

Various Options/Concepts/Issues of Compton Sources

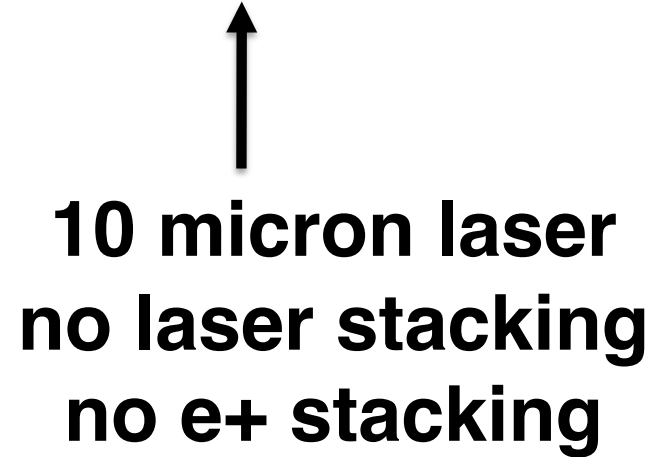
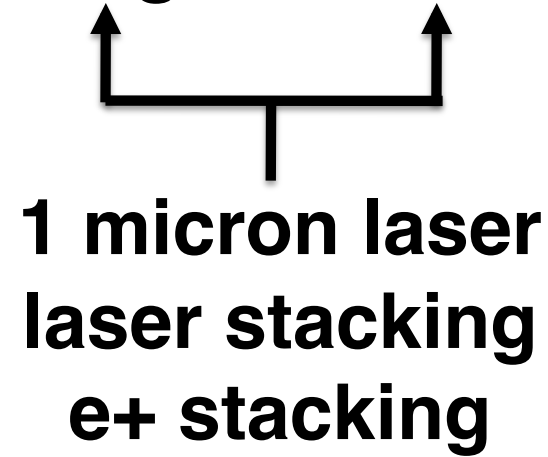
**T. Omori (KEK)
Compton Meeting at LAL
1-Dec-2008**

Our Options

Ring

ERL

Linac



Choice of CR circumference: Small CR or Large CR

$$E_{\text{spread_CR}} = (N_g(\text{cycle})/N_e)^{1/2} \times \langle E_g \rangle$$

Small CR C = 670 m, Ee = 1.8 GeV $\langle E_g \rangle = 20$ MeV

300 bunches in CR

CR 10 turn ---> create 3000 bunches

DR 10 stacking/cycle ---> CR 100 turn/cycle

$N_e = 4 \times 10^{10}$ /bunch

$N_{g_turn} = 2.7 \times 10^{10}$ (Laser : 600 mJ x 4)

$N_{g_cycle}/N_e = \{(2.7 \times 10^{10}/4 \times 10^{10}) \times 100\}^{1/2} = 8$

$E_{\text{spread_CR}} = 160$ MeV **too large!**

---> **small Ee, or , larger Ne and smaller laser E?, 2 micron laser, or , ,**

Large CR C = 6.7 km, Ee = 1.8 GeV $\langle E_g \rangle = 20$ MeV

3000 bunches in CR

CR 1 turn ---> create 3000 bunches

DR 10 stacking/cycle ---> CR 10 turn/cycle

$N_e = 4 \times 10^{10}$ /bunch

$N_{g_turn} = 2.7 \times 10^{10}$ (Laser : 600 mJ x 4)

$N_{g_cycle}/N_e = \{(2.7 \times 10^{10}/4 \times 10^{10}) \times 10\}^{1/2} = 2.6$

$E_{\text{spread_CR}} = 52$ MeV **acceptable?**

---> **small Ee is better?, larger Ne and smaller laser E?**

expensive!

put in DR tunnel?

Compton Source for ILC (Small CR option)

4 Laser Pulse Stacking Cavities (YAG)

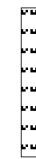
600 mJ x 4

1.8 GeV
e⁻ Linac

Compton Ring 1.8 GeV
 C = 670 m (2.2 μs / turn)
 b-to-b 6.15 nsec
 300 bunches (50x6)
 Ne⁻ = 4 x 10¹⁰/bunch

gamma

Ng = 2.7 x 10¹⁰
/turn
/bunch



Ne⁺ = 2.5 x 10⁸ /bunch

e⁺
Ne⁺/Ng = 0.9%

5 GeV e⁺
SC Linac

Collision 100 turns -> 0.6 m sec
Then 9.4 m sec for cooling

5 GeV e⁺
Main DR
C = 6.7 km
3000 bunches
T_{b_to_b} = 6.15 ns

- (1) 10 turns of Compton Ring (2.2 μs x 10) makes 3000 bunches.
- 100 turns of Compton Ring (0.6 ms) makes **10 times of stacking** in each bucket. Population reaches Ne⁺ = 2.5 x 10⁹ /bunch.
- 9.4 msec wait for damping.**
- (2) repeats (1) 10 times
Ne⁺ = 2.5 x 10¹⁰ /bunch
takes 100 m sec

