Tau Id & Tau ES with $W^* \rightarrow \tau\nu$ events

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Fitting of fake factors, 08.10.2018

HELMHOLTZ RESEARCH FOR GRAND CHALLENGES

DESY.

Problem

- large uncertainties in fake background
- fake factor background scaled by large factors during combine fit

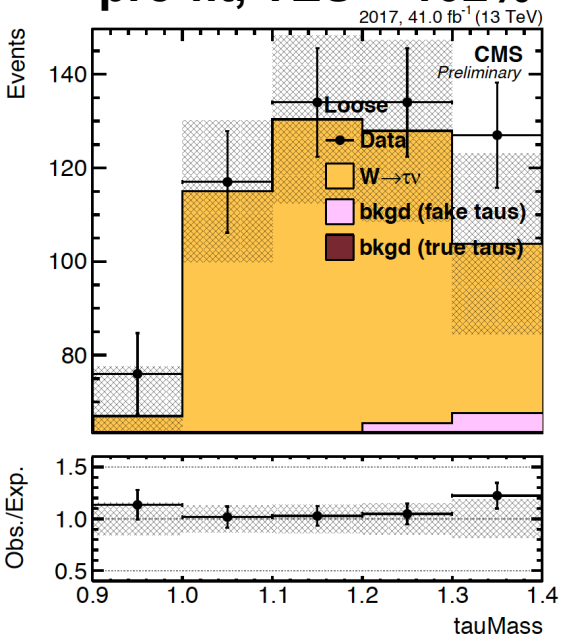
➡ TauId SFs change a lot when only small changes in analysis are made

➡ especially problematic for TES measurement : no parabola/minimum obtained in likelihood scan

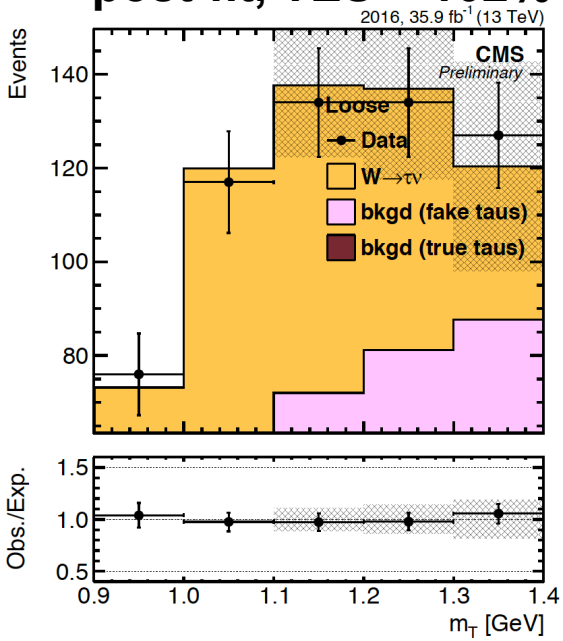
Coarser binning for fake factors or

fit fake factors to reduce uncertainties?

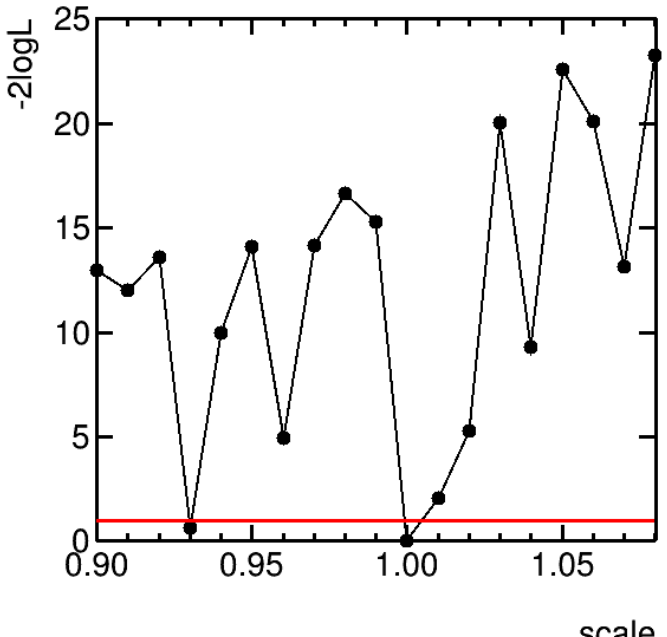
pre-fit, TES = 102%



post-fit, TES = 102%



likelihood scan

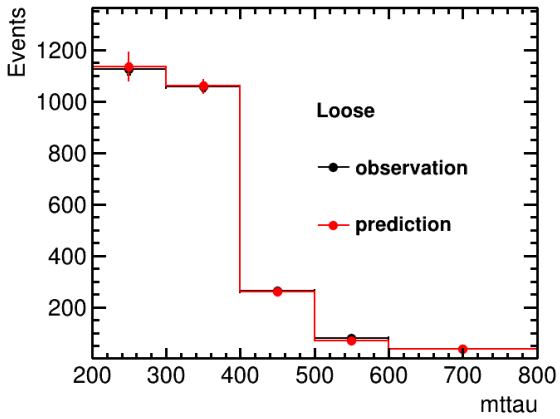


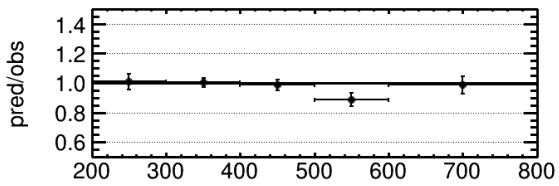
Coarser binning of fake factors

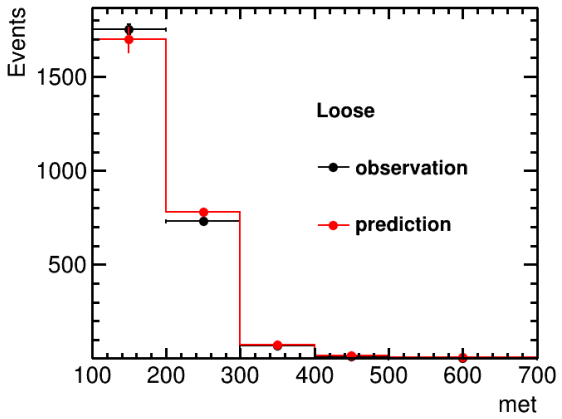
- current analysis binning:
  ratio = { 0.0 , 0.7 , 0.75 , 0.80 , 0.85 , 1.0 , 2. } ,
  JetPt ={100 , 160 , 240 , 340 , 1200};
- tried different binnings
- „best“ binnings found:
  - ratio ={ 0.0 , 0.7, 0.8, 2. }, jetPt = {100 , 160, 240, 1200} **(v1)**
  - ratio ={ 0.0 , 0.7 , 0.80 , 1.0 , 2. }, jetPt = {100 , 160, 240, 1200} **(v2)**

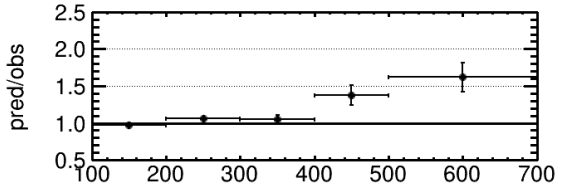
➡ **Closure? Uncertainties in pre-fit plot?**

