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Online LAr Purity Monitoring

Thanks to **Michelle Stancari** for idea and guidance,
Dominic Brailsford for filtering work

Motivation

LAr Purity directly impacts ionisation electron lifetime
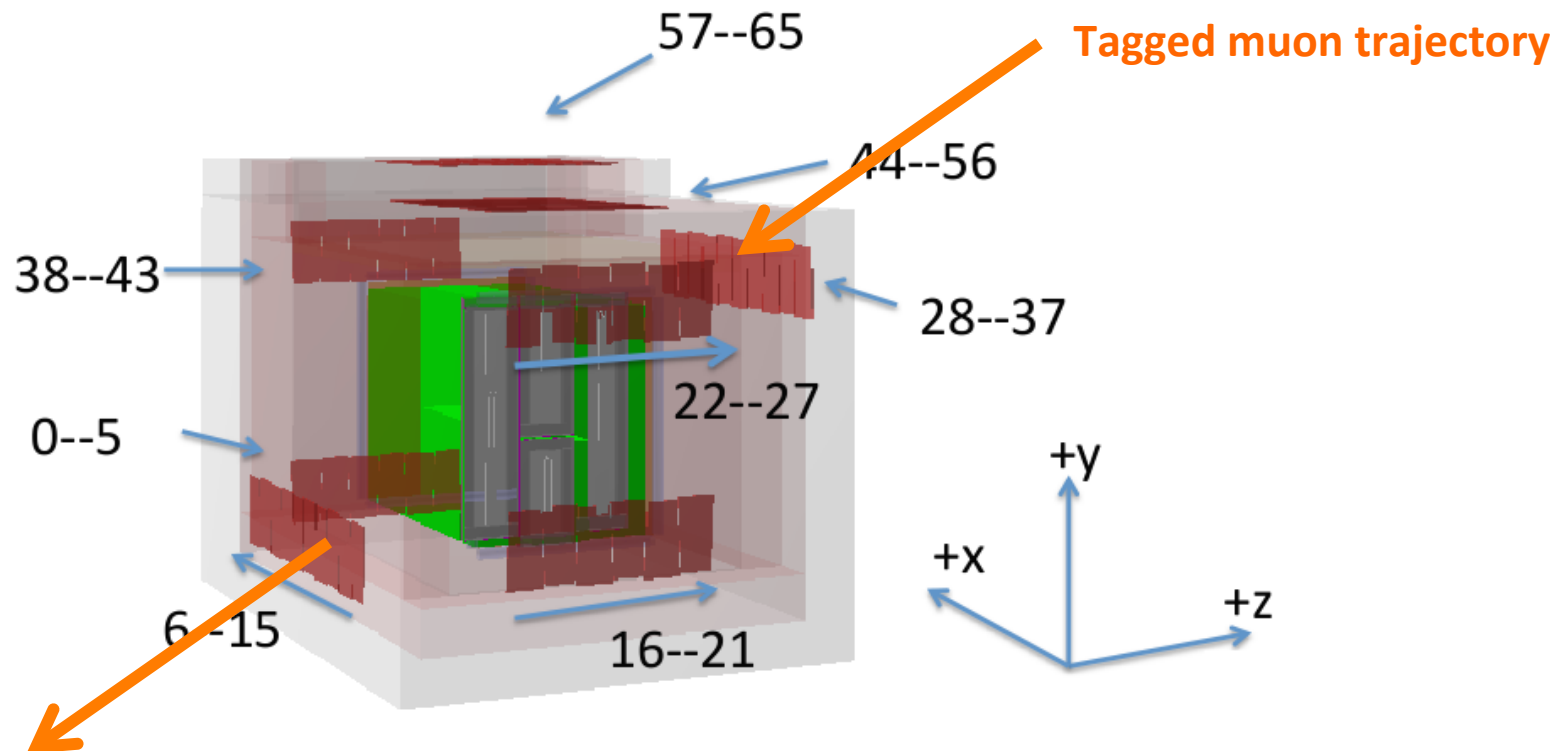
Drift distance / time long for LAr TPCs

Impure Argon means collected charge reduces with distance from APA

Can we estimate the purity from data?

Needs to be fast – use simple crude metrics

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Use external scintillator counters to tag sample of muons travelling parallel to APA

Estimate electron lifetime -> LAr purity from sample of these muons

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Create realistic Muon Sample

CRY Cosmic Ray Muons

Problem – Full simulation costs time / CPU

Solution – Cheat – only simulate muons that will hit counters

Question – Where in the simulation chain can we reject muons?

