

# PAT::Tau Tutorial



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DESY Seminar 07/01/09

# Objectives

## The Aim

- Learn about the “Connection” between Stan Lai’s Talk on Tau id. and how (hadronically decaying) Taus look like in CMS software
- Learn how to access Variables used in Tau id. from CMSSW Data-Formats
- Learn where to find Documentation about Tau id. In CMS

## The Path

- Read wiki Pages
- Browse cvs Repository
- Book and fill Histograms of Tau id. Variables

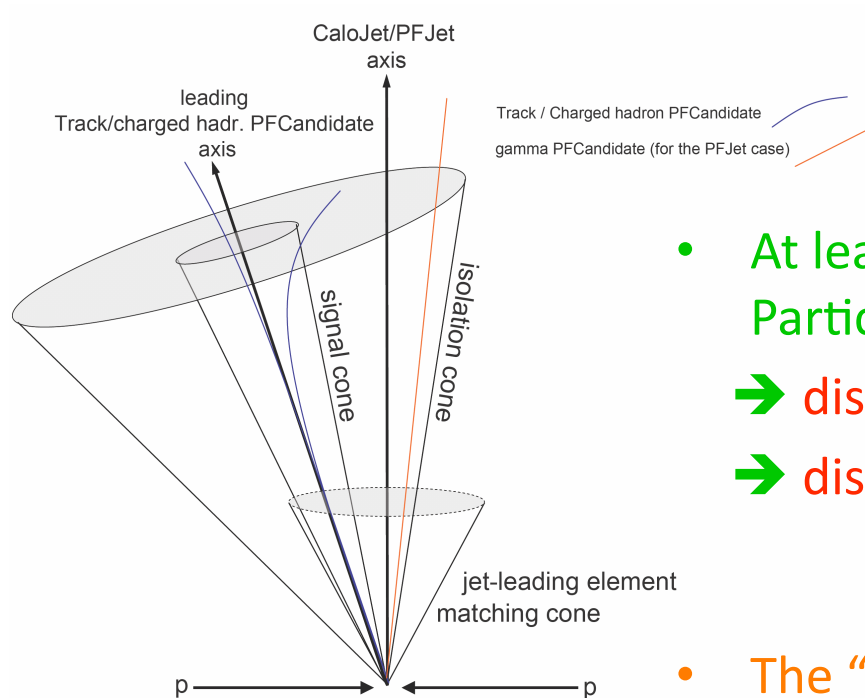
# Taus in CMS (1/2)

- (hadronically decaying) Taus can be identified from Jets either reconstructed using Calorimeter information alone (→ CaloJets) or from a combination of Calorimeter + Track information (→ PFJets)
- In both cases, Tau id. proceeds by requiring all Particles within the Jet to be concentrated in a narrow Signal, surrounded by an “empty” Isolation cone
- In CMS, identifying hadronically decaying Taus means tagging Jets:
  - Tau Jet : discriminator > cut
  - QCD Jet : discriminator < cut

In principle, the cut value can be tuned for your Analysis

It turns out, however, that generally good Performance can be achieved for most Analysis using a “standard” Set of Tau id. requirements

# Taus in CMS (2/2)



- At least 1 high  $P_T$  charged or neutral “leading” Particle is required within the Signal cone
  - ➔ `discriminatuinByLeadingTrack`
  - ➔ `discriminationByLeadingPion`
- The “emptiness” of the Isolation cone is quantified by either counting the Number of Tracks with  $P_T > 1$  GeV or training a Neural Network
  - ➔ `discriminationByIsolation`
  - ➔ `discriminationByTaNC`  
 (“Tau Neural Classifier”)

