RIDE Update

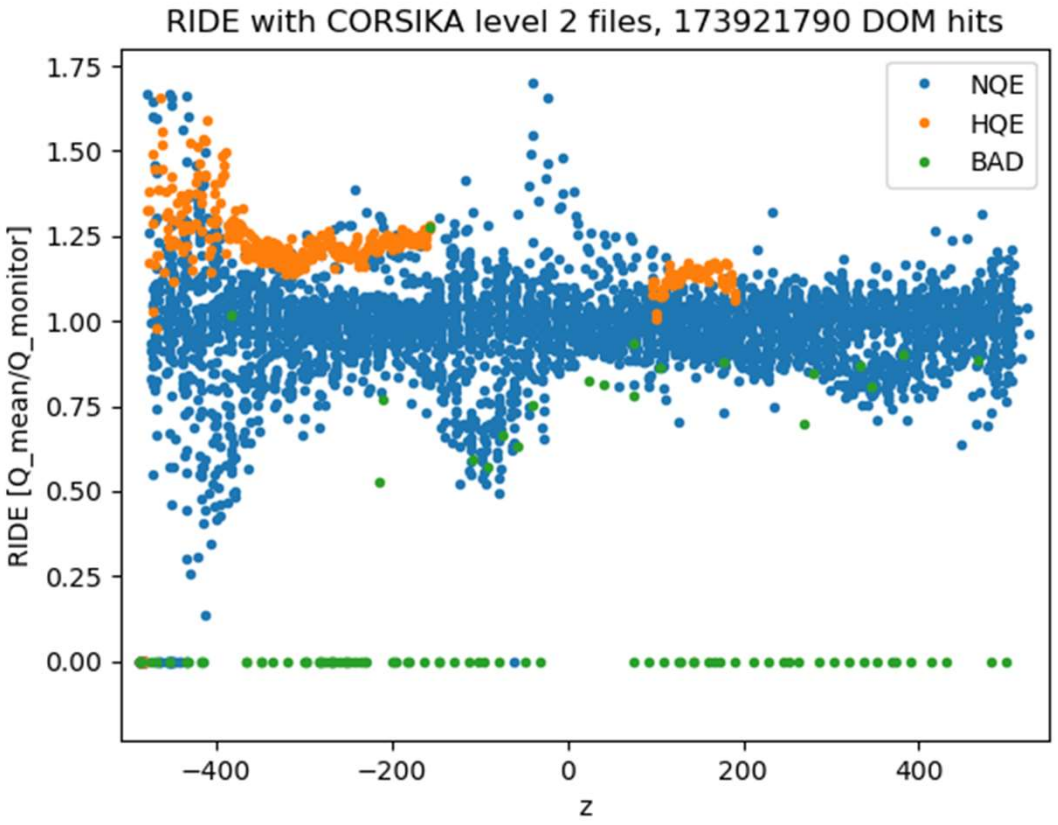
Group Meeting 18/12/2020 - Sofus Stray

Assume stopped muon

- Pick all events where muons are actually stopped
- Practically assuming that the TCN prediction is perfect
- Do so for 10,000 files

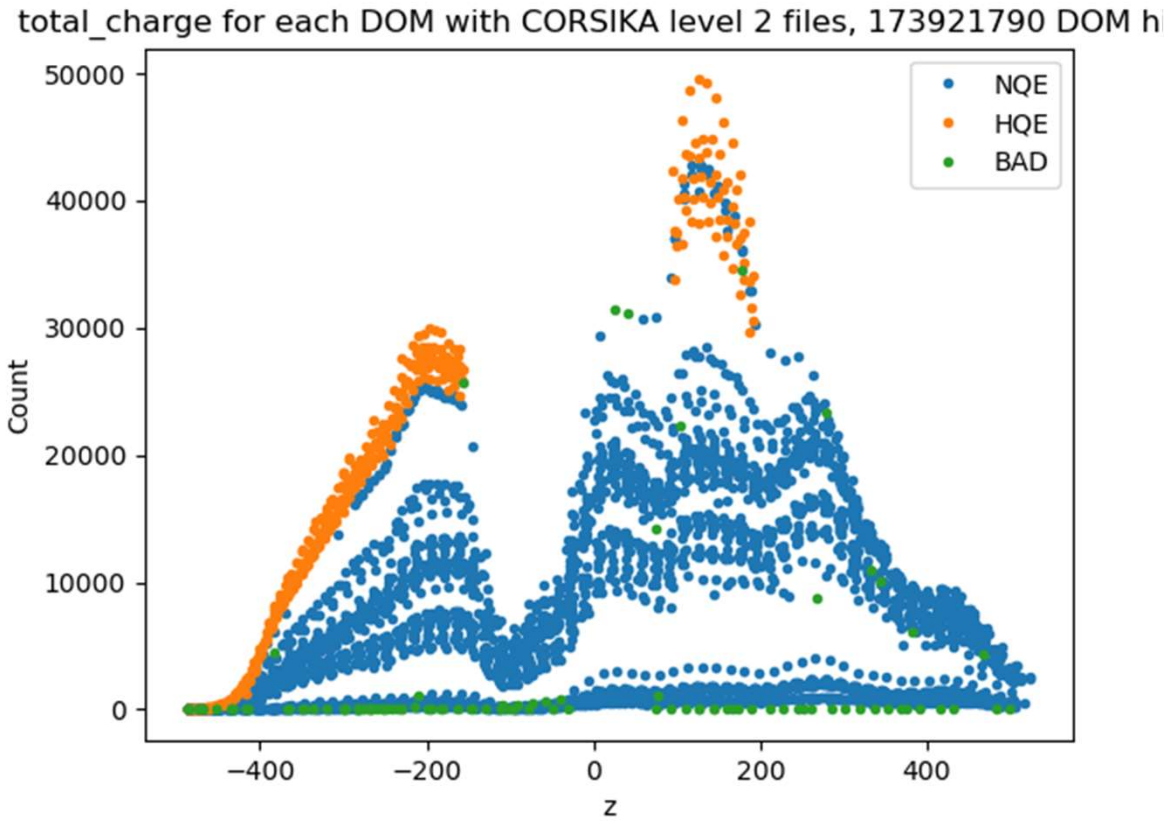
RIDE study

- Much better with more statistics
- Generally see HQE DOMs above NQE DOMs
- Still not “perfectly flat” on 1.35 and 1.
- Less stable near dust layer and bottom of detector