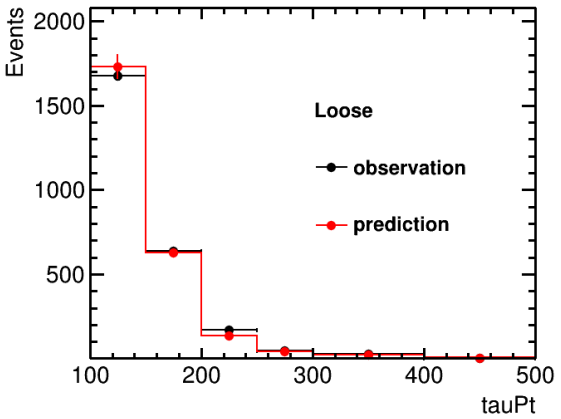
Binning v1: Closure

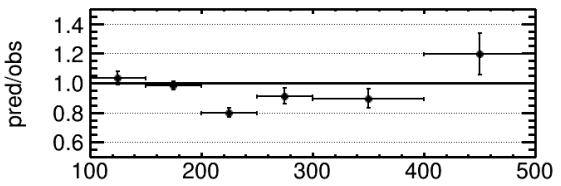


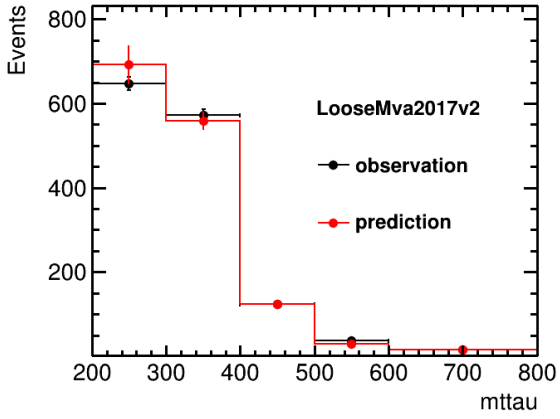


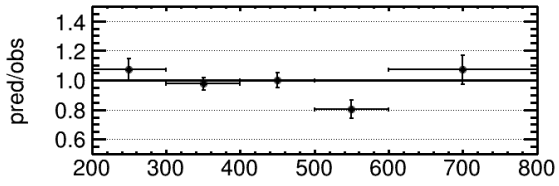


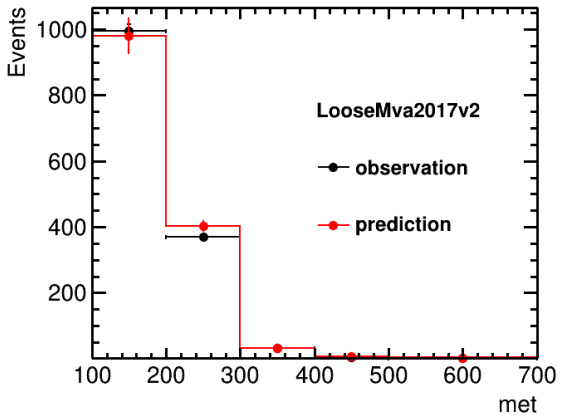


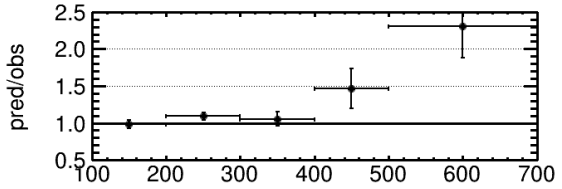


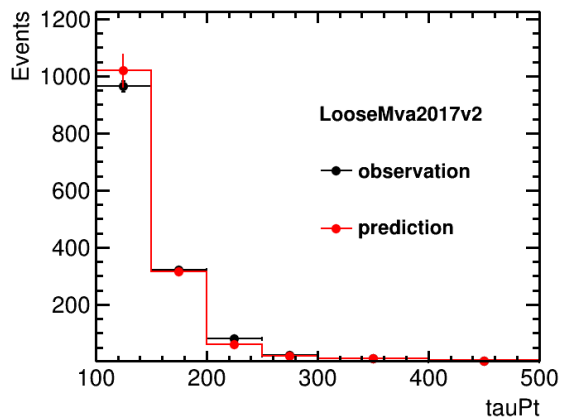


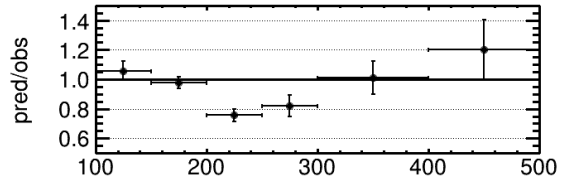






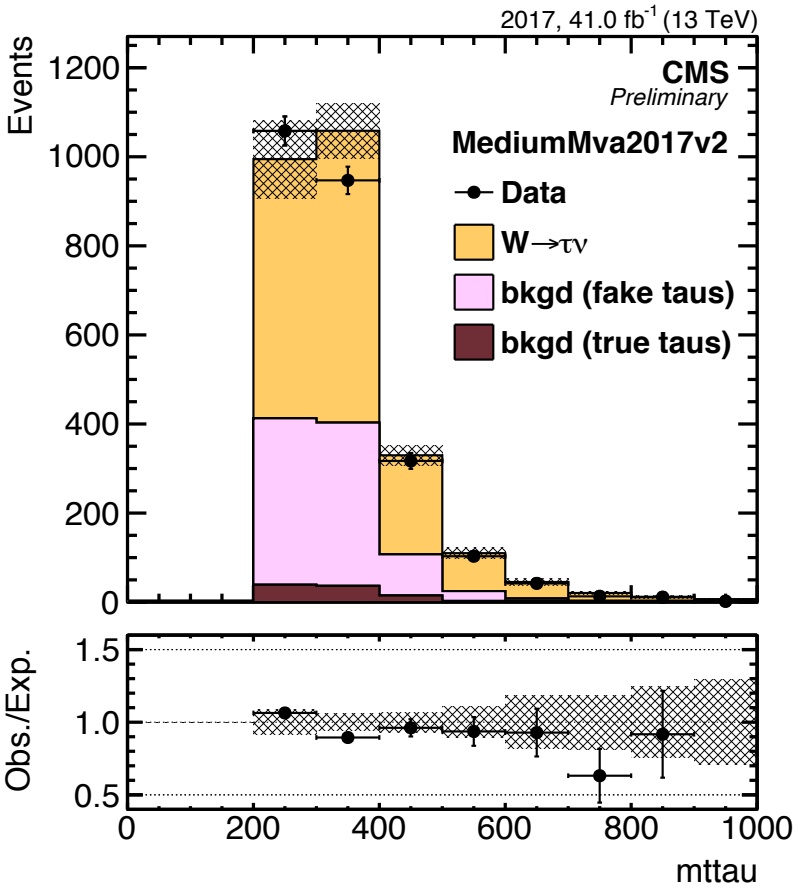




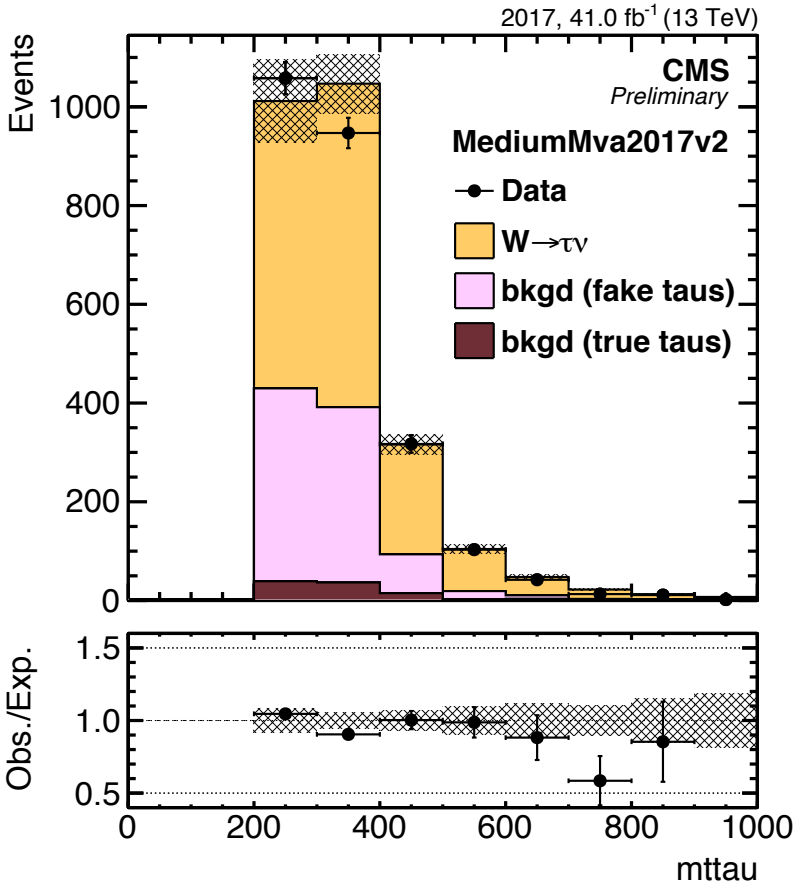


Binning v1: Pre-fit plots

current analysis binning

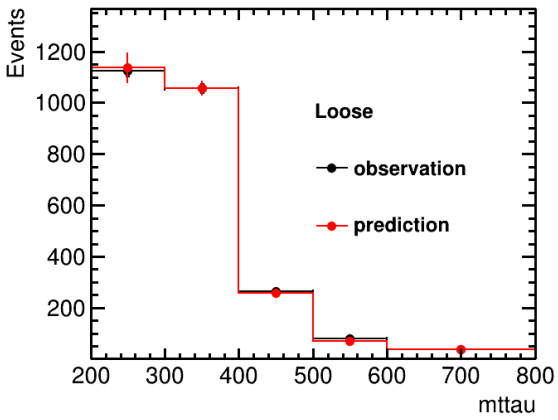


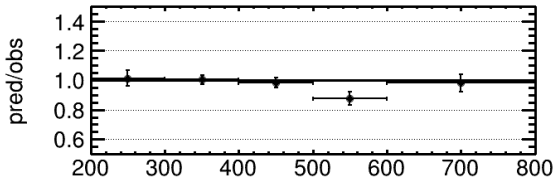
binning v1

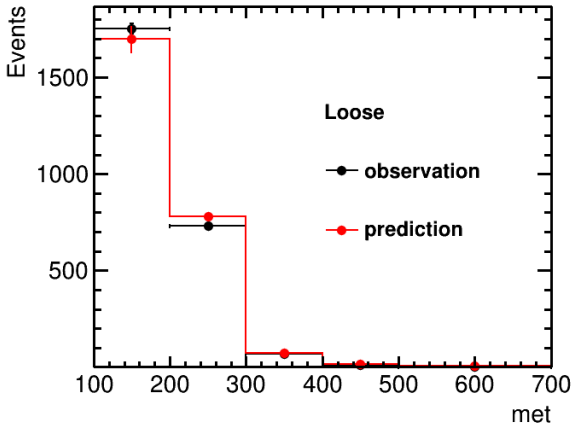


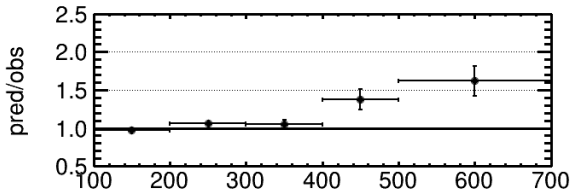
➡ **smaller uncertainties in the tails, but closure worse**

