



HINS with 8 ILC-units at 45 mA : jitter studies

(see also PAC 07, ``Start-to-End Simulations for the Proposed Fermilab High Intensity Proton Source’')

Jean-Paul Carneiro

FNAL Accelerator Physics Center

HINS meeting

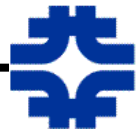
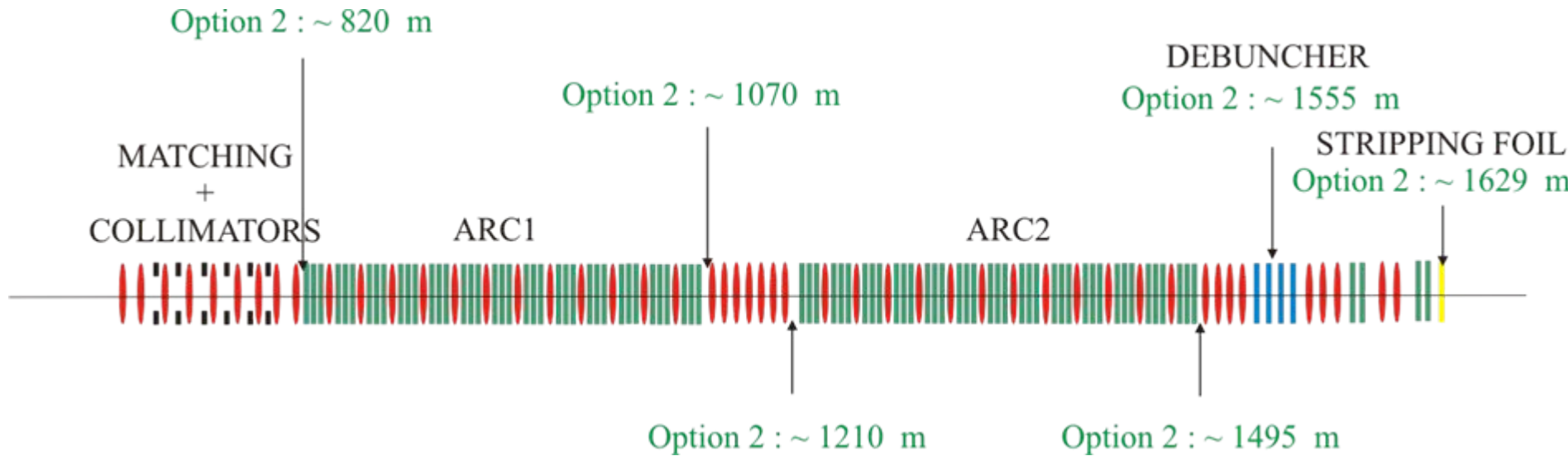
July 12th 2007

- OPTION 1 : 28 cryo – 1 quads/cryo. – 8 cavities/cryo -224 cavities
 -28 quads**

- OPTION 2 : 8 ILC-units : $(9+8+9) \times 8 = 208$ cavities – 8 quads**

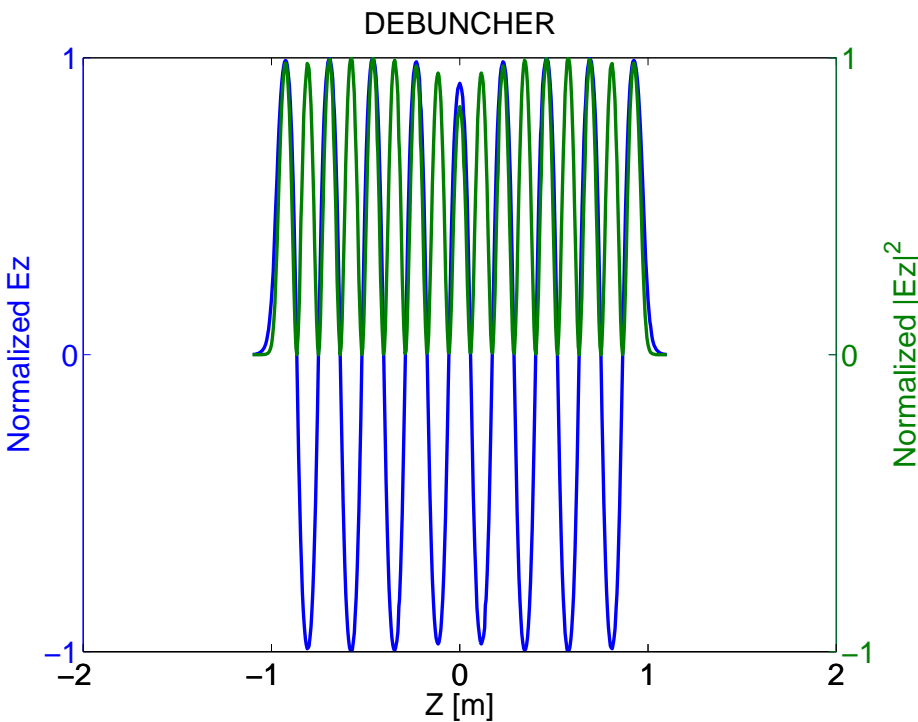


HINS Transport Line to Main Injector (MI10) (D. Johnson, FNAL)

