6D Cooling Progress

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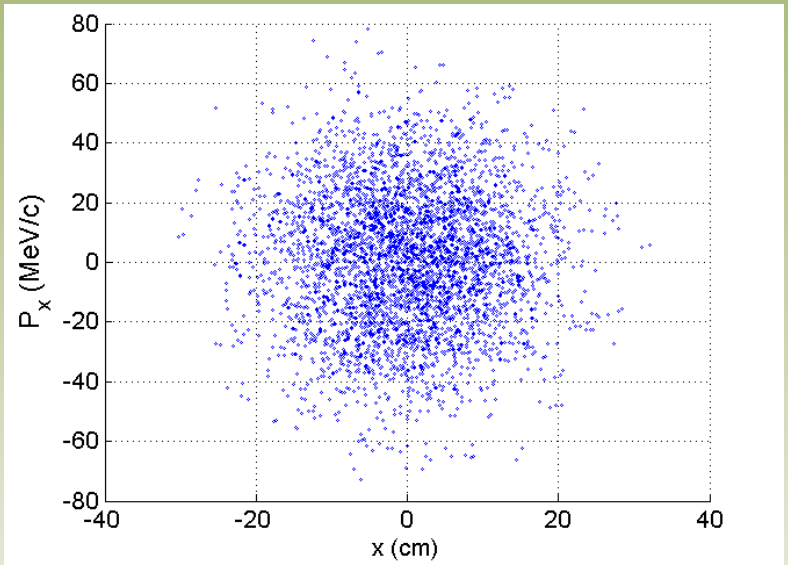
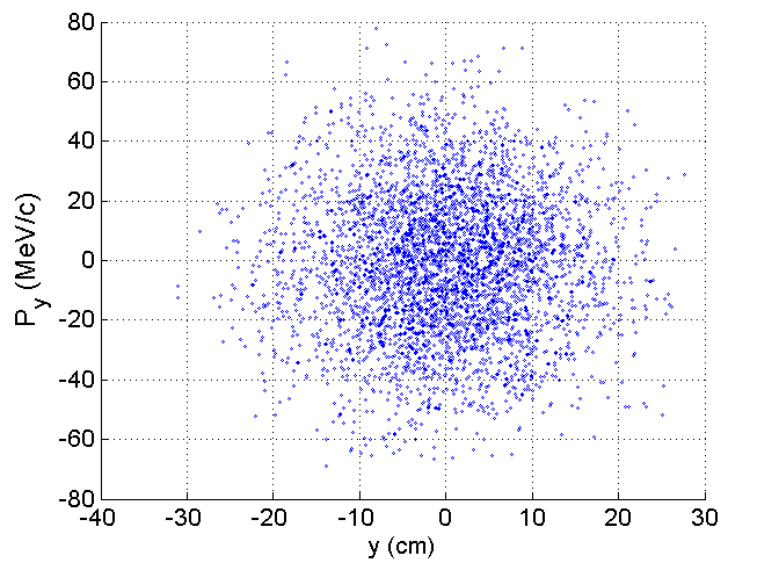
AAG Group Meeting

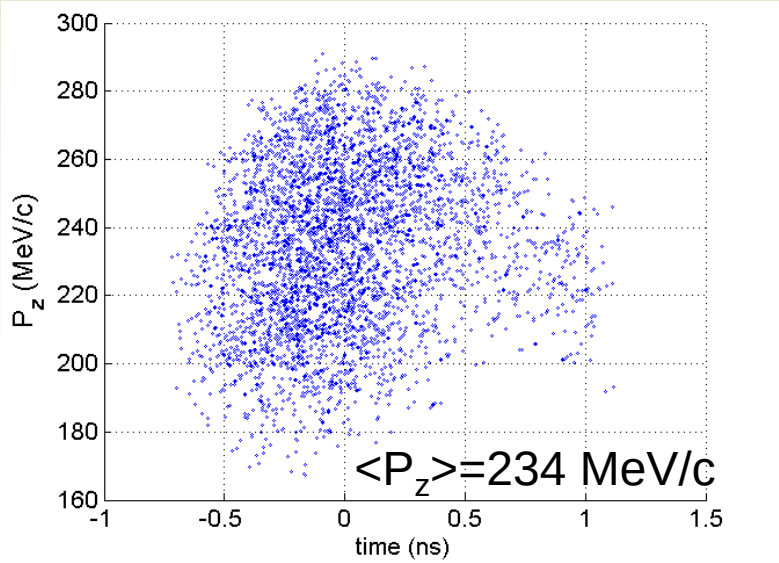
Outline

- 6D cooling with Valeri's beam
- 6D cooling with "the real" phase rotator beam
- Cooling with 6-figure beam distributions

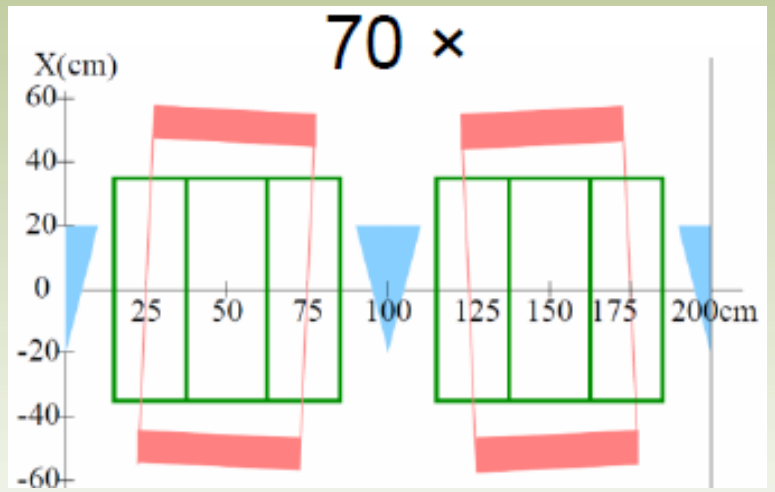
Initial Distribution (from Valeri)