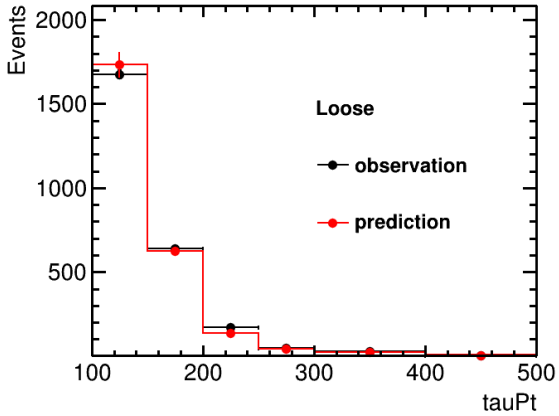
Binning v2: Closure

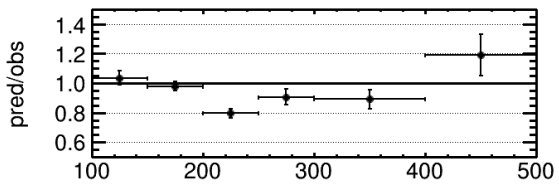


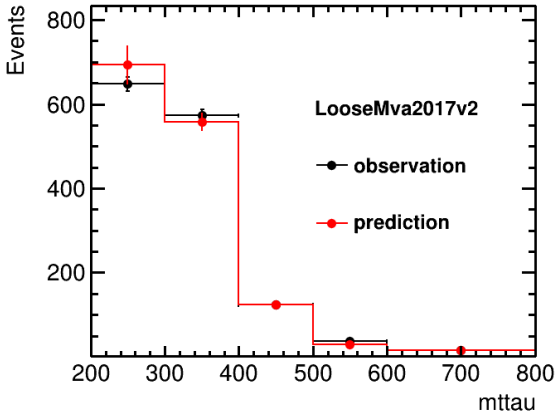


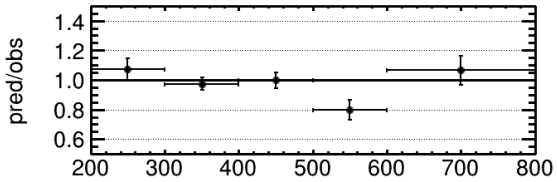


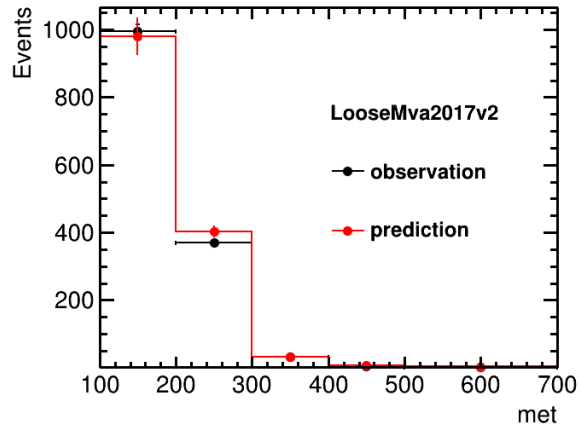


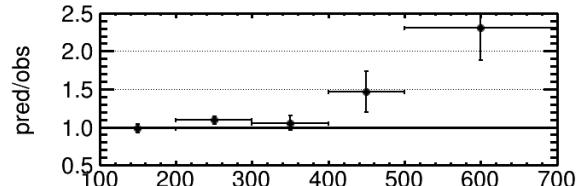


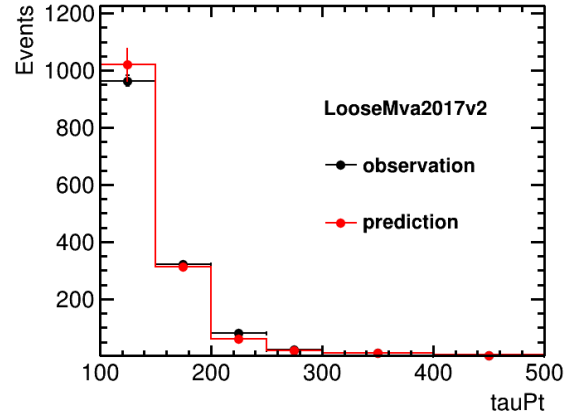


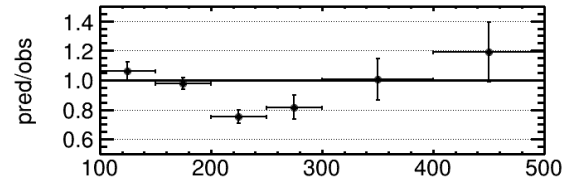






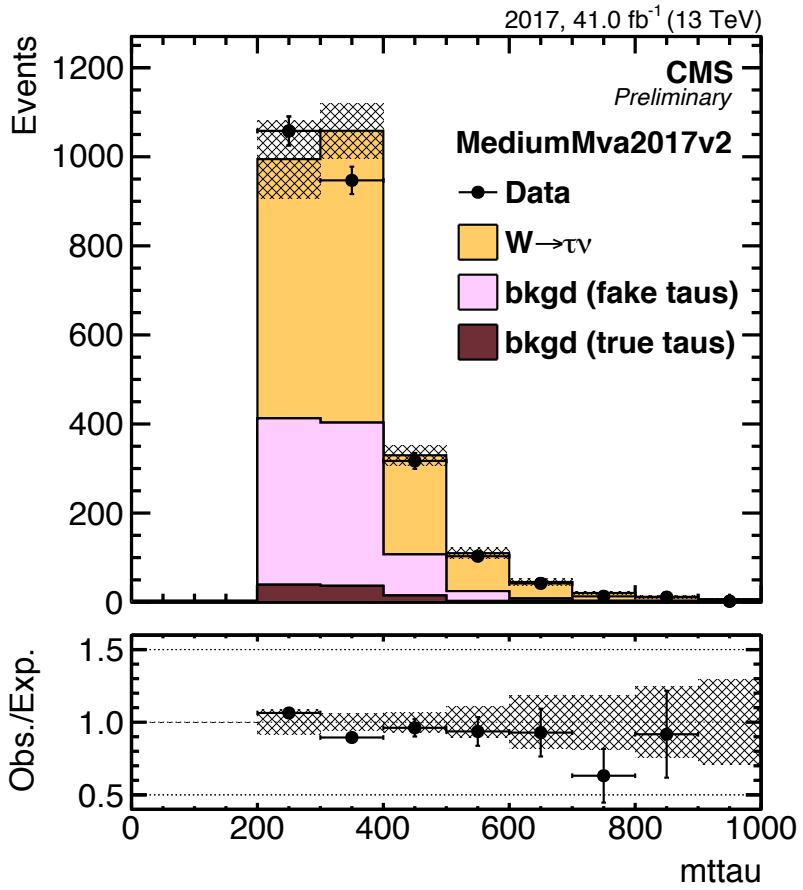




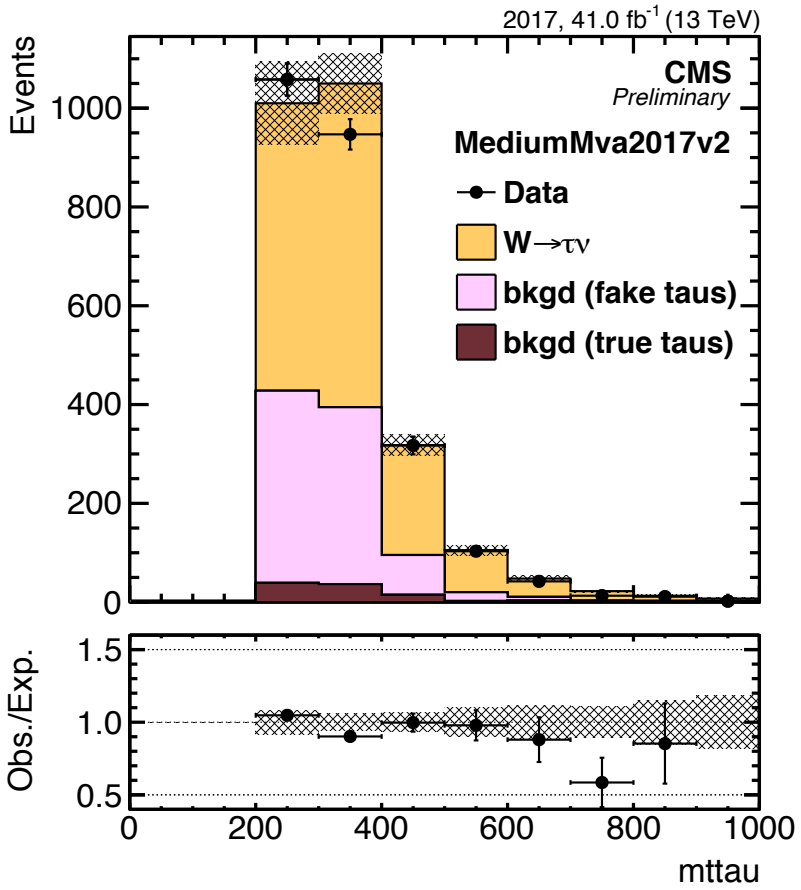


Binning v2: Pre-fit plots

current analysis binning



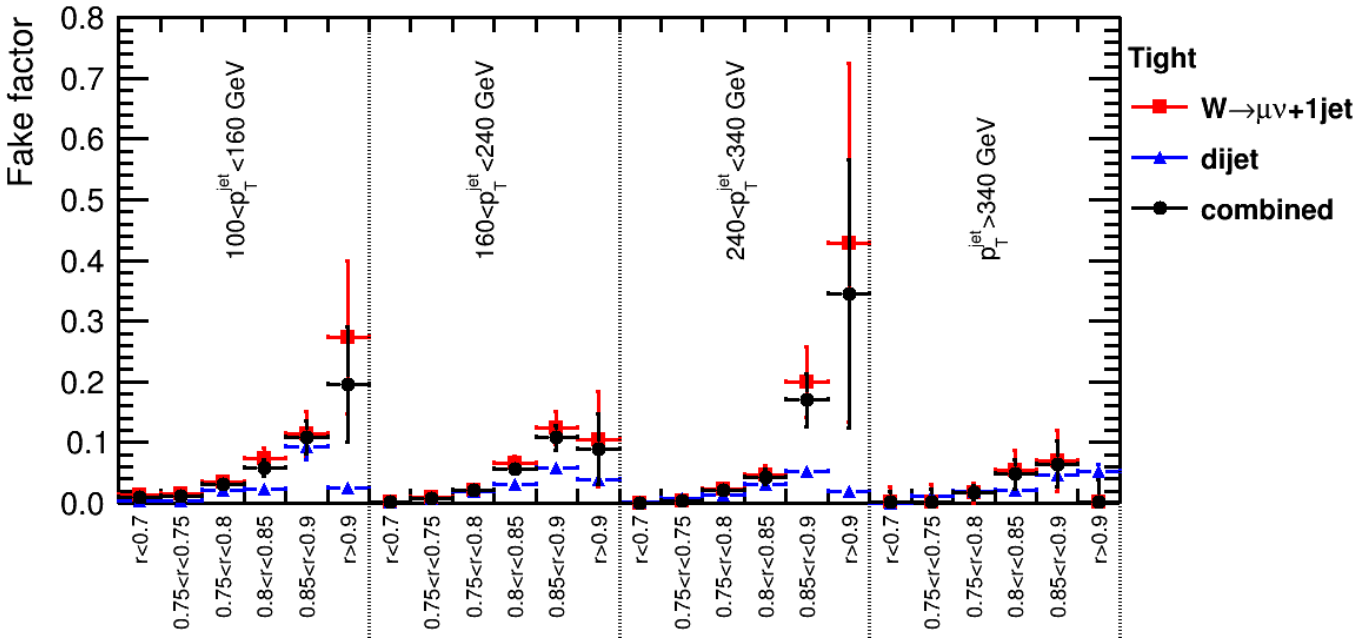
binning v2



➡ **smaller uncertainties in the tails, but closure worse**

Fit of fake factors

- fake factors binned in $p_T^{\text{tau-jet}}$ & $r = p_T^{\text{tau}} / p_T^{\text{tau-jet}}$
