Analysis framework

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Event selection

- ✔Trigger selection
- ✔Physics selection
- ✔Pile-up rejection
- ✔Vertex selection
- ✔Centrality estimation

Trigger selection

✔ ALICE experiment cannot record all events
- Large readut time of the detectors
- Data storage limitations

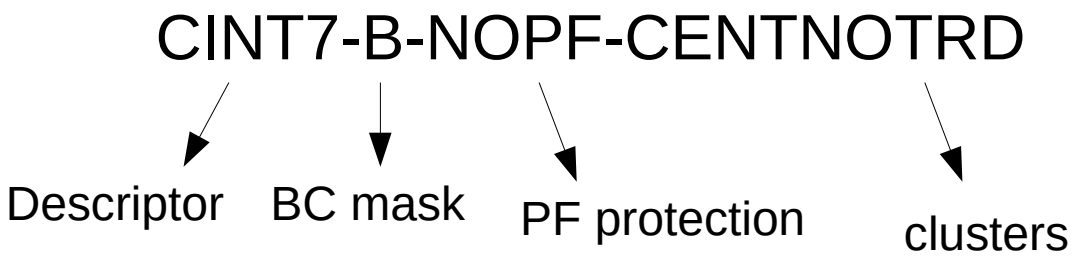
✔ Non negligible activity in ALICE detectors are necessary to start the data acquisition
SPD | V0A | VOC (kMB)
VOA & V0C (kINT7)

✔ May be interested in rare observables for which we need to collect enough statistics only requiring specific signatures in ALICE detectors (rare triggers)
- Muon triggers
- Calorimeter triggers
- Ultra-peripheral collisions

✔ Desired triggers in the analysis framework is selected using AliVEvent::EOfflineTriggerTypes

Trigger classes

- Triggers are combination of several classes



- Descriptor: combination of trigger inputs (AND, OR, VETO)
- BC mask: type of interactions (beam-beam, beam-gas)
- PastFuture (PF) protection: reject events from out of bunch pileup
- Cluster: group of detectors to be readout if the trigger condition is satisfied

kINT7

- ✔kINT7 select events if at least one of the given below classes are fired:

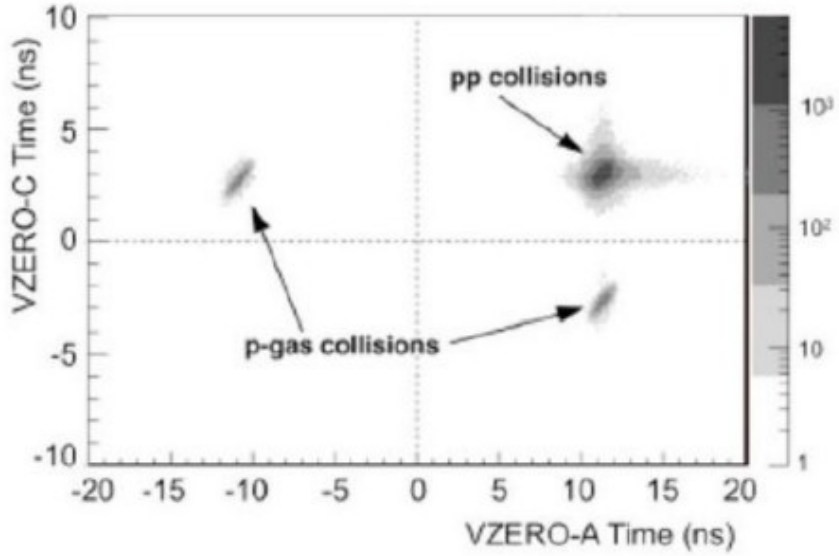
  - CINT7-B-NOPF-ALL
  - CINT7-S-NOPF-ALL
  - CINT7-I-NOPF-ALL
  - CINT7-B-NOPF-CENT
  - CINT7-S-NOPF-CENT
  - CINT7-I-NOPF-CENT
  - CINT7-B-NOPF-ALLNOTRD
  - CINT7-S-NOPF-ALLNOTRD
  - CINT7-I-NOPF-ALLNOTRD
  - CINT7-B-NOPF-CENTNOTRD
  - CINT7-S-NOPF-CENTNOTRD
  - CINT7-I-NOPF-CENTNOTRD

