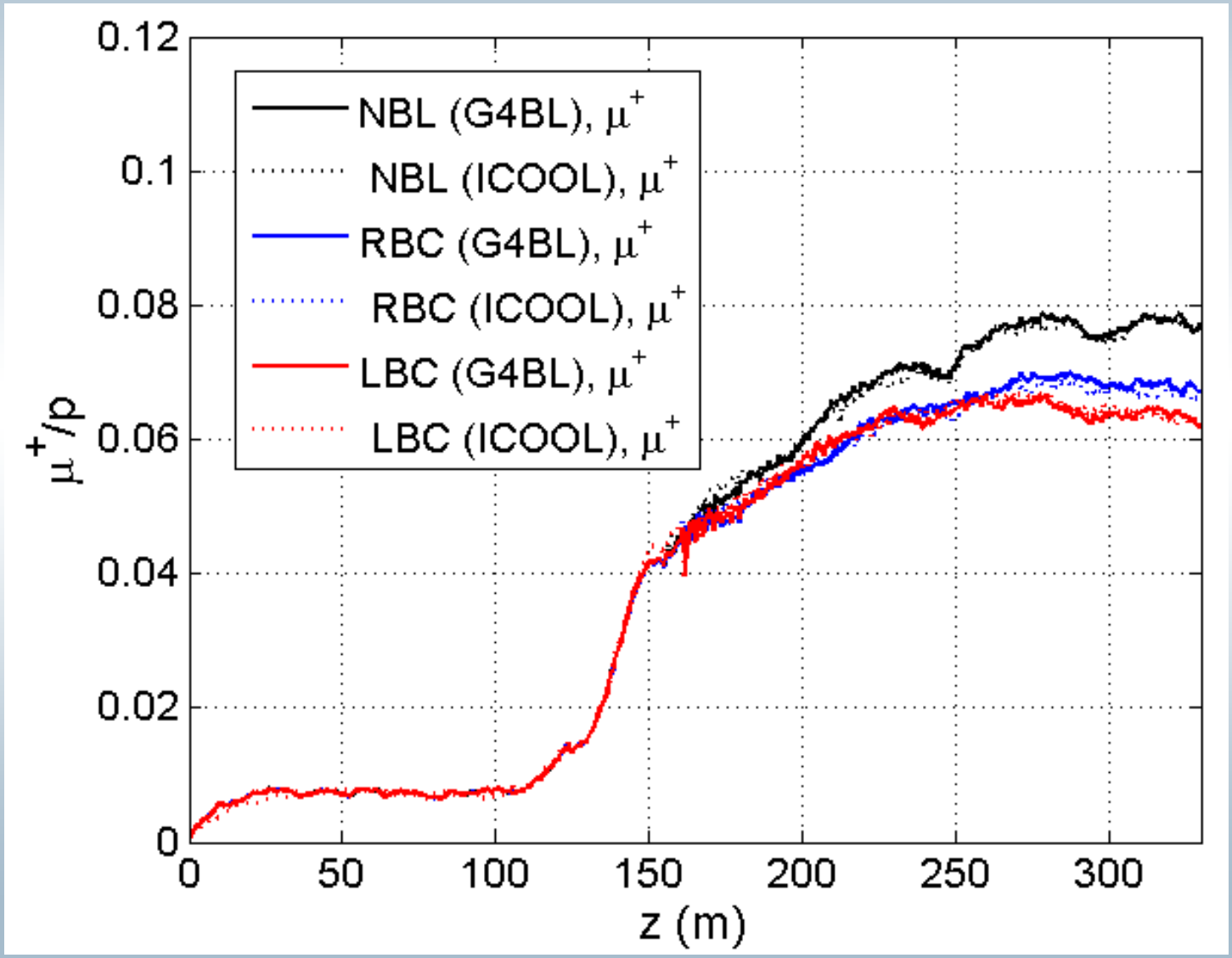


# Longitudinal Bucked Coil Scheme

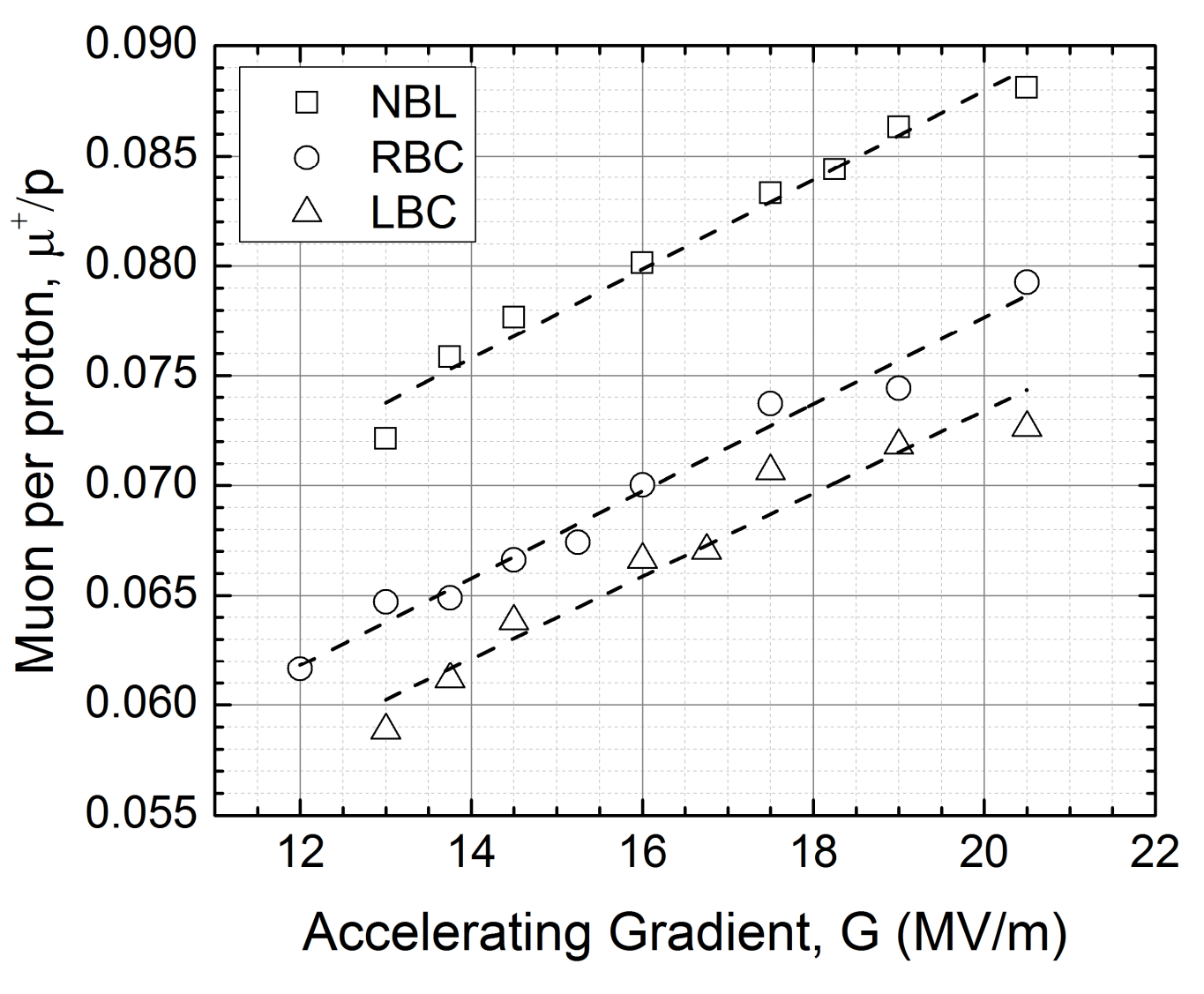




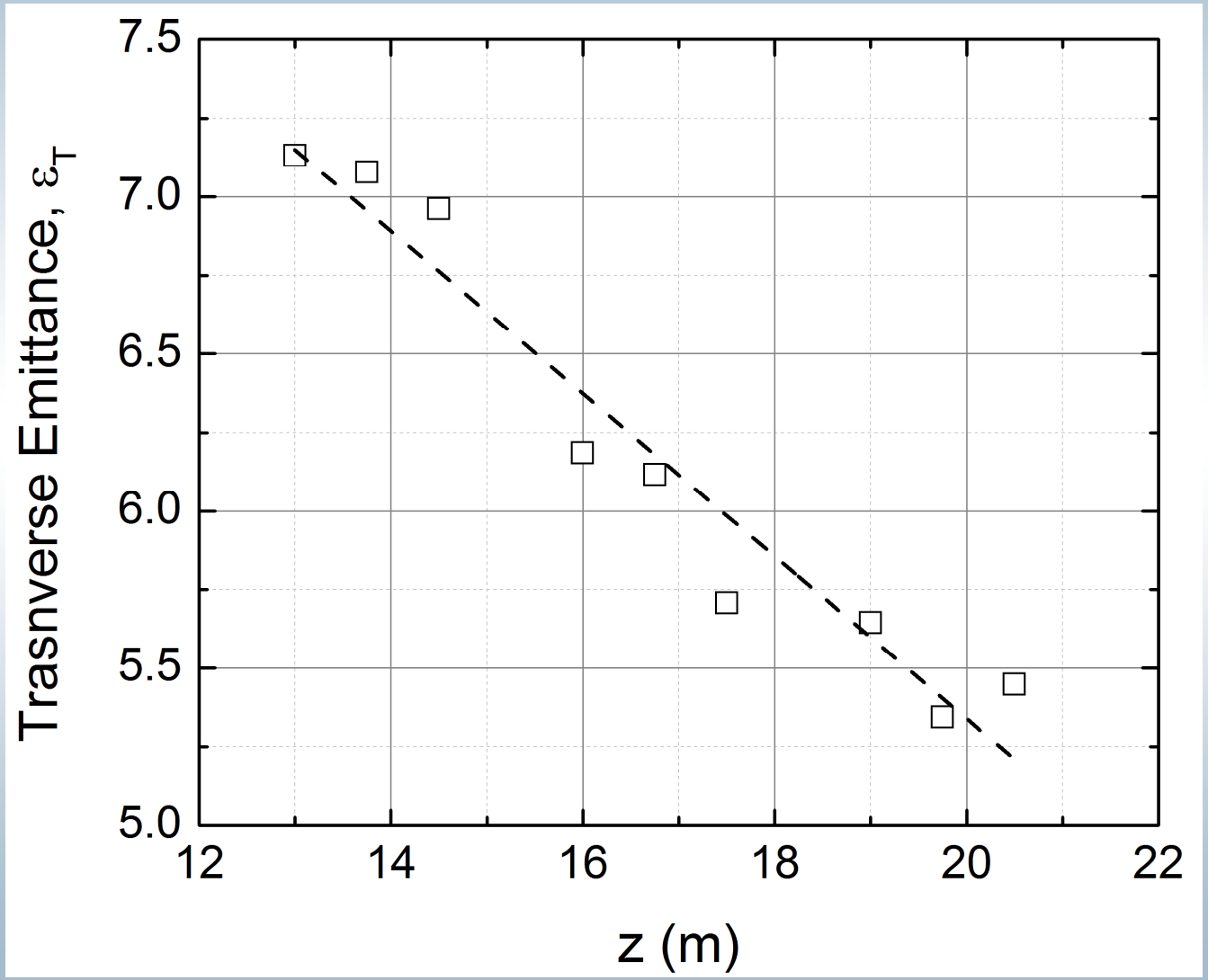
# Simulation Results (1)



# Simulation Results (2)



# Simulation Results (3)



# Summary & Outlook

- Defined new baseline parameters which includes the engineering constrains
- Simulated with G4BL & ICOOL
- Our proposed new baseline:
  - Has a longer cooler by ~ 60 m
  - Has 140 cavities instead of 130
  - Performance is reduced by 5-10%
- Examined low B-fields FE options: One with Radial and one with Longitudinal bucked coils
- After IDS: Write a report + Journal Paper