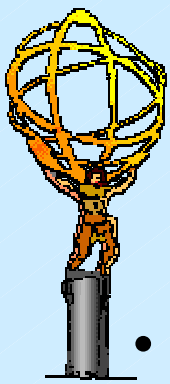


$A \rightarrow \tau\tau \rightarrow \text{hadrons}$

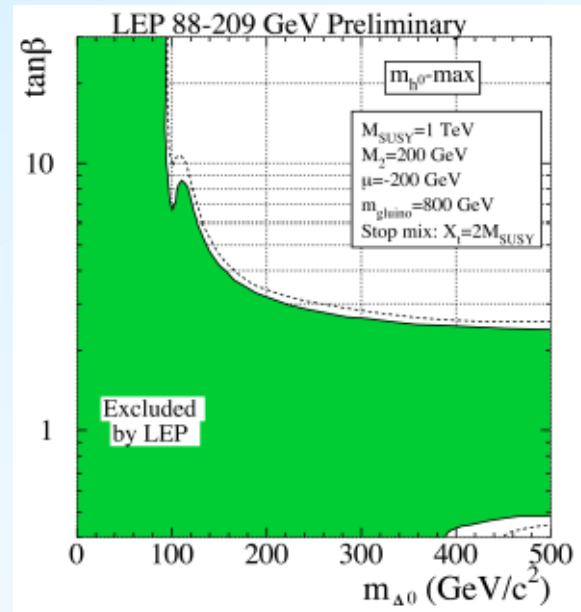
Headlines

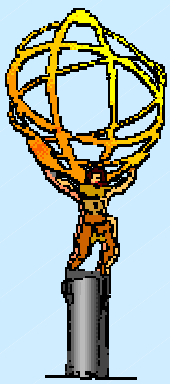
- Introduction
- Vertexing
- Analysis
- 2/3 layers comparison
- To do ...
- Conclusions



Introduction

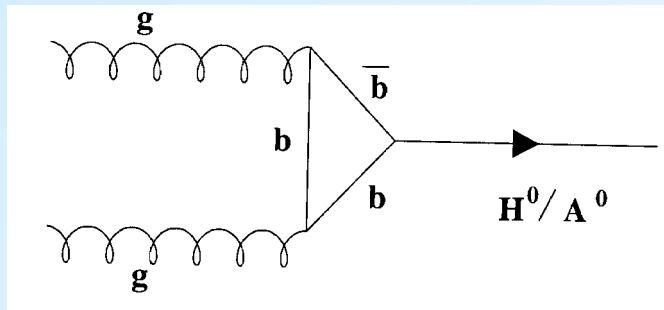
- MSSM: 5 bosoni di Higgs: h, H, A, H^+, H^- .
- At tree-level bosons masses are functions of m_A (CP-odd Higgs boson) and $\tan\beta$ ($\tan\beta = v_2/v_1$).
- LEP: $M_A > 91.9$ (al 95% CL).





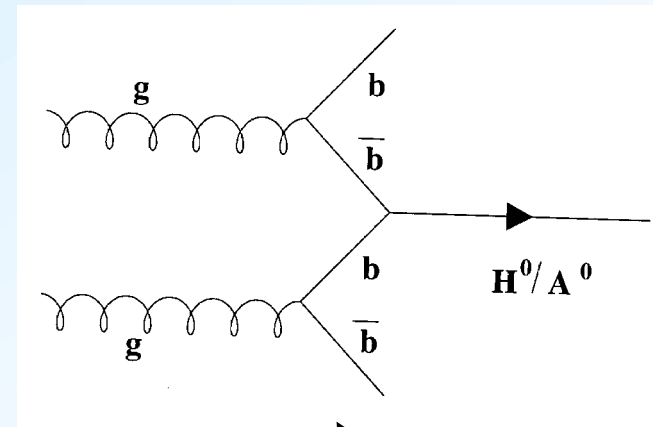
... Introduction

Direct

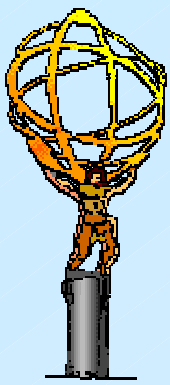


Dominates at low $\tan\beta$.

