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Electron ID for H->VV in 2012

Code to evaluate the electron ID MVA

This is a quick and dirty recipe to evaluate the MVA given inputs. It is independent on CMSSW. A cleaner implementation will be done in CMSSW.

- **reader**: the class is in Emanuele's USer Code area

To use it:

- **non-triggering electrons**:

```
fMVA->Initialize("BDTSimpleCat",
                              "elebdtweights/DanieleMVA_BDTCat_BDTG_SiDanV2.weights.xml",
                              ElectronIDMVAHZZ::kBDTSiDanV2);
```

- **triggering electrons**:

```
fMVA->Initialize("BDTSimpleCat",
                              "elebdtweights/DanieleMVA_DenomHWW_BDTCat_BDTG_SiDanV2.weights.xml",
                              ElectronIDMVAHZZ::kBDTHWWSiDanV2);
```

and then evaluate that with fMVA->MVAValue(...) providing the list of inputs. The weight files are also in the same CVS are.

Code to evaluate the electron PF-isolation with optimize vetoes

This code uses pf-candidates and produces association map electron-isolation. It may also compute in 'directional' isolation fashion (default is NOT directional). The python for the producer is in Emanuele's UserCode area

- This uses as input the PF-collection after charged hadron subtraction from pileup **(aka CHS or pfNoPileup)**, so you need to run that module first:

```
from CommonTools.ParticleFlow.pfNoPileUp_cff import *
pfPileUp.PFCandidates = "particleFlow"
pfNoPileUp.bottomCollection = "particleFlow"
pfPUSequence = cms.Sequence( pfPileUp * pfNoPileUp )
```

Effective Areas calculated on data

The following effective areas are evaluated on Z->ee events on the full 2011 data for PF isolation **with cone ΔR=0.4 or ΔR=0.3**. * the simplest approach is to correct the full neutral part by (using Aeff(+NH)) * for people using separately photon and neutral hadron isolation, we evaluate them separately.

- Isolation cone **ΔR=0.4**:

bin	EA neutral had.	EA s	EA +neutral had.
abs( )<1.0	Aeff(NH) = 0.044 +/- 0.001	Aeff( ) = 0.14 +/- 0.002	Aeff(+NH) = 0.18 +/- 0.002
1.0<abs( )<1.479	Aeff(NH) = 0.065 +/- 0.001	Aeff( ) = 0.13 +/- 0.003	Aeff(+NH) = 0.20 +/- 0.003
1.479<abs( )<2.0	Aeff(NH) = 0.068 +/- 0.001	Aeff( ) = 0.079 +/- 0.001	Aeff(+NH) = 0.15 +/- 0.002

2.0<abs( )<2.2	Aeff(NH) = 0.057 +/- 0.002	Aeff( ) = 0.13 +/- 0.003	Aeff(+NH) = 0.19 +/- 0.003
2.2<abs( )<2.3	Aeff(NH) = 0.058 +/- 0.003	Aeff( ) = 0.15 +/- 0.004	Aeff(+NH) = 0.21 +/- 0.006
2.3<abs( )<2.4	Aeff(NH) = 0.061 +/- 0.004	Aeff( ) = 0.16 +/- 0.005	Aeff(+NH) = 0.22 +/- 0.007
abs( )>2.4	Aeff(NH) = 0.11 +/- 0.005	Aeff( ) = 0.18 +/- 0.005	Aeff(+NH) = 0.29 +/- 0.008

- plots for the effective areas calibrations here
- plots for the combined average isolation sums after pileup-subtraction here

- Isolation cone **ΔR=0.3**:

bin	EA neutral had.	EA s	EA +neutral had.
abs( )<1.0	Aeff(NH) = 0.024 +/- 0.001	Aeff( ) = 0.081 +/- 0.001	Aeff(+NH) = 0.10 +/- 0.002
1.0<abs(eta)<1.479	Aeff(NH) = 0.037 +/- 0.001	Aeff( ) = 0.084 +/- 0.003	Aeff(+NH) = 0.12 +/- 0.003
1.479<abs(eta)<2.0	Aeff(NH) = 0.037 +/- 0.001	Aeff( ) = 0.048 +/- 0.001	Aeff(+NH) = 0.085 +/- 0.002
2.0<abs(eta)<2.2	Aeff(NH) = 0.023 +/- 0.001	Aeff( ) = 0.089 +/- 0.002	Aeff(+NH) = 0.11 +/- 0.003
2.2<abs(eta)<2.3	Aeff(NH) = 0.023 +/- 0.002	Aeff( ) = 0.092 +/- 0.004	Aeff(+NH) = 0.12 +/- 0.004
2.3<abs(eta)<2.4	Aeff(NH) = 0.021 +/- 0.002	Aeff( ) = 0.097 +/- 0.004	Aeff(+NH) = 0.12 +/- 0.005
abs( )>2.4	Aeff(NH) = 0.021 +/- 0.003	Aeff( ) = 0.11 +/- 0.004	Aeff(+NH) = 0.13 +/- 0.006

