TOF reconstruction:
further integration with common barrel reconstruction classes

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News from TOF reconstruction:

- New AliTOFcluster inheritance
- New matching schema in TOF Tracking

Updates in TOFCluster:
new inheritance

- TOFcluster up till now inheriting from TObject, cluster position and orientation in space defined by linking their detector indeces to the TGeo rotations/transations associated to volumes of the corresponding TOF pads
- Advantage of inheritance from AliCluster: full integration within the common barrel tracking, transparent and straightforward handling of misalignment, visualization
- Peculiar geometry of the TOF strips ("tilted" geometry along z), implying non-null xx,xy,xz elements of the covariance matrix in the tracking system, requires dedicated derived class (AliCluster3D)

Updates in TOFcluster:
new inheritance

```
class AliTOFcluster : public AliCluster3D {
public:
AliTOFcluster( UShort_t volId, Float_t x,   Float_t y,   Float_t z,
               Float_t sx2, Float_t sxy, Float_t sxz, Float_t sy2,
               Float_t syz, Float_t sz2, Int_t *lab,
               Int_t *ind, Int_t *par, Bool_t status, Int_t idx);
```

AliCluster3D constructor

Specific AliTOFcluster info

Updates in TOFcluster:
definition of the T2L matrices

- Needed ingredient: tracking-to-local systems transformation matrices
- Enough to define them for the elementary alignable TOF volumes, the strips, wrt to which the cluster (pad) local position is fixed:
- Set the appropriate T2L matrices of the TOF Strips Alignable Entries, in AliTOF::AddAlignableVolumes():

$$M_{T2L} = (M_{L2G})^{-1} M_{\varphi}, \quad M_{\varphi} = M_{T2G}$$

(rotation around the z axis by the sector azimuthal angle)

Updates in TOFcluster:
inside Local Reconstruction

- In AliTOFClusterFinder , create TOF RecPoints using the detector ID of the Digits/RAW data.

```
for (loop on Digits/RAW) {
  GetClusterPars(ind, posClus,covClus);
  AliTOFcluster *tofCluster = new
  AliTOFcluster(posClus,covClus,...)
}
```

- All the necessary transformations needed to derive the cluster position and covariance in the tracking system starting from their detector IDs are handled by a dedicated method, GetClusterPars()

Updates in TOFcluster:
inside Local Reconstruction

```
void AliTOFClusterFinder::GetClusterPars (Int_t *ind, Double_t*
pos,Double_t* cov) const
 //get the strip volume index
 UShort_t volIndex = GetClusterVolIndex(ind);
……
 // local2 tracking coordinates transformation
 const TGeoHMatrix *t2l= AliGeomManager::GetTracking2LocalMatrix(volIndex);
  t2l->MasterToLocal(lpos,tpos);
```

Local pad position
Inside the strip

```
//cluster covariance in the tracking system:
 TGeoHMatrix m;  m.SetRotation(lcov);
 m.Multiply(t2l);
 m.MultiplyLeft(&t2l->Inverse());
```

Local pad
Spatial covariance

Updates in TOFcluster:
New TOF tracking

New inheritance in TOF clusters still fully compatible with standard TOF tracking. However, the derivation from AliCluster3D offers the possibility to easily implement a more straightforward matching procedure during TOF tracking.

- Standard procedure: iterative comparison during propagation between current global track position transformed in the cluster local RS and the cluster centre, for each of the clusters pre-selected in a matching window. The cluster with closest distance to the track is taken.

- New Approach: based on the new AliExternalTrackParams functionalities allowing to propagate tracks to planes arbitrarily oriented in space.

New TOF tracking:
updates in AliTOFtrack

Need to implement two additional methods:

```
Double_t GetPredictedChi2(const AliCluster3D *c) const;
Bool_t   PropagateTo(const AliCluster3D *c);
```

calling respective functionalities in AliExternalTrackParam:

- Get Chi2 of the track to a 3D point with cov C belonging to a plane
- Propagate the track to the plane the 3D point p with cov C belongs to

New TOF tracking:

Change in the matching procedure (the rest, collection of seeds etc is all unchanged). Inside the loop on tracks:

- First determine a fiducial window starting from the track propagated at the inner TOF surface (x=370 cm), and look for clusters (practically the same as before)

- Propagate to the TOF mean sensitive plane (x= 378.6 cm)

- Then choose the best cluster according to the Chi2 of the track position to a given cluster (extrapolation of the track to the cluster plane with linear approximation).