Associated

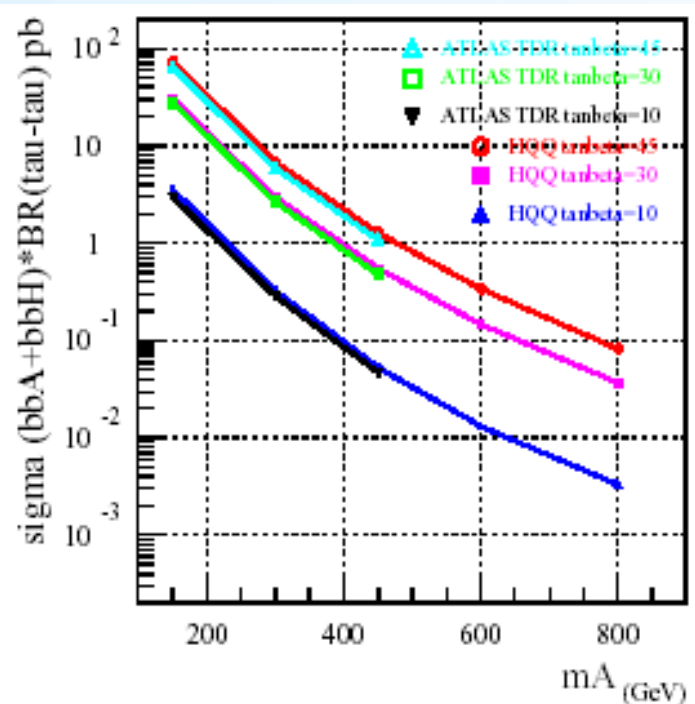
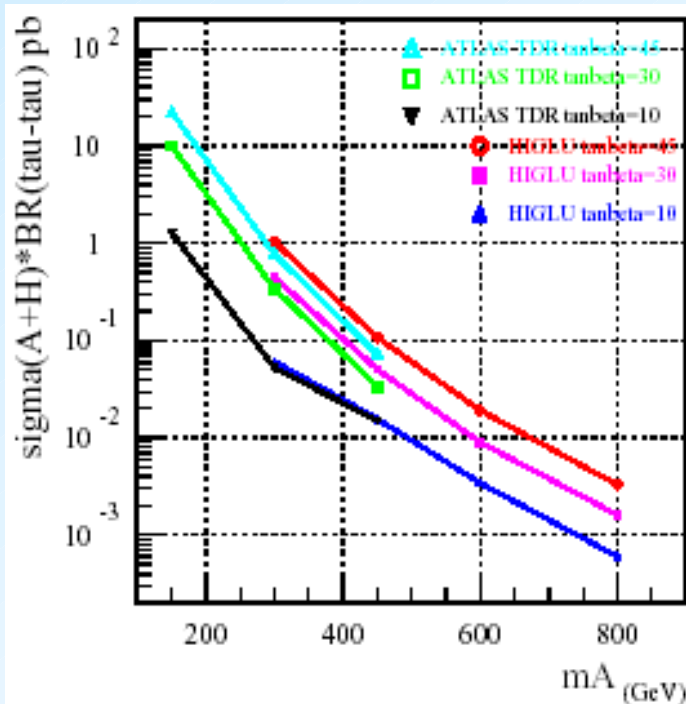