- first idea: **bin in tau jet bin, fit ratio**



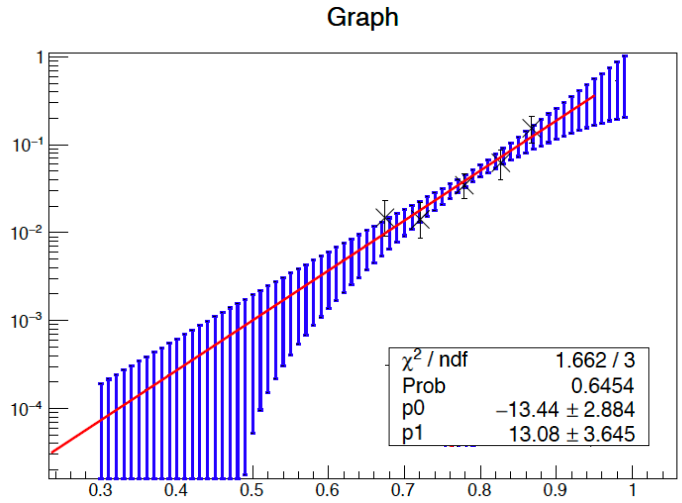
Fit of fake factors: general remarks

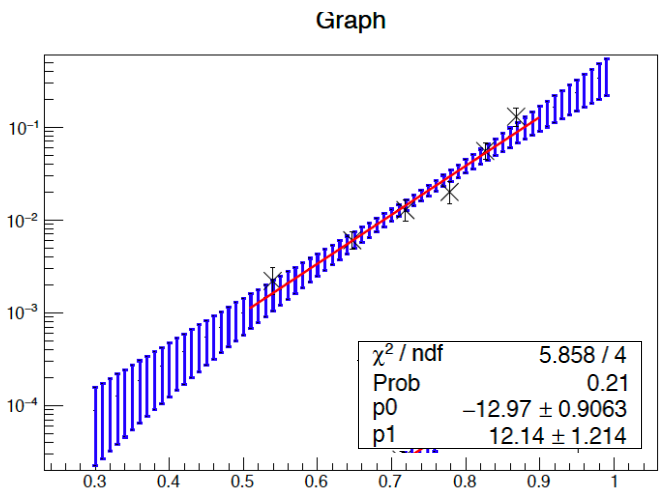
- mean value of ratio in each bin used for fitting
- fit only performed for r < 1
- remove events with r > 1 for now (have to be treated differently)
- binning used for fitting:
  - ratio = { 0.0 , 0.6 , 0.7 , 0.75 , 0.80 , 0.85 , 0.9, 1.0 };
  - ➡ finer binning to be able to describe strong dependence on ratio
  - jetPt ={100 , 160 , 240 , 340 , 1200};

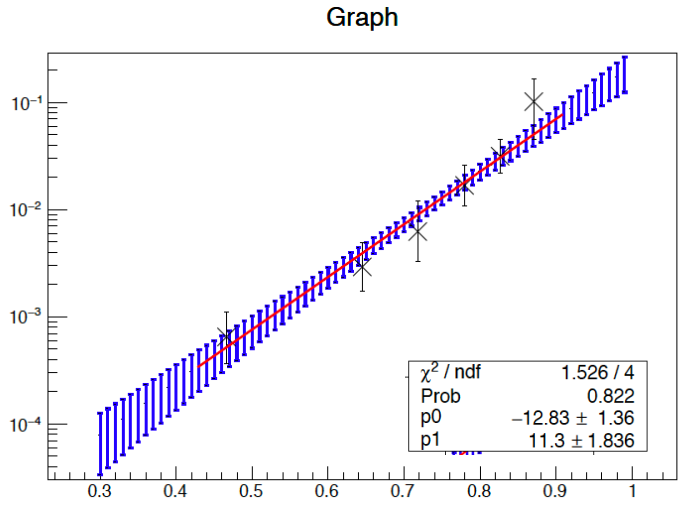
Fit of fake factors: data

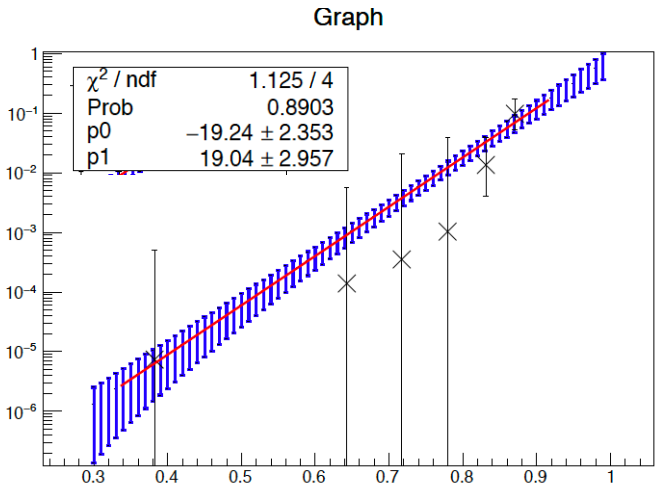
- fit of combined W+jets and dijet fake factors

➡ fit with exp(**a**+**b**x)







