Updates on η treatment in $\tau \to \mu\mu\mu$

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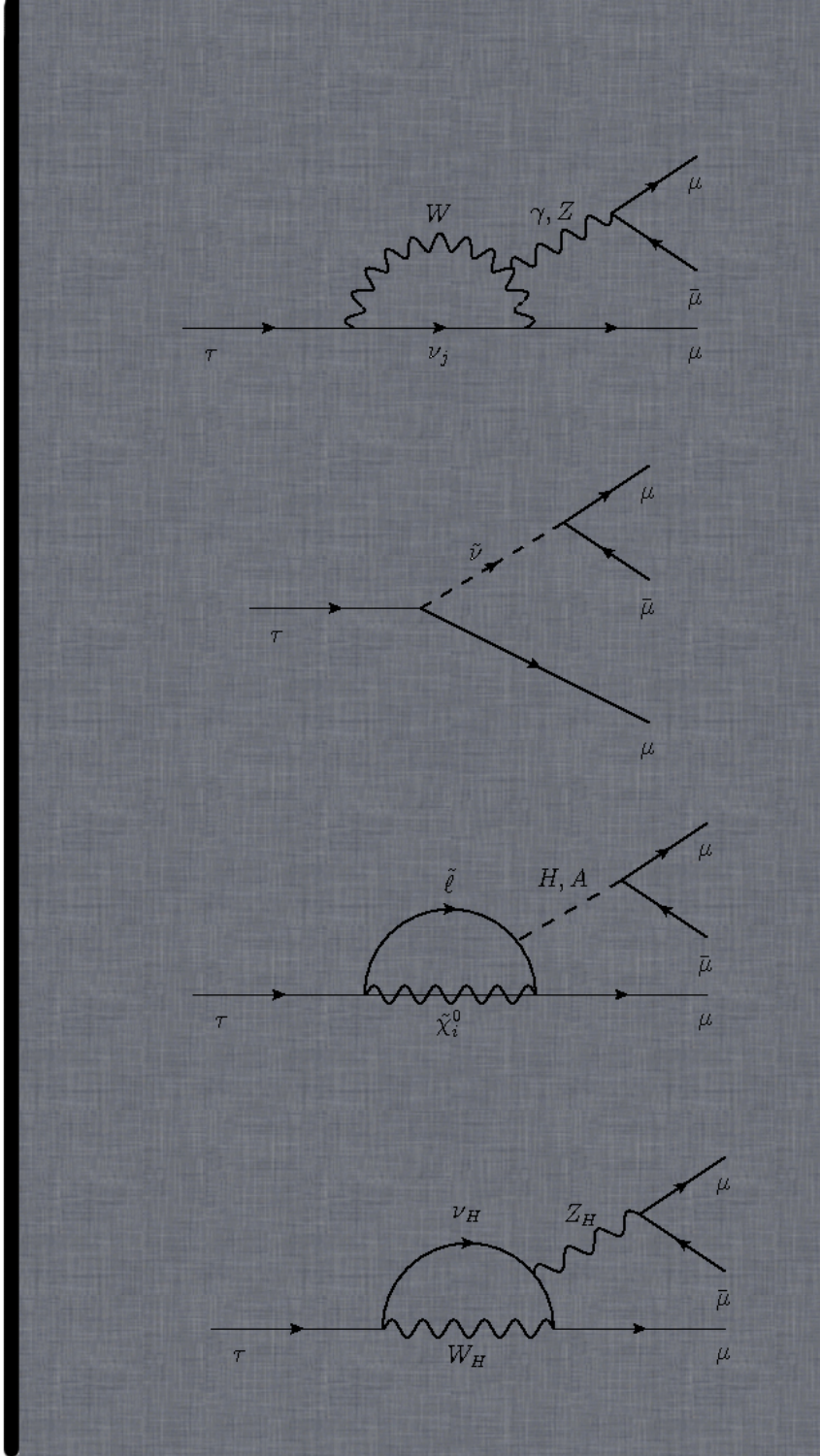