Simulate Valeri's Stage No. 1



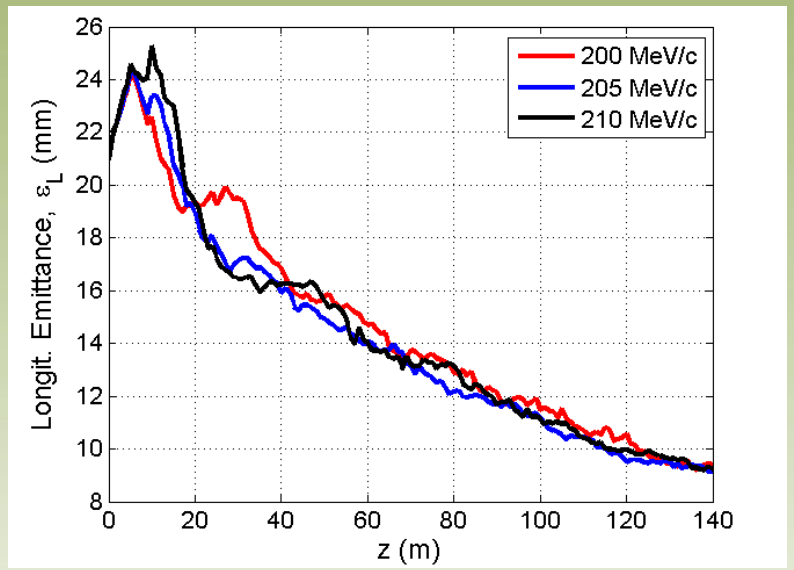
Cell parameters of the stages

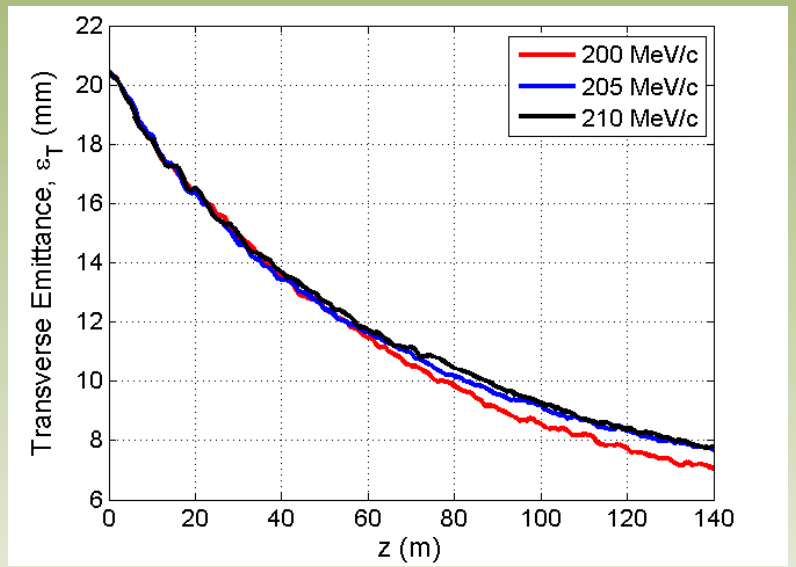
Ref. momentum 200 MeV/c, RF 325 MHz -- 25 MV/m everywhere

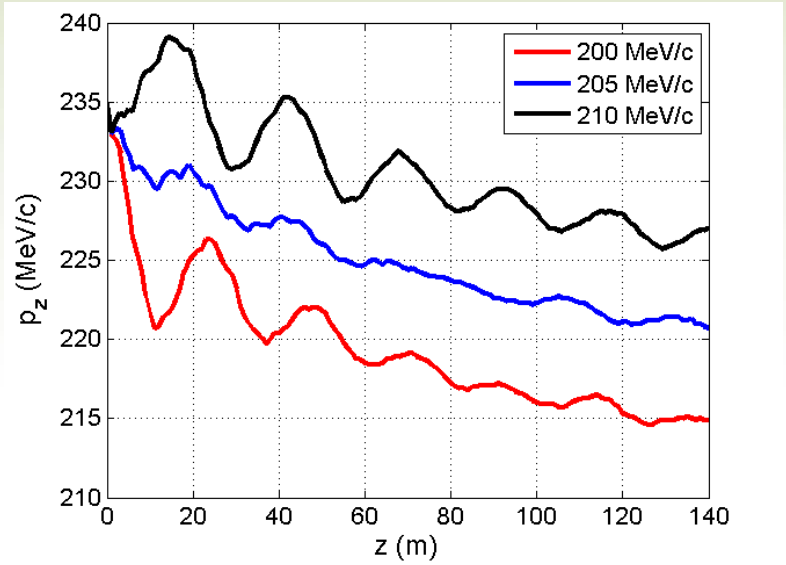
Parameter	Units	Stage 1	Stage 2	Stage 3	Stage 4
Cell length	cm	200	132	100	80
Coil length	cm	50	50	24	16
Coil inner radius	cm	45	45	10	10&5
Coil thickness	cm	10	10	10	15&20
Coil tilt	mrad	±60	±15	±30	± 20
Current density	**A/mm²**	**48.3**	**175**	**123**	**185**
Maximal field strength in coil	**T**	**3.73**	**12.3**	**10.1**	**15.6**
Synchronous phase	deg	23	23	44	44
LH_2 absorber center thickness	**cm**	**21.8**	**14.5**	~~21~~	~~21~~
Absorber opening angle	**deg**	**40**	**88**	~~148~~	~~158~~
LiH absorber center thickness	**cm**	3.9	2.6	**3.8**	**3.8**
Absorber opening angle	**deg**	7.4	20	**65**	**86**