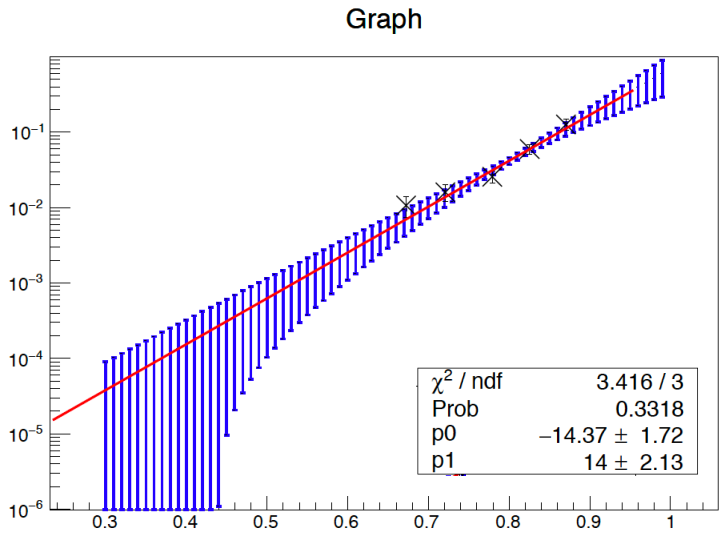


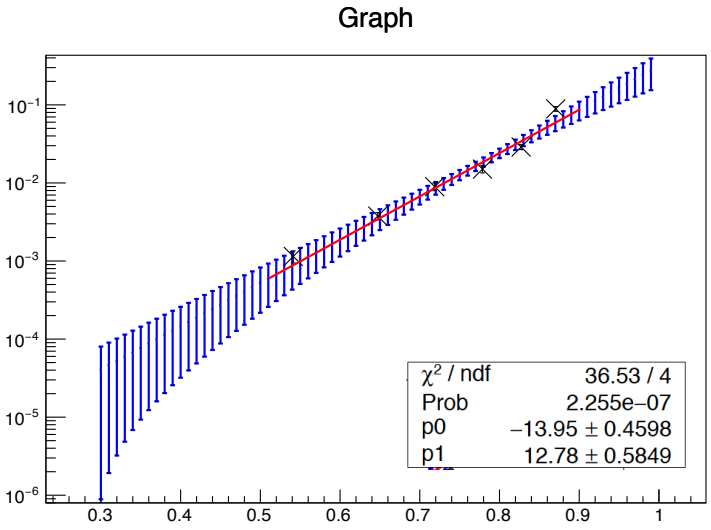
➡ fit works ~ ok

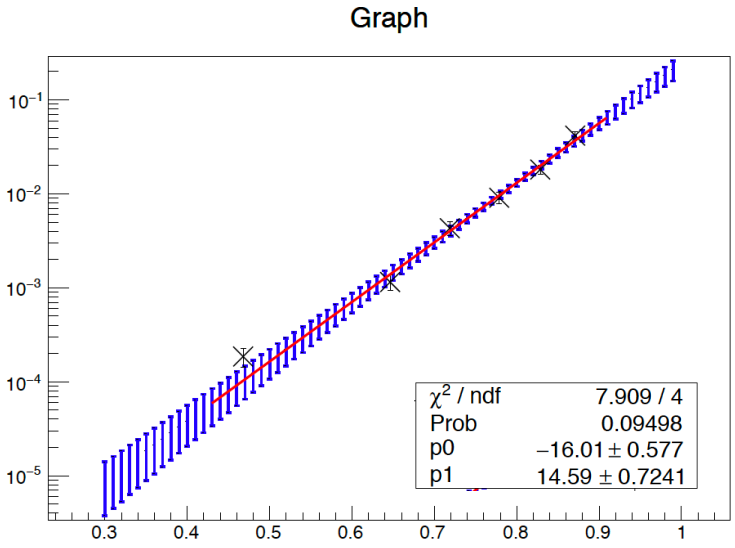
➡ uncertainties can be reduced for most values of r & taujetpt

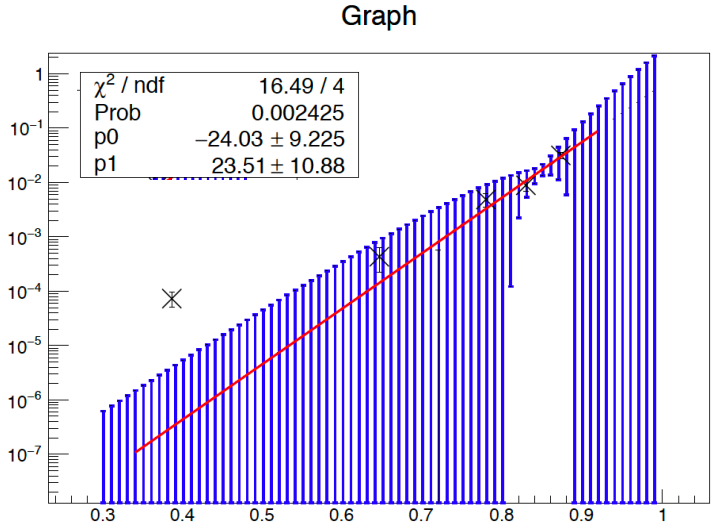
Fit of fake factors: W+jets MC

- fit of W+jets MC for closure
- ➡ fit with exp(**a**+**b**x)



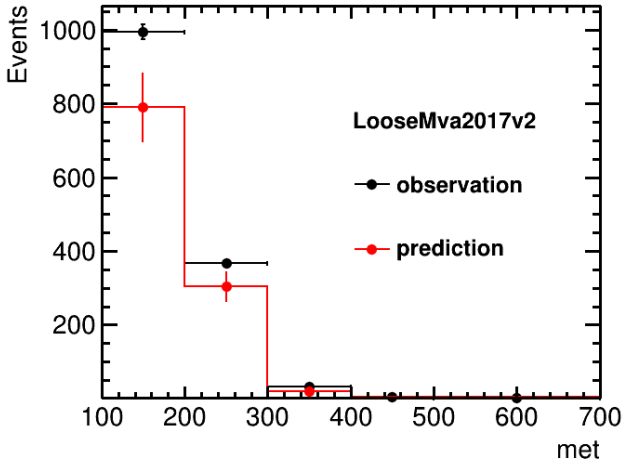


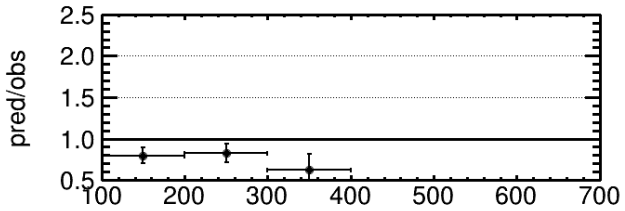


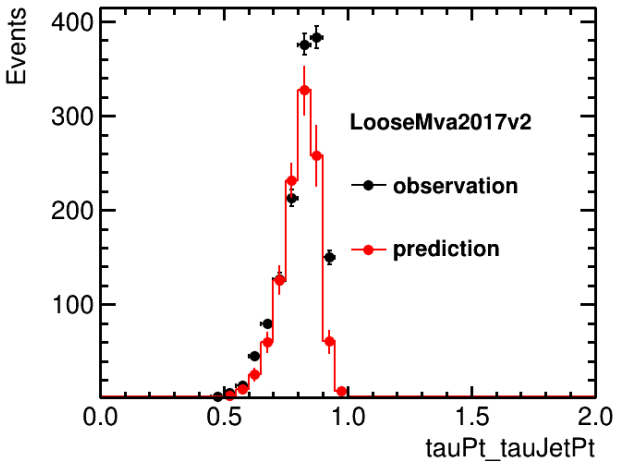


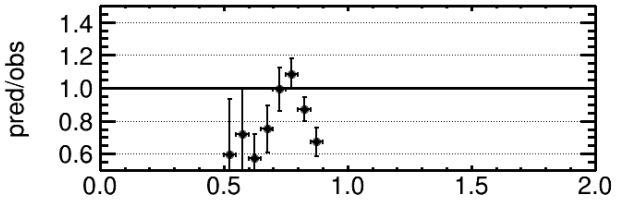
- ➡ fit fails at low and high r
- ➡steeper rise of fake factors

