

# **Wish List + Status**

# Overview

- Why I Asked for this Meeting
- Essentials
- $dE/dx$  Status in the VXD
- Actual Wish List
  - Why this list?
- Tracking of Hyperons
- What Now?

Remark: I assume, not all participants have a lot of experience. I hope nobody gets bored.

# Why I Asked for this Meeting

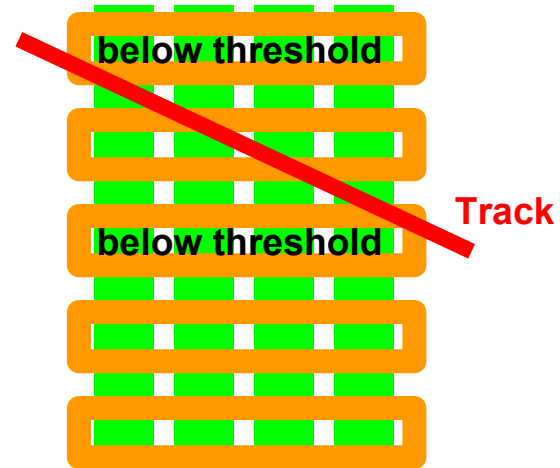
- Lots of information, that the hardware produces and is useful for tracking so far isn't used;
  - especially in the SVD (and to a lesser degree in PXD and CDC)
  - tracking group are not the experts for the detectors; detector experts e.g. recommended to rely not totally on the correctness of the simulation, but instead use calibration data;  
→ idea: let the detector experts provide the useful information via a clear interface;  
for SVD: SVD software group
  - $dE/dx$  is one of the sought after informations, so I asked as well the  $dE/dx$  in VXD interested people and Jake as  $dE/dx$  expert to join;

# Essentials

- If you want to do software development for Belle II, you need to be on software@belle2.kek.jp [I couldn't find Bianca's or Jim's e-mail address in Sympa]
- As CDC dE/dx is in handled in the super-generically named package “reconstruction”, the actual creation of likelihoods etc. probably should go there as well;  
→ librarian is Jake Bennett (although Roy made the impression @B2GM, you wouldn't care about VXD stuff);
- the actual local reconstruction probably is done better in the subdetector packages SVD/PXD;  
→ librarian for both packages is Peter Kvasnicka
- you may help the tracking group with additional stuff, that could go into the tracking package ( →me ) or the subdetector packages ad libitum;
- please give an overview about the design in the TWiki (and link the reconstruction page in the basf2 Software Portal, I can help you with the TWiki page design if necessary)

# dE/dx Status in the VXD

- Code to extrapolate tracks to sensors and estimate the “dx” in principle exists (at least twice);
  - there was a bug in the CDC related part of the code, that was fixed by → Jake; I don’t know, if the VXD is affected in the same way;
- Rough “dE” is probably simple, detailed one is probably quite complicated (seems to be true for CDC as well);
  - e.g. energy deposit in the SVD is read out from two sides, but the amount differs, e.g. because of different amount of energy deposited in strips, that stay below the noise cut;
  - Gains may vary with conditions (heat, pressure,...), strip number, time... → needs calibration;  
**This is probably the toughest thing to do!**
- Actually Christian Pulvermacher made a working dE/dx in the VXD on simulation (perhaps with the bug, see above)



# Actual Wish List

from <https://belle2.cc.kek.jp/~twiki/bin/view/Software/SpacePointCreatorModule>

SpacePoints shall contain information, that the underlying clusters may have for potential filters [...] used as quality indicator for [...] Tracks[...]. This information can stem

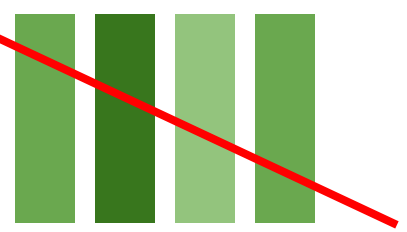
- in the SVD e.g. from
  - **timing information** (how well do the u- and v-coordinate match in time [...], what is the best time estimate vs. T0, the which best match of opposite strips is this match (1st, 2nd,...))
  - **energy deposit information** (similar as for the time based information **plus** an **estimate of the most probable expected energy loss (this is “dE”)**, if this can be estimated better than simply taking the best estimate of the factually deposited energy loss due to detailed cluster analysis [as one cluster has multiple hits/strips]),
  - **shape information** (minimum/maximum incident angle compatible with the cluster shape, favoured direction of inclination etc.)

