Group Meeting

[1]DESY-CMS Higgs Group

Update on NMSSM H(125) $\rightarrow$ aa $\rightarrow$ $\mu\mu\tau\tau$ analysis (after FSP CMS Workshop 2018)

Search with 2016 Dataset

12.11.2018

Recent studies (after FSP CMS Workshop 2018)

- Removing of delta R selection for mu-track pair

Previous selection for mu-track system:

-Mu-track system isolated in optimal $\Delta R(\mu, trk)$ for each mass point

Mass points	ΔR
4,5,6,7	0.4
8,9,10,11	0.6
12,13	0.7
14,15	0.8

Test:

-$\Delta R(\mu, trk)$ requirement removed, individual isolation for the muon and the track applied

The track is the highest p_T signal track in the track collection

- Substitution of $\Delta R(\mu, \mu)$ cone isolation for dimuon system. Three different options tested:

-Delta R cone isolation around each of the muons in dimuon system

-Particle-Flow Isolation

-Tracker-based Isolation

Goal: Reduce loose of acceptance with the increase of the mass of the pseudoscalar boson

- Inclusion of mass points until 19 GeV

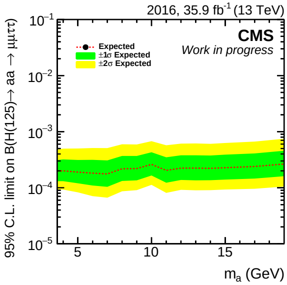
Assessing impact of change in isolation requirement for mu-track system

- Previous isolation requirement for the mu-track system:

  Mu-track system isolated in optimal $\Delta R(\mu, trk)$ for each mass point [see table in previous slide]

- Test:

  The muon and the track of mu-track system required to be isolated within ΔR cone of 0.2, no $\Delta R(\mu, trk)$ requirement applied



Delta R cone isolation around each of the muons in dimuon system

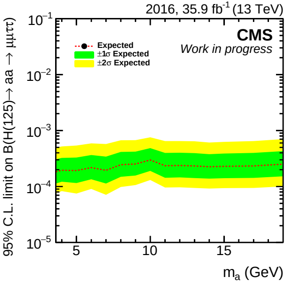
- Previous selection for the dimuon system:

  Dimuon system isolated in optimal $\Delta R(\mu, \mu)$ for each mass point

Mass points	ΔR
4,5,6,7	0.4
8,9,10,11	0.6
12,13	0.7
14,15	0.8

- Test:

  Each of the muons of dimuon system required to be isolated within ΔR cone of 0.2, keeping optimal $\Delta R(\mu, \mu)$ for each mass point

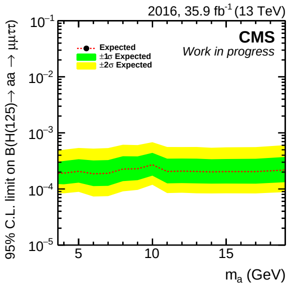


Particle-Flow Isolation

- Particle-Flow Isolation:

  PF-based combined relative isolation with Δ beta corrections for PU mitigation in a cone of size $\Delta R < 0.4$

$$PFIso = \frac{\sum p_T(ch.had\ \ from\ \ PV) + max(0, \sum E_T(neut.had) + \sum E_T(phot) - 0.5 \cdot \sum p_T(ch.had\ \ from\ \ PV))}{p_T(\mu)}$$



Working point	Muon selector	Cut value	efficiency
Very Loose	Muon::PFIsoVeryLoose	0.4	
Loose	Muon::PFIsoLoose	0.25	ϵ ~0.98
Medium	Muon::PFIsoMedium	0.20	
Tight	Muon::PFIsoTight	0.15	ϵ ~0.95
Very Tight	Muon::PFIsoVeryTight	0.10	
Very very Tight	Muon::PFIsoVeryVeryTight	0.05	

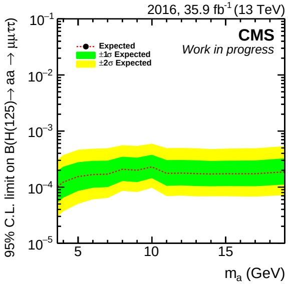
Tracker-based Isolation

- Tracker-based Isolation:

  Computed using tracks from the leading PV in the event, which are in a cone of size $\Delta R < 0.3$

  $$TkIso = \frac{\sum p_T(tracker\ \ tracks\ \ from\ \ PV)}{p_T(\mu)}$$

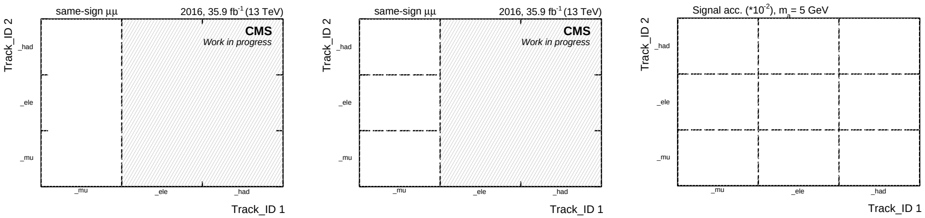
  If $\Delta R(\mu_1, \mu_2) < 0.3$ the p_T contribution of μ_2 (μ_1) in $TkIso_{\mu_1}$ ($TkIso_{\mu_2}$) is not added



Working point	Muon selector	Cut value	efficiency
Loose	Muon::TkIsoLoose	0.10	ϵ ~0.98
Tight	Muon::TkIsoTight	0.05	ϵ ~0.95

Possible new path:

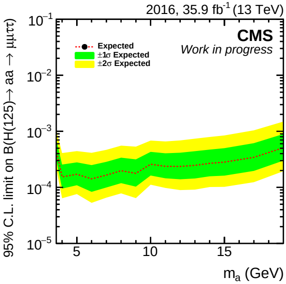
- Categorization based on the track of the muon-track pair
- Addition of new categories to the analysis (Single Muon Ntuples needed for this step)



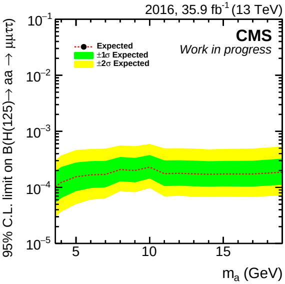
Conclusions:

- Loose of acceptance with the increase of the mass of the pseudoscalar boson reduced for mass points higher than 10 GeV

Presented at FSP CMS Workshop 2018 (only with double muon triggers):



Now (with tracker-based Isolation for the dimuon system and ΔR isolation cone of 0.2 for the mu-track system):



To do list:

- Production of Single Muon Ntuples for 2016
- Production of Single Muon and Double Muon Ntuples for 2017
- Categorization and addition of new categories to the analysis (studies ongoing)