Karlsruhe Institute of Technology

Belle II

VXD TrackFinder Development at KIT

A Status Report

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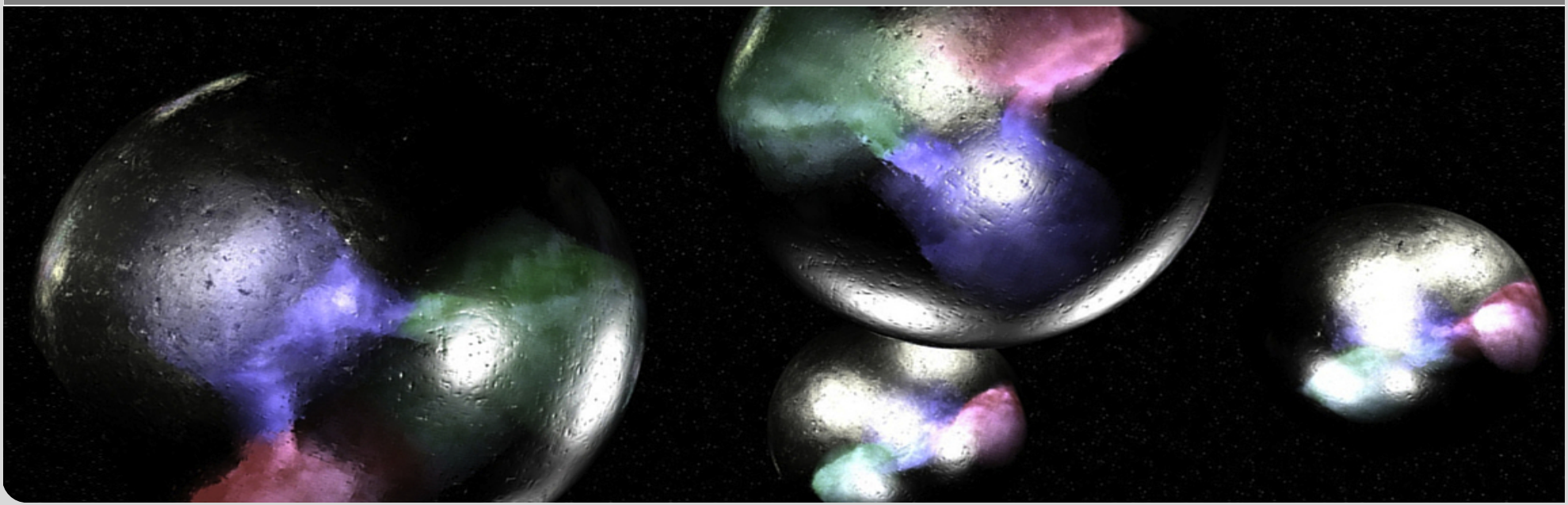
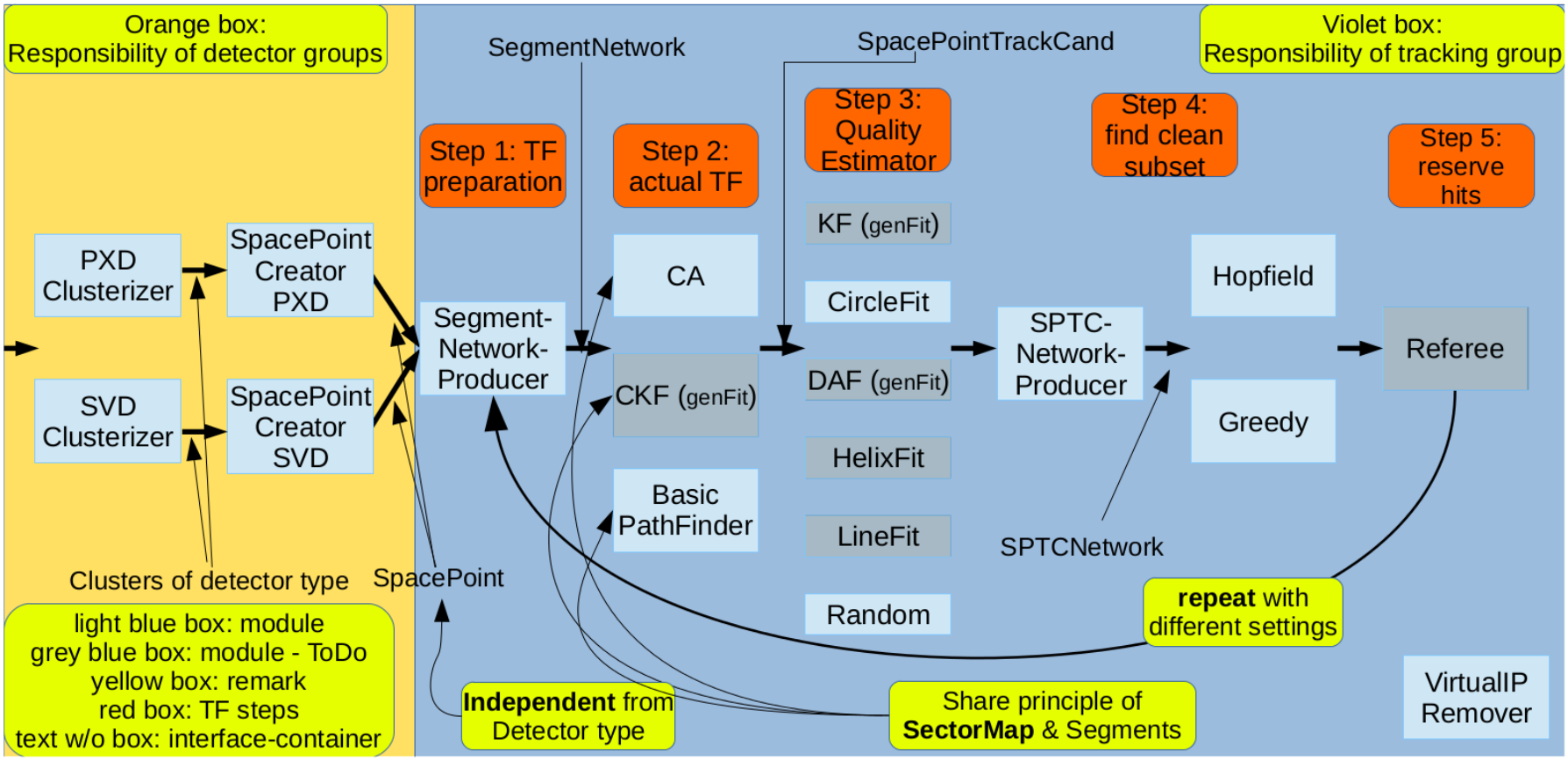
INSTITUT FÜR EXPERIMENTELLE KERNPHYSIK (IEKP)