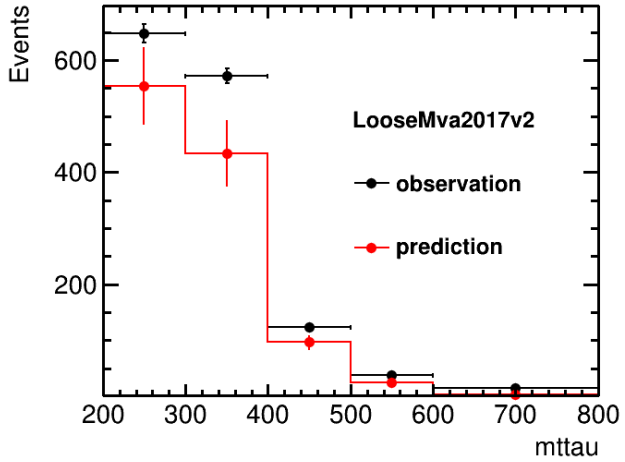
Closure test

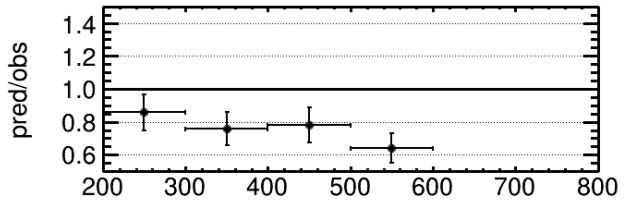


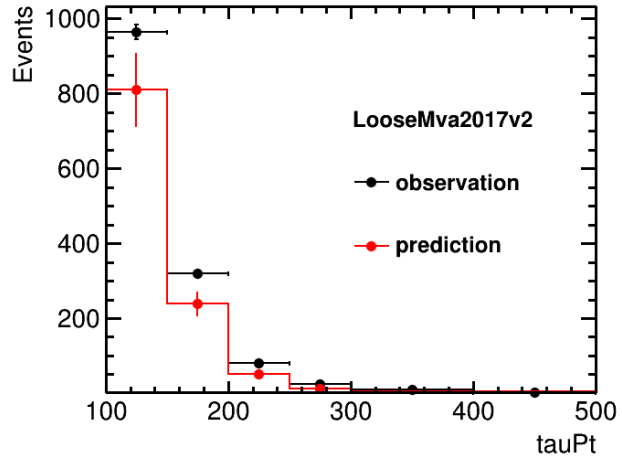


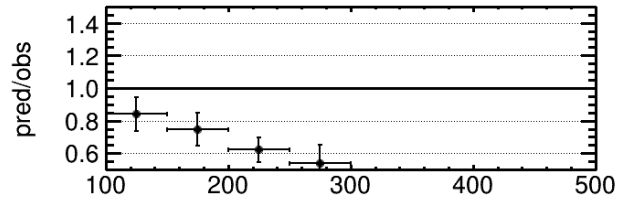








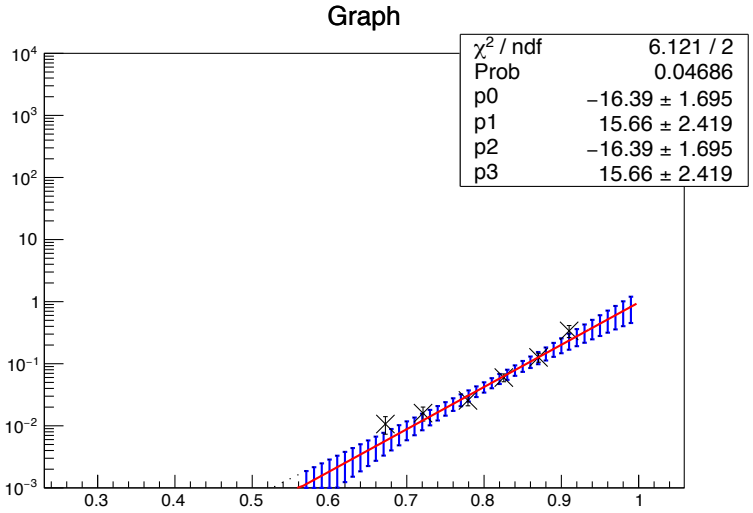


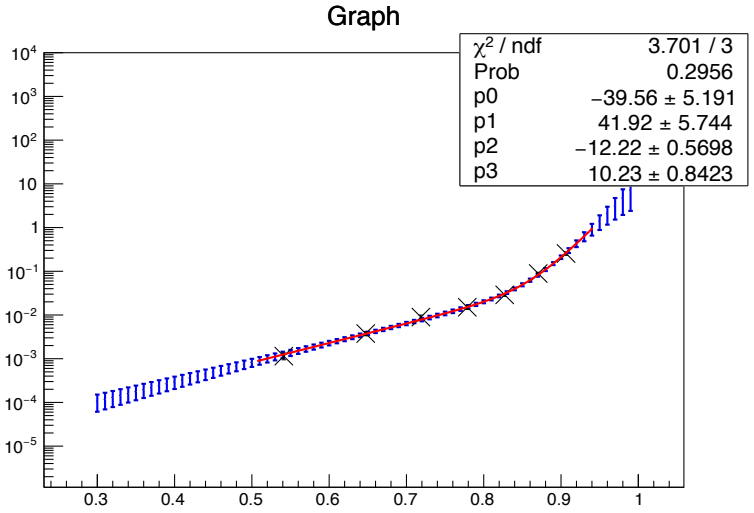


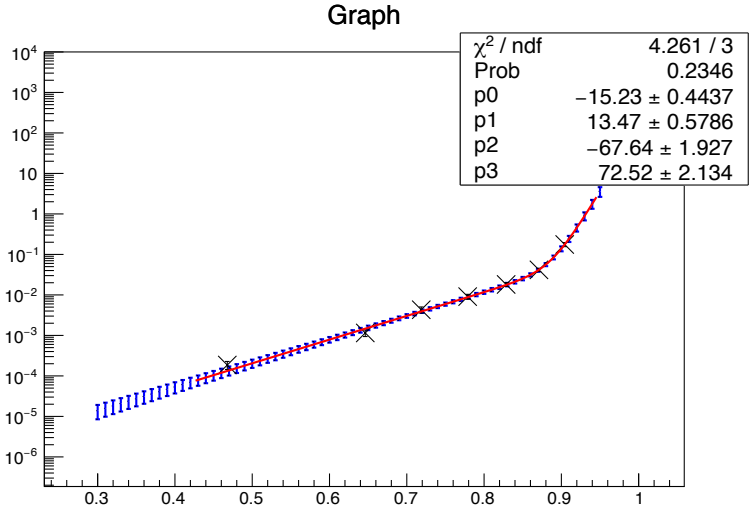
- bad closure (especially at low and high r, where also the fit fails)

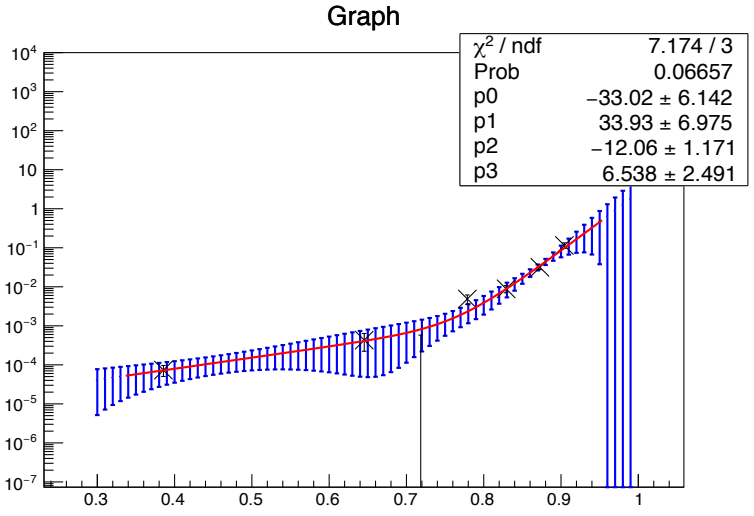
Fit of fake factors: W+jets MC

- tried different functions, fit with exp(**a**+**b**x) + exp(**c**+**d**x), but 4 parameters needed
- uncertainties are reduced in most parts