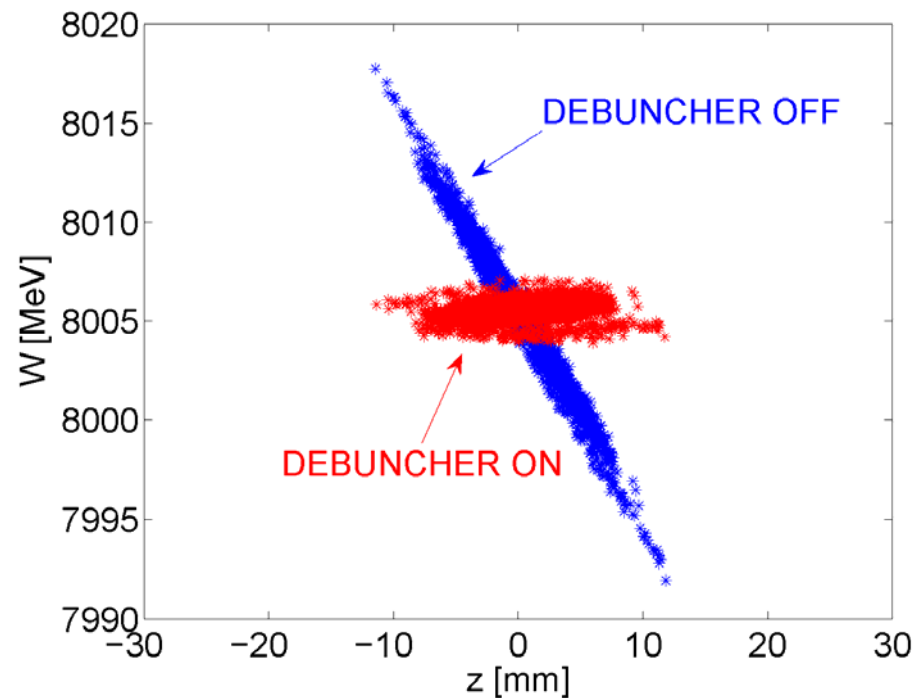


17 Cell SuperStructure Debuncher (I. Gonin, FNAL)

Ez field

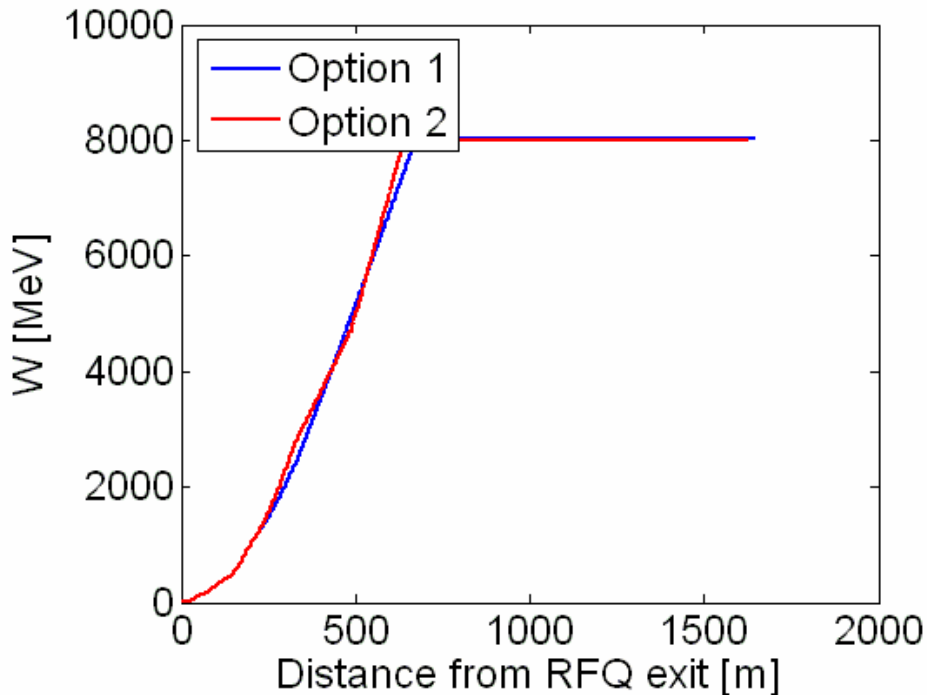


Long. Phase Space at Stripping Foil

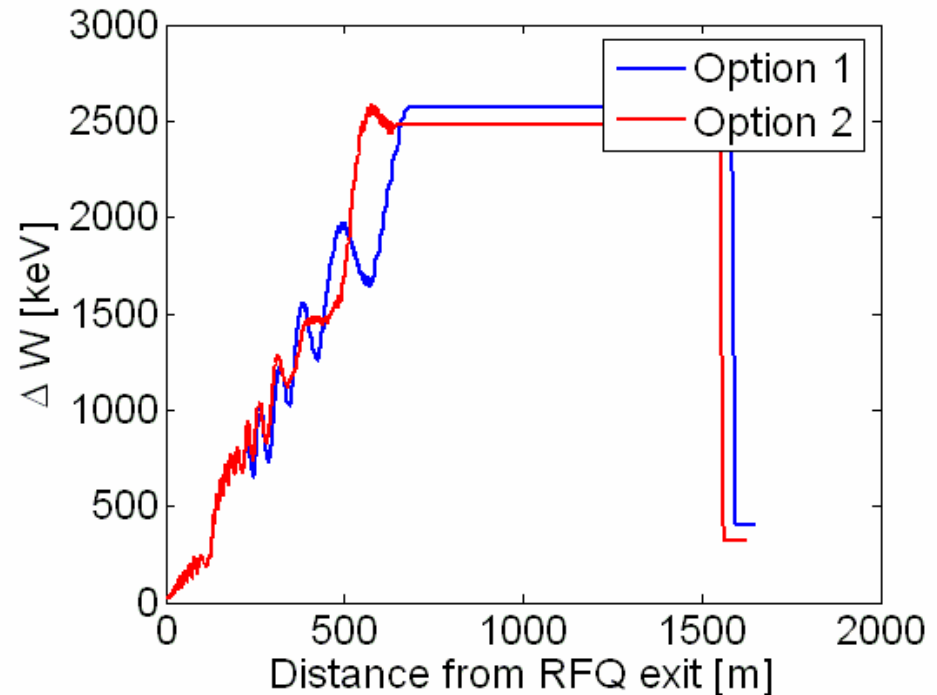


OPTION 1 (Standard) / OPTION 2 (8 ILC units) TRACK