* **correcting PF isolation for effective areas**

- ♦ First step is calculating rho. The python module to do this in CMSSW. **N.B** The calculation is different with respect the one used for jet corrections because it arrives to |eta|=2.5 to be in the tracker volume to be consistent with electron acceptance, and to avoid big fluctuations.

```
from RecoJets.JetProducers.kt4PFJets_cfi import *
kt6PFJetsForIsolation = kt4PFJets.clone( rParam = 0.6, doRhoFastjet = True )
kt6PFJetsForIsolation.Rho_EtaMax = cms.double(2.5)
```

I have used the following tags to compute it in CMSSW_4_2_8:

```
V02-04-17      RecoJets/Configuration
V04-01-00      RecoJets/JetAlgorithms
V05-05-03      RecoJets/JetProducers
```

- ♦ second step is to calculate the corrected isolation. This is simply:

```
isocorr = chargediso + max(PFIso(&gamma;) - rho * Aeff(&gamma), 0.) +  max(PFIso(NH) - rho
```

Optimized working points

Cuts are given for the ID BDT / relative PF isolation.

Non triggering electrons MVA

For the optimization the samples used are:

- **signal electrons**: Z ee Monte Carlo with mc match applied.

- **fake electrons**: data (W+1 jet fakeable sample, odd events: even events used for training of BDT)

The format of the table is: BDT ID cut / relative PF-iso (Δ R=0.4).

- **5<pT<10 GeV**

WP	/ /<0.8	0.8</ /<1.479	1.479</ /<2.5
WP 70	0.307 / 0.406	0.304 / 0.454	0.147 / 0.658
WP 80	0.100 / 0.671	0.062 / 0.655	-0.158 / 0.757
WP 85	-0.081 / 0.842	0.001 / 0.861	-0.212 / 1.064
WP 90	-0.455 / 1.147	-0.300 / 1.124	-0.537 / 1.060
WP 95	-0.286 / 48.948	-0.568 / 1.361	-0.706 / 1.400
WP HZZ	0.47 / 0.25	0.004 / 0.25	0.294 / 0.25

- **pT>10 GeV**

WP	/ /<0.8	0.8</ /<1.479	1.479</ /<2.5
WP 70	0.975 / 0.173	0.966 / 0.195	0.930 / 0.184
WP 80	0.971 / 0.625	0.903 / 0.205	0.910 / 0.330
WP 85	0.944 / 0.306	0.708 / 0.205	0.897 / 0.522
WP 90	0.877 / 0.426	0.811 / 0.481	0.707 / 0.390
WP 95	0.634 / 0.567	0.719 / 0.909	0.593 / 0.665
WP HZZ	0.5 / 0.25	0.12 / 0.25	0.6 / 0.25

Triggering electrons MVA

For the optimization the samples used are:

- **signal electrons**: Z ee Monte Carlo with mc match applied.
- **fake electrons**: data (fake electron QCD triggers, odd events: even events are used for BDT training)

The format of the table is: BDT ID cut / relative PF-iso (Δ R=0.4).

The H WW fakeable object preselection **is applied** to both signal and background probes in the optimization.

- the working point **!WP HWW** is not an optimization. Isolation and ID cuts are tuned to give the same efficiency bin-by-bin with respect the WP used for 2011 analysis. The effect on fake rate, estimated on data, is evaluated and an improvement of about 20-30% is seen. Moreover the dependency of the fake rate on pileup is small, even if the corrections are applied. Plots are in this location

- **10<pT<20 GeV**

WP	/ /<0.8	0.8</ /<1.479	1.479</ /<2.5
WP 70	0.390 / 0.144	0.301 / 0.129	0.574 / 0.191
WP 80	0.013 / 0.167	0.308 / 0.213	0.397 / 0.233
WP 85	0.082 / 0.220	0.163 / 0.228	0.272 / 0.248
WP 90	-0.004 / 0.335	-0.082 / 0.291	-0.028 / 0.288
WP 95	-0.288 / 0.408	0.039 / 2.375	-0.017 / 0.463
WP HWW	0.0 / 0.15	0.1 / 0.15	0.62 / 0.15

- **pT>20 GeV**:

WP	/ /<0.8	0.8</ /<1.479	1.479</ /<2.5
WP 70	0.977 / 0.093	0.956 / 0.095	0.966 / 0.171
WP 80	0.913 / 0.105	0.964 / 0.178	0.899 / 0.150
WP 85	0.929 / 0.135	0.931 / 0.159	0.805 / 0.155
WP 90	0.877 / 0.177	0.794 / 0.180	0.846 / 0.244
WP 95	0.858 / 0.253	0.425 / 0.225	0.759 / 0.308
WP HWW	0.94 / 0.15	0.85 / 0.15	0.92 / 0.15

-- EmanueleDiMarco - 01-Mar-2012

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