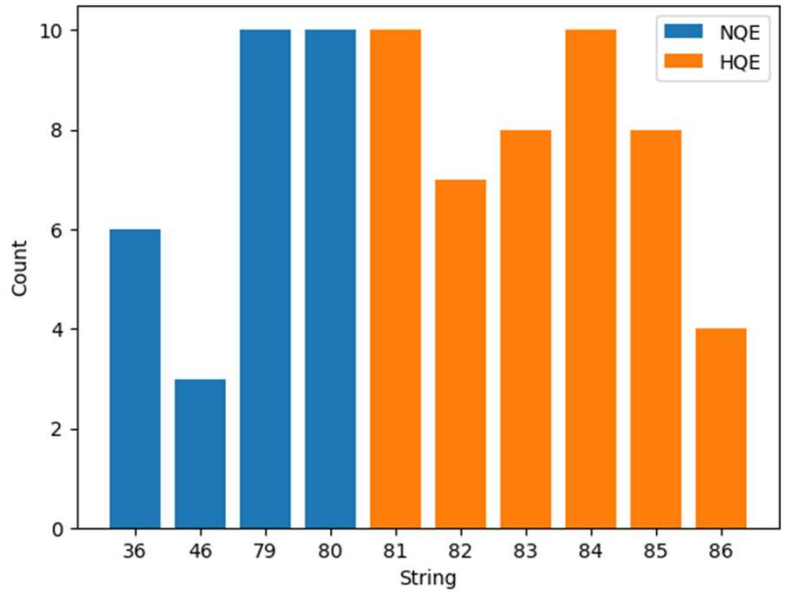
Total charge

- All HQE DOMs below dust layer and most above dust layer have a higher total charge
- Same shape as lower statistics plots
- More data → somewhat better separation below dust layer
- Still see the high-charge NQEs

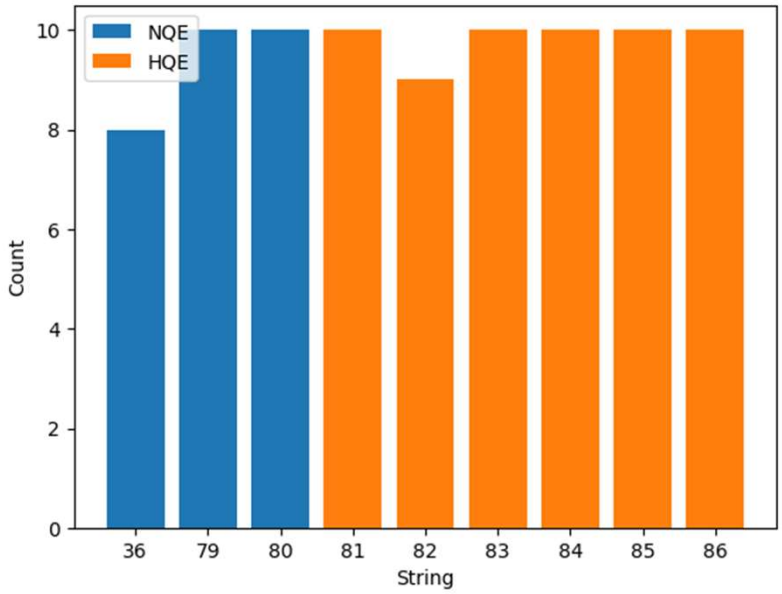


Bar plot of high charge DOMs (> 30000)