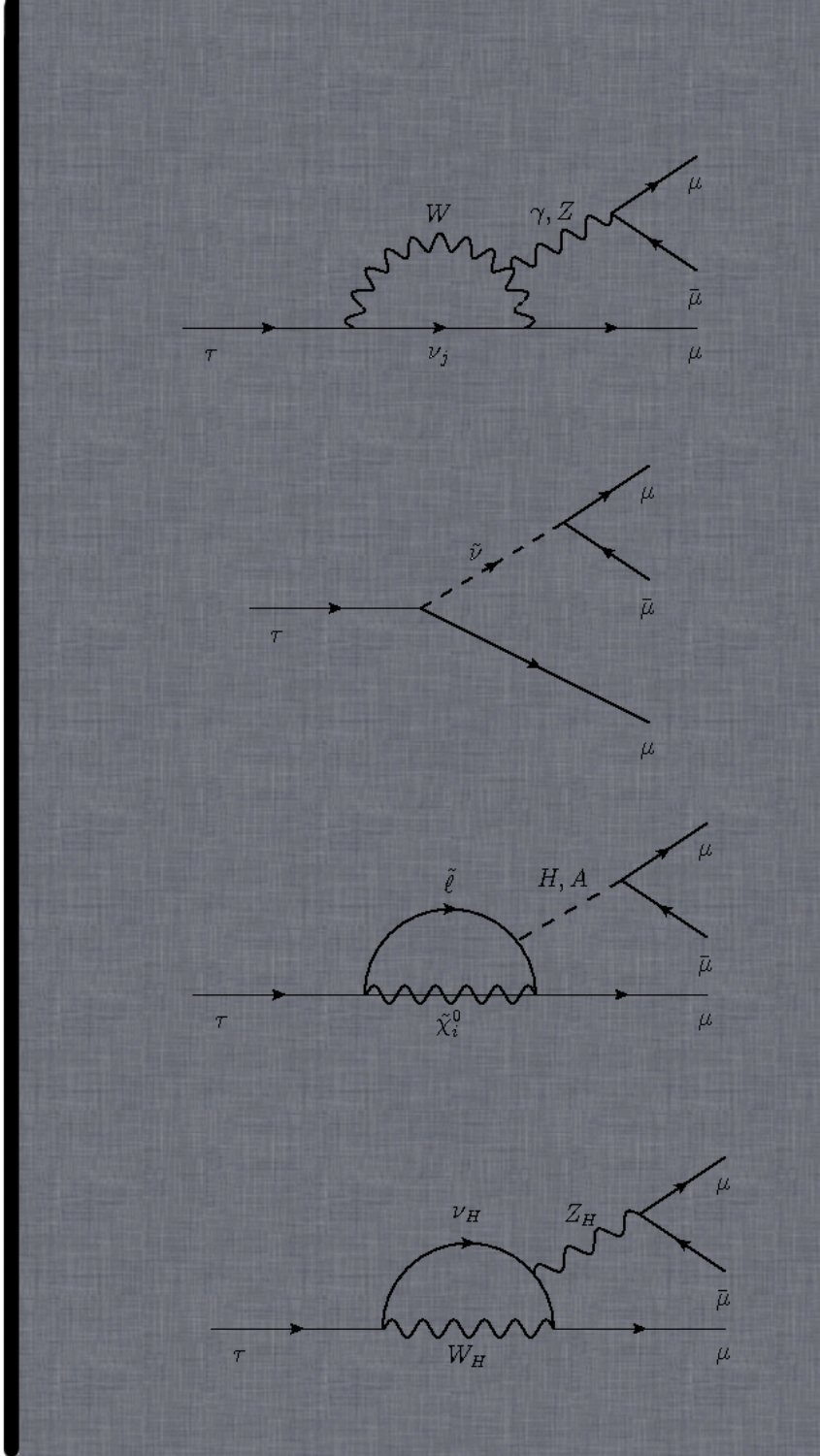


Limit studies

- Present status
- Throwing away garbage
- Problem!