- Finally, propagate the track to the best cluster, to get the optimal track parameters on the plane of the matched TOF pad (tracking times and length, …) .

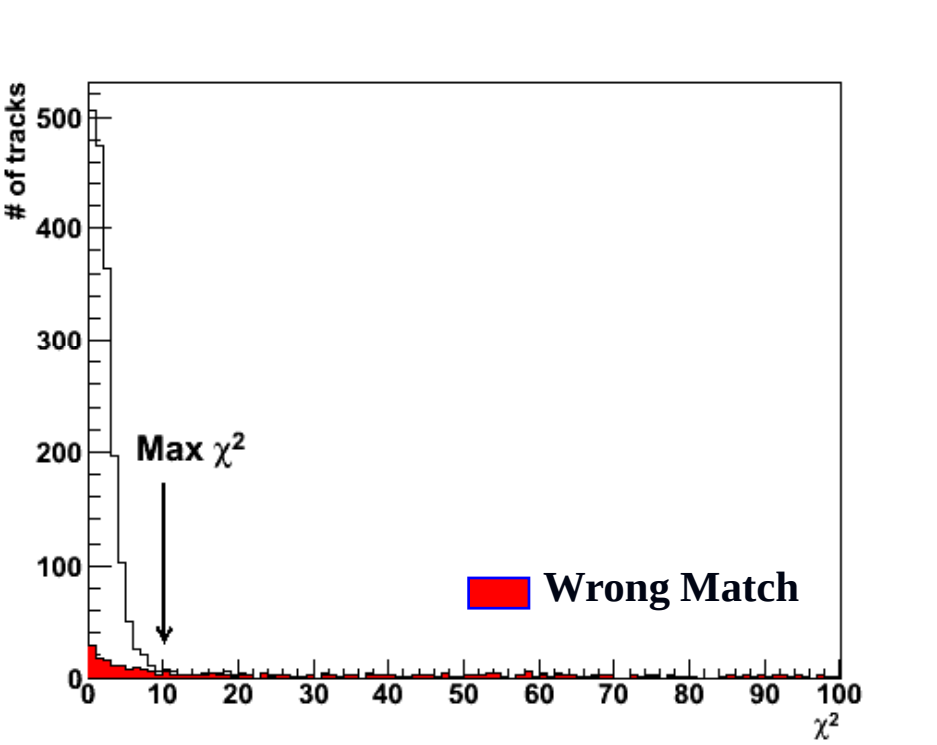
New TOF tracking:

Matching code substantially simplified with respect to standard TOF tracking:

```
AliTOFcluster *bestCluster=0;
Double_t bestChi2=maxChi2;
Int_t idclus=-1;
for (Int_t i=0; i<nc; i++){
    AliTOFcluster *c=clusters[i];  // one of the preselected clusters
    Double_t chi2=trackTOFin->GetPredictedChi2((AliCluster3D*)c);
    if (chi2 >= bestChi2) continue;
    bestChi2=chi2;
    bestCluster=c;
    idclus=index[i];
}
trackTOFin->PropagateTo(bestCluster);
```

New TOF tracking:

A very first look at its performance, on 5 test events: pion gun with dN/dy~300, flat in P [0.4,5] (low multiplicity environment)

