

XFT Review June 25 2004

We commend the XFT upgrade group for excellent presentations. The results were clearly based on huge efforts and give a consistent and clear picture despite the large phase space of possible accelerator and COT performance. The recent simulation studies show that track efficiency and p_T and ϕ resolution of current axial system is satisfactory at high luminosities, in contrast to the previous studies in the Run IIb TDR. However, there is still a need to improve purity of XFT tracks to stop quadratic growth in trigger cross-sections and cubic growth in trigger rates with instantaneous luminosity:

- Reduce high p_T single track fakes by a factor of 3-4. This is from linear extrapolation of current trigger cross-sections to design instantaneous luminosity of $2.7 \times 10^{32} +$ conservative overhead = $4.0 \times 10^{32} \text{ cm}^{-2}\text{s}^{-1}$.
- Reduce scenario C cross-section by a factor of 2-4. This is from linear extrapolation of current trigger cross-sections to base instantaneous luminosity of $1.5 \times 10^{32} \text{ cm}^{-2}\text{s}^{-1}$.

With the above goals in mind, how well do the various XFT upgrade designs perform? Note with a degraded COT, the baseline trigger rates are higher by factor of 50-100%. However, the upgrades still perform well and show similar reductions to default COT.

- **The 6-bin finder+linker+stereo option with a minimum track p_T threshold of 2 GeV/c achieves a reduction of 3-4 in trigger rates.** However, the committee finds it not feasible to replace the entire axial system in 16 months. The current axial system is robust in terms of maintenance and flexibility. The axial system is the core of the CDF Level 1 and Level 2 trigger system. There is significant risk of downtime for high p_T and B physics programs during the commissioning of a new system, when we could otherwise be filling bandwidth with physics.
 - We can gain some relief (20% reduction) with the current axial system by increasing the minimum p_T track. This could be implemented immediately.
 - We recommend investigation of a possible reduction in high p_T fake rate from option of requiring both slope bits for high p_T segments. This could also be implemented immediately.
- **The addition of SL5 and SL7 stereo superlayers gives a factor of 2 in reduction. An increase in the minimum track p_T to 2.5GeV/c improves this to a factor of 3.** The committee finds it feasible to do this in 16 months since it can be commissioned parasitically with no risk to the existing axial system. Using the stereo information seems like an intrinsically good idea, especially in the outer layers, when we are still concerned about COT aging issues.
 - The timescale for this option is feasible but aggressive. The committee strongly recommends that the XFT upgrade group choose technology already proven to work and available now from suppliers, especially for the FPGA chips for the stereo finders. There is no time and no need to choose technology on the “bleeding edge”

for this upgrade. The committee encourages the use of existing technology with expertise from CDF collaborating institutions, such as optical fibers (CMS) and Pulsar boards from the CDF Level 2 upgrade.

- The committee strongly requests a detailed plan to show that the XFT upgrade group has the required resources to make the stereo upgrade happen in the next 16 months. We are concerned about the number of tasks assigned to each person.
- The extra credit option of confirmation using the stereo information at L1 should be explored; it should be below the radar but could be very important for extending the 2 track data reach, provided this is not killed by continued problems with the COT. This option was envisioned early on in the hooks (extra bits) between XFT and XTRP. As Peter Wilson mentioned, would have to fit in with timing of existing L1 trigger system.
- The committee believes that there is too much uncertainty in future accelerator performance, length of Run 2, etc. to decide now that the stereo upgrade alone will be enough for the life of the experiment. It may be that a source of funds and manpower (and necessity) will come at a later time, without the same constraints as we have now, so that we can make the axial upgrade. Any decisions made now should leave open that possibility. Specifically, this means the new stereo finder should be built under the assumption that it could be used for the later axial finder upgrade. Other technical decisions should also be made with this in mind.

In conclusion, the committee strongly recommends the addition of information from two stereo superlayers. However, we do not recommend the replacement of the existing axial superlayer XFT system. The findings of the simulation studies have been shown to reproduce trends observed with the recent high instantaneous luminosities. This gives the committee confidence that the addition of stereo information to the XFT system will achieve the factor of 3 reduction in trigger cross-sections required for a successful CDF physics program at the highest luminosities.

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