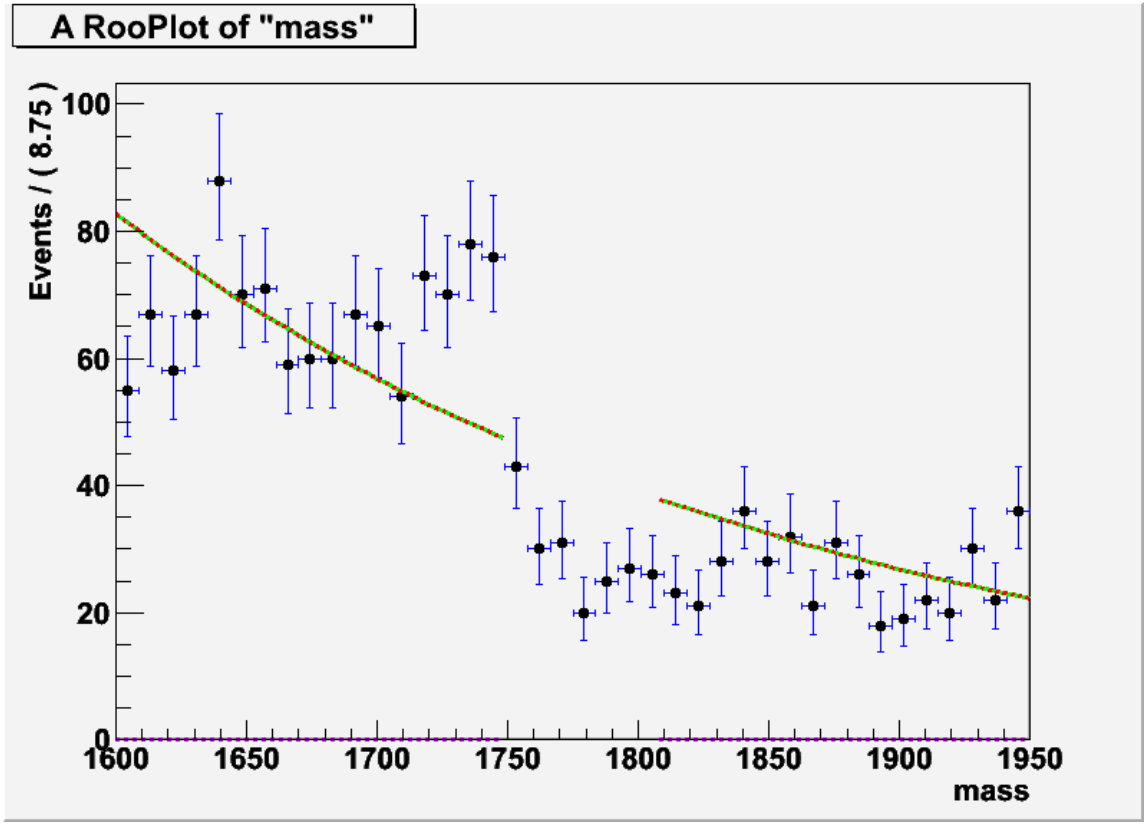
Getting ride of η

- η contamination
- Dalitz
- Callibration sample
- Tricks and tips
- TMVA for η



Where are we?

- 5 $\times$ 5 bins in PID and GEO.
- 4 $\times$ 4 have meaning according to binning optimisation.
- ”Trash bins” are rejected in the binning optimisation procedure.
- ”Trash bins” have unroftunatelly SM background.



To be, or not to be: that is the question.

Do we really need the trash bin and what is the impact on the limit?