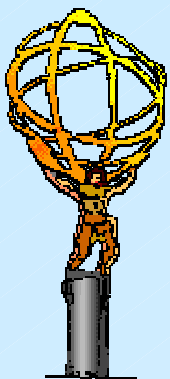
Dominates at high $\tan\beta$



... Introduction

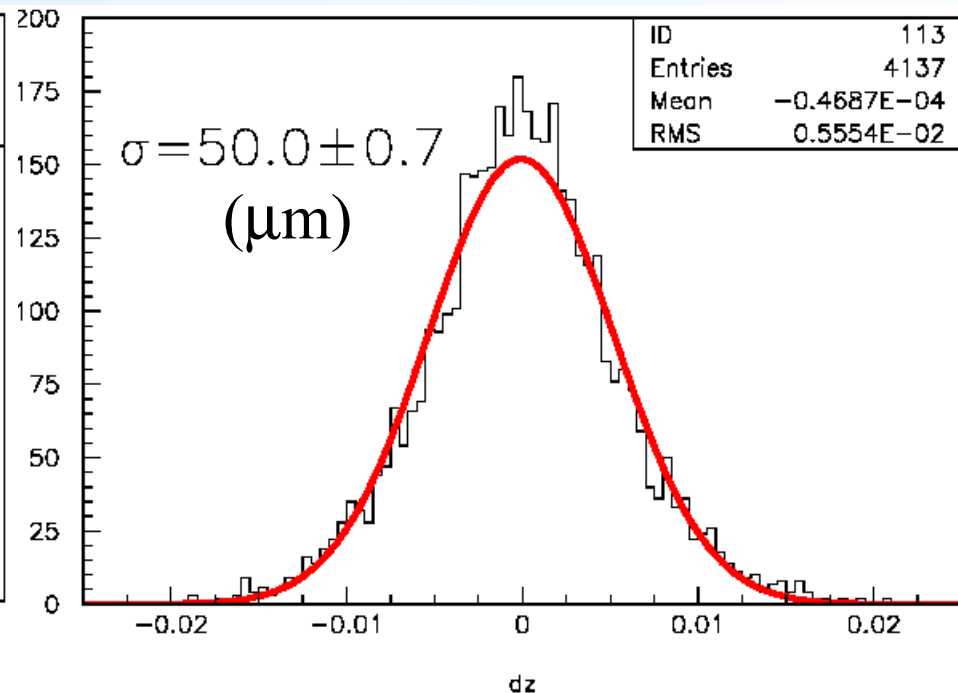
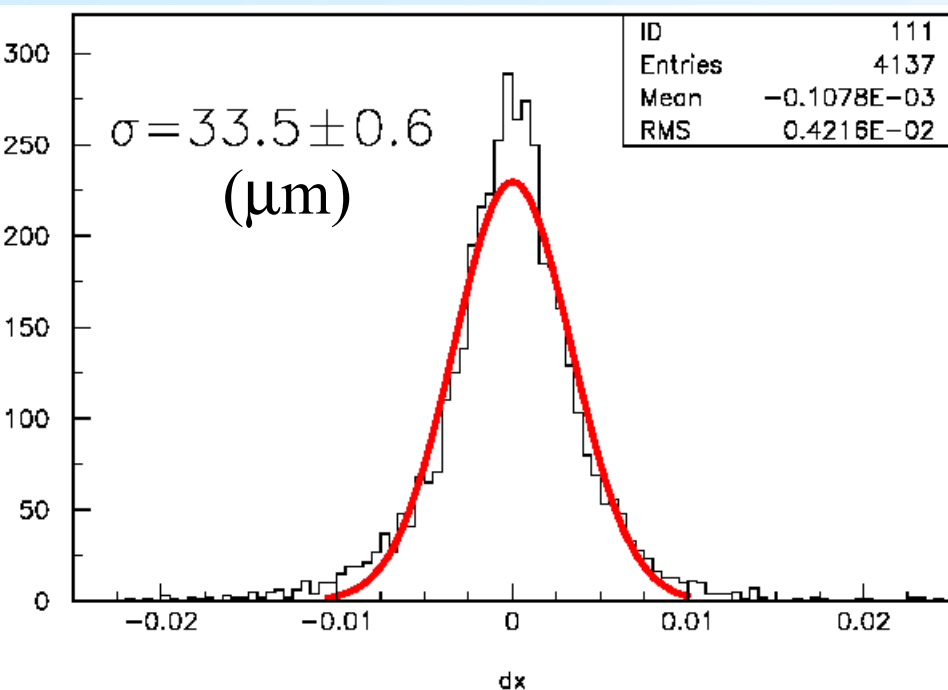
- $A \rightarrow \tau\tau$ important at high $\tan\beta$
- $BR(\tau\tau) \sim 10\%$.
- $\sigma \cdot BR(\tau\tau) \sim 10^{-1}$ pb ($\sim 3 \cdot 10^{-3}$ pb direct production) at $\tan\beta = 45$ and $m_A = 800$ GeV .