Kinetic Energy

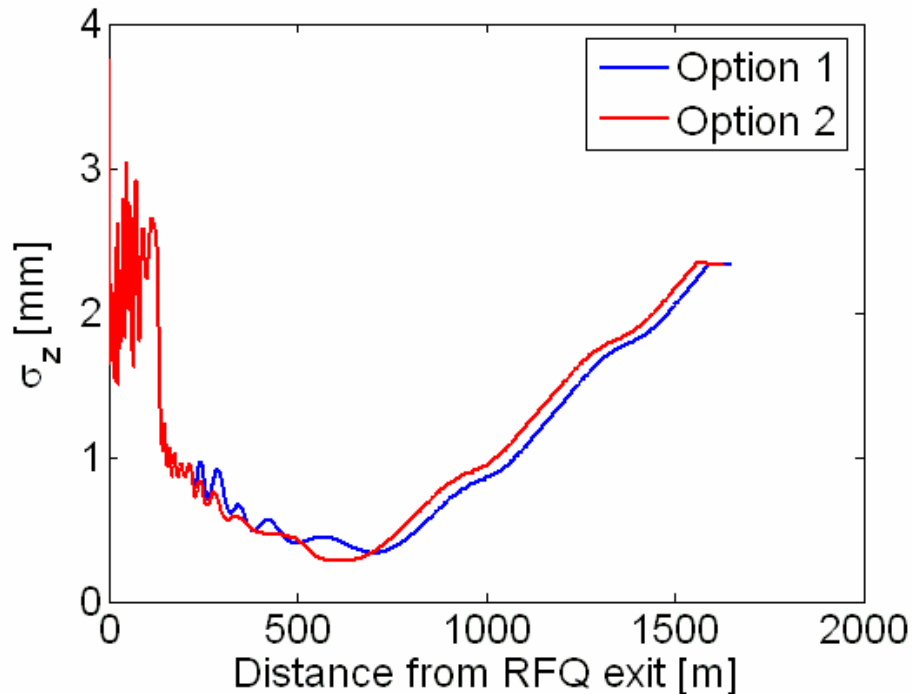


RMS Energy Spread

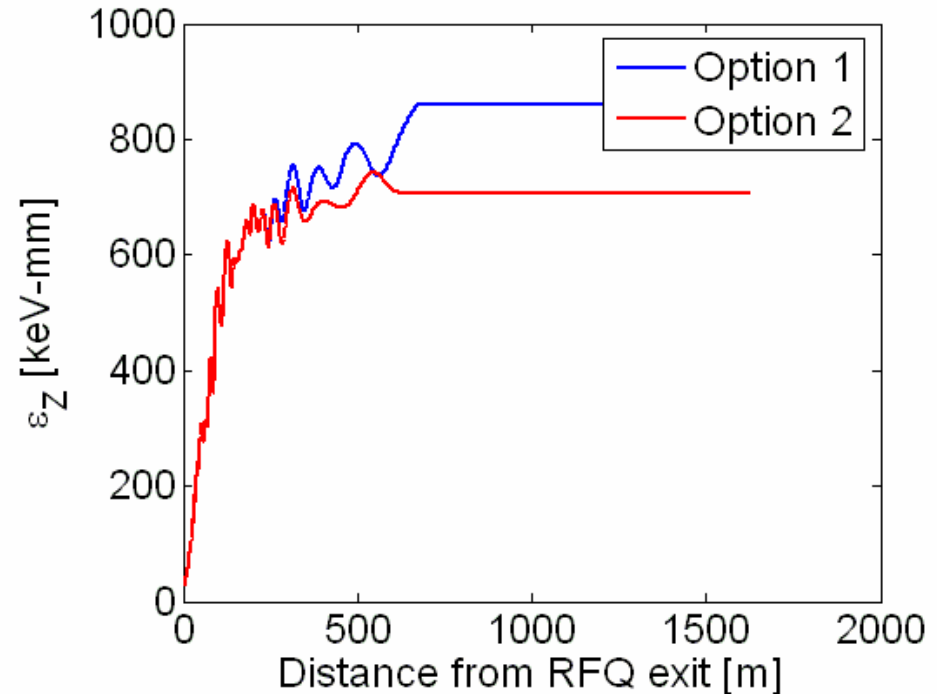


OPTION 1 (Standard) / OPTION 2 (8 ILC units) TRACK

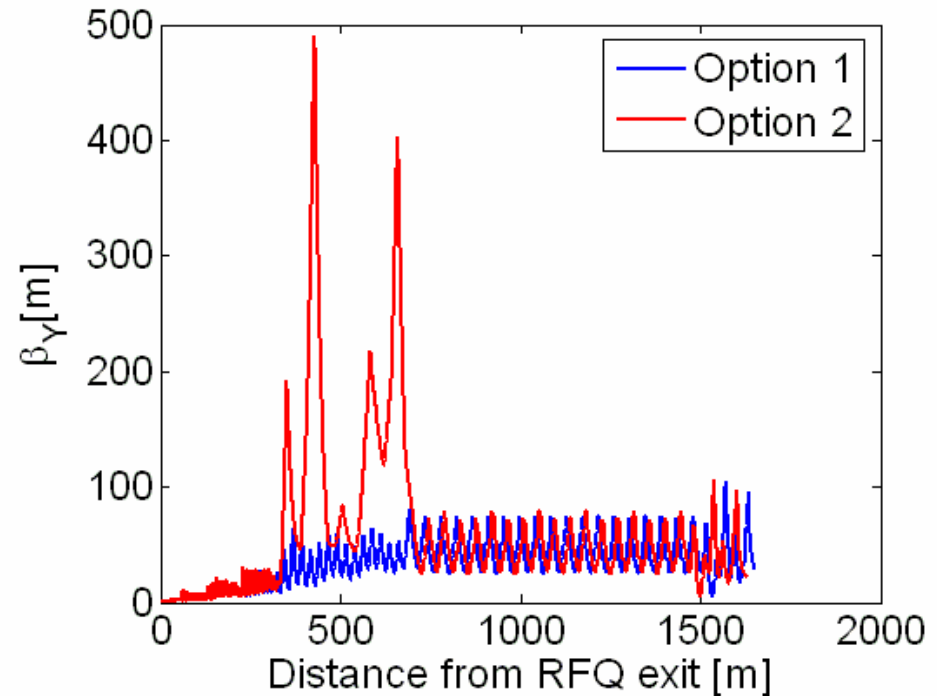
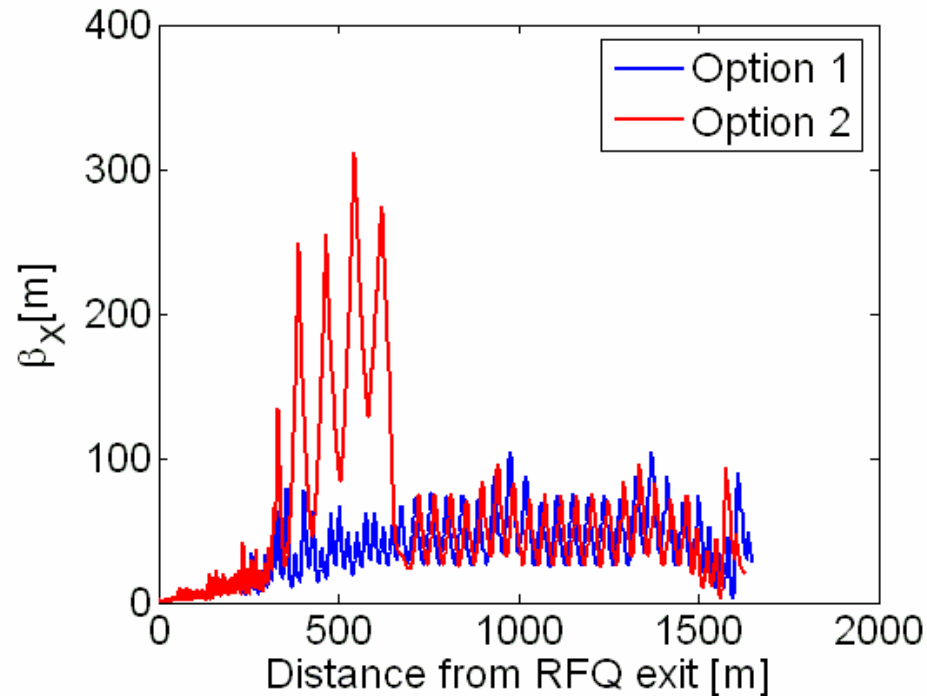
RMS Bunch Length