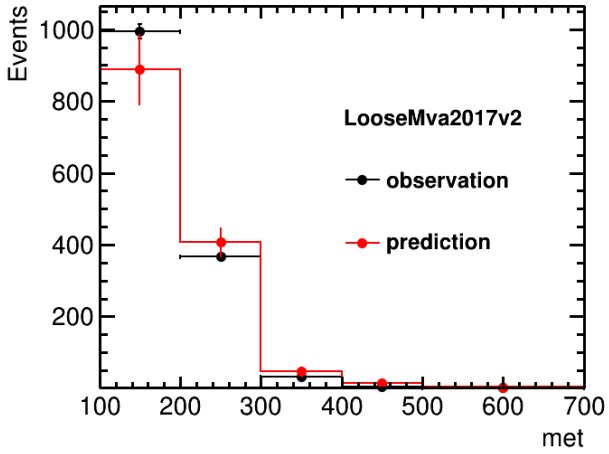


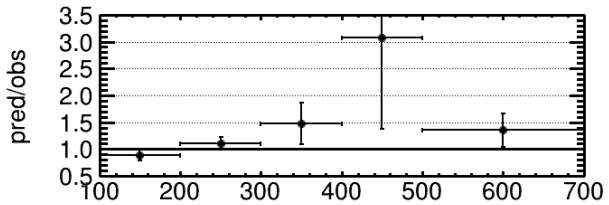


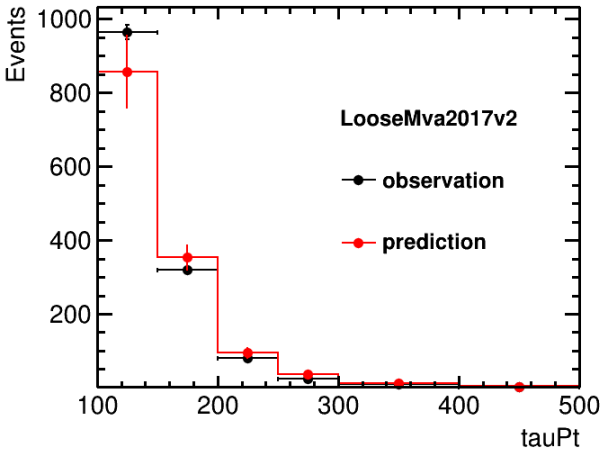


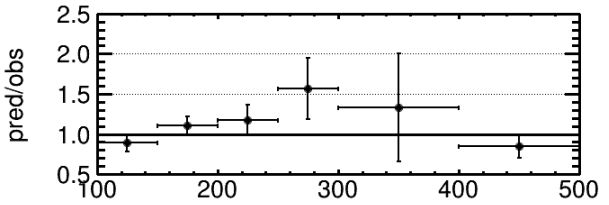


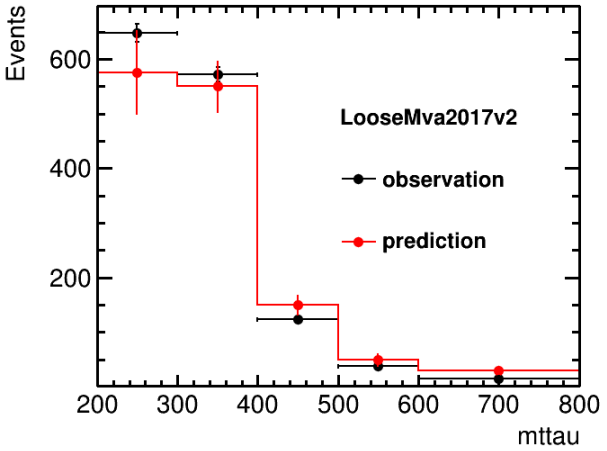
Closure test

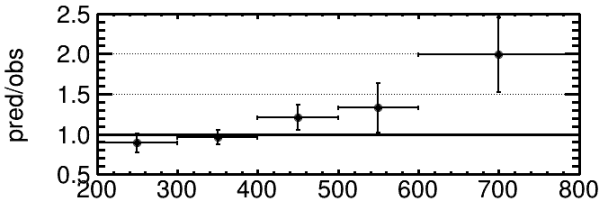


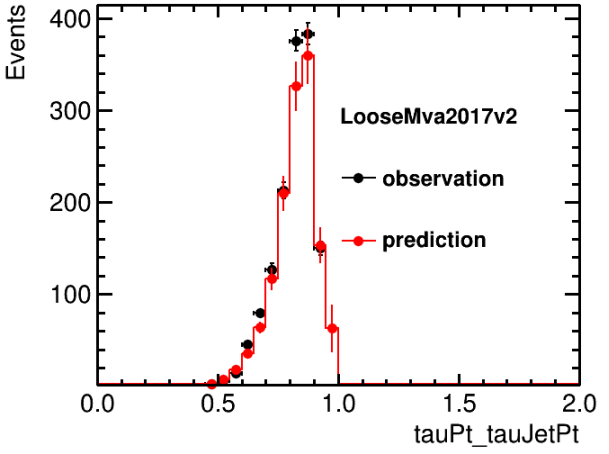


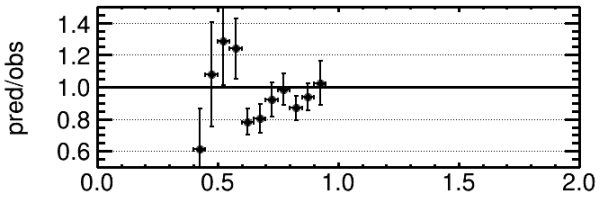












Summary and outlook

- uncertainties in fake factor background have to be reduced
- re-binning of fake factors gives smaller uncertainties, but worse closure
- performed first studies for fitting of fake rates
- fitting of fake factors as function of r, in bins of taujet pt:

  uncertainties are reduced,

  closure looks ~ok

  but many parameters needed for the fit

further ideas to study:

- different fit function?
- bin in ratio, fit taujet pT
- other ideas?

eμ channel in 2017 data

Control plots: inclusive signal region

08.10.2018

HELMHOLTZ RESEARCH FOR GRAND CHALLENGES

DESY.

First look into control plots with new ntuples

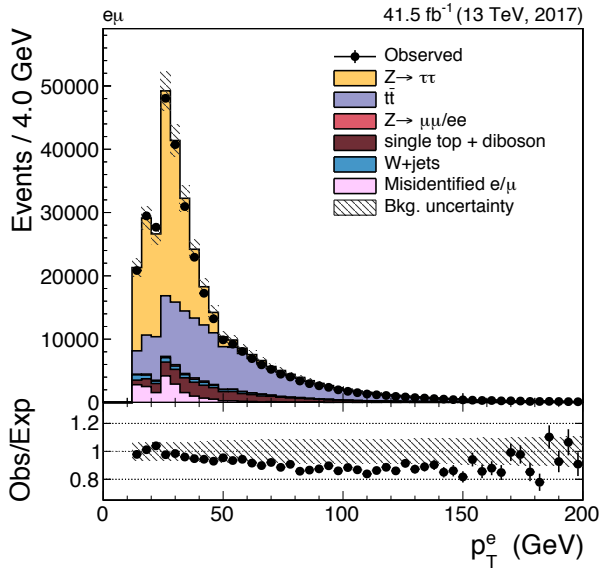
Selection:

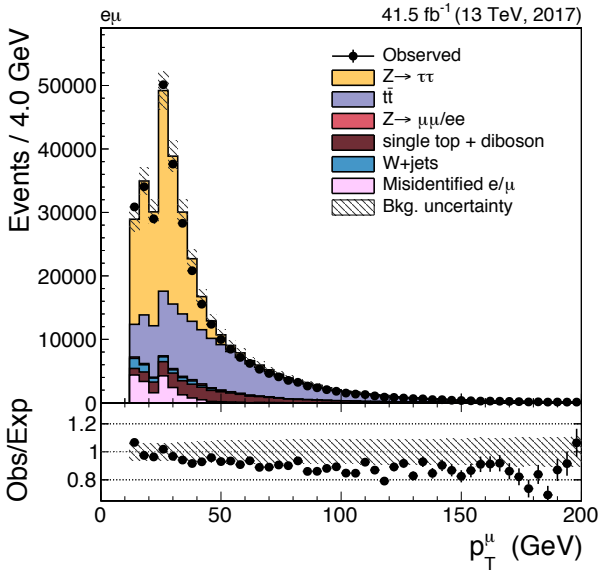
- good run selection, met filters
- HLT_Mu23_TrkIsoVVL_Ele12_CaloIdL_TrackIdL_IsoVL_DZ or HLT_Mu12_TrkIsoVVL_Ele23_CaloIdL_TrackIdL_IsoVL_DZ
- one isolated muon (pT > 13 GeV/24 GeV, |η|< 2.4, medium Id)
- one isolated electron (pT > 13 GeV/24 GeV, |η|<2.5, MVA Id)
- ΔR (μ,e) > 0.3, opposite sign
- veto additional leptons
- dzeta>-50

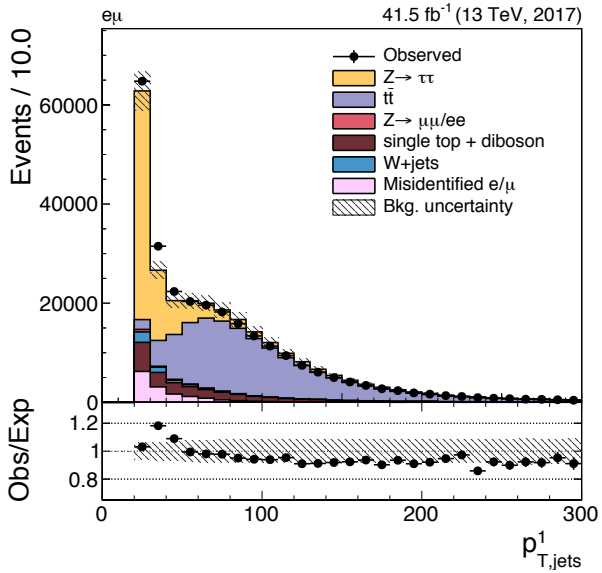
applied corrections:

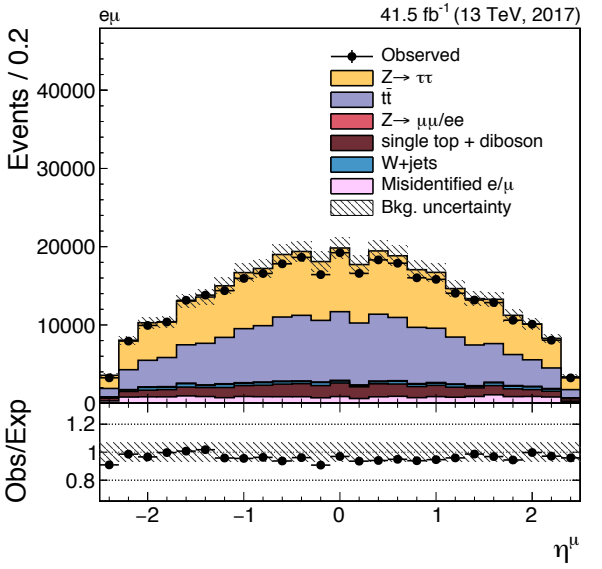
- PU re-weighting
- Id & iso SF
- tracking SF
- electron scale & smearing corrections
- JEC
- **note:** QCD SS/OS extrapolation factor set to 1