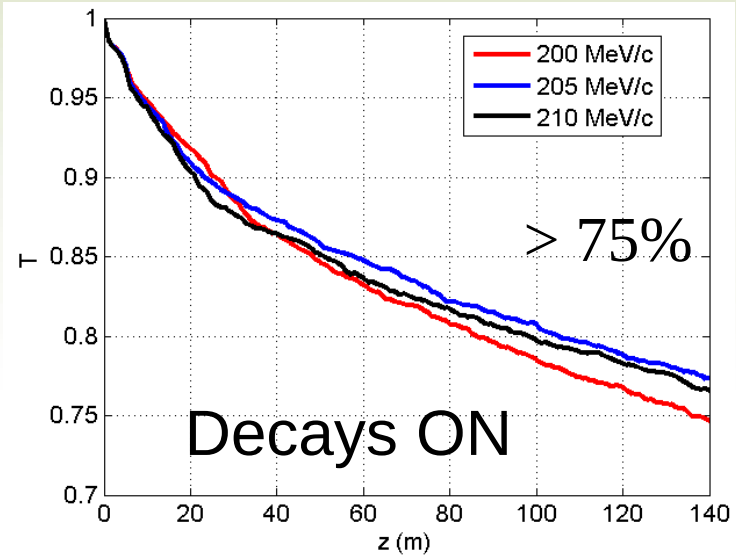
- I assume 500 micron AL absorber windows
- I do not use RF windows

Valeri's Distribution (Stage 1)





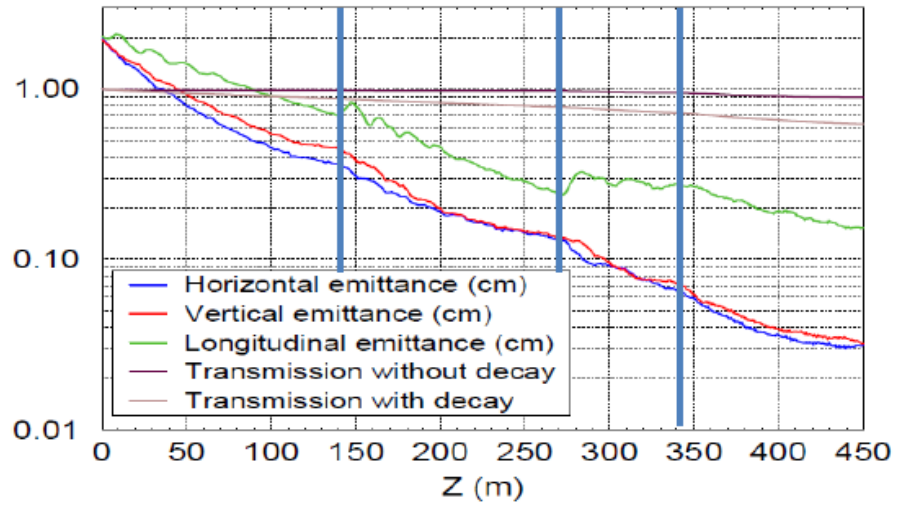




Valeri's Prediction

Cooling with self-consistent initial distribution, and matching section or matrices between the stages

1st and 2nd stages with LH_2 absorbers, 3rd and 4th – with LiH



Tr_1 = 90%

Tr_2 = 62%

E_{long} = 1.5 mm

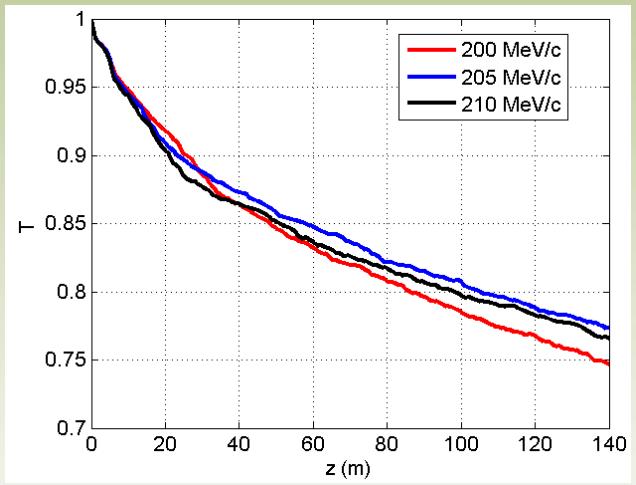
E_{trans} = 0.31 mm

Longitudinal emittance increases at the transition from each stage to next one.