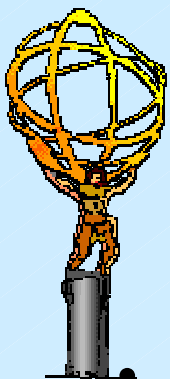




Vertexing

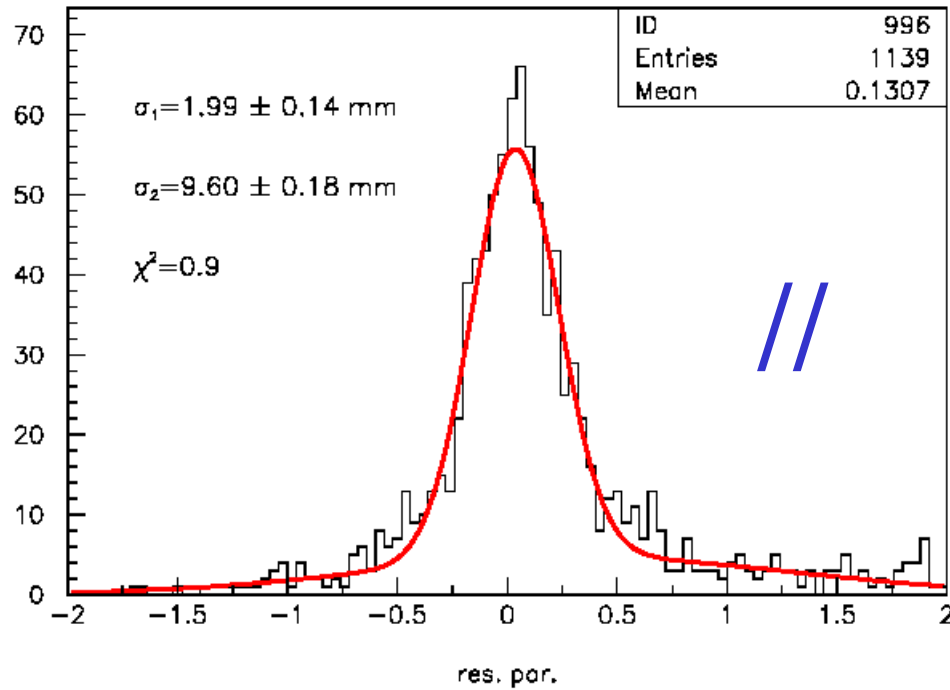
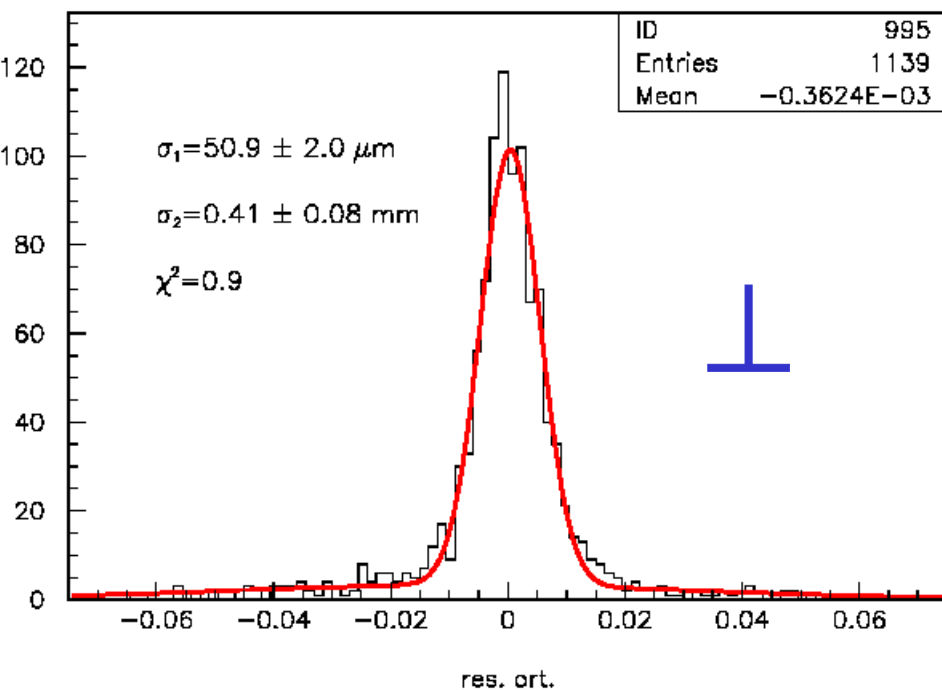
- The Vertexing tool is used to find primary and secondary vertices
- Fair primary vertex resolution

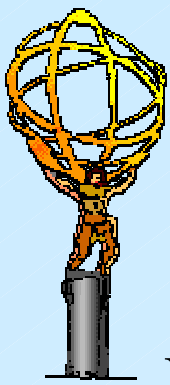




... Vertexing

- Fair secondary vtx resolution in the direction orthogonal to the jet axis
- Bad resolution along the jet axis: τ jets narrowness