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Throwing away garbage

To fully evaluate the impact of trash bins on the limit:

- Kick off all trash bins.
- New α from Paul
- Calculate the limit again(with the same script!) with and without garbage.

Results:

- Expected limit with garbage: 8.18×10^{-8}.
- Expected limit w/o garbage: 8.21×10^{-8}.

Conclusion

Let's once and for always take out the garbage.

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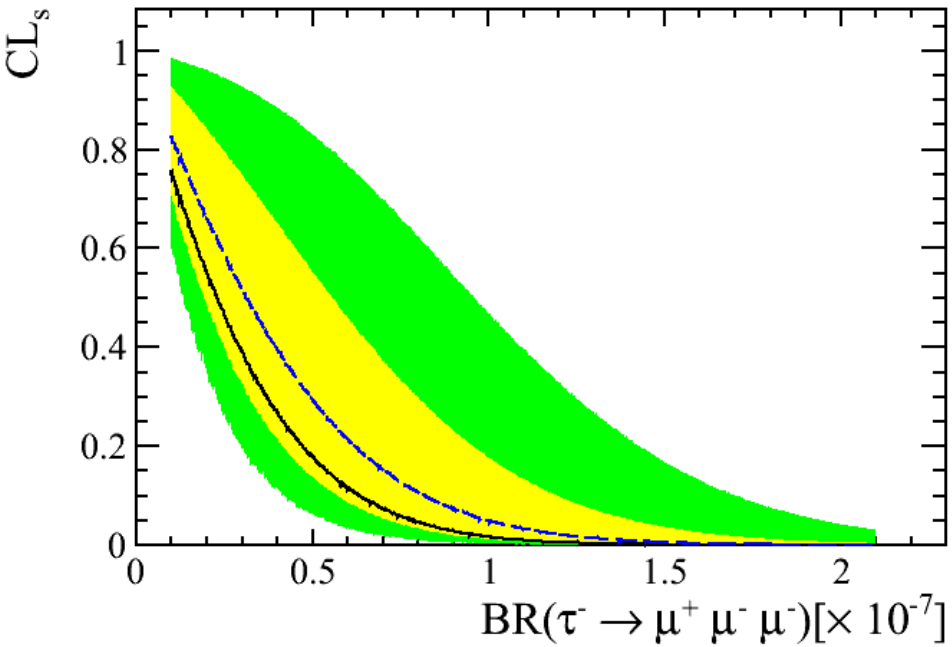
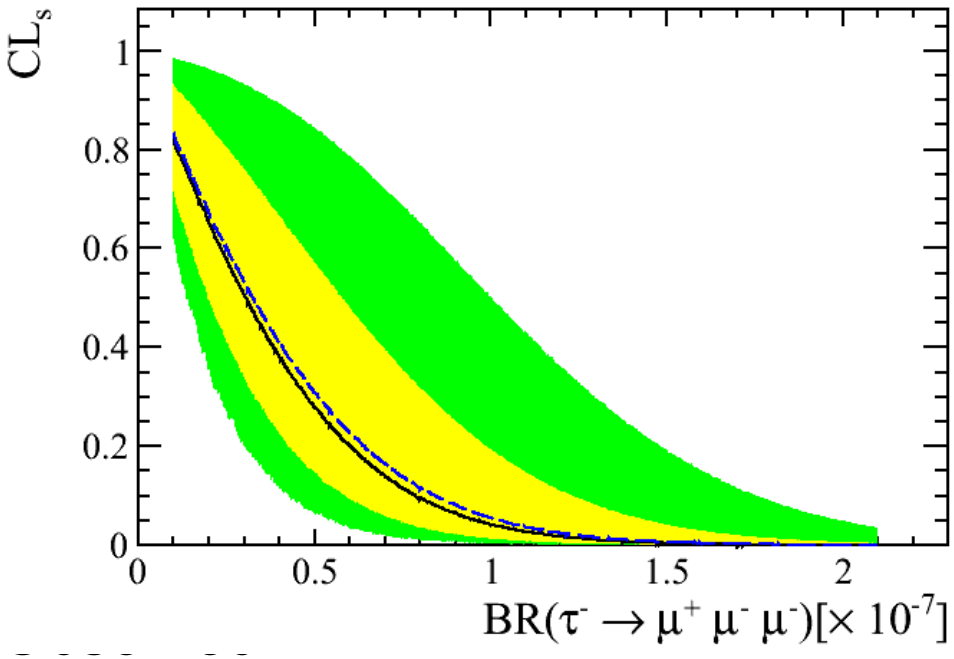
Problem