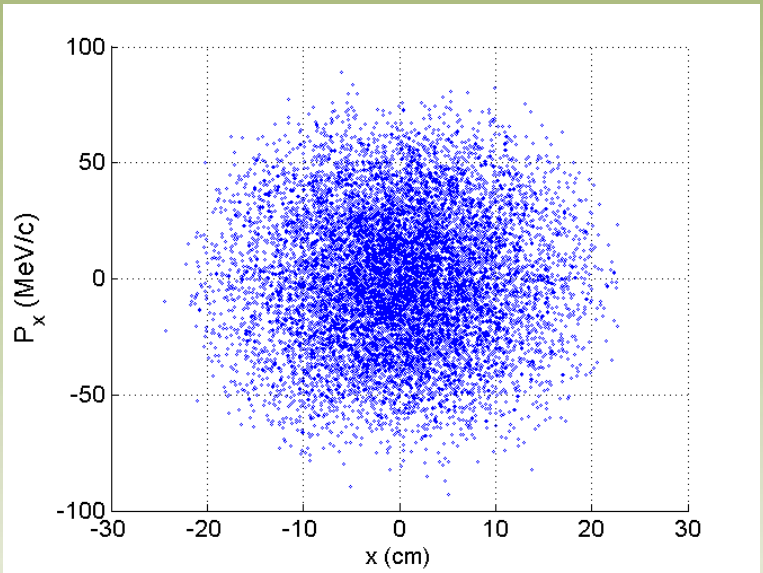
The effect is caused by longitudinal − transverse correlations (nonlinear)

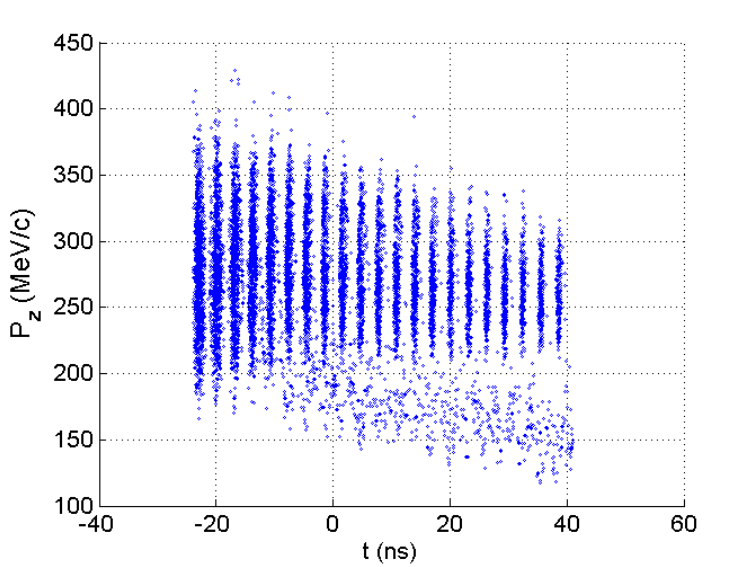
which cannot be controlled and corrected by the (linear) matching sections.

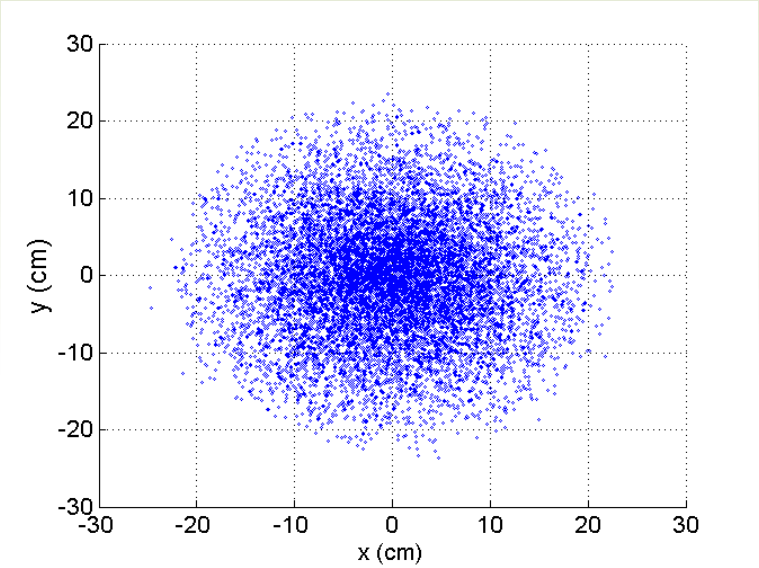
Diktys:



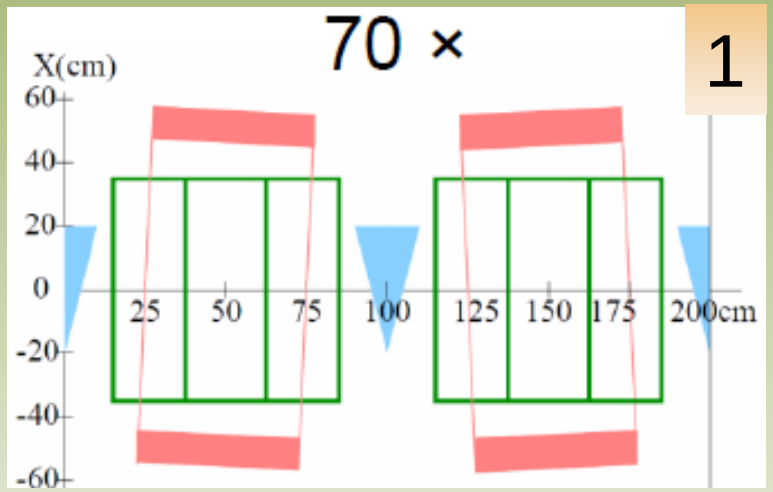
My distribution (Phase-Rot exit)