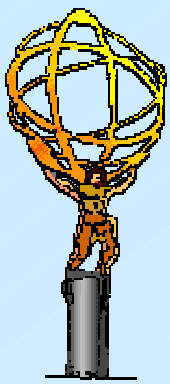




Analysis

What has been already done:

- TDR studies using full simulation: only calorimetric information and m_A range between 150 and 450 GeV
- Further papers from D. Cavalli et al. using fast simulation
- tauRec package working in Athena and tested on a few samples: τ identification relies mostly on calo. info. (SimpleTracks also used)

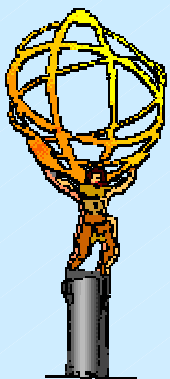


... Analysis

Data samples

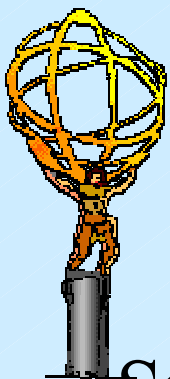
- $gg \rightarrow bb$ A A $\rightarrow \tau\tau \rightarrow$ jets (~ 4000 evts.)
- TDR qcd jets (~ 16000 evts.)
- qcd di-jets evts. generated with different $\sqrt{\hat{s}}$

TDR geometry used.



... Analysis

- Step 1: find jets
- Step 2: apply isolation criteria to select τ candidates
- Step 3: fit vertex for candidates with more than 1 track
- Step 4: use vertexing information to select τ 's

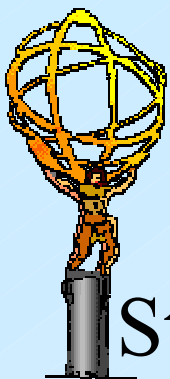


... Analysis

Step 1: find jets

tauRec with non-default parameters used as a jet-finding algorithm. The parameters used to discriminate τ jets have been modified to keep all jets found

tauRec algorithm has been found more reliable than jetRec, performing tests on τ and b jets samples

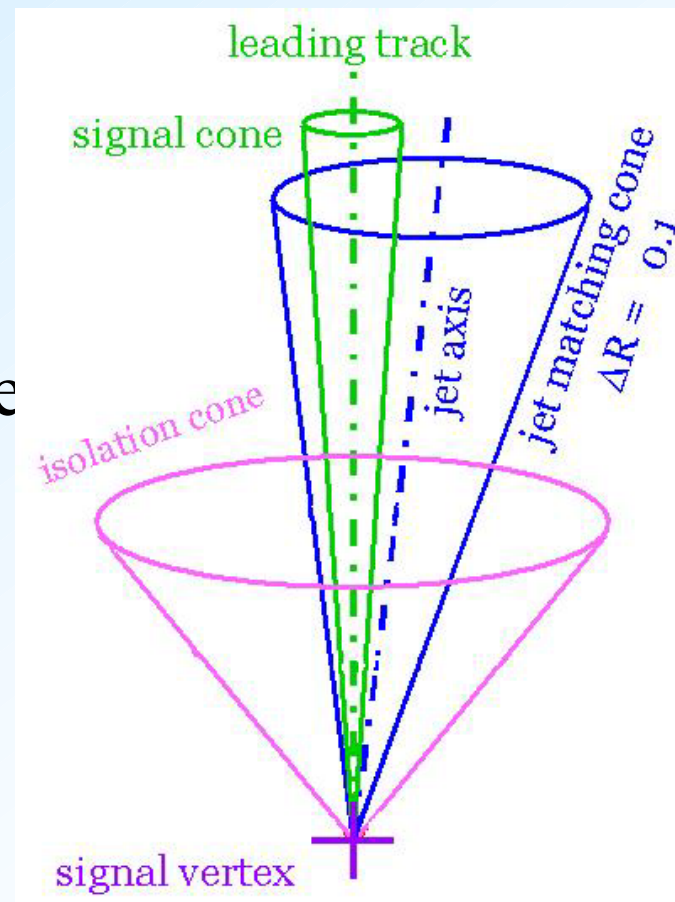


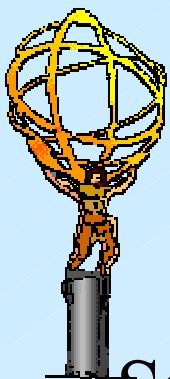
... Analysis

Step 2: $\Delta R_{em} < 0.12$ and
isolation (à la CMS)