Unfortunatelly even tho the expected limit doesn't change:



limit: 6.33×10^{-8}



limit: 7.89×10^{-8}

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η contamination

In the note you can find the updated table with eta contibution in each bin.
The only change was that I changed R form $R = 0.1748$ to $R = 0.1798$. The dicrepancy remains between me and Marta.

PID	GEO	Marta	Me
$-1.1, -0.25$	$-1.1, 0.05$	36.63	58.4975
$-1.1, -0.25$	$0.05, 0.35$	21.38	27.776
$-1.1, -0.25$	$0.35, 0.55$	18.58	21.8781
$-1.1, -0.25$	$0.55, 0.75$	14.05.	14.0586
$-1.1, -0.25$	$0.75, 1.00001$	0	0
$-0.25, -0.125$	$-1.1, 0.05$	35.24	35.557
$-0.25, -0.125$	$0.05, 0.35$	32.92	33.1856
$-0.25, -0.125$	$0.35, 0.55$	44.97	45.4749
$-0.25, -0.125$	$0.55, 0.75$	11.77	11.7761
$-0.25, -0.125$	$0.75, 1.00001$	2.12	2.11926
$-0.125, -0.025$	$-1.1, 0.05$	60.09	60.3985
$-0.125, -0.025$	$0.05, 0.35$	83.36	85.07
$-0.125, -0.025$	$0.35, 0.55$	75.04	75.0836
$-0.125, -0.025$	$0.55, 0.75$	35.01	35.2021
$-0.125, -0.025$	$0.75, 1.00001$	5.61	5.61795
$-0.025, 0.05$	$-1.1, 0.05$	35.39	35.7631
$-0.025, 0.05$	$0.05, 0.35$	58.80	59.245
$-0.025, 0.05$	$0.35, 0.55$	45.13	45.155

PID	GEO	Marta	Me
$-0.025, 0.05$	$0.55, 0.75$	44.68	44.9531
$-0.025, 0.05$	$0.75, 1.00001$	3.98	3.98138
$0.05, 1$	$-1.1, 0.05$	10.65	10.6573
$0.05, 1$	$0.05, 0.35$	15.58	15.5424
$0.05, 1$	$0.35, 0.55$	14.88	14.888
$0.05, 1$	$0.55, 0.75$	13.48	13.5751
$0.05, 1$	$0.75, 1.00001$	0.805	0.80517

Comments:

- Marta's "low" bins have always less events. "High" bins are ok.
- Mayby one file is missing?
- My script(plug and play): CLIC.
- I think in the end this will not matter(next slides).

