Vertex Detector EOI RAL LOI Preparation

Discuss plans for making progress on vertex detector design

- Much work on “generic” parameters already done by LCFI
- What simulations do we want/need?
  - For our own design purposes
  - For LOI
- Other issues
  - Cabling and electronics
  - Sensors

Simulation

- What is needed to understand basic resolution parameters, especially in the forward direction?
  - We know much of this information already. IP resolution will be determined by mass, inner radius, and pixel size. More complex questions include:
    - How resolution is degraded with angle in the forward direction
    - Optimizations
      - Decreased time resolution technologies in outer layers
      - Non square pixels in forward region?
      - Vertex pixel size optimization (power/pixel size tradeoffs)
  - We need to integrate Nick's new code
    - Understand where it is needed (forward cluster shape is one example)
- *This is not part of the LOI benchmark study, but to validate our own design*

Simulation II

- What is needed to understand pattern recognition performance?
  - Overall tracking in 3D over full angular range
  - Ability to change geometries and sensor charactoristics
  - Ability to add beam background
- What is needed to understand physics performance? Are the standard benchmarks what we want? Would like a mode or modes that allows us to:
  - Cleanly study capabilities
  - Emphasize forward tracking (SiD strength)
  - Incrementally build understanding – adding more complex studies as appropriate
  - Interact efficiently with benchmarking studies groups
- Do any of the standard benchmarks give us what we need?

Simulation III (from Norm)

- $e^+e^- \rightarrow ZH$, $H \rightarrow e^+e^- X$, $\mu^+\mu^- X$ (M_H =120 GeV, E_{cms} =250 GeV)
  - Simple events, no vertexing or forward emphasis
- $e^+e^- \rightarrow ZH$, $H \rightarrow cc$, $Z \rightarrow \nu\nu$ (M_H =120 GeV, E_{cms} =250 GeV)
  - Clean test of vertexing and charm tagging, no specific forward emphasis – may be a good start. Is the physics in BR?
- $e^+e^- \rightarrow ZH$, $H \rightarrow cc$, $Z \rightarrow qq$ (M_H =120GeV, E_{cms} =250GeV)
  - Adds pattern recognition and jet reconstruction – not a place to start
- $e^+e^- \rightarrow Z \rightarrow \tau^+\tau^-$ (E_{cms} =500 GeV)
  - Hard tau tracks, pattern recognition of locally dense tracks
  - A_{fb} of this might be an interesting way to look at forward tracking
- $e^+e^- \rightarrow tt$, $t \rightarrow bW$, $W \rightarrow qq'$ (M_{top} =175 GeV, E_{cms} =500 GeV)
  - Good test of vertexing – but complex, also depends on PFlow
- $e^+e^- \rightarrow \chi^+ \chi^- / \chi_2^0 \chi_2^0$ (E_{cms} =500 GeV)
  - Mostly a test of particle flow, calorimetry

None of these are really perfect

Benchmarks

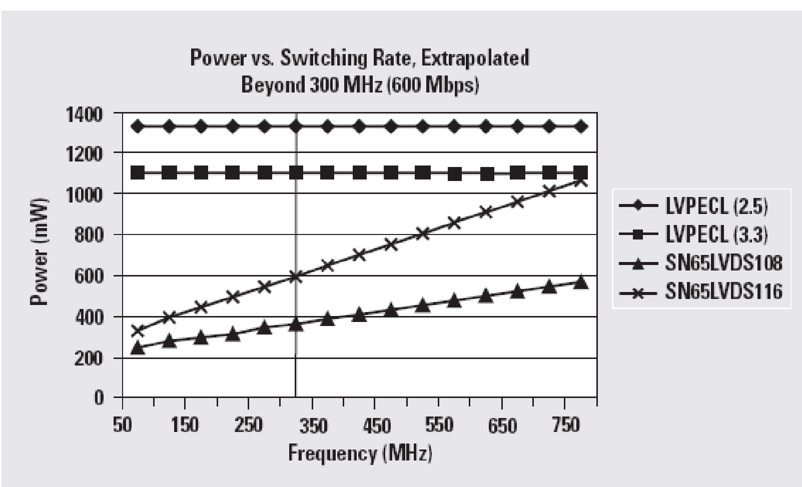
- I would prefer studies which do not rely on sophisticated analysis techniques (neural nets …) but focus on resolutions and efficiencies.
- It would be nice if this overlaps with a benchmark reaction
  - Look at single mode
  - Able to directly measure mass resolution
  - Able to measure vertex resolution and efficiency
    - Charm might be a good candidate – a single vertex with short lifetime
- A_{FB} in $e^+e^- \rightarrow bb$, cc, while not on the compulsory list, is an appealing reaction to start with.

