

Damping Rings RF Session Introduction

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BAW-2 Themes

								<i>upgrade</i>
Centre-of-mass energy	E_{cm}	GeV	200	230	250	350	500	1000
Luminosity	L	$\times 10^{34} \text{ cm}^{-2} \text{ s}^{-2}$	0.5	0.5	0.7	0.8	1.5	2.8
Luminosity (Travelling Focus)	L_{TF}	$\times 10^{34} \text{ cm}^{-2} \text{ s}^{-2}$	0.5		0.8	1.0	2.0	
Number of bunches	n_b		1312	1312	1312	1312	1312	2625
Collision rate	f_{rep}	Hz	5	5	5	5	5	4
Electron linac rate	f_{linac}	Hz	10	10	10	5	5	4
Positron bunch population	N_+	$\times 10^{10}$	2	2	2	2	2	2

Low-power option (1312 bunches):

→ Smaller circumference damping ring (6.4 km → 3.2 km)

Low E_{cm} running luminosity improved (over original SB2009) with 10Hz alternative pulse operation mode for e⁺ production → const. charge:

→ Requires shorter damping time in DR

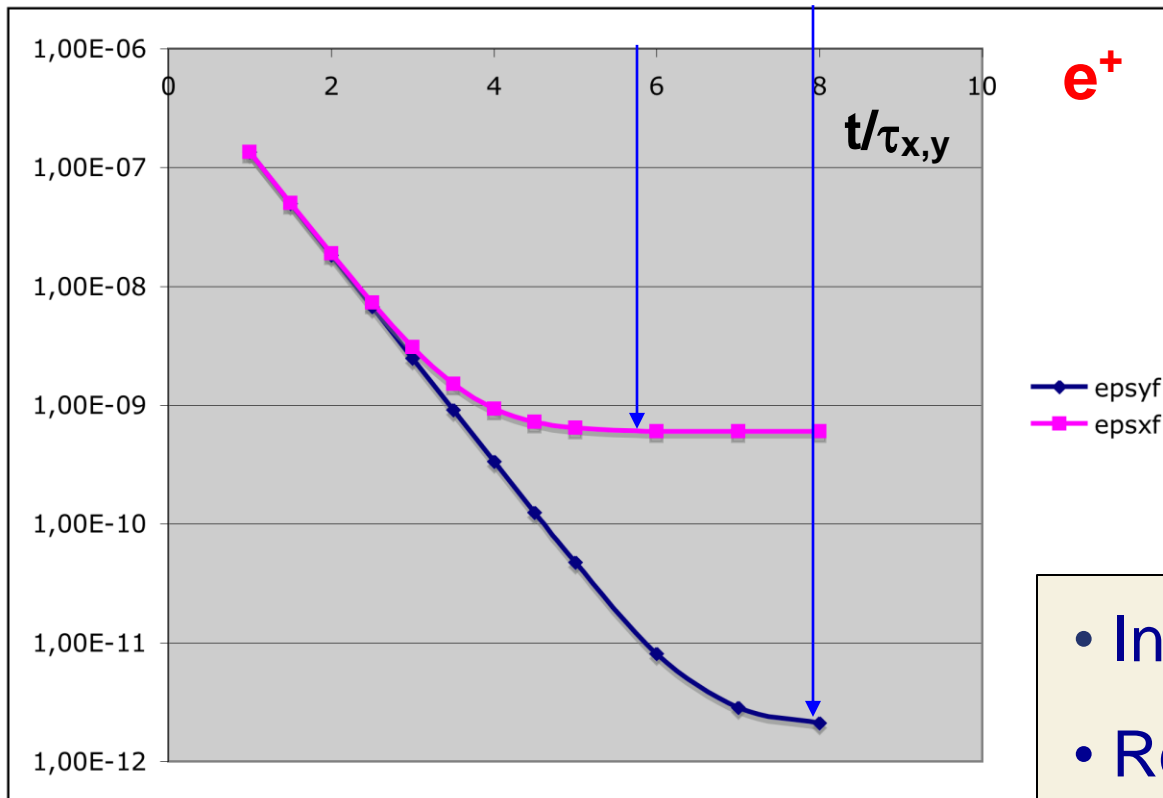
→ 50% duty cycle DR operation

DR Implications

1 TeV Upgrade:

→ assumes re-establishment of full RDR bunch number (2625)

Positron emittance damping



~8 damping times
are needed for the
vertical emittance

5 Hz $\Rightarrow \tau_{x,y} \leq 26$ ms

10 Hz $\Rightarrow \tau_{x,y} \leq 13$ ms

- Increase wiggler field
- Reduce wiggler period
- Double the number of RF cavities

Particle	SB2009 Low P. 5Hz	SB2009 High P. 5Hz	SB2009 Low Power 10Hz		SB2009 High Power 10Hz	
	e ⁺ /e ⁻	e ⁺ /e ⁻	e ⁺	e ⁻	e ⁺	e ⁻
Circumference (m)	3238	3238	3238	3238	3238	3238
N bunches	1305	2610	1305	1305	2610	2610
Damp. time τ_x (ms)	24	24	13	18	13	18
En. loss/turn (MeV)	4.5	4.5	8.4	6.2	8.4	6.2
RF Voltage (MV)	7.5	7.5	13.4	10.4	13.4	10.4
Average curr. (A)	0.39	0.78	0.39	0.39	.78	.78
Beam Power (MW)	1.76	3.51	3.28	2.42	6.55	4.84
N. of RF cavities	6	12	9	9	18	15
Power/cavity (kW)	293	292	364	269	363	322
Voltage/cav. (MV)	1.25	0.63	1.5	1.16	0.74	0.70
Klystron/ring	2	4	3	3	6	5
Power/klystron (kW)	880	880	1093	807	1090	970

Summary for 2 rings (e^+ and e^-)

	SB2009			
	Low P. 5Hz	High P. 5Hz	Low P. 10Hz	High P. 10Hz
Circumf. (m)	3238	3238	3238	3238
N bunches	1305	2610	1305	2610
Damp. time τ_x (ms)	24	24	13/18	13/18
Num. of RF cavities (2 rings)	12	24	18	33
Power/cavity (kW)	293	292	364/269	363/322
Voltage/cavity (MV)	1.25	0.63	1.5/1.16	0.74/070
Tot. numb. of kly's	4	8	6	11

- e^- linac runs at 10 Hz alternating:
 - 1 pulse for positron production and injection into e^+ DR
 - 1 pulse for collisions at 5 Hz
- e^+ DR is empty half of the time (100 ms):
 - Beam injected in ~ 1 ms
 - Beam stored for 100 ms for damping
 - Beam extracted in ~ 1 ms
- Main Concern:
 - large beam loading variation in a very short time (1 ms)
 - implications on RF system and beam stability
- WG2 RF Session, Wednesday 16:00: Discussion to get advice from RF experts in preparation of BAW2 meeting, SLAC 18-22 Jan 2011
 - Feasible? Needs more R&D? Cost implications?