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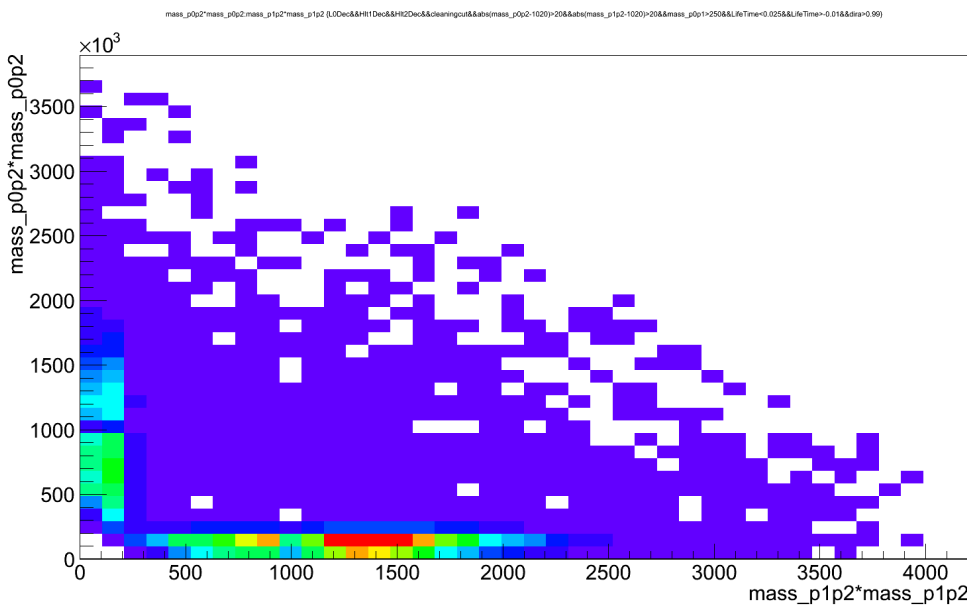
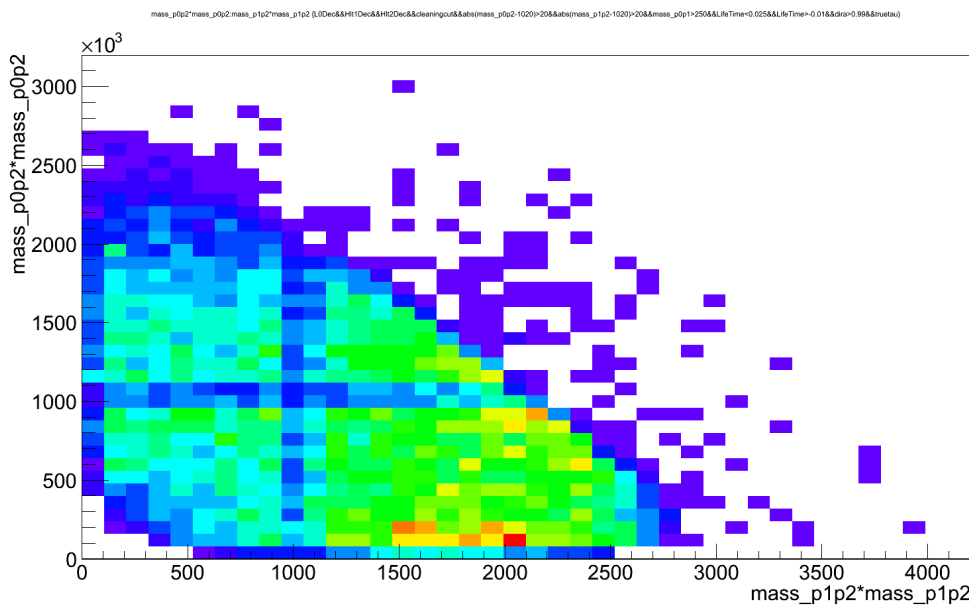
Dalitz

EVERYWHARE I APPLIED STANDARD VETOS AND CUTS

Let's look into Dalitz plots of η and signal MC.





$D_s \to \eta\mu\nu$ $\tau \to \mu\mu\mu$

Looks like this can be used. But here comes a problem: How to evaluate the cut?