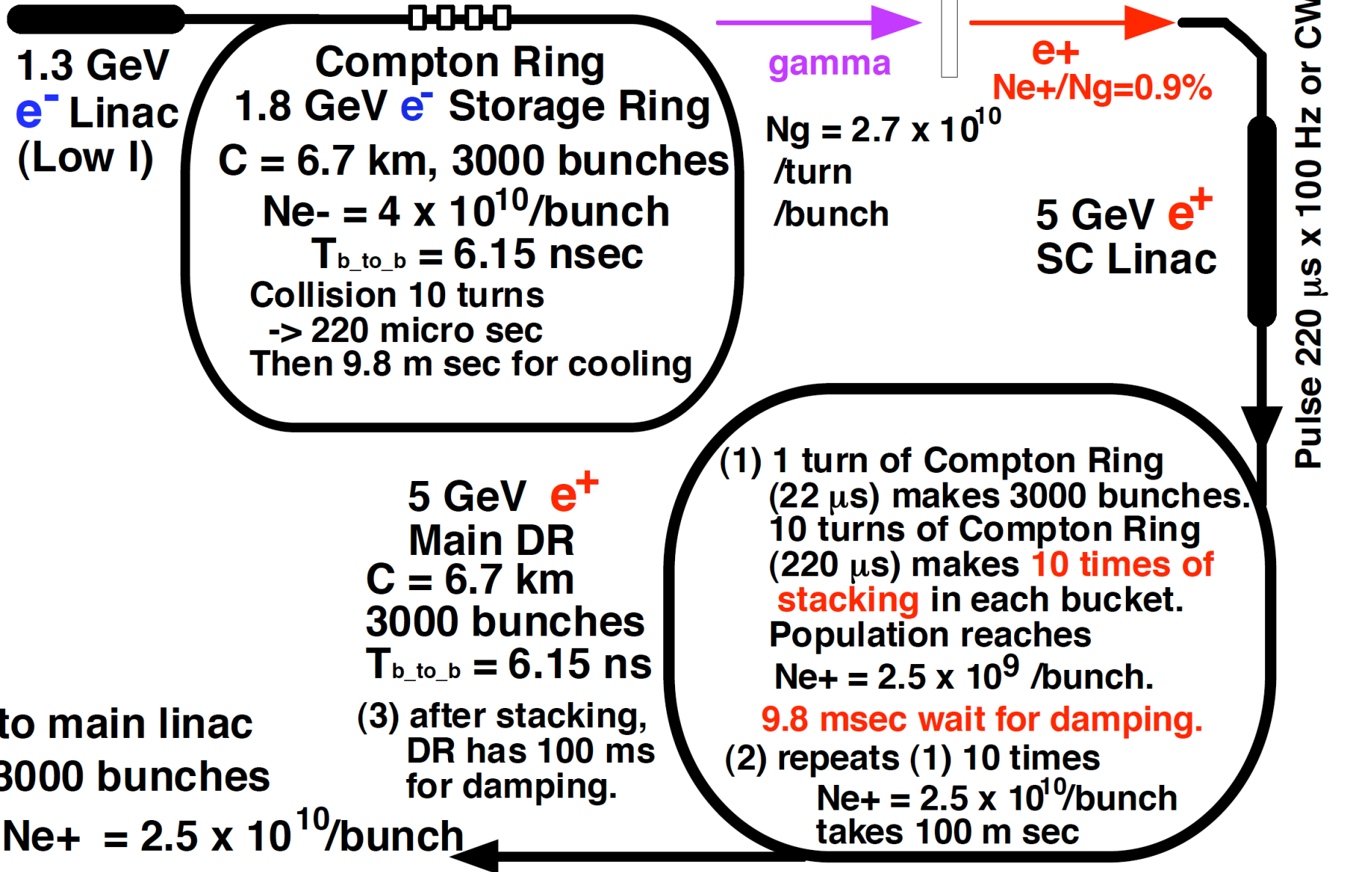
to main linac
3000 bunches

Ne⁺ = 2.5 x 10¹⁰ /bunch

Compton Source for ILC (Large CR option)

4 Laser Pulse Stacking Cavities (YAG)

600 mJ x 4



New Options ?

- Pre-DR (ILC)?