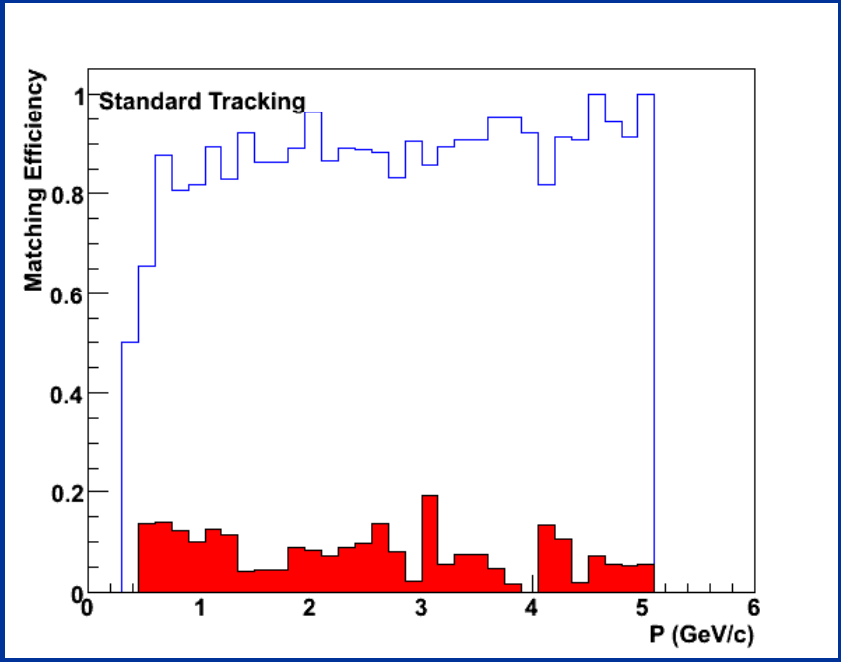


- Require $\chi 2$ <10 to have a track- - TOF cluster matching,
- Enhancement of "wrong match" distribution at $\chi 2$ close to 0 due to the tracks secondaries

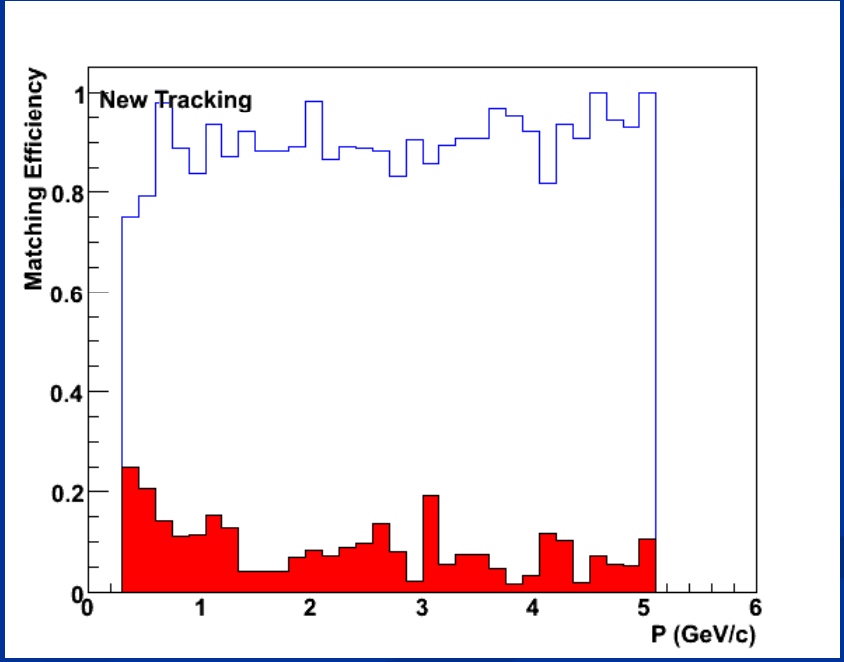
New TOF tracking:

When requiring $\chi 2 < 10$, practically same performance as the standard TOF tracking (low multiplicity environment)