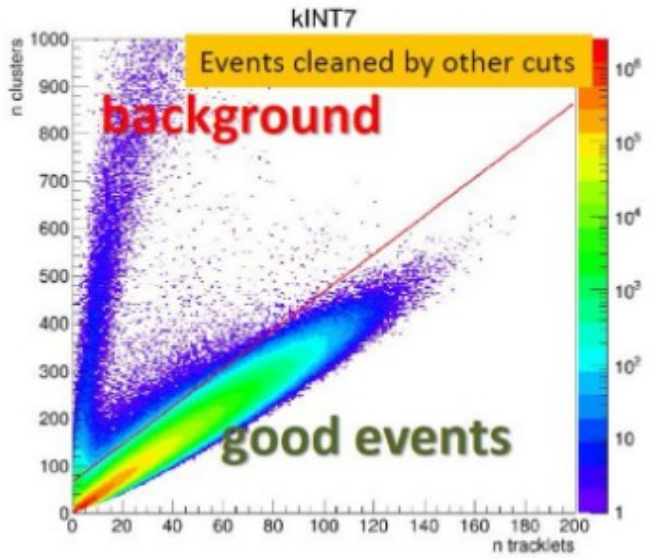
Physics Selection

✔Physics Selection class: AliPhysicsSelection

- Select events with the fired trigger class
- Rejection of background and bad quality events
- Reject out of bunch pileup in SPD readout time

✔Rejection of beam induced background (using V0, SPD, ZDC)