Last week's high charge DOMs

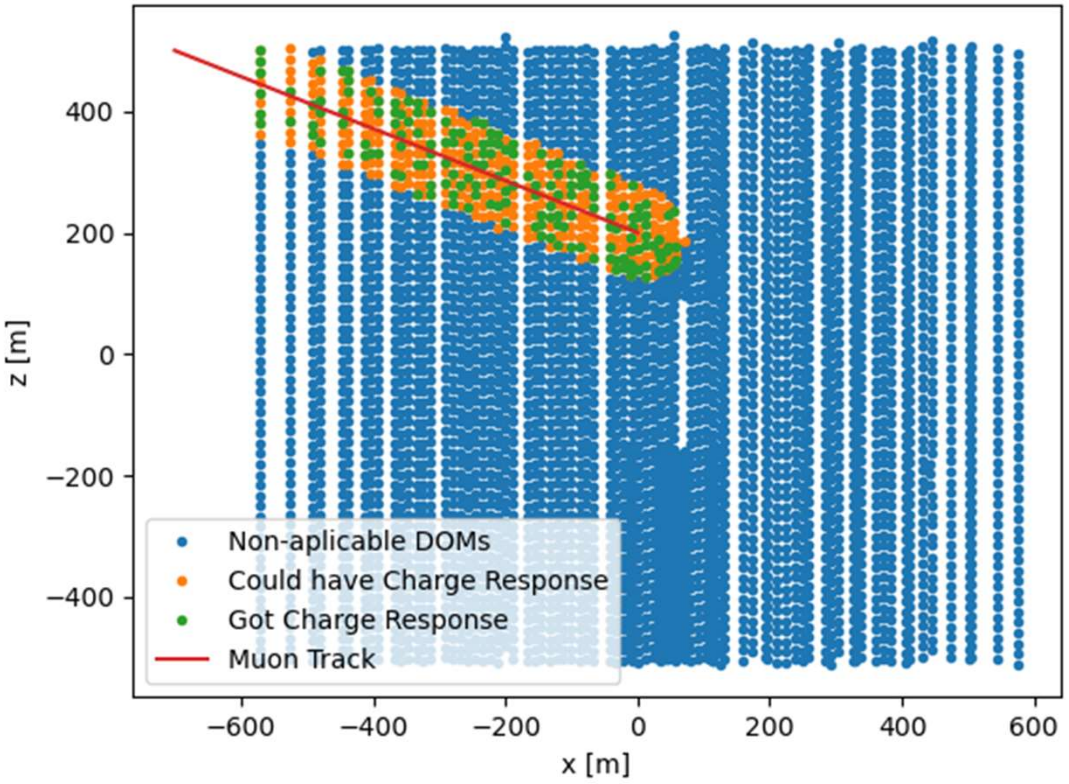


This week's high charge DOMs



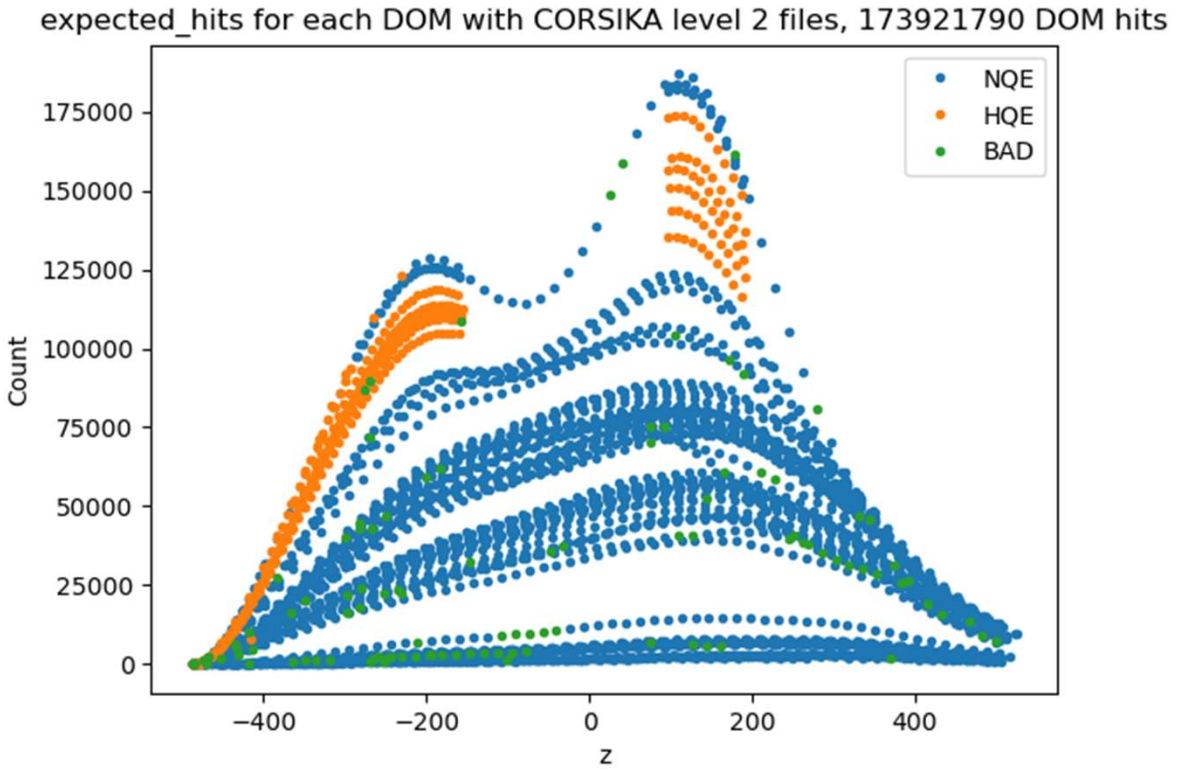
Expected hits

- Expect a hit for all DOMs within 75 meters of last 200 meters of a track



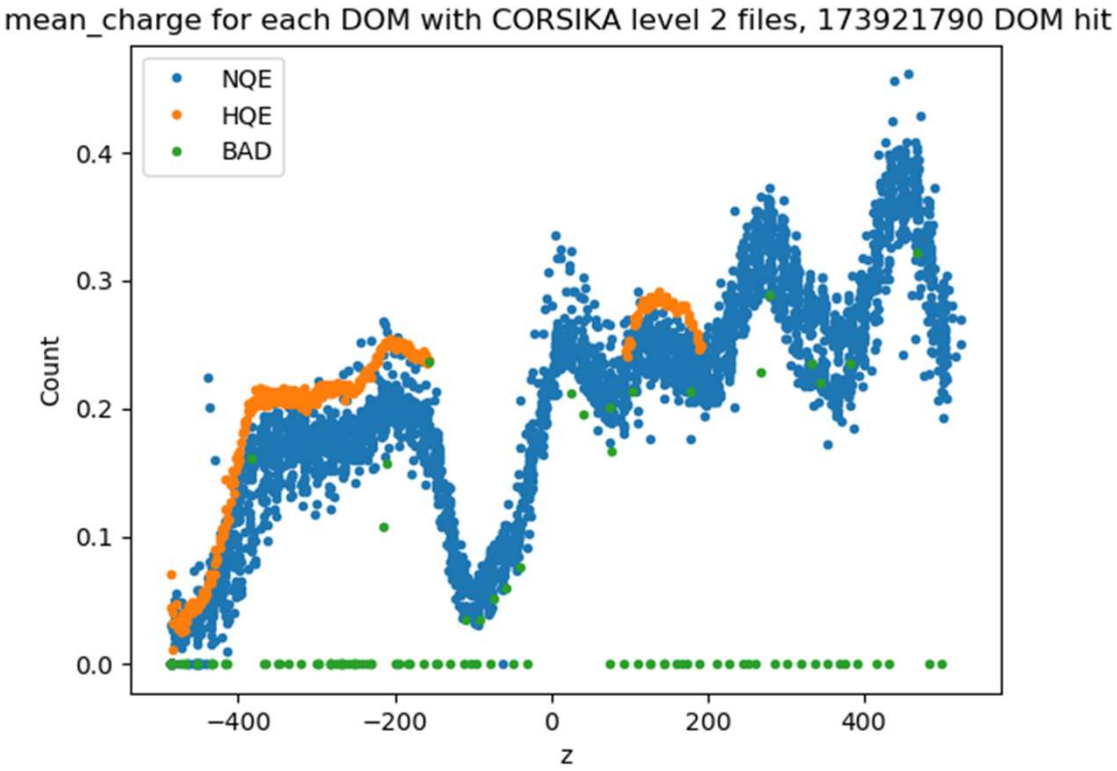
Expected hits

- Expect a hit for all DOMs within 75 meters of last 200 meters of a track
- Much more smooth
- Dust layer effect reduced
- HQE DOMs only expect more charge due to center position