RMS Long. Emittance

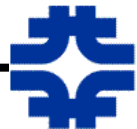
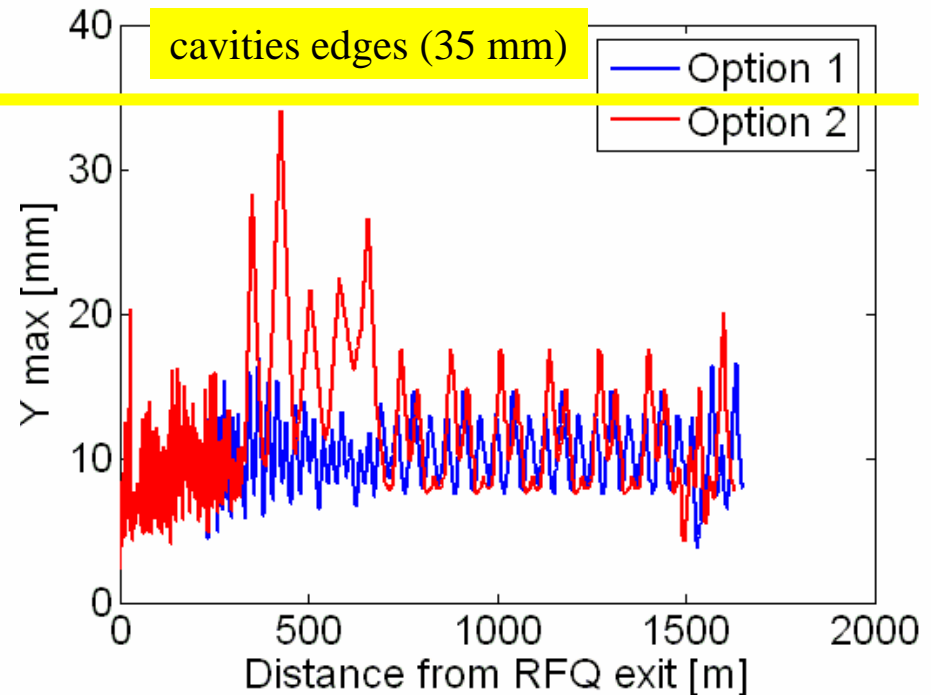
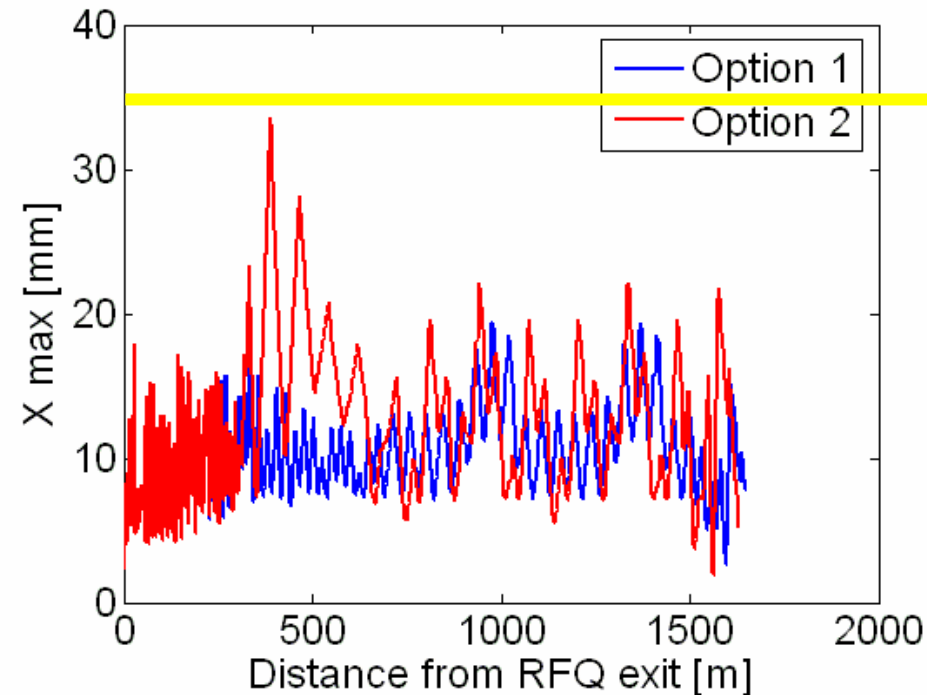


Beta Function



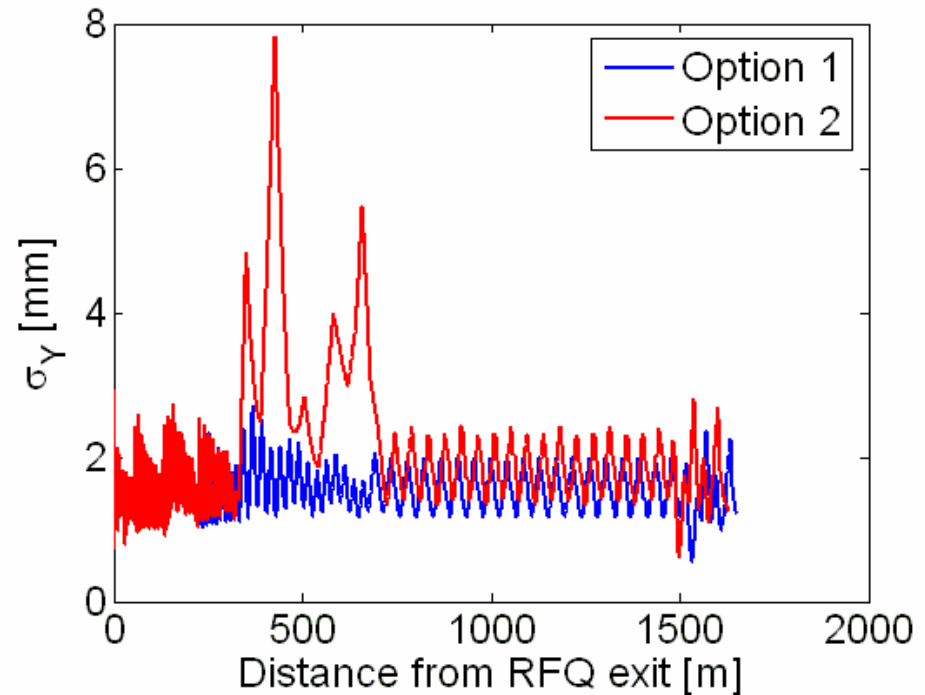
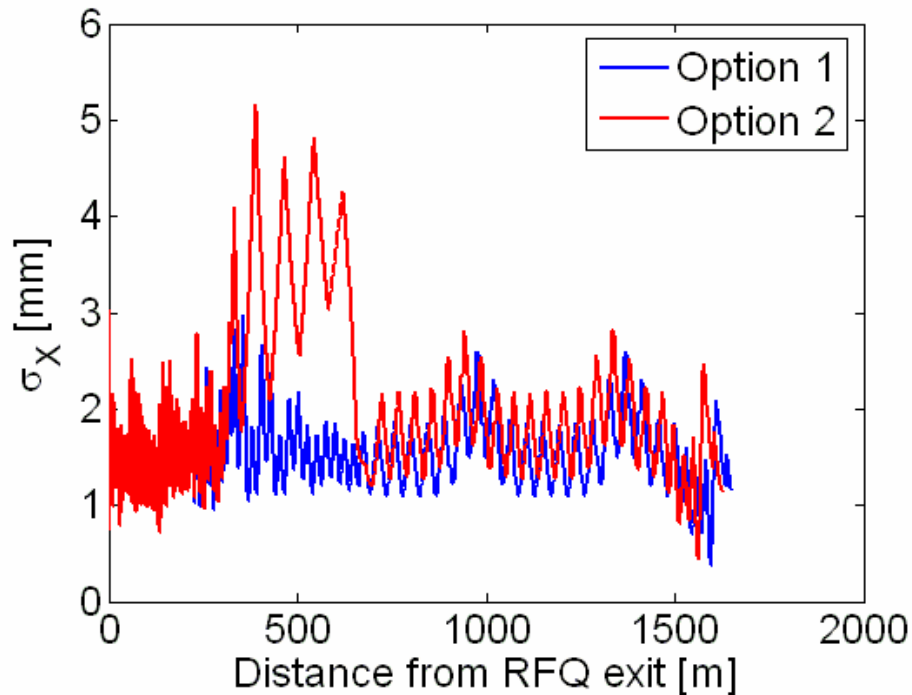
OPTION 1 (Standard) / OPTION 2 (8 ILC units) TRACK