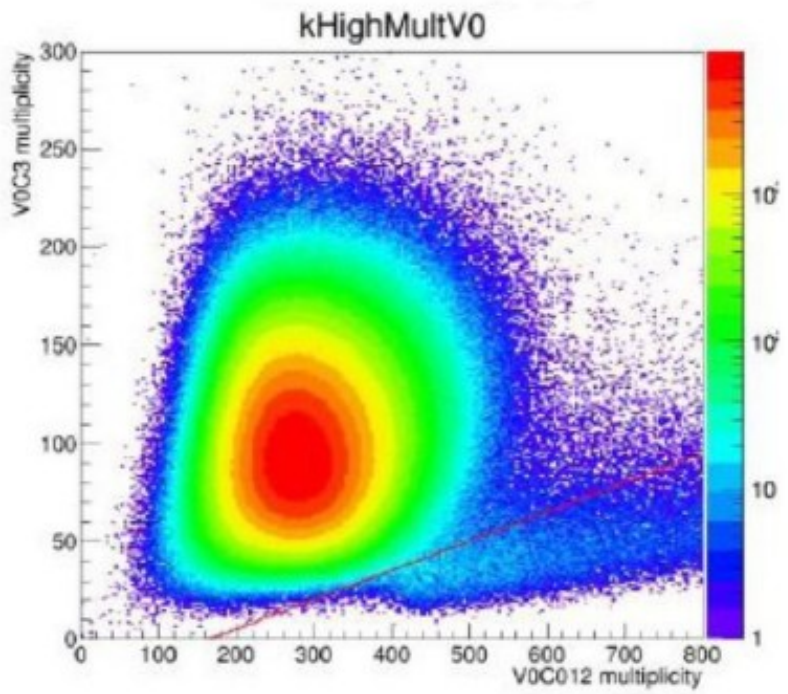


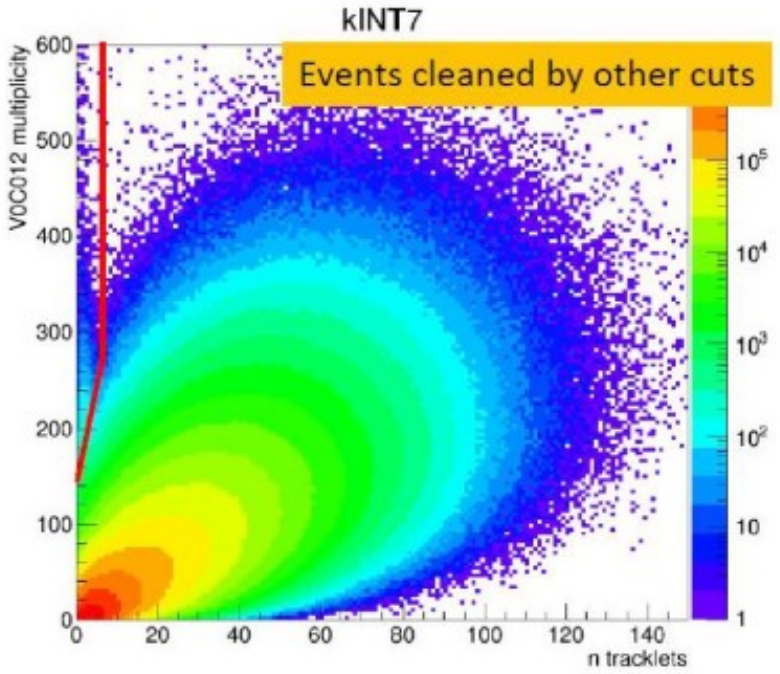


Physics Selection

✔ Further background rejection cuts

- V0C012 vs V0C3 asymmetry cut
- V0C012 vs tracklet background cut





Pileup

Same bunch pile-up

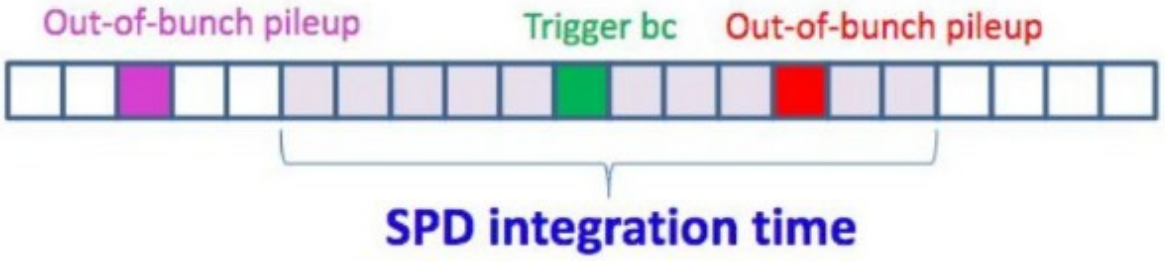
- ✔Two or more collisions in the same bunch
- ✔Seen by all detectors
- ✔Can be removed at the event selection level with cuts based on multiple reconstructed vertices

Out of bunch pile-up

- ✔One or more collisions occuring in bunch crossing
- ✔Detectors are affected differently depending on their readout time
- ✔Can be removed at the event selection level and also based on track selection cuts

Pileup tagging, removal

- ✔ Past-Future protection: allows to remove out of bunch pileup outside the SPD readout time (300 ns)
- Based on V0 detector, which records on +/- 10 bunch crossings around the triggered event
- Reject events based on correlation of SPD with V0M




```
AliPhysicsSelectionTask* physSelTask =
AddTaskPhysicsSelection(mcAnalysisFlag
,kTRUE);
```

Pileup tagging, removal

- ✔ Multiple vertices with the SPD: sensitive to same-bunch and out-of-bunch pileup within the SPD readout window
- ✔ Event is tagged as pileup event if more than one vertex is found
- ✔ Accessed by AliESDEvent::IsPileUpFromSPD()

- For low multiplicity pp events: IsPileupFromSPD(3,0.8,3,2,5)
- For high multiplicity pp and p-Pb events: IsPileupFromSPD(5,0.8,3,2,5)