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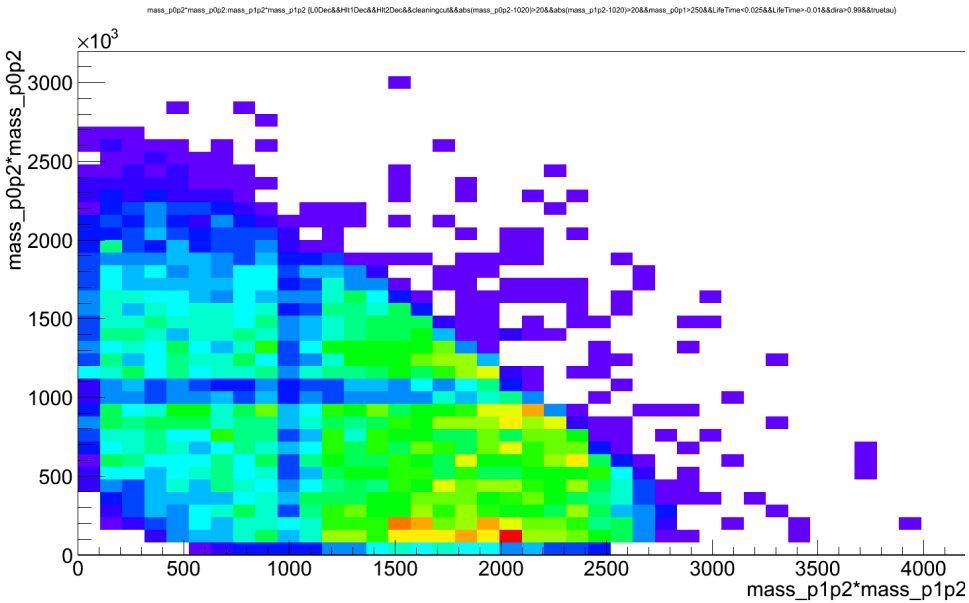
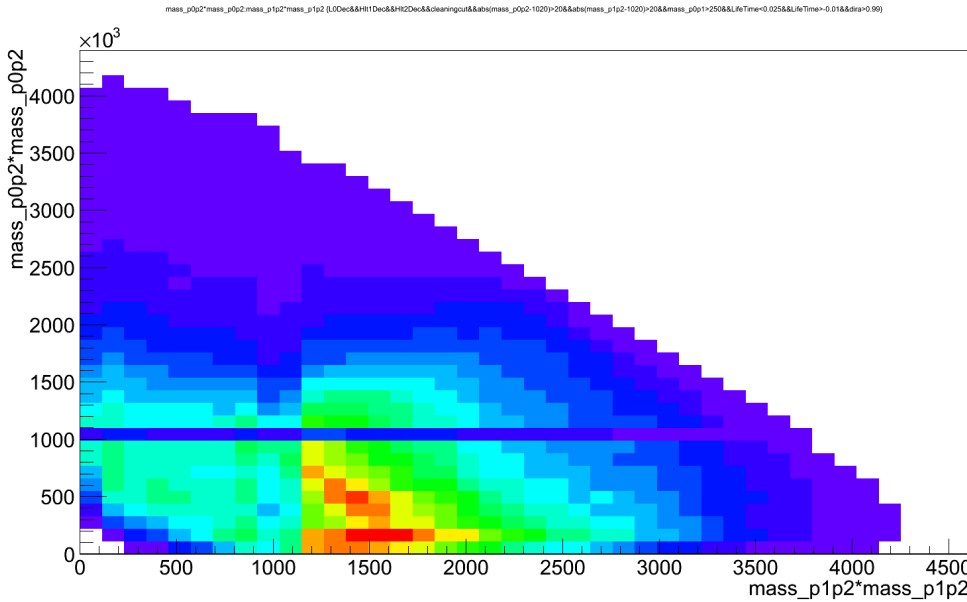
Data after stripping





$\tau \to \mu\mu\mu$

Stripping data.