Max envelope

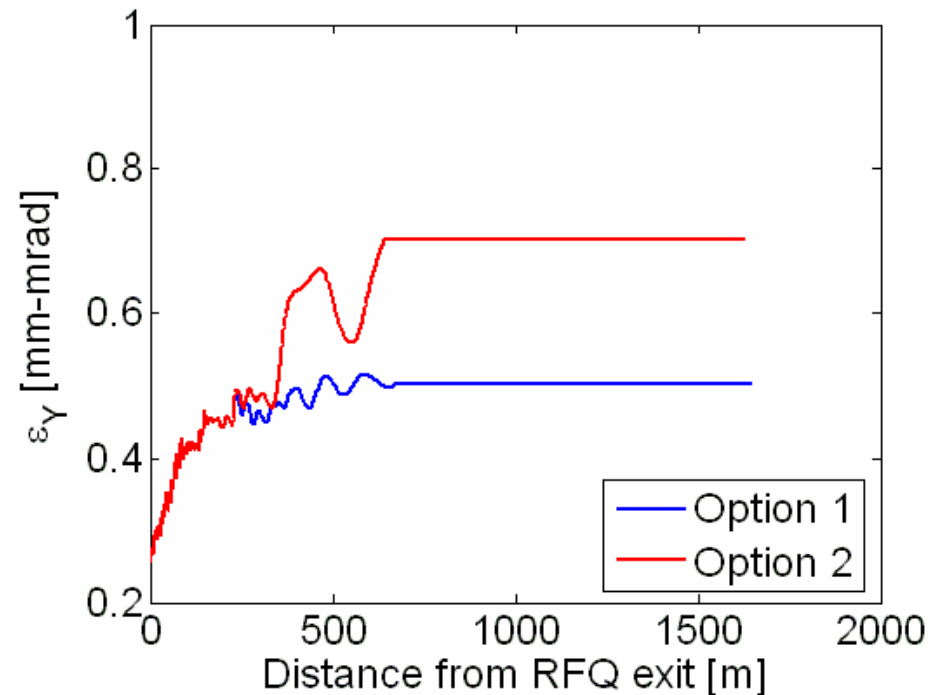
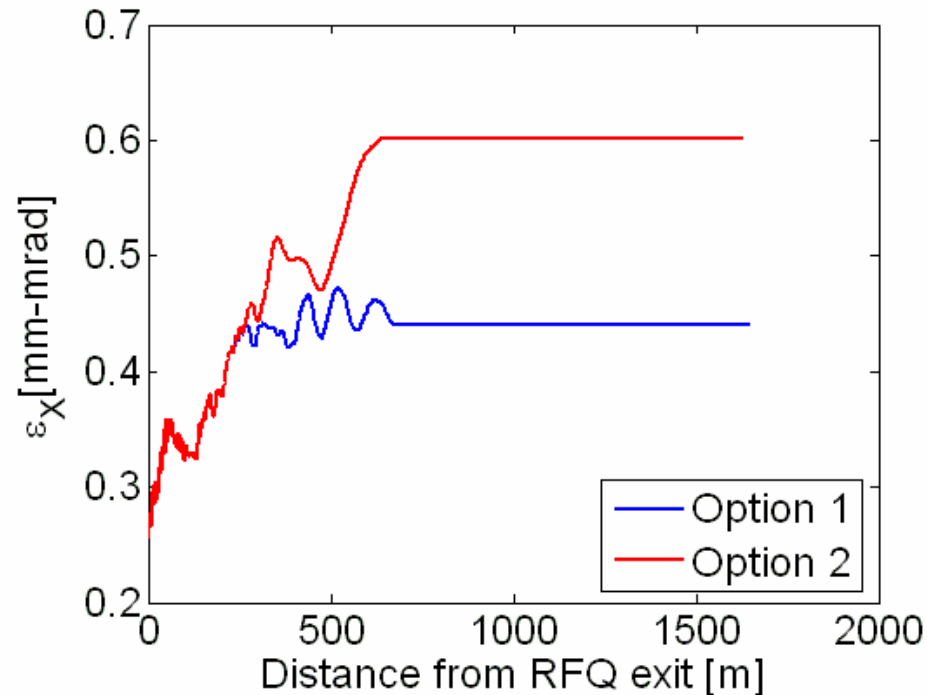


OPTION 1 (Standard) / OPTION 2 (8 ILC units) TRACK

RMS Transverse Size



RMS Transverse Emittance



Parameters at the Stripping Foil (From PAC07 paper, 200kp)

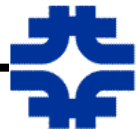
Table 1: Beam parameters at the stripping foil for both options of the accelerator. Beam average current of 45 mA.

Beam parameters	Option 1	Option 2
W [MeV]	8026	8006
σ_E [keV]	401	320
σ_Z [mm]	2.33	2.34
ϵ_Z [keV-mm]	869	725
σ_X / σ_Y [mm]	1.15 / 1.21	1.14 / 1.25
ϵ_X / ϵ_Y [mm-mrad]	0.46 / 0.50	0.62 / 0.70



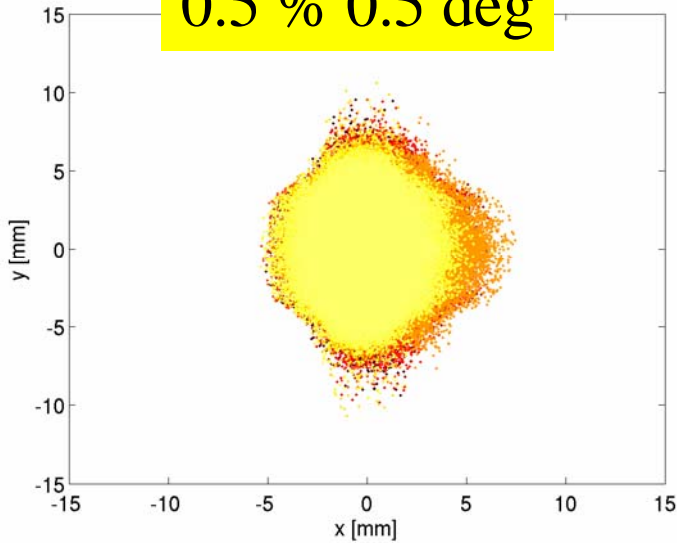
OPTION 2 (8 ILC Units) : Statistical Error Simulations