Chain == CRY generation -> GEANT -> Detector Response -> …

Answer – Working with Dominick Brailsford (Lancaster, UK) on filter

Dominic has prototype GEANT stage filter

We have ideas for CRY generation stage filter

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Filtering

Answer – Working with Dominick Brailsford (Lancaster, UK) on filter

Dominic has prototype GEANT stage filter

We have ideas for CRY generation stage filter

GEANT stage filter

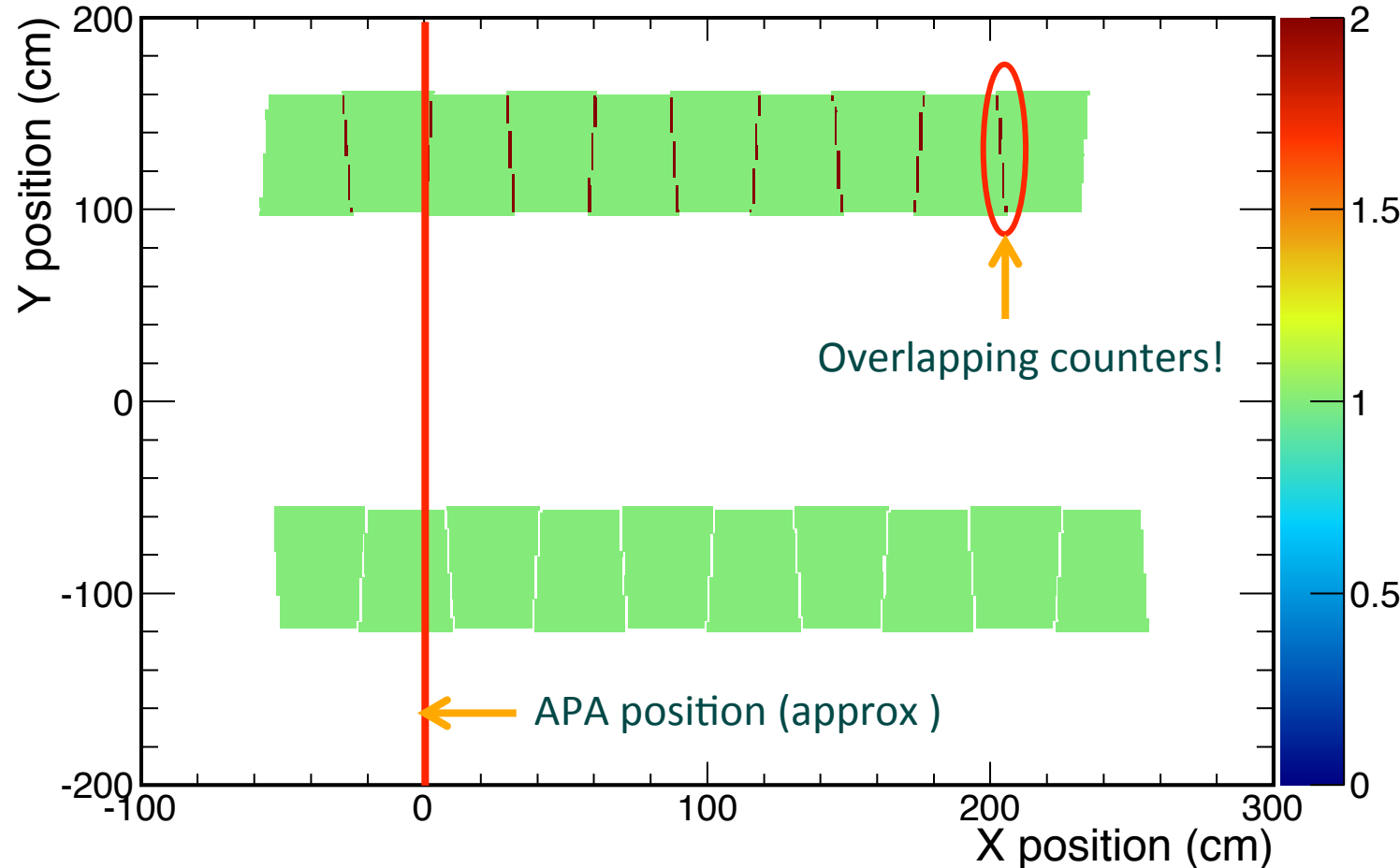Checks to see if particle of interest has deposited energy in a counter pair – **In Testing Phase**

CRY generation stage filter

Idea is to check `simb::MCTruth` particle position / momentum to see if it will hit counter pairs – **In Development Phase**

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Counter Map using Geometry service – XY projection

(X == beam direction, Y == vertical)

Counter Positions XY Plane

Overlapping counters!

APA position (approx)

Using geometry service in ART

Can interrogate counters and ask:

Do you contain this point?

(See backup slide for code snippet)

Next Steps

Testing of Dominic's filters

Produce CRY samples

Could determine the time taken for each stage of simulation chain

- Do we need to place the filter in the CRY stage?

- If so, develop CRY stage filter

Back to purity estimation with more realistic samples

- Estimate sample size / livetime necessary to get decent measurement

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BACKUP SLIDES

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Code snippet

```
art::ServiceHandle<geo::Geometry> geom;
const geo::AuxDetGeo *   ThisAuxDetGeo = geom->AuxDetGeoVec()[counterID];
const TGeoVolume* ThisAuxDetTotalVolume = ThisAuxDetGeo->TotalVolume();
const TGeoShape* ThisAuxDetShape = ThisAuxDetTotalVolume->GetShape();

double this_world_point[3]={x,y,z}
double this_local_point[3]={0,0,0}

ThisAuxDetGeo->WorldToLocal(this_world_point, this_local_point)
if( AuxDetShape->Contains(this_local_xyz) ) //Counter contains that point
else //Counter doesn't contain that point
```

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