Overview of the Initial State



- Karlsruhe's current focus is on Step 2 to 4
- Highly dependent on the complex Sector Map (Step 1, Pisa)

First Results

Further modularization of the Track Finder Modules

Introduction of new Quality Estimators

- Helix Fit
- Triplet Fit

Rework of the Overlap Checker Modules (Martin)

Completion of the Chain (Jonas)

- Conversion of SPTC to Reco-Tracks
- Storable Sector Map (Pisa)
- Fitting of final Reco-Tracks
- Validation Script

$\Rightarrow$ **First comparable results**

Found and (mostly) fixed several bugs and misconfigurations

Some of the Current Issues

Two-Hit Filters always remove the Virtual Interaction Point

- Virtual IP is needed to provide more hits if necessary.
- How should he be included into the training?

Some parameter do not work as intended

- Minimal number of hits per track
- Virtual IP Remover
- Sector Map configuration (due to restructuring)

Quality Estimators provide misleading results

- Tracks with 3 hits are removed (fixed)
- Less hits $\Rightarrow$ better χ^2 

Current Quality Estimators

Circle Fit

- Based on simplified Karimaki Circle Fit returning χ^2 and p_T
- Uses only 2D information
- Tracks with 3 hits $\Rightarrow$ $\chi^2 \approx 0$ ↯

  $\Rightarrow$ might be fixed if virtual IP is included...

Random Quality Estimator

- Only useful for debugging

Only one useful Quality Estimator tested so far

Code is shared with VXDTF 1

Quality Estimator Probability

Quality Estimators are based on the χ^2 values from fitting algorithms:

```
probability = TMath::Prob(chi2, nHits - 3)
```

However, this still appears to favor track candidates with less hits!

$\Rightarrow$ Use other fit methods for quality estimation

- Kalman Filter
- Deterministic Annealing Filter
- Helix Fit
- Line Fit
- Triplet Fit

$\Rightarrow$ Use 3D information for quality estimation

$\Rightarrow$ Try to include number of hits

$\Rightarrow$ Test χ^2 / N_{dof}

New Quality Estimators

Helix Fit

Simple expansion to the existing VXDTF helix fit:

now returns also a χ^2 value...

Triplet Fit

Track Reconstruction Algorithm based on Hit Triplets and Broken Lines
by André Schöning (arXiv 1606.04990v1, arXiv 1408.5536v1)

- Provides fast χ^2 value for combination of 3 hits
- Triplets can be combined for longer tracks

Both new Quality Estimators still have to be tested!

Jakob also suggested to use the Helix and Circle fit implemented in the CDC package.
However, these provide much more functionality, thus might be slower.

Next Steps

Restructuring of the whole VXDTF 2

- Entangle VXDTF 1 and 2
- Find suitable names and directory structure
- Update work flow and example scripts
- implement unit tests

Test and improve Quality Estimators

Train “full scale” Sector Map

- Which training sample?