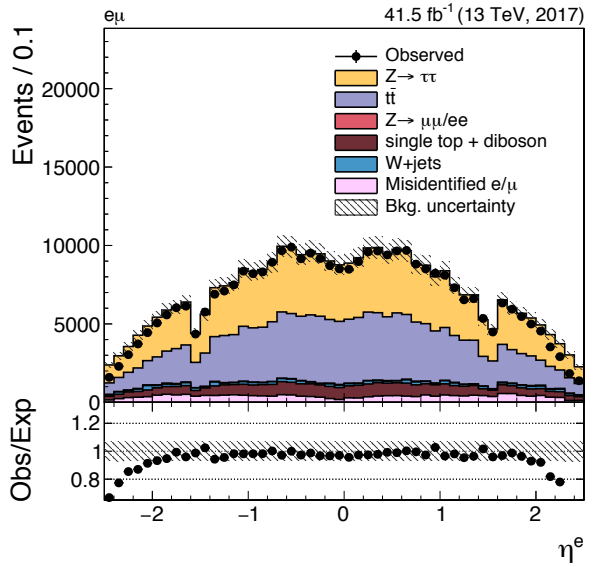
Control plots

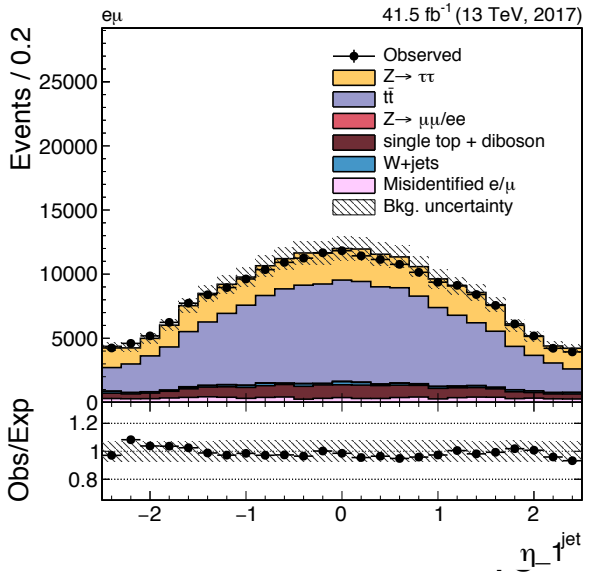




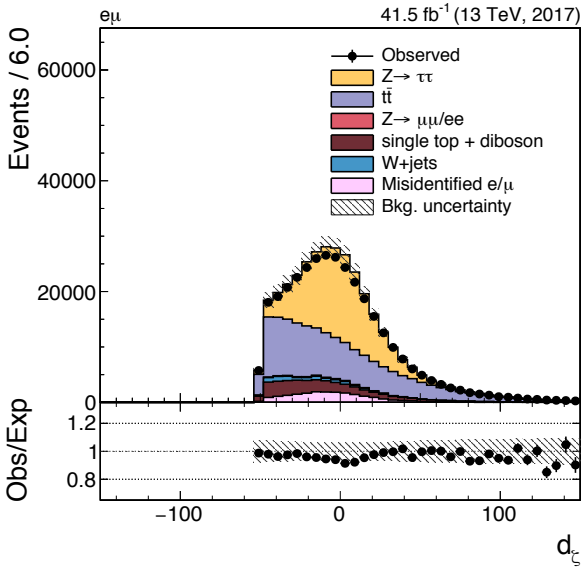


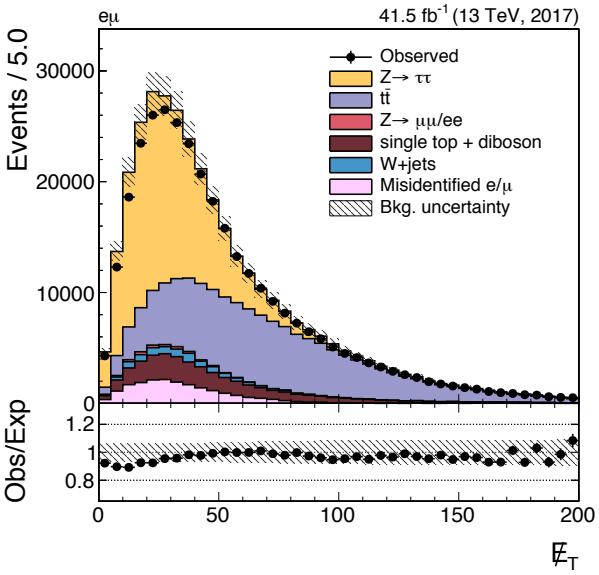


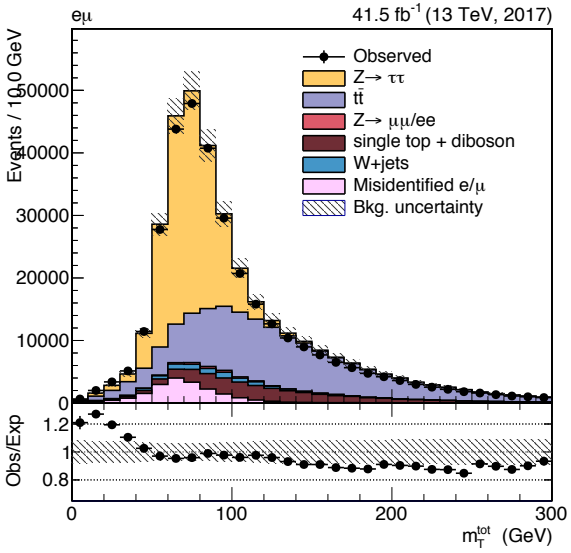


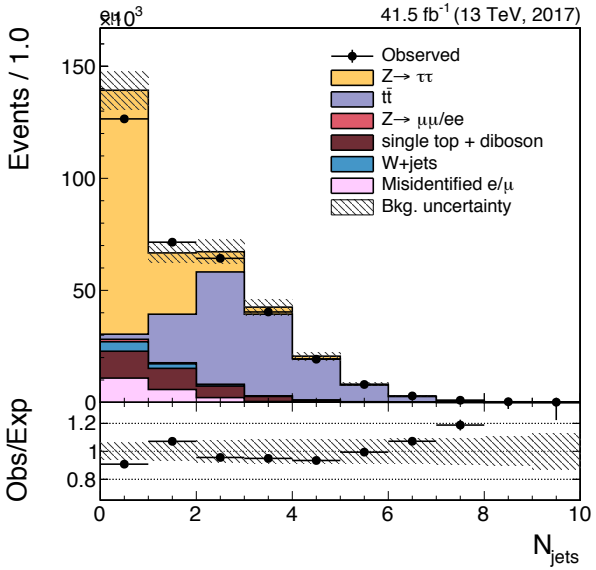


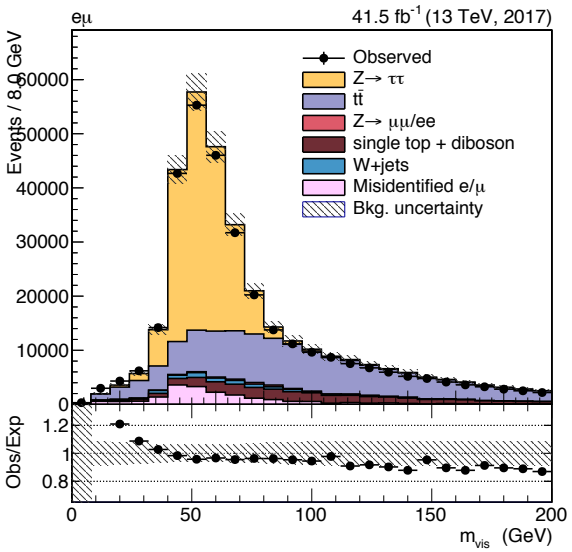
Control plots

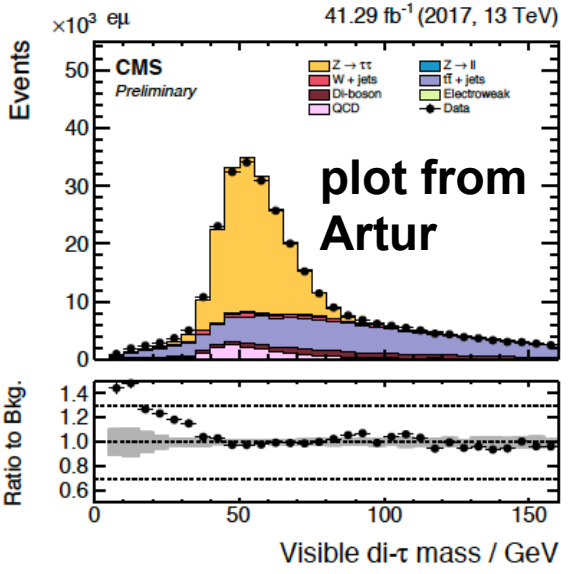












Next steps

- determine SS/OS extrapolation factor
- compare to Artur's synchronization ntuples
  - VBF ntuples still in production
- determine trigger efficiencies