stacking simulations for e+ Compton source - update 2

Frank Zimmermann

Thanks to: Alessandro Vivoli, Tsunehiko Omori, Robert Chehab, Alessandro Variola, Vitaly Yakimenko

1 April 2008

previous improvement (March 10):

- ✓ energy pre-compression [x3] (R. Chehab)
- ✓ additional DR wigglers for faster damping [x2]
- ✓ larger rf voltage [x 1.5]

March 14 (A. Vivoli):

best energy pre-compression only “x2”

other remedies that could be tried in the future:

- ❑ smaller momentum compaction factor
- ❑ reduced synchrotron tune
- ❑ larger interval between cycles
- ❑ different circumference
- ❑ two rings, or pre-damping ring

	ILC 2008 – **February**	ILC 2008 – **March**	ILC 2008 – **April**
beam energy	5 GeV	5 GeV	5 GeV
circumference	6695 m	6695 m	6695 m
particles per extracted bunch	2.0×10^{10}	2.0×10^{10}	2.0×10^{10}
rf frequency	650 MHz	650 MHz	650 MHz
harmonic number	14516	14516	14516
no. trains stored in the ring	52.5 (52.5/pulse)	52.5 (52.5/pulse)	52.5 (52.5/pulse)
#bunches/train	50	50	50
bunch spacing	6.15 ns	6.15 ns	6.15 ns
gap between trains	~50 ns	~50 ns	~50 ns
#e+ / injection	6.65×10^{7}	6.65×10^{7}	**6.82×10^{7}**
#turns between injections in 1 bucket	2	2	2
injections/bucket per cycle	30	30	30
injection frequency	80 MHz	80 MHz	80 MHz
full cycle length	200 ms	200 ms	200 ms
time between injection periods	10 ms	10 ms	10 ms
#turns between cycles	450	450	450
length of one injection period	0.963 ms	0.963 ms	0.963 ms
TI=total # injections/bucket	300	300	300
ST=store time after last injection	110 ms	110 ms	110 ms
IP=time interval with injection periods	90 ms	90 ms	90 ms
energy loss/turn	**2 MeV**	**8.7x2 MeV**	**8.7x2 MeV**
longitudinal damping time $\tau_{\|\|}$	**12.8 ms**	**6.4 ms**	**6.4 ms**

e+/pulse is too high for ERL option, or?

	ILC 2008 – **February**	ILC 2008 – **March**	ILC 2008 – **April**
transv. normalized edge emittance at injection (10x rms)	0.063 rad-m	0.063 rad-m	**0.070, 0.060 rad-m**
transv. normalized dynamic aperture (Ax+Ay)gamma	0.4 rad-m	0.4 rad-m	0.4 rad-m
rms bunch length at injection	3.8 mm	**11.4 mm**	**9 mm**
rms energy spread at injection	0.12%	**0.04%**	**0.059%**
final rms bunch length	9 mm	**5.2 mm**	**5.2 mm**
final rms energy spread	0.128%	**0.091 %**	**0.091 %**
longit. "edge" emittance at inj.	0.72 meV-s	0.72 meV-s	**0.87 meV-s**
rf voltage	24 MV	**36 MV**	**36 MV**
momentum compaction	4.2×10^{-4}	4.2×10^{-4}	4.2×10^{-4}
2nd order momentum compaction	-	-	-
synchrotron tune	0.067	**0.084**	**0.084**
bucket area	150 meV-s	**129 meV-s**	**129 meV-s**
ICM=bucket area / long. edge emit. /π	66	**57**	**47**
RMIN=TI/ICM	5	5	**6**
$IP/RMIN/\tau_{\|\|}$	1.4	**2.8**	**2.3**
$IP/RACT/\tau_{\|\|}$	0.78	**1.56**	**1.56**
synchronous phase	21.30°	**28.97°**	**28.97°**
separatrix phases 1&2	158.70 °, -124.19 °	**151.03 °, -82.64 °**	**151.03 °, -82.64 °**
max. momentum acceptance	+/- 1.57%	+/- 1.6%	+/- 1.6%
total loss	76%	**11%**	**15%**
loss for single injection cycle	35%	**11%**	**15%**

energy pre-compression at 5 GeV should further improve the yield