Recap (as of Nathan's presentation)

- Earlier the signal MC was produced with Fastsim with Pythia6 doing the τ decays (Tauola block being deactivated)
- There were issues with Tauola in 5_3_X
- Overcome this issue with Tauola++ (can be invoked only in CMSSW_6_2_X onwards)
- Successfully tested Tauola++ for decaying τ's in 6_2_X – the production was validated and checked with Tauola experts (Aachen group)

- Caveat: That case the signal MC will be done in CMSSW_6_2_X but rest of the samples will remain in 5_3_X.
- This posed problems and hence had to look for other solutions
- Decided to use particle *embedding technique* developed by C. Veelken et al (for Ztautau samples)
- This consists of using standard Htautau sample produced in 5_3_X and replace the τ's with μ's at the generator level and then let it run through the full reconstruction chain.
- Work ongoing adopting this method

Today

- Finally – **we have a Solution**
- Many Thanks to *Steve Mrenna*
- After spending some time trying the Embedding method (ParticleReplacement) I came back to do it in a more formal way
- Discussion between Tauola experts / Pythia experts(Steve) / myself / CMS generator personnel (Vitaliano)
- Conclusion: To use Pythia8 !

- Main advantage of using Tauola was that it took care of tau decays in all prongs thereby producing more visible energy (That is why using mere Pythia to decay the τ's – the results would not have been approved)

- Apparently there were requests from both ATLAS and CMS to Pythia to take care of τ decays for exotic processes and the Pythia8 team responded to it.

- It's official!

Pythia8 to the rescue !

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PYTHIA 8

Welcome to PYTHIA - The Lund Monte Carlo!

PYTHIA 8 is the successor to PYTHIA 6, rewritten from scratch in C++. With the release of PYTHIA 8.1 it now becomes the official "current" PYTHIA version, although PYTHIA 6.4 will be supported in parallel with it for some time to come. Specifically, the new version has not yet been enough tested and tuned for it to have reached the same level of reliability as the older one. This testing will only happen if people begin to work with the program, however, which is why we encourage a gradual transition to the new version, starting now. There are some new physics features in PYTHIA 8.1, that would make use of it more attractive, but also some topics still missing, where 6.4 would have to be used. Further, many obsolete features will not be carried over, so for some backwards compatibility studies again 6.4 would be the choice.

Pythia8 version #

- 8.175: 18 February 2013: (from Pythia8 **Update History**)

The sophisticated tau decay machinery has been expanded so that it can also handle production of taus in hypothetical lepton-number-violating processes, such as H0 -> tau+ mu-.

So now one can bypass Tauola and do everything with Pythia8 !

```
ParticleDecays:sophisticatedTau  = 2
ParticleDecays:tauPolarization = 0
ParticleDecays:tauMother = 25
```

Tau Decays in Pythia 8

Philip Ilten

arxiv.org:1211.6730

Abstract

As of version 8.150 of Pythia, the isotropic decay model of τ-leptons has been replaced with sophisticated τ-lepton decay machinery. The decays and spin correlations for τ-leptons in Pythia 8 are described, including the spin correlation algorithm, the available τ-lepton production processes, the τ-lepton decay models, the user interface, and the implementation.

Multiplicity	Model		$\mathcal{M}$	Decay Products
2-body	single hadron		1521	π^-, K^-
3-body	leptonic		1531	$e^-\bar{\nu}_e$, $\mu^-\bar{\nu}_\mu$
	Kühn and Santamaria	[9]	1532	$\pi^0\pi^-$, K^0K^-, ηK^-
	Finkemeier and Mirkes	[10]	1533	$\pi^-\bar{K}^0$, π^0K^-
4-body	CLEO	[11]	1541	$\pi^0\pi^0\pi^-$, $\pi^-\pi^-\pi^+$
	Finkemeier and Mirkes	[12]	1542	$K^-\pi^-K^+$, $K^0\pi^-\bar{K}^0$, $K^0_S\pi^-K^0_S$, $K^0_L\pi^-K^0_L$, $K^0_S\pi^-K^0_L$, $K^-\pi^0K^0$, $\pi^0\pi^0K^-$, $K^-\pi^-\pi^+$, $\pi^-\bar{K}^0\pi^0$
	Decker, et al.	[13]	1543	$\pi^0\pi^0\pi^+$, $\pi^-\pi^-\pi^+$, $K^-\pi^-K^+$, $K^0\pi^-\bar{K}^0$, $K^-\pi^0K^0$, $\pi^0\pi^0K^-$, $K^-\pi^-\pi^+$, $\pi^-\bar{K}^0\pi^0$, $\pi^-\pi^0\eta$
	Jadach, et al.	[14]	1544	$\gamma\pi^0\pi^-$
5-body	Novosibirsk	[15]	1551	$\pi^0\pi^-\pi^-\pi^+$, $\pi^0\pi^0\pi^0\pi^-$
6-body	Kühn and Wąs	[16]	1561	$\pi^0\pi^0\pi^-\pi^-\pi^+$, $\pi^0\pi^0\pi^0\pi^0\pi^-$, $\pi^-\pi^-\pi^-\pi^+\pi^+$

This takes care of the visible energy for which we were using Tauola

More caveat and more solutions

- The problem is Pythia8.175 comes with CMSSW_6_2_0 onwards
- in CMSSW_5_3_3 we have Pythia8.153 (which is buggy)
- **But there is a work around..**
- One can use an earlier version of CMSSW but still set external Pythia8.175 generator
- **How to setup the SCRAMV1 tool with pythia8 version different from CMSSW default**

  See this Twiki:

  https://twiki.cern.ch/twiki/bin/view/CMS/Pythia8Interface#How_to_setup_the_SCRAMV1_tool_wi
- But with this I shall have to submit local condor jobs and can not do it over CRAB (at least I don't know of a way to transfer external tools via crab)