Standard tracking



New tracking

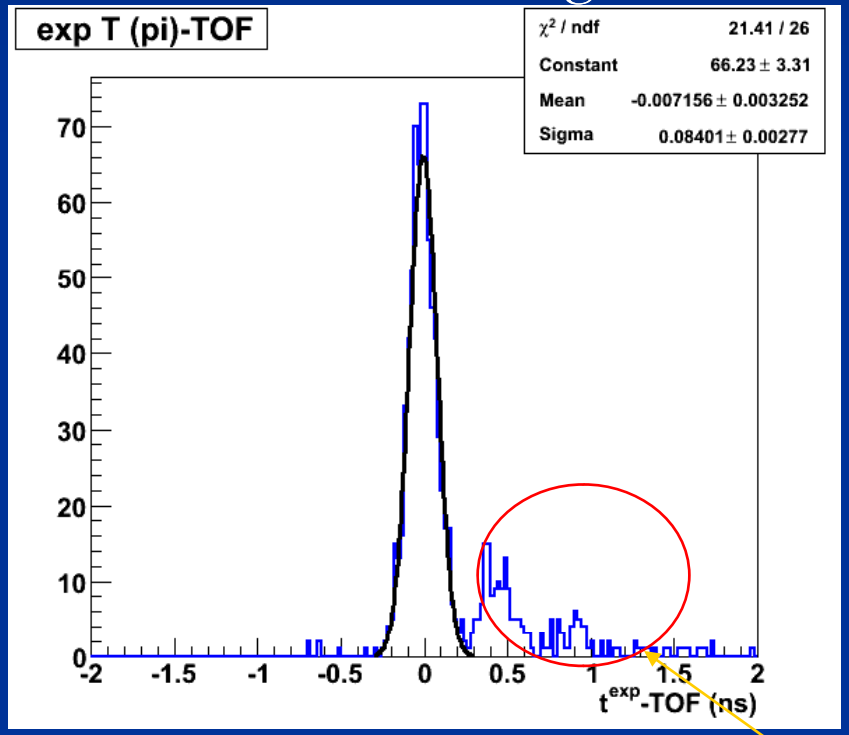


Must still totally check (and tune) the algorithm in high flux conditions

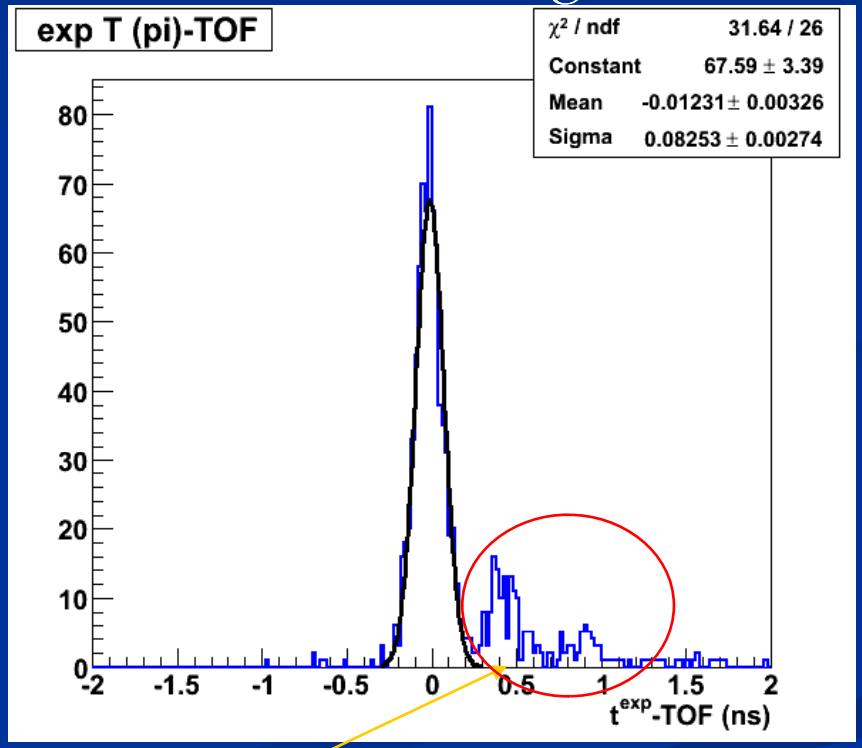
New TOF tracking:

Quality of the reconstruction of the times from tracking unaltered:

New tracking



Old tracking



Long-known problem
in the TRD inward refit step

Summary

Recent changes in TOF reconstruction & tracking:

- Inheritance of AliTOFcluster from common base AliCluster (via AliCluster3D): integration within common approach to handle misalignment & visualization

- First prototype of new TOF tracking (AliTOFtrackerV1) committed to CVS, with essentially equivalent performance with respect to the standard TOF tracking (in low multiplicity environment)

- Plan to test also on a large sample of pp events, needs still to be totally checked/tuned/validated on Pb-Pb events

- For the moment, the standard TOF tracking stays as the default in the event reconstruction. New tracking schema can be activated in the reconstruction via option rec.SetOption("TOF,"V1")

TOF tracking:

ESD times from tracking with/wo TRD recpoints