BIB occupancy plots

And some thoughts on the next steps

Muon collider tracking meeting - 23/02/2021

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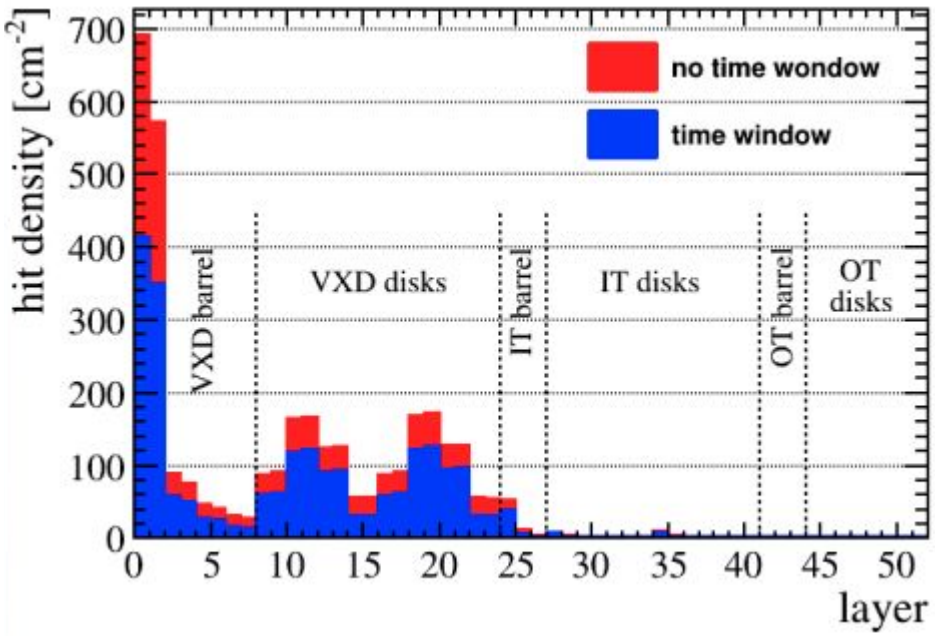
Goal

Nadia's talk at the restricted ECFA meeting was a chance to update the previous density plot.

The main reason is that the rejection power of the timing requirements is potentially much larger than what was suggested by the previous plot.



- Since the overlay software needs a time window for the overlay of the BIB, the hit counts in the **"no time window" category still depends on another time window**.
- We should at least disclose how large the window is -> volunteered to update the plot.

Technicalities

The plots were re-produced using the latest geometry and software:

