



10 Hz Study a first shot at cost increments

**just a quick view,
don't trust the numbers yet
public version for posting**

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Starting point(s):

- Nick Walker's ADI-23-06-homework.pdf – June 4, 2010
- http://ilc-edmsdirect.desy.de/ilc-edmsdirect/file.jsp?edmsid=*907775
- Raised some questions as to scope which sent to Nick and then discussed 6/17 with Nick, Marc, Akira, Ewan, and PHG
- Many configurations: full power, $\frac{1}{2}$ power, $\frac{2}{3}$ power, repetition rate, and energy range $\sqrt{s}/2 = 100 - 150$ GeV
- Although the intention was to do many configurations, I was only able to look at one, trying out formats, etc.
- Main Linac RF: RDR full beam-power with $n_b = 2630$
6.4 km racetrack DR and 2-stage Bunch Compressor
compare 5 Hz 250 GeV/beam w 10 Hz 150 GeV/beam
- Likely choose **X** Hz 150 GeV e- *posi*, **X** Hz **YYY** GeV e- *lumi*, where **X** and **YYY** are chosen to optimize power/cost



Assumptions & Questions

| System | Rep Rate/Energy | Comments |
|-----------|-----------------|--------------------------------------|
| e- Src | 10 Hz 5 GeV | |
| e+ Src | 5 Hz 5 GeV | – extra target load? |
| e- DR | 10 Hz 5 GeV | |
| e+ DR | 5 Hz 5 GeV | – but $t_{\text{damp}} \sim 0.1$ sec |
| e- RTML | 10 Hz 15 GeV | – remember 2 BCs |
| e+ RTML | 5 Hz 15 GeV | |
| e- ML | 5 Hz 150 GeV | <i>posi</i> & 5 Hz 150 <i>lumi</i> |
| e-/e+ BDS | 5 Hz 150 GeV | |

Ignored: new e- posi dump line, which beam dump,
e- lumi impact e+ target, bypass undulator?



Assumptions & Questions (2)

- Assume we have capability for 5 Hz 250 GeV/bam
- Power Considerations & Hardware Considerations
- Gross beam power
(10 Hz 150 GeV) = **1.20** * (5 Hz 250 GeV)
but remember shorter t_{pulse} , lower klystron efficiency
Nick, using Adolphson's Kly-eff gets 1.17 for MR
- Costs \sim Power $^{\alpha}$, Cooling $^{\beta}$, Cryo $^{\gamma}$ $\alpha \leq 1$, $\beta \leq 1$, $\gamma = 0.6$
- Modulators/PS – Dan Wolff, Fermilab, 3/29/2010
can run half-charge at 10 Hz at no extra cost,
but full charge at 10 Hz => increase cost 22%
- DR wigglers – no cost increase, M. Palmer 3/28/10



Assumptions & Questions (3)

- e- Src – Axel – 6/21 – same devices, more power
need info on power for warm RF
- e+ Src – no change, ignore extra e- *lumi* beam load
- e- DR – add 2x RF Cavities & Drivers, Power & Cool
I used same # wigglers – gotta fix
- e+ DR – add 2x RF Cavities & Drivers, same P & C
I used same # wigglers – gotta fix
- e- RTML – upgrade Modulators/PS, Power & Cool
- e- ML – upgrade Modulators/PS, Power & Cool
- No changes for e+ RTML, e+ ML, e- BDS, e+ BDS
- Still have to deal with e+ target area and *posi* dump



Summary of Long Spreadsheet

- Incremental cost over RDR 5 Hz 250 GeV/beam for 5 Hz 150 GeV lumi & 5 Hz 150 GeV posi beams =
- **128 M** ILCU or extra **1.9%** relative to 6.617 B ILCU
- Is it worth it? Most likely one could reduce repetition rate or max lumi energy for this mode to keep costs reasonable – optimize vs. Luminosity
- Increments by Area
 - **cannot post due to confidentiality**
- Increment drivers are both the e- and e+ DRs

to do:

- Need clearer, easier to digest format, which better separates out terms – *done!*
- Understand how much of the CFS Cooling Load RDR Table 4.5-1 goes to which Power source in RDR Table 4.3-1
- Check for errors, inconsistencies, driver terms
- What are power terms for warm RF for e- Source?
- Continue to work my cost estimating way through space of beam power configurations, repetition rates, and E_{lumi}