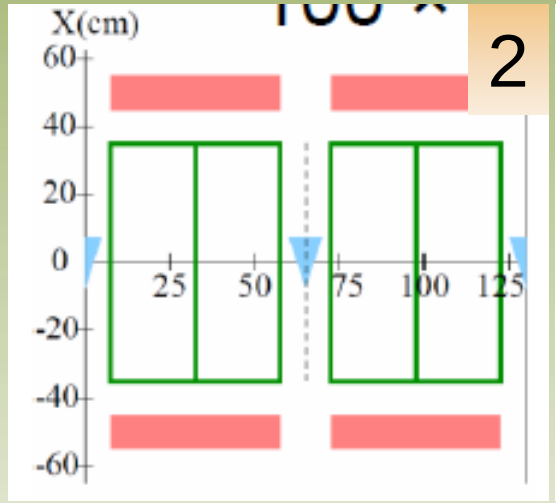


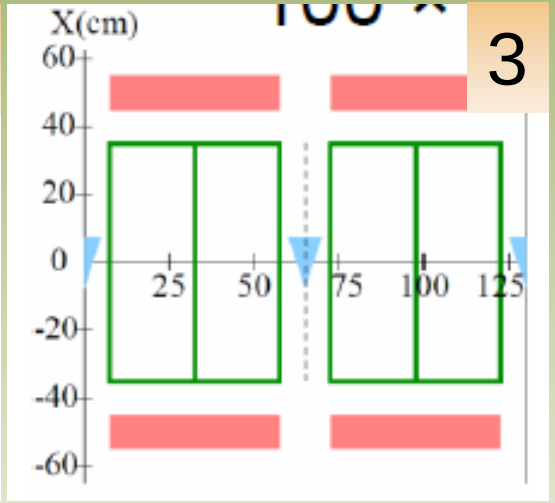


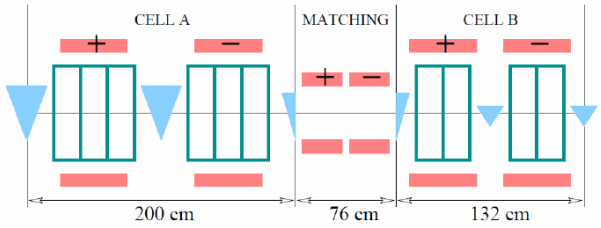


Cooling in Three Stages







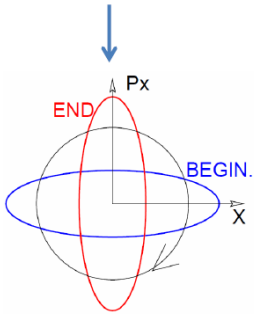


Matching section

Betatron phase advance 90°

Inherent beta 47 cm ≈ $(\beta_A\beta_B)^{1/2}$

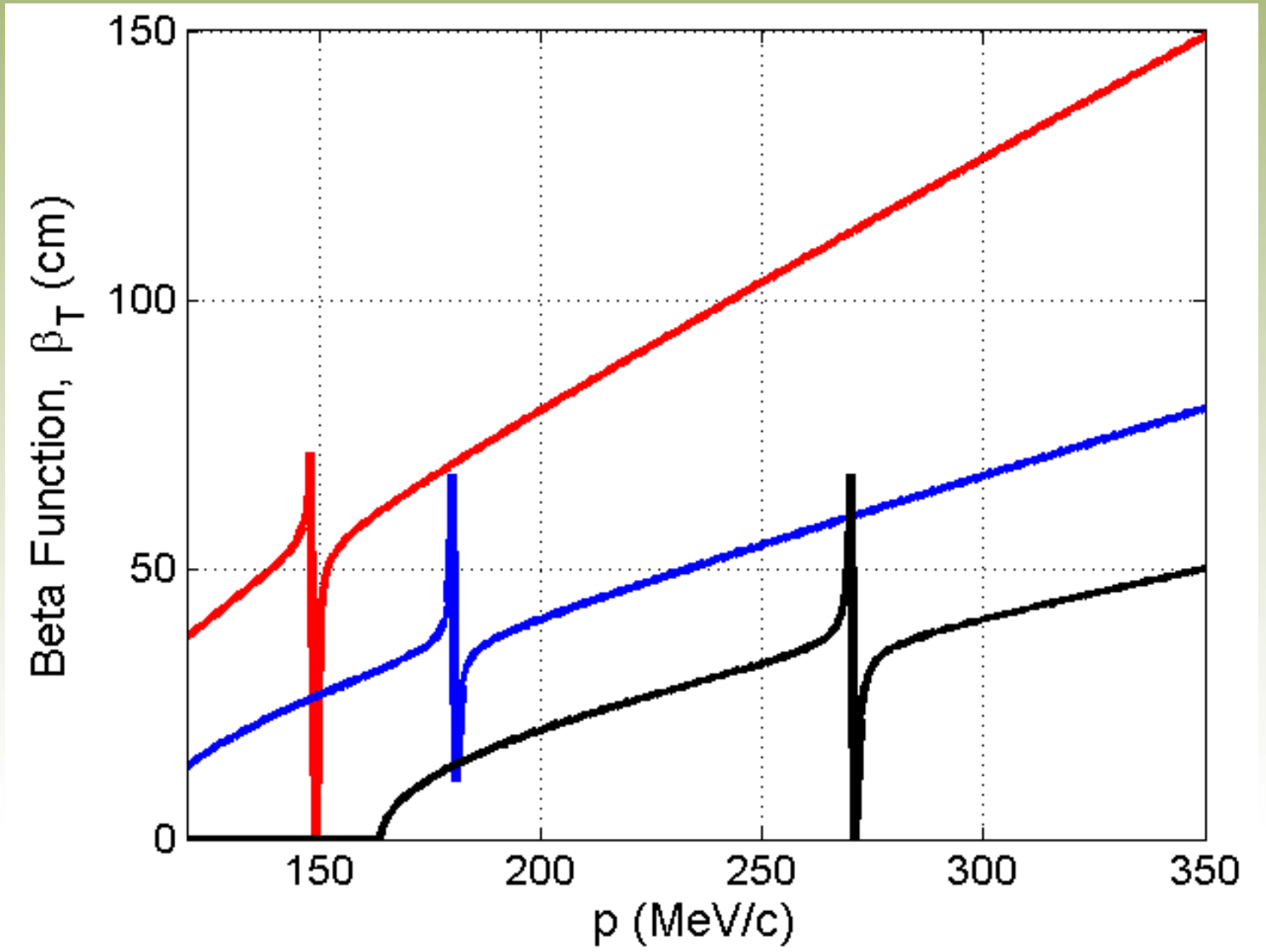