- v02-05-MC → infnpd/mucoll-ilc-framework:1.4-centos8

Geometry: MuColl_v1

Time window for BIB overlay: [-360, 480] ps **for all subdetectors**

Hits retained if [-3σ_t, +5σ_t] using the TOF-corrected hit time

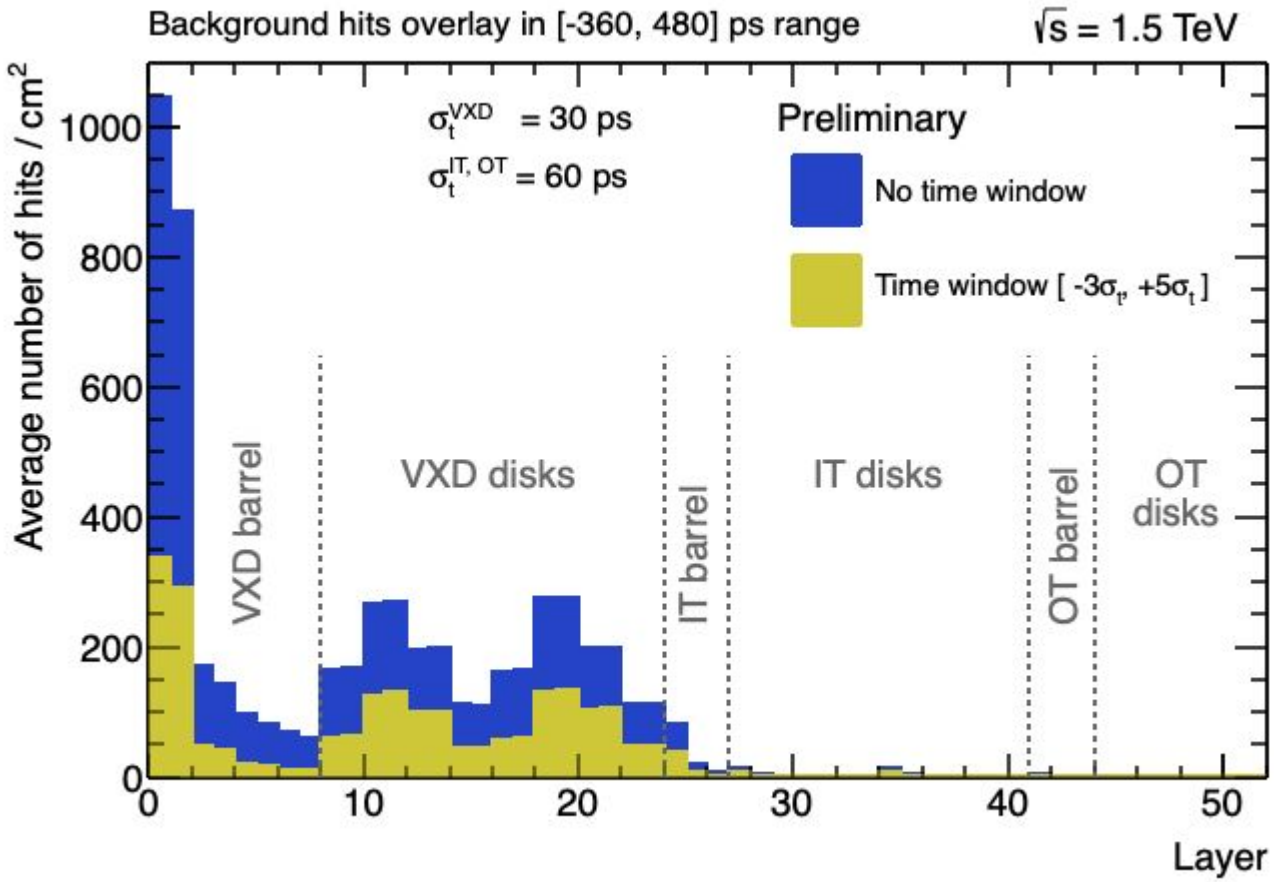
No double-layer (“stub track”) filter

Hard-scatter: $\mu^+\mu^-$ > $\nu\nu$ from Madgraph ($\sqrt{s}$ = 3 TeV)

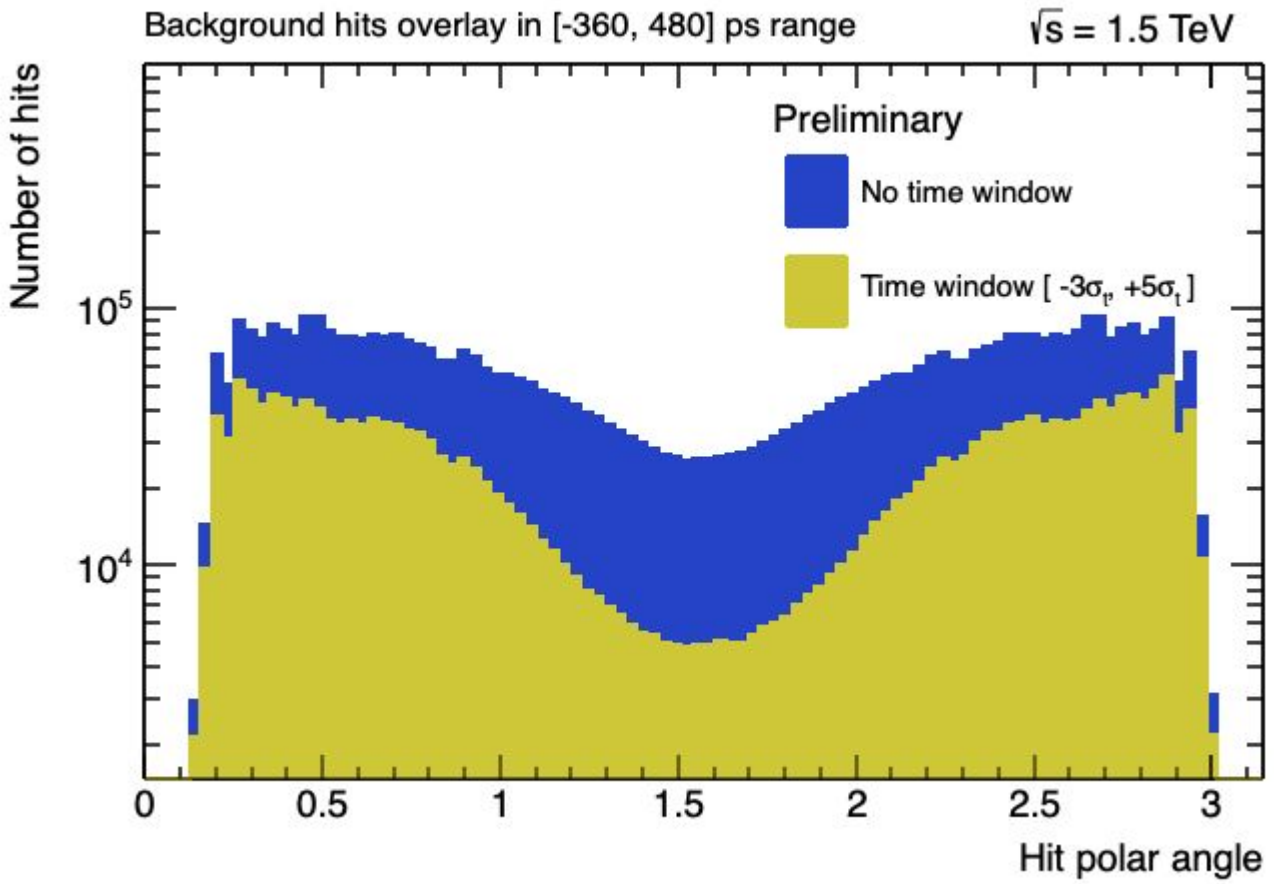
Updated BIB files from Massimo (thanks!):