- **Statistical Error Simulations performed on OPTION 2 (45 mA) with the 8 ILC-units at ANL (JAZZ) with TRACK**
- **RF jitter (phase and fields)**
- **4 cases (24 seeds, 200kp, 45 mA, 3D SC in acc. section)**
 - **0.5% 0.5 deg (NO collimators)**
 - **1% 1 deg (NO collimators)**
 - **1% 1 deg (WITH collimators : 2H 2V 6mm, 1H 1V 5.5mm)**
 - **2% 2 deg (NO collimators)**
- **Gaussian Truncated at +/- 3 SIGMA**

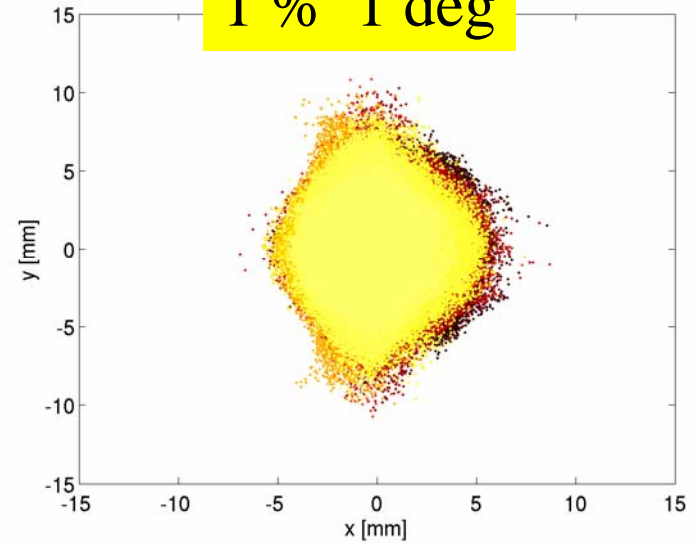


Statistical Error Simulations : Beam Spot at Stripping Foil

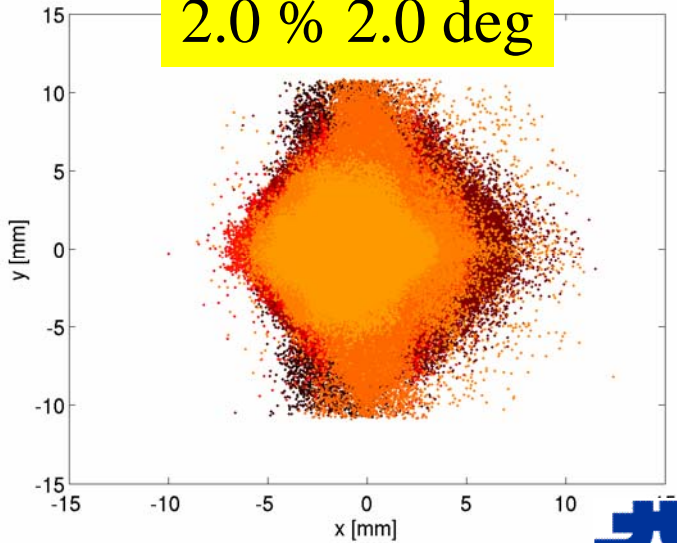
0.5 % 0.5 deg



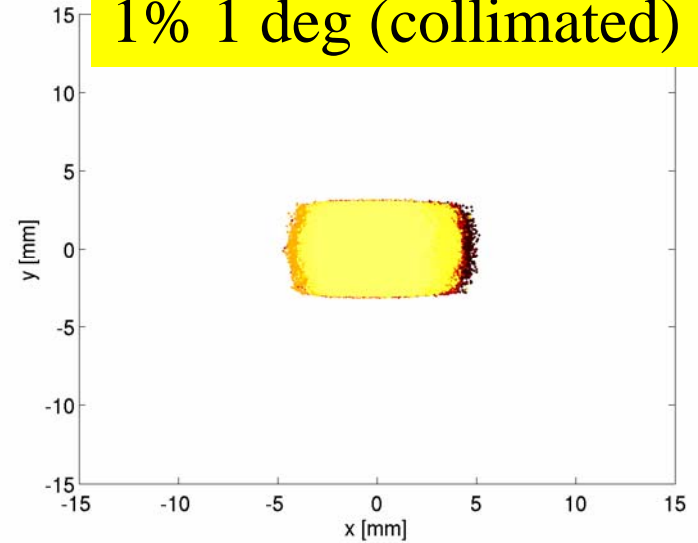
1 % 1 deg



2.0 % 2.0 deg

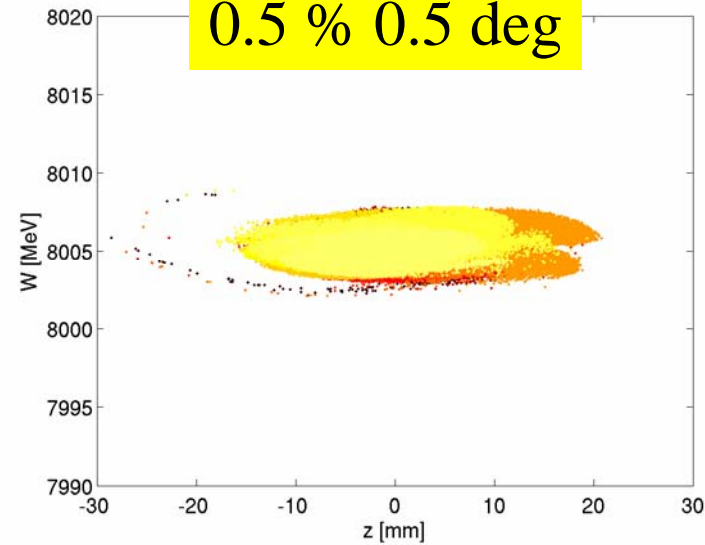


1% 1 deg (collimated)