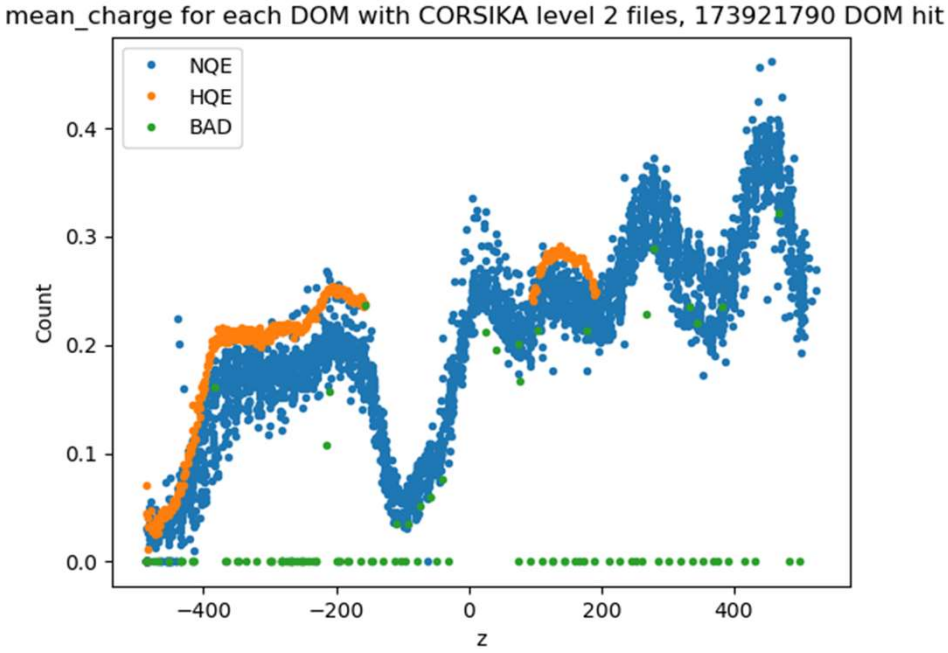


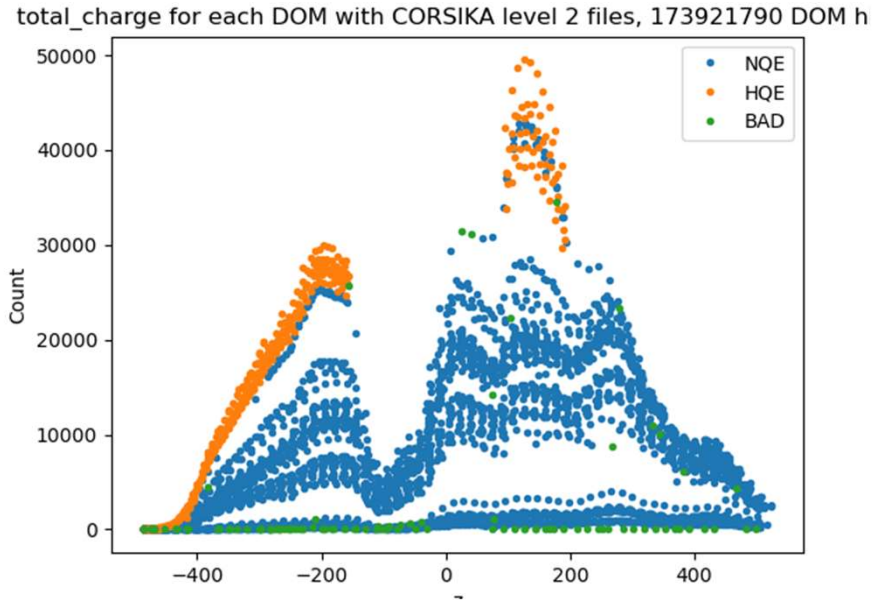
Mean charge

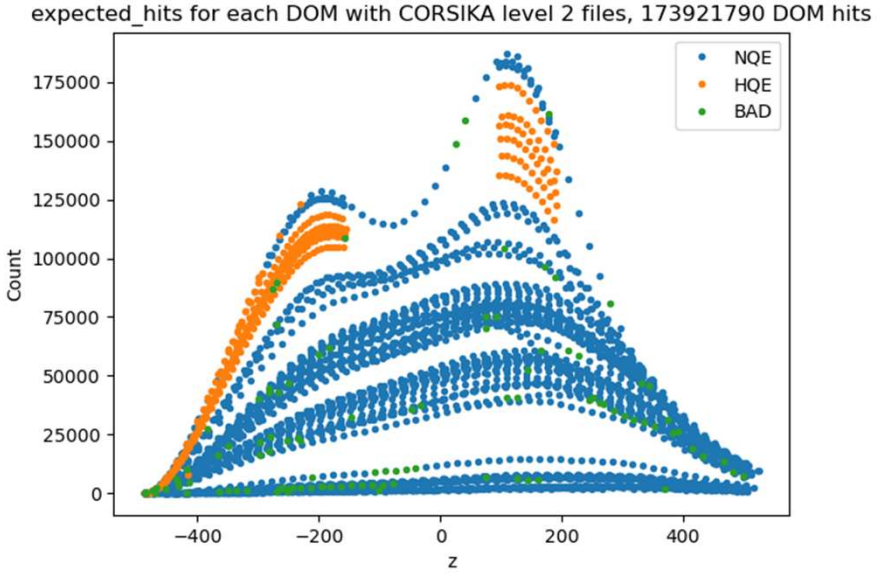
- Essentially total charge over expected hits
- Should be very flat if every expected hit resulted in a charge response
- Accentuates the shape of the total charge plot
- Multiple hills and valleys
- Shows the increased charge response from HQEs