- MuCollv1_25ns_nEkin150MeV_QGSPBERT/sim_mumi-1e3x500-26m-lowth-excl_c00.slcio
- MuCollv1_25ns_nEkin150MeV_QGSPBERT/sim_mupl-1e3x500-26m-lowth-excl_c00.slcio

Hit density vs detector layer



Bonus 1: BIB hit polar angle distribution

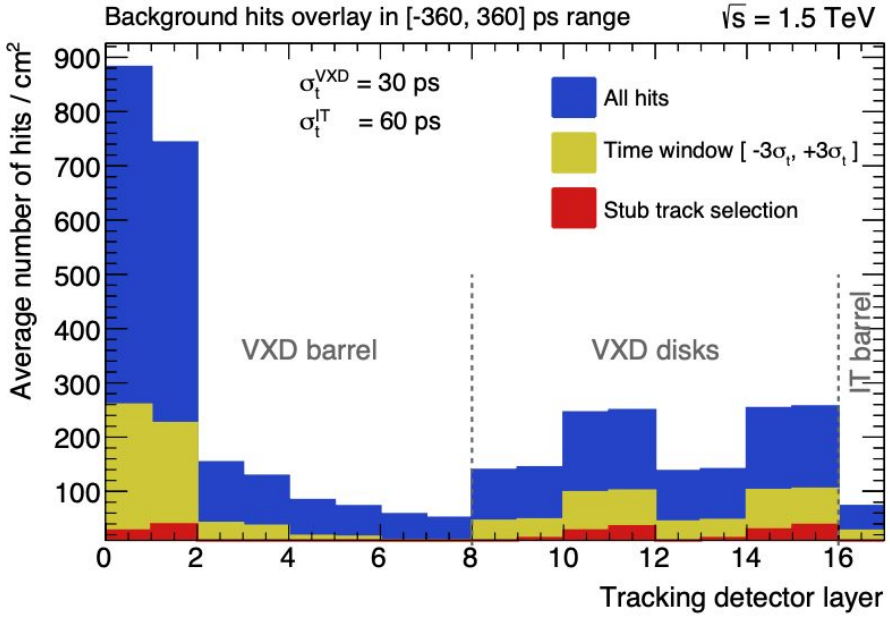


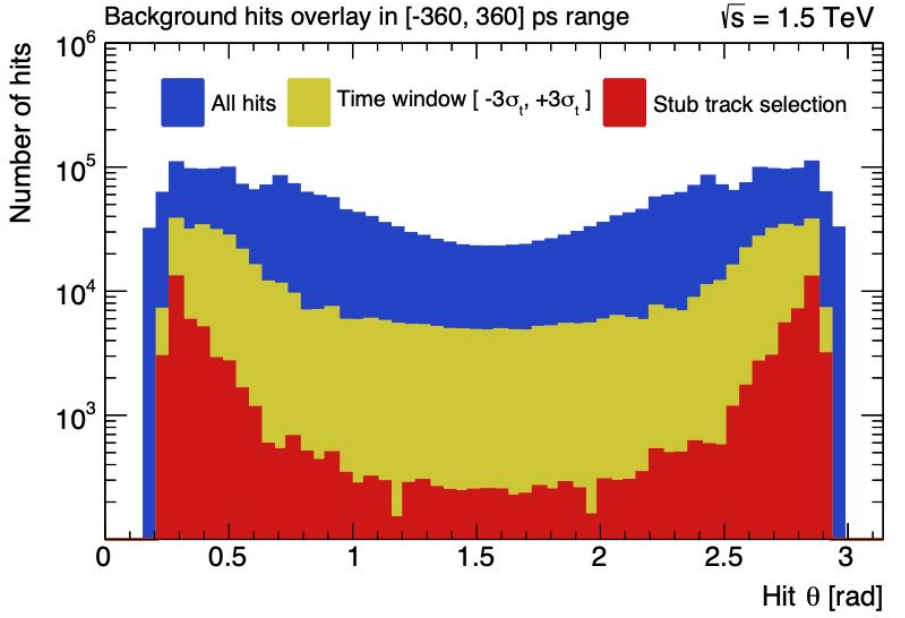
Bonus 2: stub track selection

Example of the effect of the stub track selection (in a specialised setup).

Caveats:

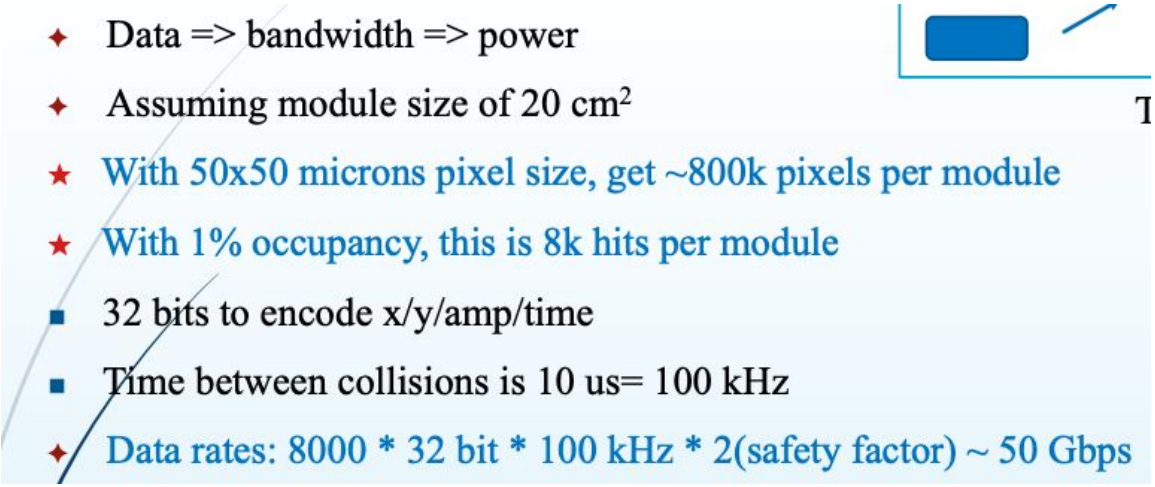
- Only a subset of the tracking detectors considered (VXD barrel, 2 VXD disks, 1 IT barrel)
- Double-layer angular thresholds are optimised for a specific class of BSM signals
  -> Δϕ very tight (1 mrad)
- Results based not on official software (this was the private package developed for the BSM studies I've been pursuing, which is doing ~the same things as the official software and will be abandoned now that the pheno study is complete)





What's next?

- We should next make the "no time window" more realistic and adjust it to something which is not an arbitrary time interval.
- Goal: define (online) time selections which are compatible with the data transmission limits and don't harm (too much) the Muon collider physics case.



From Sergo/Donatella's talk at PITT PACC

Step 0:

- look at worst case scenario: what's the occupancy if we leave the detector always on (a [ε, 10-ε] μs BIB overlay window)?
- Side question: is the BIB sim adequate for such a long time?