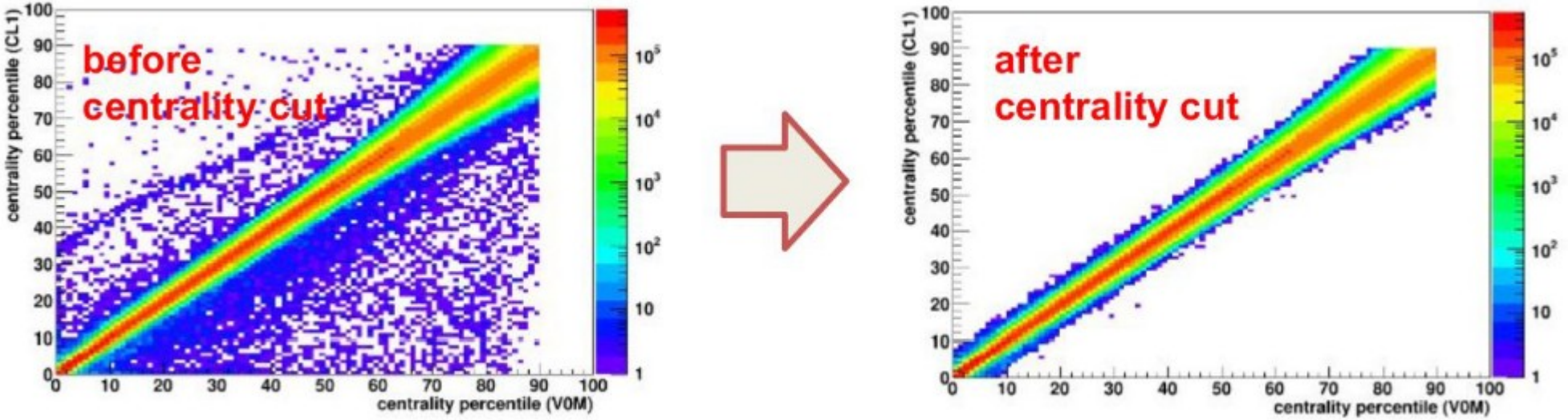
- ✔ Arguments for tagging SPD pileup:

- Min. no. of contributors (tracklets) to the pileup candidate vertices
- Min. distance (cm) along z-direction between the main and candidate pileup vertices
- Min. distance (in sigmas) along z-direction between the main and candidate pileup vertices
- Max. distance (in sigmas) from the center of the diamond in the transverse plane
- Max. distance (in sigmas) from the center of diamond in z-direction

Pileup tagging, removal

- ✔ Multiple vertices with tracks: Can be removed by simultaneous vertex finding using ITS, TPC and TOF

- ✔ Correlation between centrality estimaters (Pb-Pb): cut on correlation between V0 and CL0, CL1 centralities



Pileup tagging, removal

- ✔Can be removed in track level
- ✔Require the track status to include kITSrefit
- ✔fESDtrackCuts-> SetClusterRequirementITS(AliESDtrackCuts::kSPD, AliESDtrackCuts::kAny)
  AOD
  track->HasPointOnITSLayer(0)||track->HasPointOnITSLayer(1)
- ✔Require matching to TOF
  track->GetTOFBunchCrossing()==0

Primary vertex selection

✔Primary vertex information can be retrieved from ESD and AOD events
AliVVertex* vtx = event->GetPrimaryVertex();

✔This method will return:
- Vertex reconstructed from global tracks (ITS+TPC)
- The SPD vertex
- Vertex from TPC tracks

✔ More selections can be applied in order to reject events with poorly reconstructed vertex
- Selection on contributors to vertex, vtx->GetNContributors()>1
- Selection on SPD vertex type (3D or z reconstruction)

```
AliVVertex* vtxSPD = event->GetPrimaryVertexSPD();
if(vtxSPD->IsFromVertexer3D()){
// vertex with 3D (x,y,z) reconstruction from SPD tracklets
}
if(vtxSPD->IsFromVertexerZ()){
// vertex with Z reconstruction from SPD tracklets and x,y from mean vertex
}
```

Primary vertex selection

Further selections can be applied in order to reject events with poorly reconstructed vertex
Special selections for SPD vertex (based on z resolution/dispersion)

```
fMaxResol=0.25 , fMaxDipersion=0.03 ;
AliESDVertex* esdVtxSPD = esdEvent->GetPrimaryVertexSPD();
  if ( esdVtxSPD->IsFromVertexerZ() && esdVtxSPD->GetDispersion()>fMaxDipersion ) {
    // vertex Z reconstructed with very poor resolution, suggestion is to reject these events
  }
AliVVertex* vtxSPD = event->GetPrimaryVertexSPD();
  Double_t cov[6]={0};
  vtxSPD->GetCovarianceMatrix(cov);
  Double_t zRes = TMath::Sqrt(cov[5]);
  if ( vtxSPD->IsFromVertexerZ() && (zRes>fMaxResol)) {
    // vertex Z reconstructed with very poor resolution, suggestion is to reject these events
  }
```