Cabling and Interconnect

- Power delivery design
  - Serial power / DC-DC conversion / Capacitive switching
    - Controls
    - Regulation locations, number of cables to outside
    - Division of modules?
- Cable routing. Along beam pipe or along support cylinder
- Optical or electrical interconnect
  - power required, location
- Sensor/cable interface design.
- Lorentz forces.
- Pulsed power R&D – This an important aspect of any ILC – based electronics system and needs to be studied.

Interconnects

- Optical or electrical – similar power requirements
  - 10 mw/line with modest frequency dependence
- Rough estimates needed for voltage drop on power lines (RY guess 5 V for 25 V supply)



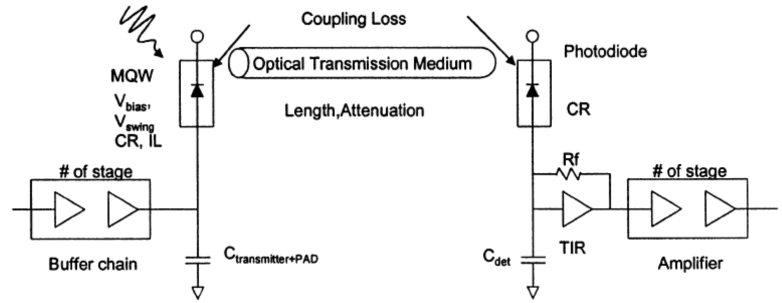


Fig. 1. Schematic showing board-level high-speed optical interconnect.

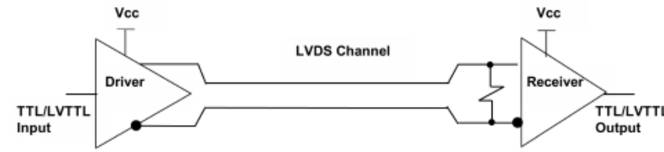
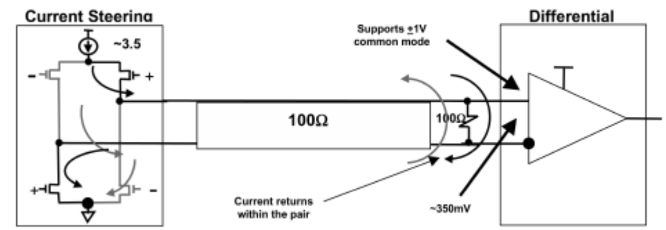


FIGURE 1.



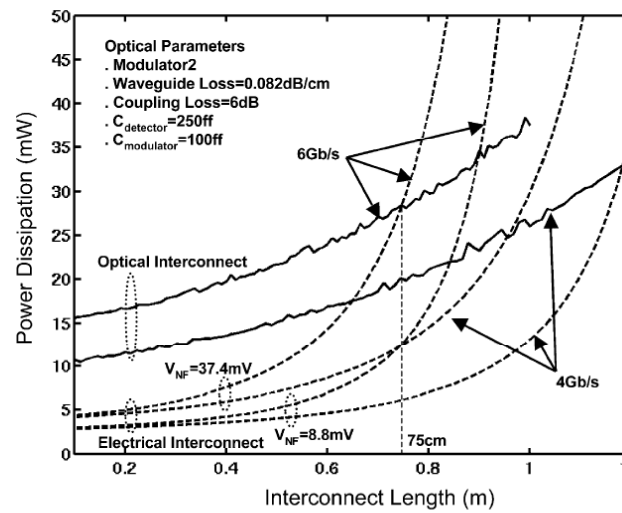


Fig. 9. Power comparison between electrical and optical interconnects for modulator 2.

Sensors

- Again, to what extent do we want a generic design?
- Rolling shutter vs time stamp model
- Thickness
  – How does thickness affect large angle track resolution?
- Charge sharing model
  – fully depleted vs diffusion
  – signal/noise expected
- Disk sensors
  – Type
  – Pixel size
  – segmentation