Phase space transformation



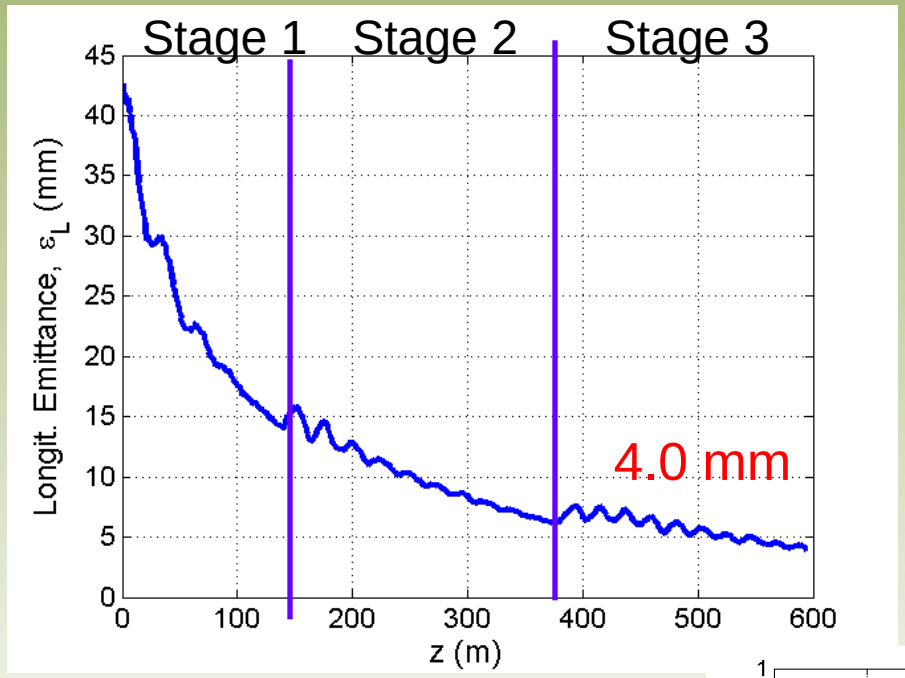
Parameters of the matching section

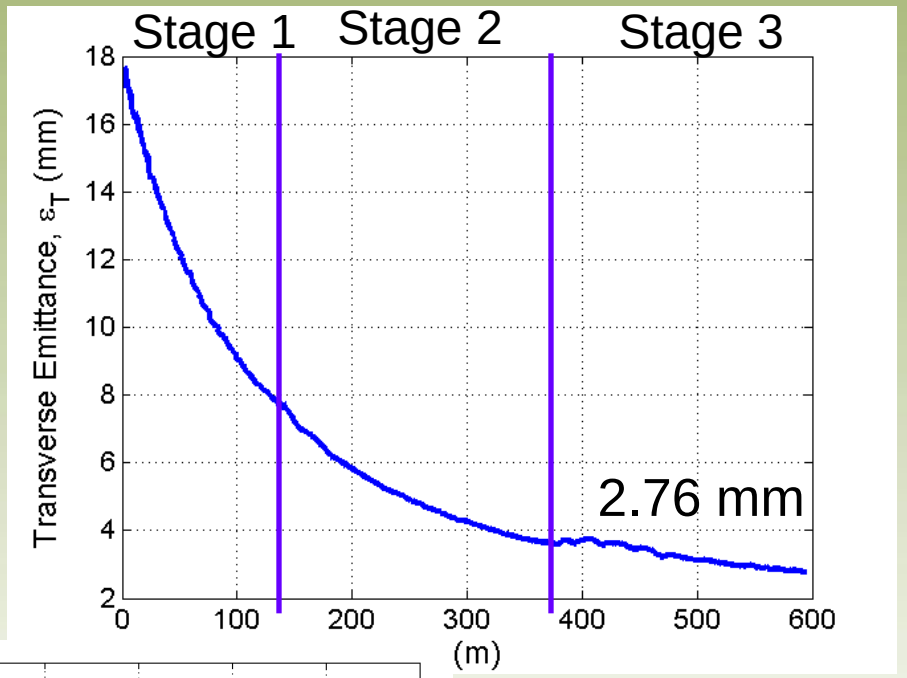
Section length	76 cm
Coil length	30 cm
Coil inner radius	20 cm
Coil thickness	10 cm
Current density	95.2 A/mm^2
Axial field	3.85 T
Coil field	6.47 T