Quick comparison

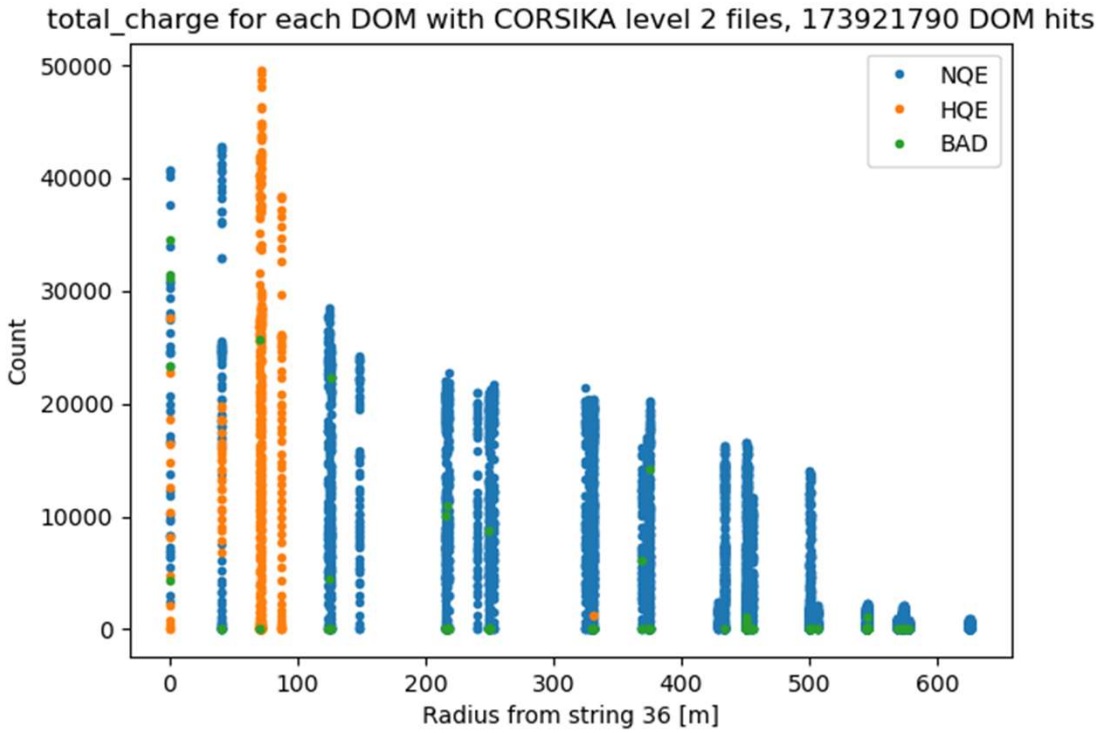






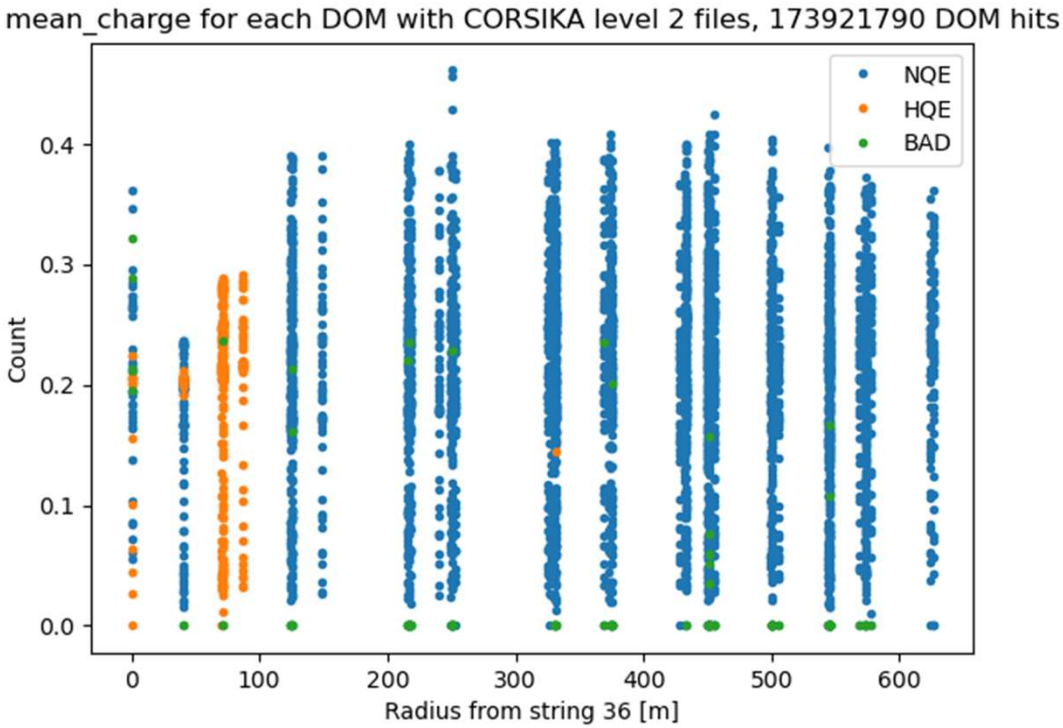
Total charge (distance from string 36)

- Look at distribution as a function of radius from string 36 (roughly center of IceCube)
- Clearly see decrease in response at the edge of detector
- Agrees with the bar plot