Cut on absolute distance between track and SPD vertices (Pb-Pb 2011)

```
const AliVVertex* vtx = event->GetPrimaryVertex();
const AliVVertex* vtxSPD = event->GetPrimaryVertexSPD();
  if(TMath::Abs(vSPD->GetZ()-vtx->GetZ())>0.5) {
    // reject, bad reconstructed track vertex
```

AliEventCuts usage

- ✔ All of the previous cuts can be accessed by AliEventCuts class

- ✔ Modify your header file
  AliEventCuts fEventCuts;

- ✔ QA plots in the list can be added by following lines in the UserCreateOutputObjects function of your class
  fEventCuts.AddQAplotsToList(fList)

- ✔ In the UserExec method to reject events that do not pass the event cuts:

```
if (!fEventCuts.AcceptEvent(ev))
{

}
```

AliEventCuts usage

- ✔ AliEventCuts::AcceptEvent(AliVEvent* ev) retrieves the information about the centrality (Pb-Pb) and primary vertex. Can be obtained by:
  float centrality = fEventCuts.GetCentrality();
  AliVVertex* vtx = fEventCuts.GetPrimaryVertex();

Advance setting manually:

```
fEventCuts.SetManualMode(); ///Enable manual mode
//Example of manual settings (taken by the standard pp Run2 event selection)
fEventCuts.fRequireTrackVertex = true;
fEventCuts.fMinVtz = -10.f;
fEventCuts.fMaxVtz = 10.f;
fEventCuts.fMaxDeltaSpdTrackAbsolute = 0.5f;
fEventCuts.fMaxResolutionSPDvertex = 0.25f;
fEventCuts.fTriggerMask = AliVEvent::kINT7;
fEventCuts.fRejectDAQincomplete = true;
fEventCuts.fSPDpileupMinContributors = 3;
fEventCuts.fSPDpileupMinZdist = 0.8;
fEventCuts.fSPDpileupNsigmaZdist = 3.;
fEventCuts.fSPDpileupNsigmaDiamXY = 2.;
fEventCuts.fSPDpileupNsigmaDiamZ = 5.;
fEventCuts.fTrackletBGcut = true;
```

Correlation between number of TPC (100 μs) clusters and sum of SDD+SSD clusters: TPC pileup

- fEventCuts.SetRejectTPCPileupWithITSTPCnCluCorr(kTRUE) sets the default cut, which removes most of the pileup in TPC readout time (removes ~32% of events)
- fEventCuts.SetRejectTPCPileupWithITSTPCnCluCorr(kTRUE,2) sets a looser cut: removes 18% of the events with high multiplicity pileup
- fEventCuts.SetRejectTPCPileupWithITSTPCnCluCorr(kTRUE,3) sets an even more looser cut: removes 11% of the events with high multiplicity pileup
- fEventCuts.SetRejectTPCPileupWithITSTPCnCluCorr(kTRUE,4) sets a very loose cut: removes 6% of the events with high multiplicity pileup

Centrality estimation

✔ Add lines in UserExec

- Get AliMultSelection object

```
AliMultSelection *obj = (AliMultSelection*) event->
FindListObject("MultSelection");
```

- Get desired multiplicity percentile

```
Float_t lcent;
lcent = obj->GetMultiplicityPercentile (“V0M”);
```

Reference links

- ✔ https://alice-doc.github.io/alice-analysis-tutorial/analysis/
- ✔ https://twiki.cern.ch/twiki/bin/viewauth/ALICE/AliDPGtoolsEventProp#Primary_vertex
- ✔ https://twiki.cern.ch/twiki/bin/viewauth/ALICE/AliDPGtoolsPileup
- ✔ https://indico.cern.ch/event/586577/