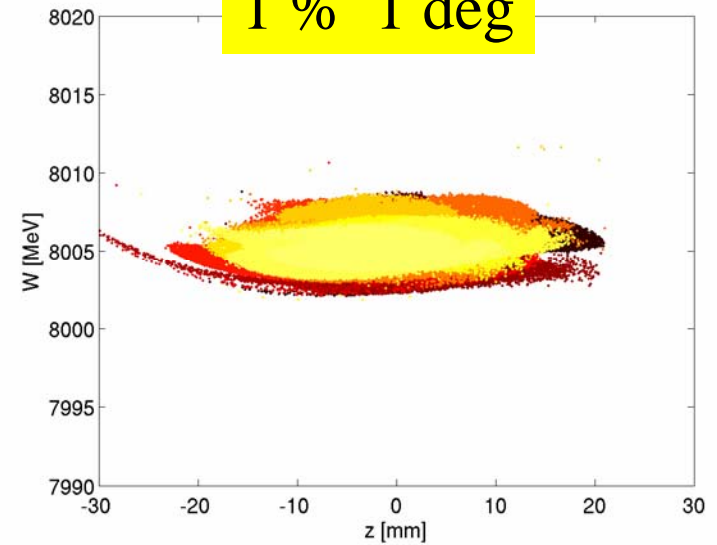


Statistical Error Simulations : Long. Phase Space at Stripping Foil

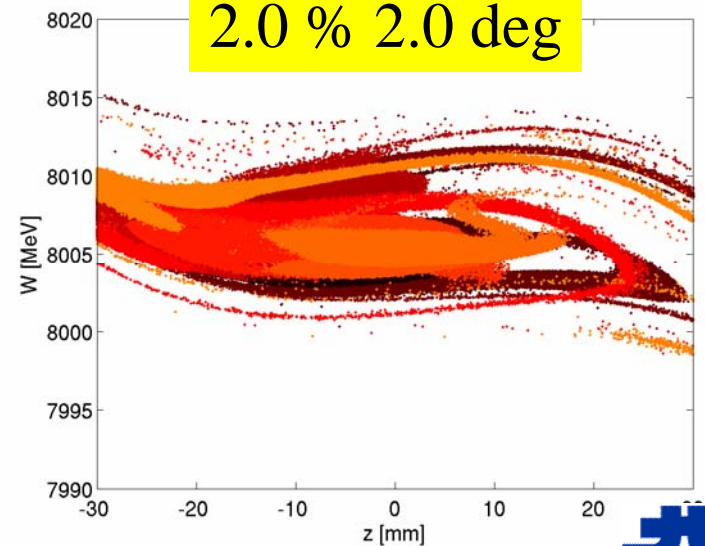
0.5 % 0.5 deg



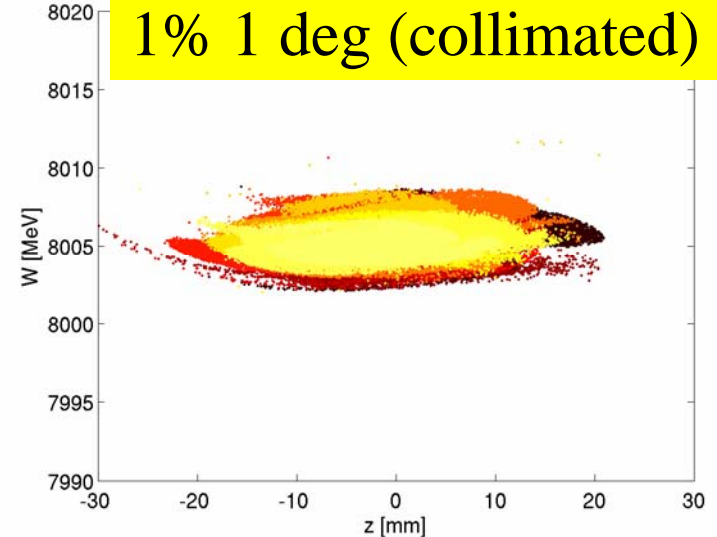
1 % 1 deg



2.0 % 2.0 deg

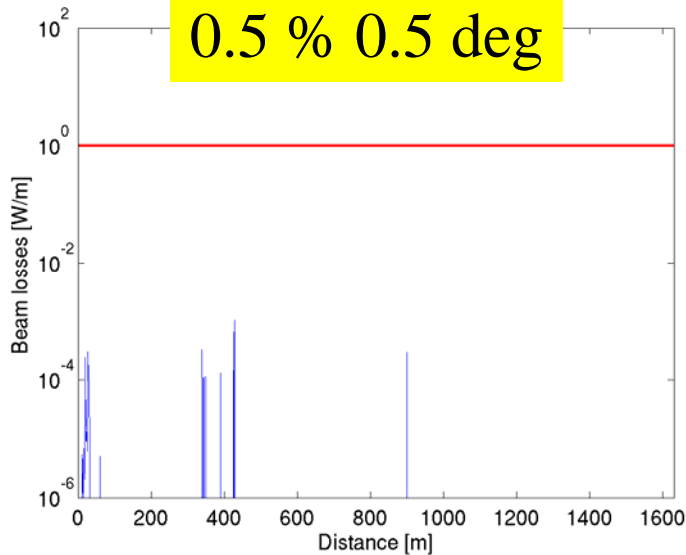


1% 1 deg (collimated)