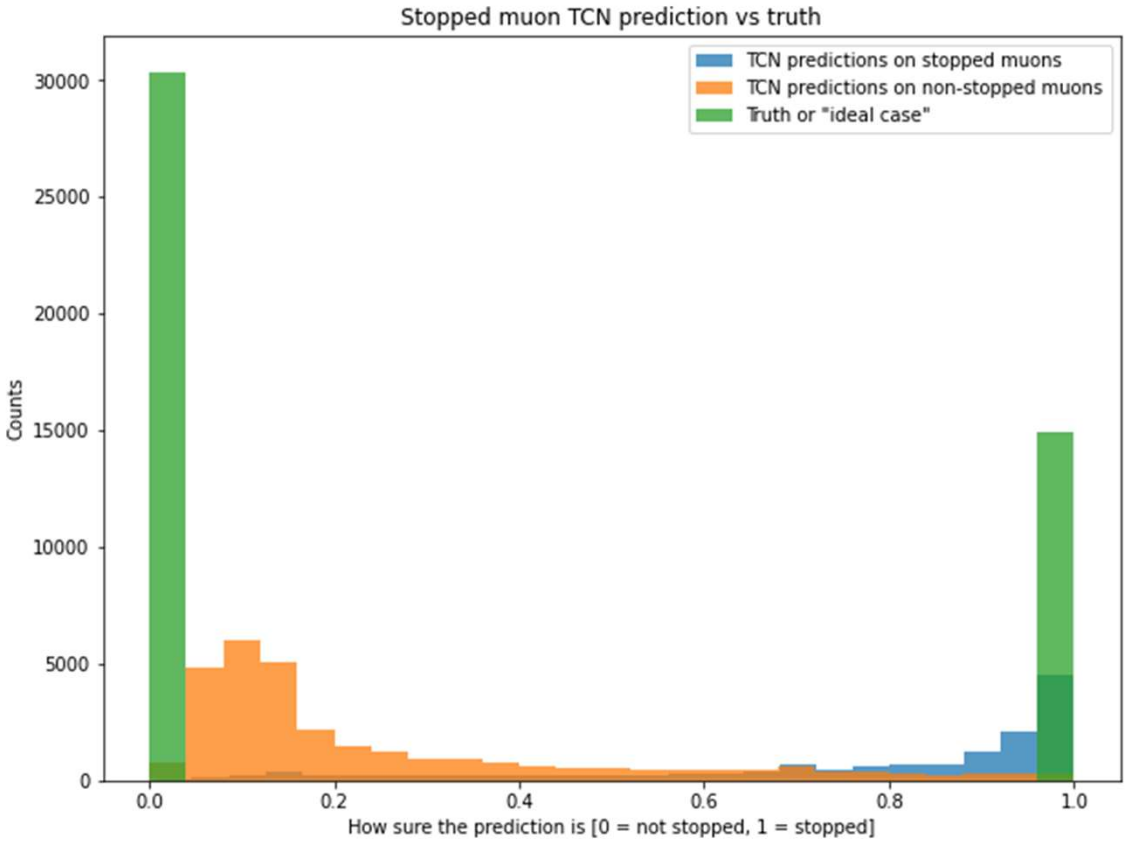
Mean charge (distance from string 36)

- Effect of radius smaller
- Generally flatter as a function of radius



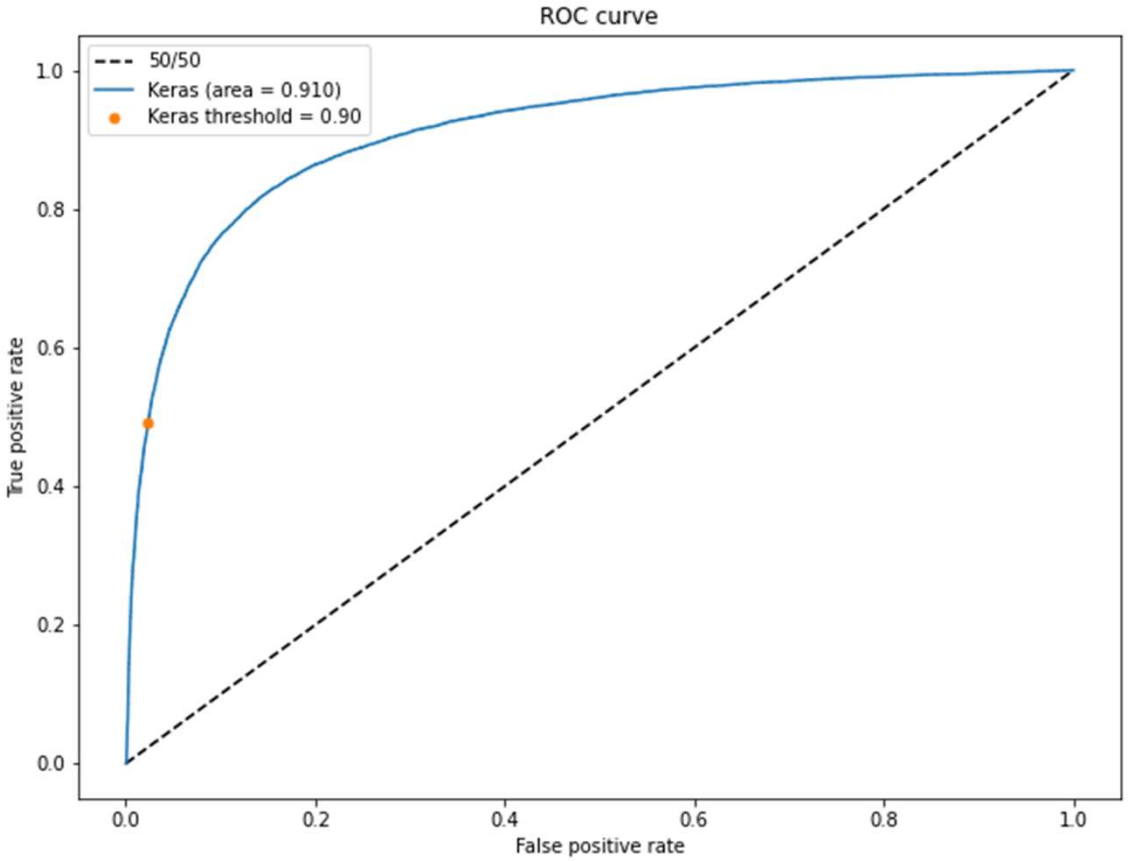
Update on TCN

- Use CORSIKA instead of MuonGun data
- Fit on 1000 files
- Good initial results (only 5 epochs)
- Even with small amount of data and small training time, the separation is strong