- Pre-DR help stacking? ---> need study

- Issue: $E_{\text{spred_CR}}$

$$E_{\text{spred_CR}} = (\text{Ng}(\text{cycle})/\text{Ne})^2 \times \langle E_g \rangle$$

CR_C = Pre-DR_C = 670 m, Ee= 1.3 GeV $\langle E_g \rangle = 15 \text{ MeV}$

300 bunches in CR

300 bunches in Pre-DR

CR 100 turn ---> create 100 x 300 bunches

Pre-DR 100 stacking/cycle ---> CR 100 turn/cycle

Ne = 6×10^{10} /bunch

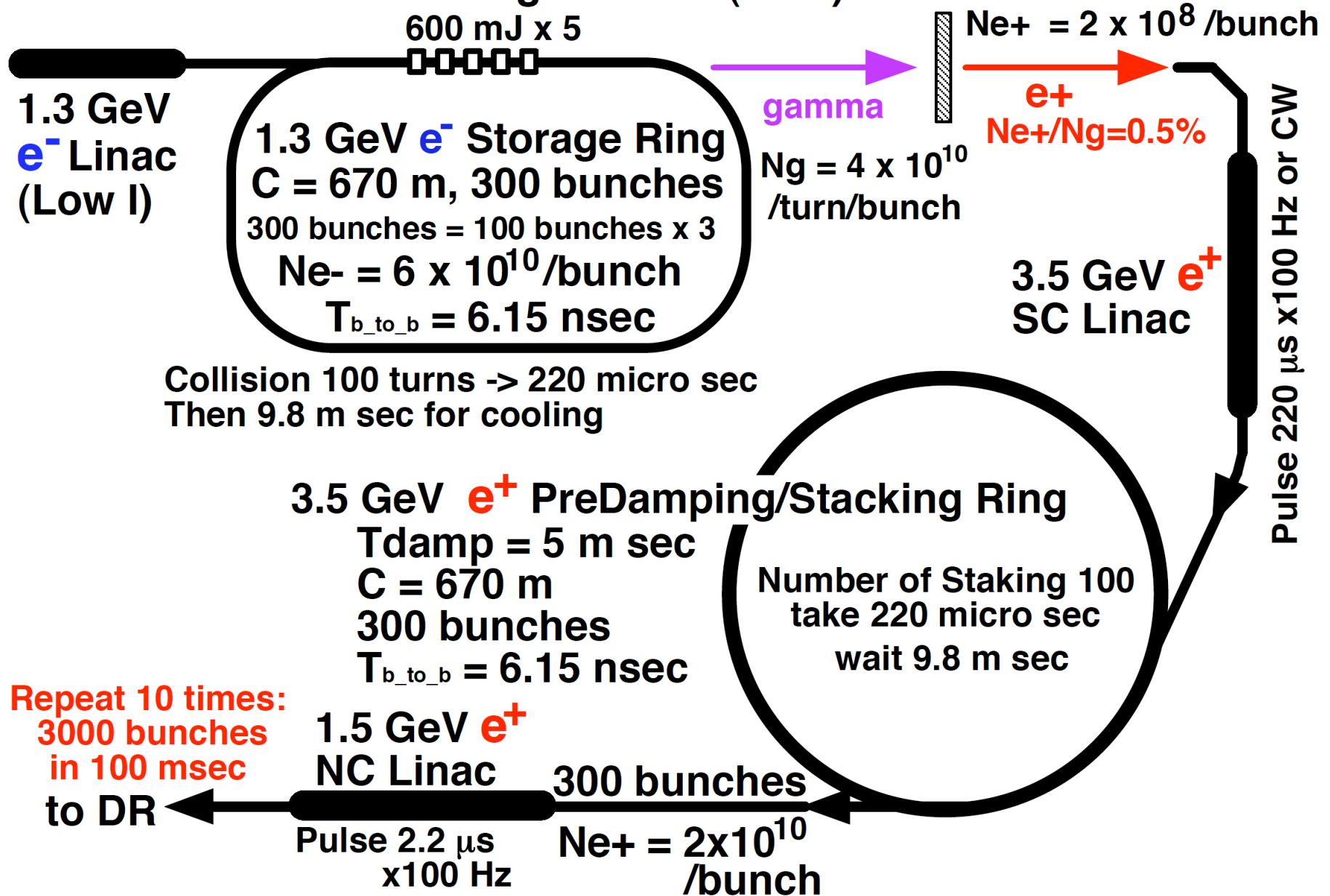
Ng_turn = 4×10^{10} (Laser : 600 mJ x 5)

Ng_cycle/Ne = $\{(4 \times 10^{10} / 6 \times 10^{10}) \times 100\}^{1/2} = 8$

$E_{\text{spred_CR}} = 120 \text{ MeV}$ **too large!**

Compton Source for ILC (Pre-DR option)

5 Laser Pulse Stacking Cavities (YAG)



New Options ?

- e+ stacking in Linac scheme

Linac



10 micron laser
no laser stacking
e+ stacking (<10)

assume : Linac 300 Hz, 100 bunches/train
needs "80 m sec" to get 2600
no time remains for stacking

assume : Linac 600 Hz, 100 bunches/train
needs "10 m sec" to get 1300 (Minimum Machine)
we have time for 4 stacking

Summary

- **Many Options/Concepts/Issues are summarized.**
- **ILC Minimum Machine Option**
Many things go to little easier
- **Necessary number of consideration are twice more.**
for ILC and for CLIC