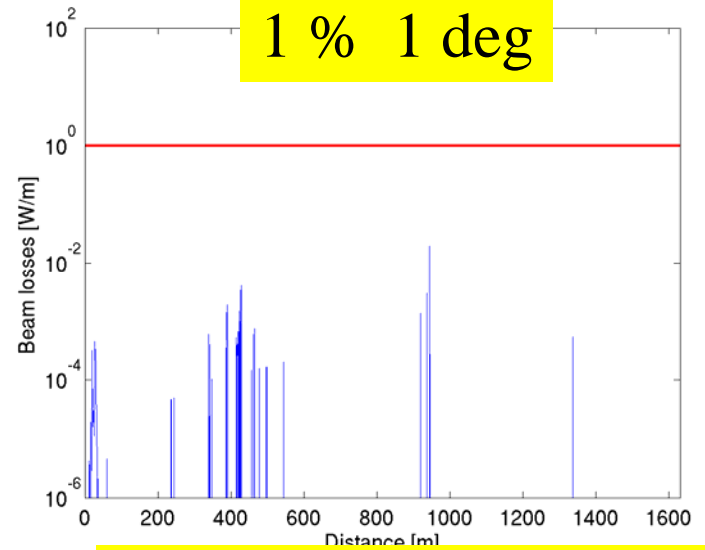


Statistical Error Simulations : Losses

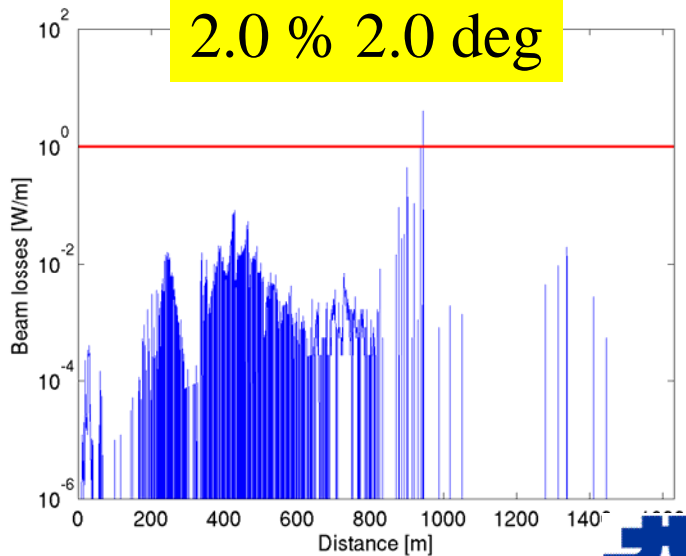
0.5 % 0.5 deg



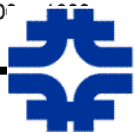
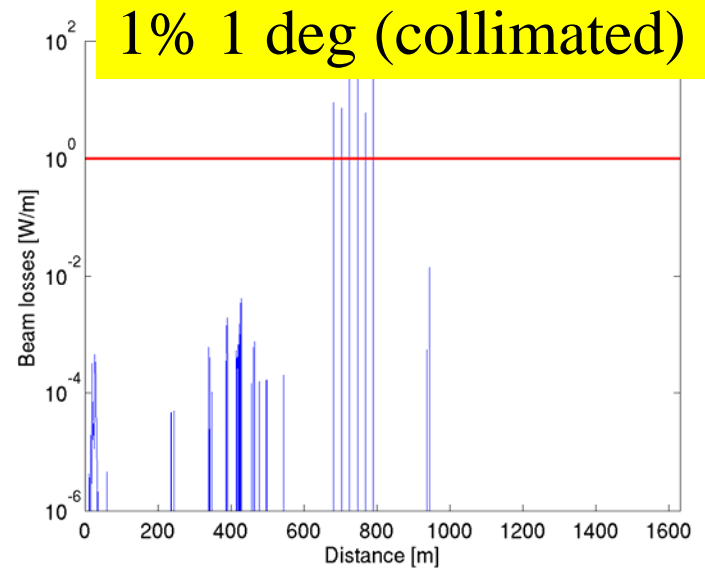
1 % 1 deg



2.0 % 2.0 deg



1% 1 deg (collimated)



Parameters at the Stripping Foil (From PAC07 paper, 200kp)

Table 2: Beam parameters at the stripping foil for three sets of RF errors (magnetic field errors of $1 \cdot 10^{-3}$).

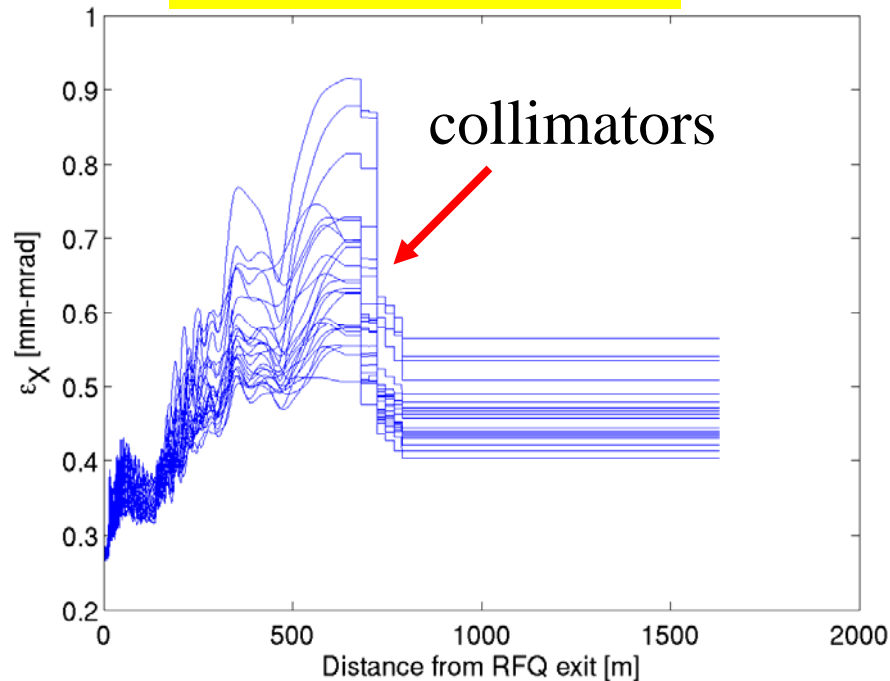
Beam param.	0.5% 0.5 ⁰	1% 1 ⁰	2% 2 ⁰
W [GeV]	8006 ± 0.5	8006 ± 0.8	8006 ± 1.6
σ_E [keV]	342 ± 36	378 ± 78	955 ± 788
σ_Z [mm]	2.5 ± 0.2	2.9 ± 0.4	5.7 ± 4.1
ϵ_Z [keV-mm]	827 ± 81	998 ± 182	5461 ± 8046
σ_X [mm]	1.1 ± 0.1	1.2 ± 0.2	1.3 ± 0.3
σ_Y [mm]	1.3 ± 0.1	1.4 ± 0.3	1.6 ± 0.5
ϵ_X [mm-mrad]	0.6 ± 0.1	0.6 ± 0.1	0.9 ± 0.3
ϵ_Y [mm-mrad]	0.7 ± 0.1	0.7 ± 0.1	1.0 ± 0.3



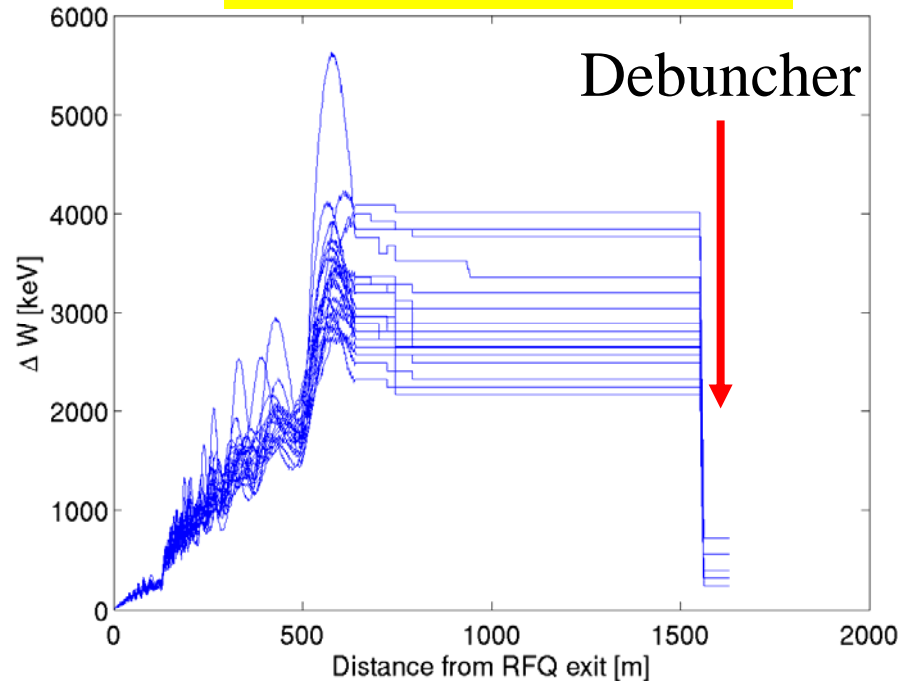
Statistical Error Simulations : 1 % 1 deg with collimation

- 24 seeds, 45 mA, 200 kp

RMS Emittance X



RMS Energy Spread



Conclusion & Next Steps

- **1deg 1% RF jitters looks OK at 45 mA with 8 ILC RF Units**
- **How many phase shifters do we need in the 8 ILC units ?**
- **Beam loading ?**
- **Wakefields ?**
- **Losses from Stripping ?**