- no more than 3 tracks in the
signal cone ($\Delta R=0.03$)
- no tracks in the isolation cone
($\Delta R=0.4$)

Step 3: tauRec's selected
tracks are fitted to find vtx if
they satisfy isolation criteria





... Analysis

Step 4: cut #1 .OR. cut #2 .OR. cut #3

#1

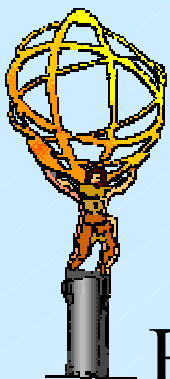
- 3 tracks
- $pT_3 > 7 \text{ GeV}$
- $\Sigma\chi^2_i$ contribution to the secondary vtx less than contribution to the primary

#2

- 3 tracks
- $pT_2 > 40 \text{ GeV}$
- vertex fit OK

#3

- $\Delta r > 0.4 \text{ cm}$
 - $pT_1 > 50 \text{ GeV}$
 - 2 tracks + $pT_2 > 35 \text{ GeV}$
 - 3 tracks + $pT_2 > 25 \text{ GeV}$
- OR**



... Analysis

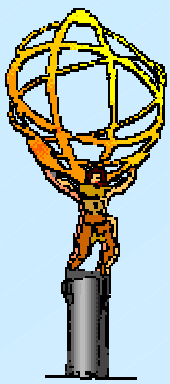
Results

	tau 3 prong	tau 1 prong	qcd 100-500	qcd 500-1000	qcd 1000	TDR qcd			H400 -> bb
	~1600	~6400	800	3120	4900	<----- 16000 events----->			1050
ISO	1147	3743	3	9	9	2	3	5	4
tau selection	942	164	0	4	0	0	0	0	0
cut #1	593	95	0	1	0	0	0	0	0
cut #2	711	68	0	4	0	0	0	0	0
cut #3	749	120	0	1	0	0	0	0	0

$$\epsilon_{3\text{-pr}} = 58.9\% \quad \epsilon_{1\text{-pr}} = 58.5\%$$

$$\epsilon_{\text{tot}} = 58.6\%$$

vertexing contribution: **+11.8%**

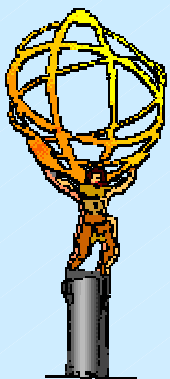


3/2 layers

Second layer turned off. Material still there.

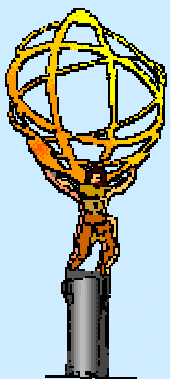
	tau 3 prong	tau 1 prong	qcd 100-500	qcd 500-1000	qcd 1000	TDR qcd		
	~1600	~6400	800	3120	4900	<----- 16000 events----->		
ISO	1147	3743	3	9	9	2	3	5
	973	3529	3	5	8	2	2	4
tau selection	942	164	0	4	0	0	0	0
	811	167	0	1	0	0	0	0
cut #1	593	95	0	1	0	0	0	0
	588	105	0	0	0	0	0	0
cut #2	711	68	0	4	0	0	0	0
	578	77	0	1	0	0	0	0
cut #3	749	120	0	1	0	0	0	0
	678	123	0	0	0	0	0	0
				3 layers				
				2 layers				

Less efficiency, less bkg. $\Delta\epsilon_{3\text{-pr}} = -8.2\%$ $\Delta\epsilon_{\text{tot}} = -4.3\%$



To do ...

- Generate and analyze signal and qcd with new geometry
- Generate and analyze more bkg samples (e.g. $t \bar{t}$, $W + \text{jet}$, etc.)
- Implement the new τ identification in the existing analysis



Conclusions

- Existing τ identification has been implemented with ID information and Vertexing tool in order to recover 3-prong τ decays
- Encouraging results both in signal efficiency and in qcd jet rejection
- New samples with more statistic needed to complete the job