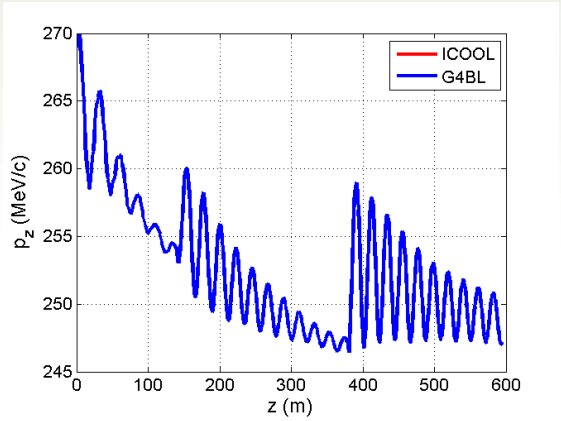
Lattice Functions

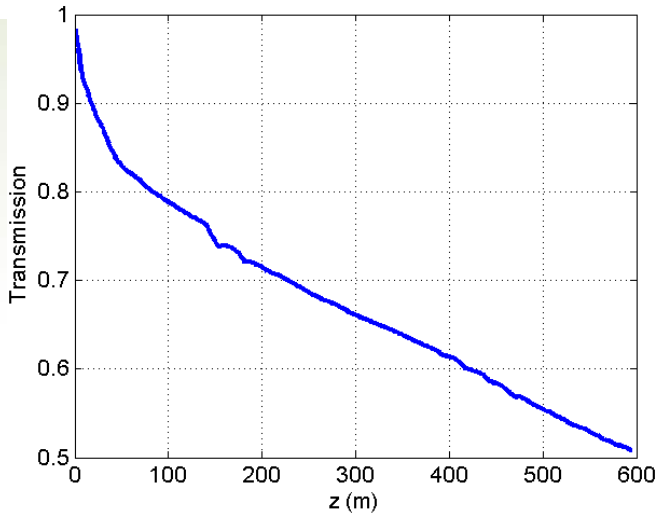


Overall Performance (in progress…)



