

Gamma/Electron Ratio and, Comparison of Small-CR and Large-CR

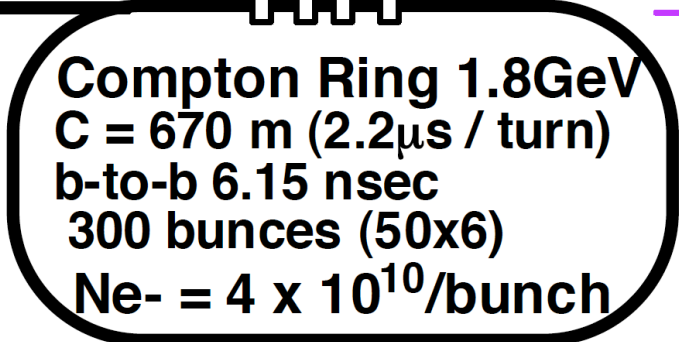
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Compton Source for ILC (Small CR option)

4 Laser Pulse Stacking Cavities (YAG)

600 mJ x 4

1.8 GeV
e⁻ Linac



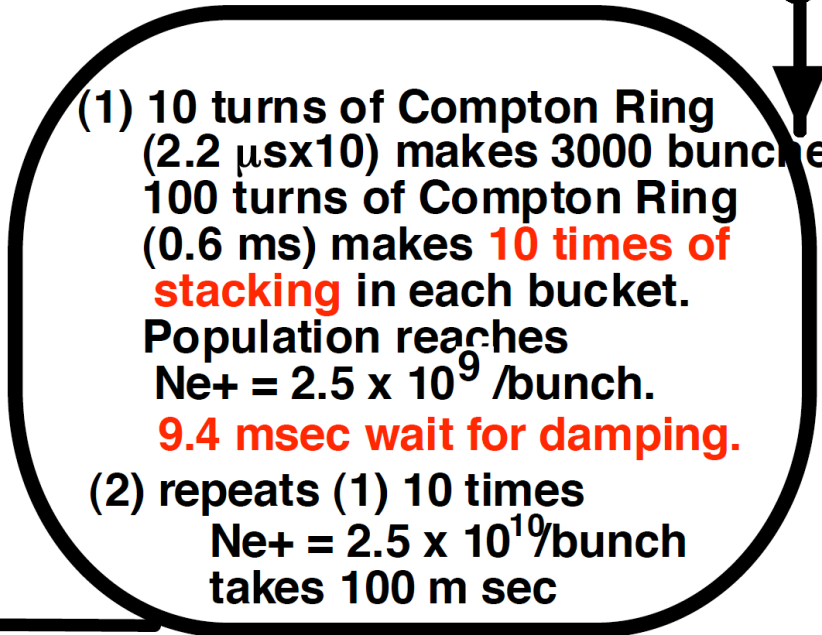
Collision 100 turns -> 0.6 m sec
Then 9.4 m sec for cooling

gamma
Ng = 2.7x10¹⁰
/turn
/bunch

Ne+ = 2.5x10⁸ /bunch
e+
Ne+/Ng=0.9%

5 GeV e⁺
SC Linac

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

(3) after stacking, DR has 100 ms for damping.

Choice of CR circumference: Small CR or Large CR

$$E_{\text{spred_CR}} \text{ (just after single gen. cycle)} = (\text{Ng_cycle}/\text{Ne})^{1/2} \times \langle E_g \rangle$$

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

300 bunches in CR

CR 10 turn ---> create 3000 bunches

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

Ne = 4×10^{10} /bunch

Ng_turn = 2.7×10^{10} (Laser : 600 mJ x 4)

$\{\text{Ng_cycle}/\text{Ne}\}^{1/2} = \{(2.7 \times 10^{10}/4 \times 10^{10}) \times 100\}^{1/2} = 8$

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

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

Compton Source for ILC (Large CR option)

4 Laser Pulse Stacking Cavities (YAG)

600 mJ x 4

1.8 GeV
e⁻ Linac
(Low I)

Compton Ring
1.8 GeV e⁻ Storage Ring
C = 6.7 km, 3000 bunches
Ne⁻ = 4 x 10¹⁰/bunch
T_{b_to_b} = 6.15 nsec
Collision 10 turns
-> 220 micro sec
Then 9.8 m sec for cooling

gamma

Ng = 2.7 x 10¹⁰
/turn
/bunch

Ne⁺ = 2.5 x 10⁸ /bunch

e⁺
Ne⁺/Ng=0.9%

5 GeV e⁺
SC Linac

Pulse 220 μs x 100 Hz or CW

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

(3) after stacking,
DR has 100 ms
for damping.

- (1) 1 turn of Compton Ring (22 μs) makes 3000 bunches. 10 turns of Compton Ring (220 μs) makes **10 times of stacking** in each bucket. Population reaches Ne⁺ = 2.5 x 10⁹ /bunch. **9.8 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

Choice of CR circumference: Small CR or Large CR

$$E_{\text{spread_CR}} \text{ (just after single gen. cycle)} = (\text{Ng_cycle}/\text{Ne})^{1/2} \times \langle E_g \rangle$$

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

Ne = 4×10^{10} /bunch

Ng_turn = 2.7×10^{10} (Laser : 600 mJ x 4)

$\{\text{Ng_cycle}/\text{Ne}\}^{1/2} = \{(2.7 \times 10^{10}/4 \times 10^{10}) \times 100\}^{1/2} = 8$

$E_{\text{spread_CR}} = 160$ 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

Ne = 4×10^{10} /bunch

Ng_turn = 2.7×10^{10} (Laser : 600 mJ x 4)

$\{\text{Ng_cycle}/\text{Ne}\}^{1/2} = \{(2.7 \times 10^{10}/4 \times 10^{10}) \times 10\}^{1/2} = 2.6$

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

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

expensive!

put in DR tunnel?

Possible Cure

- **Choose $T_{b_to_b} < 6.15$ n sec,
For example 2.05 n sec, Then we can put factor 3 bunches.
RF kicker at injection to DR
Laser collision every N-th bunch (N=3 in this example)**
- **Other Cure?**