Update on TCN

- With more training, the “ideal TCN” assumption earlier might not be crazy
- Still need to compare with FiniteReco + MPE



Question about CORSIKA files

- 2012 CORSIKA files used MCTree

Name	Type
CVMultiplicity	I3HitMultiplicityValues
CVStatistics	I3HitStatisticsValues
CalibratedWaveformRange	I3TimeWindow
ClusterCleaningExcludedTanks	I3Vector<TankKey>
CorsikaInteractionHeight	I3PODHolder<double>
CorsikaWeightMap	I3Map<string, double>
DSTTriggers	I3SuperDSTTriggerSeries
FilterMask	I3Map<string, I3FilterResult>
FilterMask_IceTopSplit0	I3Map<string, I3FilterResult>
FilterMask_NullSplit0	I3Map<string, I3FilterResult>
FiniteRecoCuts	I3FiniteCuts
FiniteRecoFit	I3Particle
FiniteRecoLlh	I3StartStopParams
GCFilter_GCFilterMJD	I3Double
I3DST12	I3DST12
I3DST12Header	I3DSTHeader12
I3DST12Reco	I3DSTReco12
I3EventHeader	I3EventHeader
I3MCPESeriesMap	I3Map<OMKey, vector<I3MCPE> >
I3MCPulseSeriesMap	I3Map<OMKey, vector<I3MCPulse> >
I3MCPulseSeriesMapParticleIDMap	I3Map<OMKey, map<I3ParticleID, vector<unsigr
I3MCTree	I3LinearizedMCTree
I3SuperDST	I3SuperDST
I3TriggerHierarchy	I3Tree<I3Trigger>
IceTopDSTPulses	I3RecoPulseSeriesMapMask
IceTopPulses	I3RecoPulseSeriesMapMask
InIceDSTPulses	I3RecoPulseSeriesMapMask
InIcePulses	I3RecoPulseSeriesMapMask
LineFit	I3Particle
LineFitParams	I3LineFitParams
MMCTrackList	I3Vector<I3MMCTrack>
MPEFit	I3Particle
MPEFitCharacteristics	I3TrackCharacteristicsValues
MPEFitCramerRaoParams	CramerRaoParams
MPEFitFitParams	I3LogLikelihoodFitParams
MPEFitMuEX	I3Particle
OfflineIceTopHLCTankPulses	I3Map<OMKey, vector<I3RecoPulse> >
OfflineIceTopHLCVEMPulses	I3Map<OMKey, vector<I3RecoPulse> >
OfflineIceTopSLCVEMPulses	I3Map<OMKey, vector<I3RecoPulse> >
PassedAnyFilter	I3Bool

Question about CORSIKA files

- Using the command

```
frame['I3MCTree'].get_daughters(frame['I3MCTree'].get_primaries()[0])
```

  yields image to the right
- Well defined length

```
[[ I3Particle MajorID : 2987278708993022763
              MinorID : 2828
               Zenith : 0.808108
              Azimuth : 3.25649
                    X : -2038.79
                    Y : -342.892
                    Z : 1950.08
                 Time : 2278.17
               Energy : 1499.57
                Speed : 0.299792
               Length : 3475.77
                 Type : MuMinus
        PDG encoding : 13
                Shape : StartingTrack
               Status : NotSet
             Location : InIce
]]
```

Question about CORSIKA files

- 2016 CORSIKA files has I3MCTree_preMuonProp
- Despite its name still has muons in it

Name	Type
BeaconLaunches	I3Map<OMKey, vector<I3DOMLaunch> >
CalibratedWaveformRange	I3TimeWindow
CleanIceTopRawData	I3Map<OMKey, vector<I3DOMLaunch> >
ClusterCleaningExcludedTanks	I3Vector<TankKey>
CorsikaInteractionHeight	I3PODHolder<double>
CorsikaMoonMJD	I3PODHolder<double>
CorsikaSunMJD	I3PODHolder<double>
CorsikaWeightMap	I3Map<string, double>
DSTTriggers	I3SuperDSTTriggerSeries
Estres_Homogenized_QTot	I3PODHolder<double>
FilterMask	I3Map<string, I3FilterResult>
FilterMask_NullSplit0	I3Map<string, I3FilterResult>
Homogenized_QTot	I3PODHolder<double>
I3CorsikaInfo	I3CorsikaInfo
I3DST	I3DST16
I3EventHeader	I3EventHeader
I3MCTreePEcounts	I3Map<unsigned int, unsigned int>
I3MCTree_preMuonProp	TreeBase::Tree<I3Particle, I3ParticleID,
I3MCTree_preMuonProp_RNGState	I3SPRNGRandomServiceState
I3SuperDST	I3SuperDST
I3TriggerHierarchy	I3Tree<I3Trigger>
IceTopDSTPulses	I3RecoPulseSeriesMapMask
IceTopPulses	I3RecoPulseSeriesMapMask
IceTopRawData	I3Map<OMKey, vector<I3DOMLaunch> >
InIceDSTPulses	I3RecoPulseSeriesMapMask
InIcePulses	I3RecoPulseSeriesMapMask
InIceRawData	I3Map<OMKey, vector<I3DOMLaunch> >
LineFit	I3Particle
LineFitParams	I3LineFitParams
MMCTrackList	I3Vector<I3MMCTrack>
OfflineIceTopHLCTankPulses	I3Map<OMKey, vector<I3RecoPulse> >
OfflineIceTopHLCVEMPulses	I3Map<OMKey, vector<I3RecoPulse> >
OfflineIceTopSLCVEMPulses	I3Map<OMKey, vector<I3RecoPulse> >
PassedAnyFilter	I3PODHolder<bool>
PassedConventional	I3PODHolder<bool>
PassedKeepSuperDSTOnly	I3PODHolder<bool>
PoleEHESummaryPulseInfo	I3PortiaEvent
PoleMuonLinefit	I3Particle
PoleMuonLlhFit	I3Particle
PoleMuonLlhFitFitParams	I3LogLikelihoodFitParams
PolyplopiaInfo	I3Map<string, int>
	[scroll down for more]