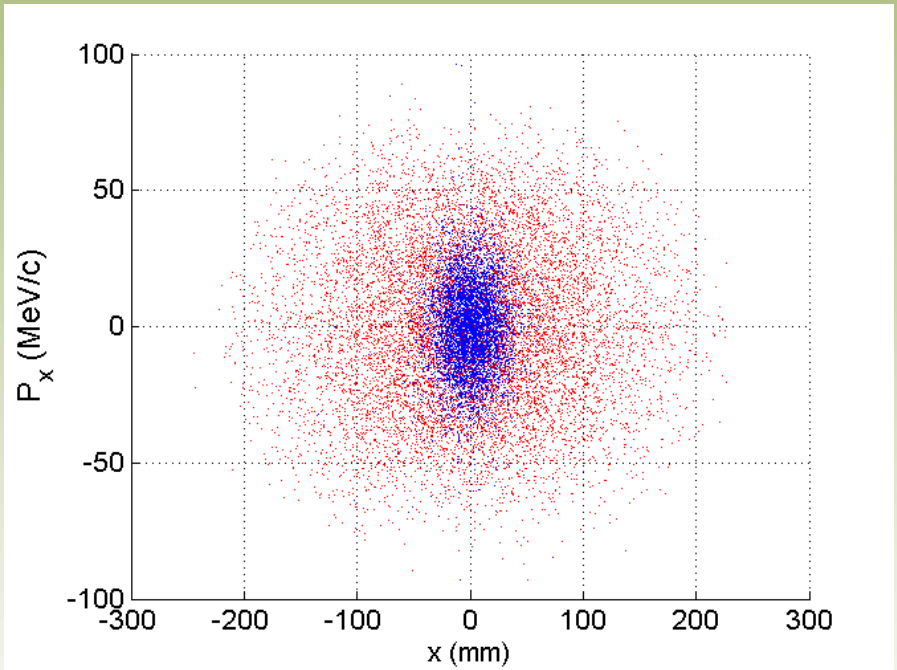


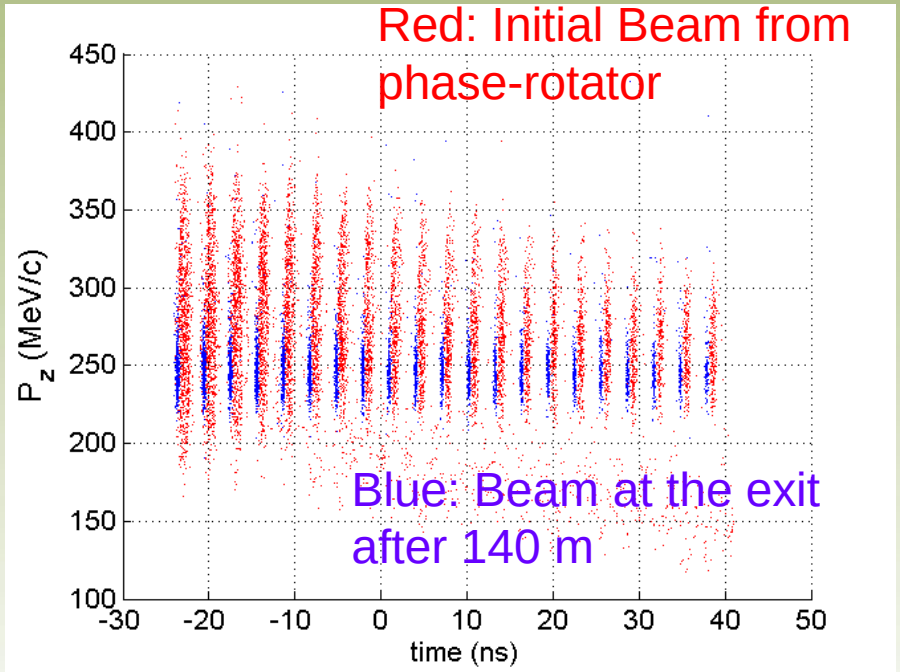




Required:
1.8 mm (Long.),
1.3 mm (Transv.)

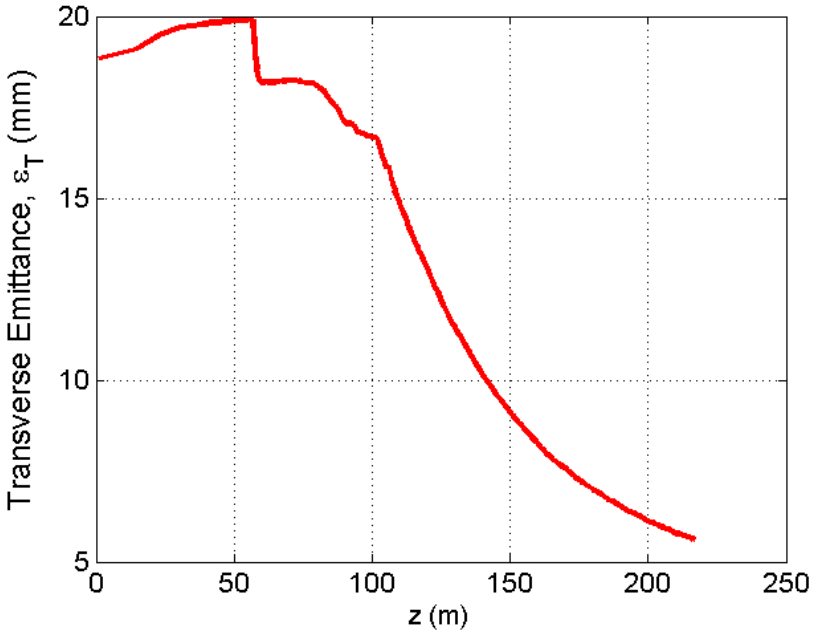
Beam Cooling!

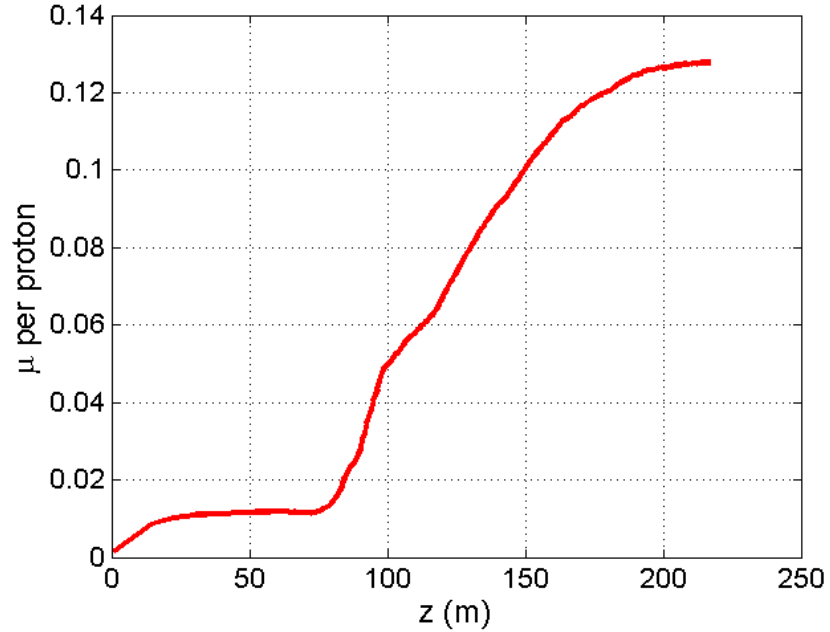




Front-End (1 million particles)

- Scott fixed a bug. Now we can run at NERSC with 6 figure particle distributions
- Results match Neuffer's simulations





Phase-Rotator Exit

- Output after exiting phase rotator of new FE (325 MHz)