Skeleton 2

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Worldwide Study of
the Physics and Detectors
for Future Linear
$e^+ e^-$ Colliders

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The copy of this talk one can find at the http://www.desy.de/˜morgunov

RGB imaging Analysis

Can be applied as for **analog calorimeter readout**

as for **semi–digital readout** with tree threshold discriminators;

AND as well as for **pure digital calorimeter readout** after special hit density making pocedure.

Which is: find the simple topological density of each hit, i.e. number of nearest neighbour.

Needs for 1 week, maximum 2 weeks

All of these because the Class Structure for reconstruction itself is delayed

1. Two MARLIN processors for digitization.

a) **Calorimeter_digitization**: Cell joining for TESLA Calorimeter; (latter on it should work with any geometry)

Should create **CalorimeterHit** from **SimCalorimeterHit**. Should work with BRAHMS and Mokka events in TESLA detector.

b) **TPC_smearing**: The simplest for now TPC hits smearing in BRAHMS manner;

Should create **TrackerHit** from **SimTrackerHit**

2. Two MARLIN processors for toy and not toy physical analysis.

a) **Pseudo_Particle_Flow**: Make LCIO Particle–Flow objects just from HEP data; including possibility to spread calorimeter data; excluding parton level, so, long lived particles only !

Should create **ReconstructedParticle** (pseudo) from **MCParticle**.

b) **Physical_analysis**: Physical analysis of that pseudo Particle–Flow objects; including a possibility to use different jet finders. It should latter on analyze the real reconstructed Particle–Flow objects.

Output might be as AIDA clouds, ROOT trees or HBOOK ntuples.

3. Simulation with BRAHMS and Mokka events in TESLA detector:

Z-pole, ttbar, ZH, W+W-, ... 350, 500, 800 GeV; sets of e^+e^-, $\mu^+\mu^-$, γ, π^0, $\pi^+\pi^-$, K^0_S, K^0_L, n, p

To be ready for reconstruction and detector performance analysis.

And also to prove a new reconstruction methods, which will come soon.

Needs for Reconstruction Classes

1. Reconstruction Classes should include as **TPC_Rec_Hits** as **Calorimeter_Rec_Hits** and any of their combinations to make a simplest and fast Nearest–Neighbour clustering.

2. Should use **Physical_Geometrical_Database** for any parameter access; such as merging distance, electromagnetic cascade parameters, geometry boundaries, energy conversion coefficients ...

3. **Rec_Cluster** Class should be flexible to allow any combinations of its pieces used together either in Nearest–Neighbour clustering or in any other (that we will image) procedures.

4. It also should allow easily calculate topological properties of clusters. Such as number of links between Nearest–Neighbours in cluster.

5. Many pure mathematical functions:
Like – hit fitting by line, by helix, by track model with energy losses (as for TPC and for ECAL and HCAL).
Hit distance to line and helix.

Electromagnetic cascade parameterized for any particle energy and calorimeter structure.
π^0 decay model and mass construction to get angle between two gammas in the ECAL; then π^0 mass fitting using found two gammas.

Your proposals are welcome

Needs for Reconstruction Classes (continue)

What can we do with clusters?

0. Calculate its common/general parameters such as center of gravity, principal axis of inertia tensor, helix model, electromagnetic shower shape ....

1. Extract sub–cluster(s) of particular color(s), extracted clusters should remember about parent cluster.

2. Merge two or more sub–cluster(s) either from the same cluster or from the other one and even from the previous level of clusterization.

3. Sort hits in cluster with some criteria ... many are possible.

a) hit energy b) hit distance to it center c) hit distance to reference frame zero d) hit distance to principal axis e) angular hit distance to some direction f) hit distance to some helix curve ....

4. Sort clusters itself by its distance to reference frame zero

5. Search of consistence of particular sub–cluster in the set of all clusters.

6. Search of “neighbour” cluster or hit with some criteria: Criterias can be: a) along the principal axis of initial cluster up to some distance. b) along the predicted helix up to some distance. c) In some volume – cylinder or cone or inertia ellipsoid that surround of the initial cluster.

7. Find nearest TPC track by the center of cluster or by the Chi-square to the all hits in cluster to the track helix prediction.

8. Something more ... and unknown yet.

Your proposals are welcome

Needs for Reconstruction Classes (continue)

Cluster can by asked to fit by:

1. 3–D first order line
2. 3–D second order line
3. 3–D helix
4. 3–D complex track model with energy losses and multiple scattering taken into account.
5. 2–D Gaussian in some projection (mainly on the perpendicular to the principal inertia tensor axes)
6. 2–D Exponential in some projection (mainly along to the principal inertia tensor axes)
7. 3–D full electromagnetic shower model
8. 3–D two overlapped full electromagnetic shower models
9. More and unknown up to now.

Your proposals are welcome

Needs for TPC Track Reconstruction

1. After a simplest Nearest–Neighbour clustering one needs to split tracks that were joined by clustering.
For this it can be applied second NN–clustering aspecially for TPC (done)
The procedure of a simplest helix fit along the second clusters to predict a next neighbour hit;
or even simply build a helix for each 5 hits. (should be checked).

2. Some tracks are splited by NN–clustering they should be joined with the simplest helix fit prediction along the existing pieces of tracks.

3. After the finishing of the pure topological track finding one will need a serious track fit with taking into account energy losses and kalman filter.

4. The last visible procedure is to find kinks, gamma vertexes, albedo tracks and curled track by special procedures.

Your proposals are welcome

Needs for Calorimeter Reconstruction

1. After a simplest Nearest–Neighbour clustering one needs to split clusters were joined by clustering.

For this: one needs to make NN–clustering in the RGB colors and then (I hope) it will need a joining only.

2. As also join clusters that were splitted.

For this: one needs a simplest helix fit or even simply build a helix for each 5 hits to find the position of predicted neighbour hit or cluster. There are also needs a Inertia tensor to build and Eigenvectors for it and distance to helix.

3. Photon finder will need electro–magnetic shower model as well as π^0 decay model and mass constructor.

4. To find an electro–magnetic shower inside the hadron shower one needs the RGB analysis,
in particular clustering in RED.

5. Latter on we will need ECAL and HCAL hadron shower models to find number of nuclear interactions in each shower; and, of course, the TRACK information for shower prediction.

6. Last visible step is to calculate corrected energy of hadron shower using a founded neutron hits inside the hadron shower volume.

Your proposals are welcome