Question about CORSIKA files

- Using the command

```
frame['I3MCTree_preMuonProp'].get_daughters(frame['I3MCTree_preMuonProp'].get_primaries()[0])
```

  yields image to the right
- Length is nan
- Same for every single frame
- Can’t find stopped muons

```
[[ I3Particle MajorID : 12582755045013862045
              MinorID : 923
               Zenith : 0.718566
              Azimuth : 4.5404
                    X : -714.963
                    Y : -2517.54
                    Z : 1950.08
                 Time : 3917.08
               Energy : 628.296
                Speed : 0.299792
               Length : nan
                 Type : MuPlus
        PDG encoding : -13
                Shape : StartingTrack
               Status : NotSet
             Location : InIce
]]
```

Question about CORSIKA files

- Could use “MMCTrackList”

Name	Type
BeaconLaunches	I3Map<OMKey, vector<I3DOMLaunch> >
CalibratedWaveformRange	I3TimeWindow
CleanIceTopRawData	I3Map<OMKey, vector<I3DOMLaunch> >
ClusterCleaningExcludedTanks	I3Vector<TankKey>
CorsikaInteractionHeight	I3PODHolder<double>
CorsikaMoonMJD	I3PODHolder<double>
CorsikaSunMJD	I3PODHolder<double>
CorsikaWeightMap	I3Map<string, double>
DSTTriggers	I3SuperDSTTriggerSeries
Estres_Homogenized_QTot	I3PODHolder<double>
FilterMask	I3Map<string, I3FilterResult>
FilterMask_NullSplit0	I3Map<string, I3FilterResult>
Homogenized_QTot	I3PODHolder<double>
I3CorsikaInfo	I3CorsikaInfo
I3DST	I3DST16
I3DSTHeader	I3DSTHeader16
I3EventHeader	I3EventHeader
I3MCTreePEcounts	I3Map<unsigned int, unsigned int>
I3MCTree_preMuonProp	TreeBase::Tree<I3Particle, I3Particle
I3MCTree_preMuonProp_RNGState	I3SPRNGRandomServiceState
I3SuperDST	I3SuperDST
I3TriggerHierarchy	I3Tree<I3Trigger>
IceTopDSTPulses	I3RecoPulseSeriesMapMask
IceTopPulses	I3RecoPulseSeriesMapMask
IceTopRawData	I3Map<OMKey, vector<I3DOMLaunch> >
InIceDSTPulses	I3RecoPulseSeriesMapMask
InIcePulses	I3RecoPulseSeriesMapMask
InIceRawData	I3Map<OMKey, vector<I3DOMLaunch> >
MMCTrackList	I3Vector<I3MMCTrack>
OfflineIceTopHLCTankPulses	I3Map<OMKey, vector<I3RecoPulse> >
OfflineIceTopHLCVEMPulses	I3Map<OMKey, vector<I3RecoPulse> >
OfflineIceTopSLCVEMPulses	I3Map<OMKey, vector<I3RecoPulse> >
PassedAnyFilter	I3PODHolder<bool>

Question about CORSIKA files

- Could use “MMCTrackList”
- Most TrackList frames contain multiple particles with vastly different characteristics
- Not sure which to use at which frame
- (also is xi, xc, xf = initial, current, final?)

```
MMCTrackList [I3Vector<I3MMCTrack>]:
[I3MMCTrack = [
 (xi, yi, zi, ti, Ei) = (119.917 ,-408.226 ,800 ,9559.74 ,223.101)
 (xc, yc, zc, tc, Ec) = (-0.400169 ,-68.0556 ,24.4279 ,12918.4 ,0.105658)
 (xf, yf, zf, tf, Ef) = (-0.400169 ,-68.0556 ,24.4279 ,12918.4 ,-90928.1)
 Elost = 222.995
 Particle = [ I3Particle MajorID : 12582755045013862045
            MinorID : 5523
             Zenith : 0.435449
            Azimuth : 5.05235
                  X : 298.333
                  Y : -912.657
                  Z : 1950.08
               Time : 5329.55
             Energy : 547.571
              Speed : 0.299792
             Length : 2123.85
               Type : MuPlus
       PDG encoding : -13
              Shape : StartingTrack
             Status : NotSet
           Location : InIce
]]
, I3MMCTrack = [
 (xi, yi, zi, ti, Ei) = (-26.7462 ,-170.164 ,800 ,7295.21 ,396.63)
 (xc, yc, zc, tc, Ec) = (197.235 ,121.188 ,116.249 ,9884.51 ,155.34)
 (xf, yf, zf, tf, Ef) = (381.415 ,360.766 ,-445.999 ,14164.5 ,-40189.3)
 Elost = 396.524
 Particle = [ I3Particle MajorID : 16737750018721178958
            MinorID : 6617
             Zenith : 0.493173
            Azimuth : 4.05698
                  X : -403.471
                  Y : -660.201
                  Z : 1950.03
               Time : 2934.26
             Energy : 1650.69
              Speed : 0.299792
             Length : 2720.18
               Type : MuPlus
       PDG encoding : -13
              Shape : StartingTrack
             Status : NotSet
           Location : InIce
```