Q1: Parameters

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Parameter Plane

- Discussion point: Tor's parameter sets for
  - 'Nominal'
  - Low Q
  - Large $\sigma*_y$
  - Low average beam power

  2×10^{34} cm^{-2}s^{-1}

- In addition
  - Original TESLA TDR set 3×10^{34} cm^{-2}s^{-1}
  - USSC 2.7×10^{34} cm^{-2}s^{-1}
  - High Luminosity 5×10^{34} cm^{-2}s^{-1}

pushing the limits!

Our Goal for the BCD

- Is **NOT** to select a <u>single</u> parameter set
- but to understand the limitations for each sub-system
- examine the relative trade-offs between the parameters
- make sure we allow enough flexibility in our design to deal with the unexpected
  - risk mitigation
- If we design to a single parameter set we effectively loose overhead (safety margin)
  - and the possibility of luminosity $>2{\times}10^{34}$ cm^{-2}s^{-1}

Beam and IP parameters for 500 GeV cms

	TESLA	USSC	Nominal	Low Q	Large Y	Low P	High L
E_{cms} (GeV)	500	500	500	500	500	500	500
N (10^{10})	2.0	2.0	2.0	1.0	2.0	2.0	2.0
n_b	2820	2820	2820	5640	2820	1330	2820
t_b (ns)	336.9	336.9	307.7	153.8	307.7	461.5	307.7
bucket interval	438	438	400	200	400	600	400
I_{ave} (mA)	9.5	9.5	10.4	10.4	10.4	6.9	10.4
Gradient	23.4	28.0	30.0	30.0	30.0	30.0	30.0
$\gamma\epsilon_x^*$ (mm·rad)	10	9.6	10	10	12	10	10
$\gamma\epsilon_y^*$ (mm·rad)	0.03	0.04	0.04	0.03	0.08	0.035	0.03
β_x^* (mm)	15	15	21	12	10	10	10
β_y^* (mm)	0.4	0.4	0.4	0.2	0.4	0.2	0.2
σ_x^* (nm)	554	543	655	495	495	452	452
σ_y^* (nm)	5.0	5.7	5.7	3.5	8.1	3.8	3.5
σ_z (μm)	300	300	300	150	500	200	150
D_x	0.226	0.235	0.162	0.0708	0.468	0.226	0.170
D_y	25.3	22.3	18.5	10.0	28.6	27.0	21.9
Υ_{ave}	0.054	0.055	0.046	0.061	0.036	0.100	0.133
δ_{BS}	0.030	0.031	0.022	0.018	0.024	0.057	0.070
P_{BS} (MW)	0.335	0.347	0.248	0.205	0.267	0.306	0.790
n_γ	1.477	1.504	1.257	0.823	1.664	1.756	1.725
Inc. Pairs/bc 10^6	0.414	0.366	0.259	0.084	0.350	0.612	0.637
H_D	1.80	1.78	1.70	1.56	1.79	1.65	1.74
$\mathcal{L}_{geom}$ 10^{34}	1.64	1.45	1.20	1.29	1.12	1.24	2.83
$\mathcal{L}$ 10^{34}	2.94	2.57	2.03	2.01	2.00	2.05	4.92

WG feedback

- WG1: direct – thanks!
- WG2: *no comment*
- WG3a: *no input*
- WG3b: *nothing new since GG1 parameters session*
- WG4: *nothing new since GG1 parameters session*
- WG5: *no comment*

Damping Rings

- Low Q set a discussion point
- No real cries of 'impossible' (yet!) although we push limits hard
- Low Q / lower bunch number makes life easier for DR designers
  - Although these two parameters are not independent
  - Low Q requires 6000 bunches
- Pushes problem elsewhere
  - Shorter bunch required (150 μm)
  - Small σ^*_y (larger divergence)

Damping Rings (cont.)

- Other variants discussed
- Very low Q
  - Not far from TR low Q but pushes limits still further (large n_b still needed)
- Reduction of n_b (factor 2) $\rightarrow$ low P_{av}
- Larger ε_y with smaller ε_x $\rightarrow$ large σ^*_y set
- Increased repetition rate (10Hz)
  - *Currently not foreseen in parameter range*
  - *So-called 'high-power' option removed*

Pulse Length

- Longer RF pulse (~2ms) suggested
  - Peak current reduced by 2
  - Coupler power reduced by 2
  - Halves number of klystrons/modulators
    - Potential significant cost saving
  - Increase in cyro by factor 2
- Klystrons & modulators do not currently exist
  - R&D programme
  - Not for BCD at present (IMO) but should be considered as alternative
- Other gotchas
  - source problems (laser for e-, capture section for e+)

note: range for tuneable Q_{ext} not infinite!

LET considerations

- Cannot currently guarantee emittance budget
  - Much (simulation) work to be done (on-going)
    - *Importance of large σ^*_y parameter set*
- Solutions for factor 40 bunch compression exist
  - but needs 2-stage compressor $\rightarrow$ cost!
  - for factor 20 single-stage may work
    - but excludes 150 μm bunch length (low Q and high L)

BDS

- Two critical issues
  - beamstrahlung (spent beam extraction)
  - angular divergence (β^*)
- Current 500 GeV parameter sets look OK
  - extraction for high-L for 2mrad questionable
- Original 1TeV high-L not feasible
  - alternate solution suggested by Seryi
  - shifts stress to DR/LET emittance preservation
    - very tough: should perhaps consider reducing high-L luminosity (ie reduce 'safety margin')

Preliminary Conclusions

- Current set of 500 GeV numbers cover most of the discussed parameter space

- Still waiting for feedback from WGs

- Two parameters not in current plane
  - 10Hz operation
  - 2ms pulse length

  Not baseline, but could be considered alternatives

- Concrete constraint from WG4 for 1TeV high-L parameter set

  - the first 'can't do that' request!

- Bottom line: no real need to change these parameter ranges as yet

  - we await more input from WGs (especially DR)