# Tau Data-Formats in CMSSW (1/2)

For knowing how to get access to Tau id. Variables, you need to know about the Inheritance Hierarchy of the PAT::Tau:

tricky Usage of C++  
Templates, simplified in  
future PAT versions

- pat::Tau inherits from pat::Lepton<reco::BaseTau>  
DataFormats/PatCandidates/interface/Tau.h
- pat::Lepton<reco::BaseTau> inherits from pat::Object<reco::BaseTau>  
DataFormats/PatCandidates/interface/Lepton.h
- pat::Object<reco::BaseTau> inherits from reco::BaseTau  
(common base-Class for reco::CaloTau and reco::PFTau)  
DataFormats/TauReco/interface/BaseTau.h
- reco::BaseTau inherits from reco::RecoCandidate  
DataFormats/RecoCandidate/interface/RecoCandidate.h
- Reco::Candidate inherits from reco::LeafCandidate  
DataFormats/Candidate/interface/LeafCandidate.h
- Reco::LeafCandidate inherits from reco::Candidate  
DataFormats/Candidate/interface/Candidate.h
- Reco::Candidate inherits from reco::Particle  
DataFormats/Candidate/interface/Particle.h

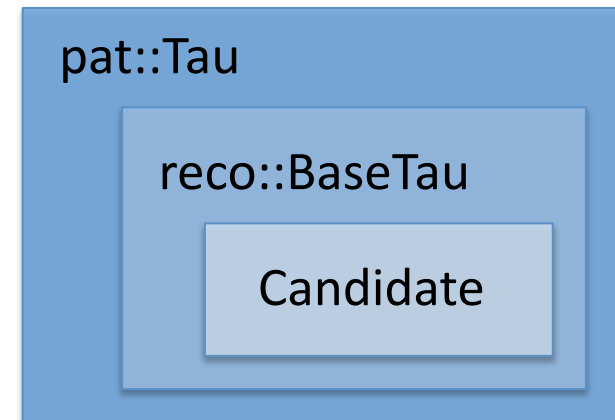
Puh!!

# Tau Data-Formats in CMSSW (2/2)

Please don't get scared by all these levels of Inheritance

In practice, I find it sufficient (most of the time) to keep in mind the two Levels:

- `pat::Tau`  
(for Tau id. Variables and Discriminators)
- `reco::Candidate`  
(for generic Particle information  
like Energy,  $P_T$ ,  $\eta$  and  $\phi$ )



An important thing to keep in mind, though, is that in case a method is implemented in a base-Class and reimplemented in a derived Class, the derived Class Implementation is the one that actually gets called

➔ when looking for a method to access a certain Tau id. Variable start searching for it from the “top” of the Inheritance Hierarchy

# Documentation

- Tau id. for PFJets described in the Analysis Note CMS AN-2008/043:  
“Tau reconstruction and identification with particle-flow techniques  
using the CMS detector at LHC”

[http://cms.cern.ch/iCMS/jsp/openfile.jsp?tp=draft&files=AN2008\\_043\\_v12.pdf](http://cms.cern.ch/iCMS/jsp/openfile.jsp?tp=draft&files=AN2008_043_v12.pdf)

- Tau id. wiki in CMSSW software Guide:

<https://twiki.cern.ch/twiki/bin/view/CMS/SWGuidePFTauID>

- CMSSW cvs Repository:

<http://cmssw.cvs.cern.ch/cgi-bin/cmssw.cgi/CMSSW/>

<http://cmslxr.fnal.gov/lxr/search>

- Particle-Flow & Tau id. Hypernews Forum:

<https://hypernews.cern.ch/HyperNews/CMS/get/eflow.html>

# Now it is your Turn!

- Open:
  - [PhysicsTools/PatExamples/plugins/PATTauAnalyzer.h](#)
  - [PhysicsTools/PatExamples/plugins/PATTauAnayzer.cc](#)
- Add Histograms for:
  - $\eta$  and  $\phi$  of Tau Jet
  - $P_T$  of leading Track
  - discriminatorAgainstElectron
- Compile and Test your Changes:

```
cd PhysicsTools/PatExamples
cmsenv
scramv1 b
cmsRun analyzePatTau_fromPatTuple_cfg.py

root patTau_idEfficiency.C
new TBrowser
```