VxdID, and other special information (e.g. was the SpacePoint created from a dead/noisy channel, of course one might as well under some circumstances not create a SpacePoint from a noisy channel, despite there is a cluster).

- in the PXD ... (no timing information, single energy measurement per silicon volume etc.)

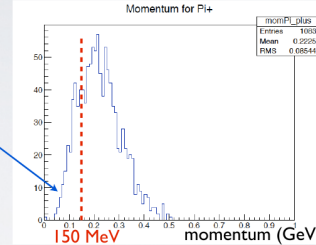
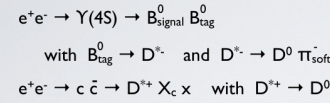
# Why this list?

“expected dE” and actual estimated dE may differ, as there are several hits/strips in one cluster;



- Most of the information can help to distinguish between fake tracks and real tracks, which is fairly important for low momentum tracks;
- timing helps to distinguish between curlers and primary outgoing arms; could perhaps help as well with PID in connection with time of flight...; but such slow particles are “fish in a barrel” using dE/dx?; perhaps not for hyperons... [see later]
- best estimate of deposited energy can be put into track fit directly, otherwise (usually) we just take the most probable energy loss for the momentum and given mass hypothesis; **We want this for CDC, too!**
- most probable expected energy loss can be used to estimate the momentum, assuming a mass hypothesis

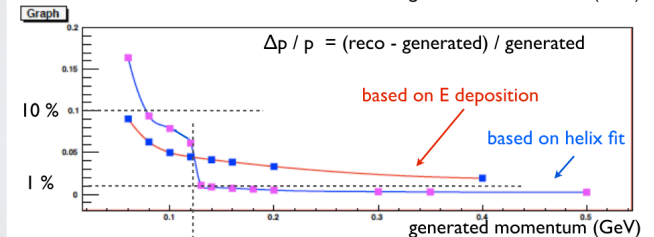
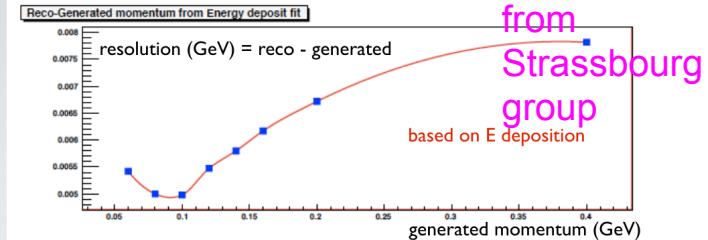
- Flavour tagging based on the  $\pi_{\text{soft}}$  charge:



- Track helix radius considerations:

SVD: radius = 3.8 - 13.5 cm

## Momentum resolution



➤ ~ CDC is also used for helix track fit

# Tracking of Hyperons

- biggest problem is the short lifetime;
- Good news:
  - We will rescue most hyperon PXD hits, due to our cluster analysis for slow pions;
- Bad news:
  - there will be probably hundreds, if not thousands of clusters per event, that saturate the PXD read-out; → finding charged hyperons without follow-up charged particle is difficult;
  - identifying a hyperon, if the follow-up charged particle is found, seems trivial...



# What Now

- Before actually discussing this, maybe we hear what Bianca did in Belle, but for the sake of completeness, let me state some points:
  - Shouldn't the reconstruction librarian take as well care a little bit for the VXD stuff, or was this forbidden?
  - Do you want to base the creation of the actual likelihoods on the stuff Christian did? Jake used it for the CDC dE/dx and was somewhat happy with it?!
  - Is someone willing to go beyond dE/dx and work on all the stuff, we would like to have for the tracking?
- Probably a reasonable way:
- Postpone complicated local reconstruction with MVA methods etc. for later, make a somewhat working structure first;