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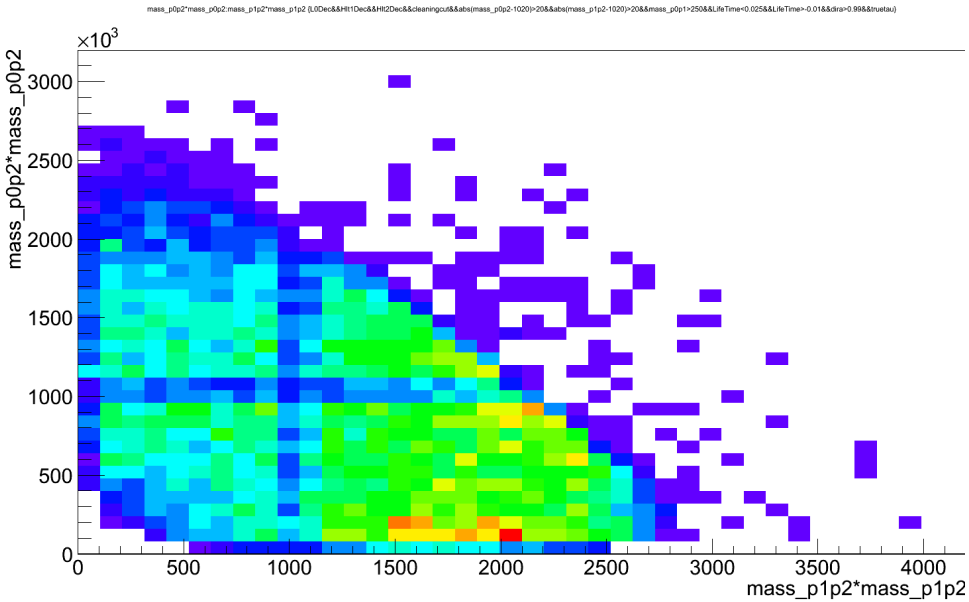
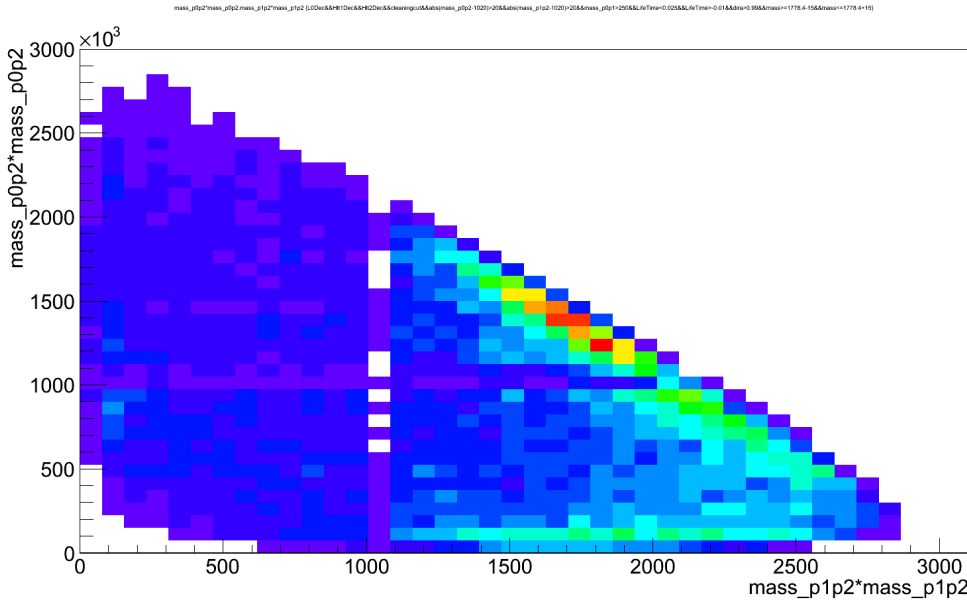
”Learn from yesterday, live for today, hope for tomorrow”, A.Einstein

The Dalitz may be different in different mass windows:





$\tau \to \mu\mu\mu$ Stripping data in signal window.

Looks promising. But this is sample that has ”potentially” signal.

Where to get a callibration sample?

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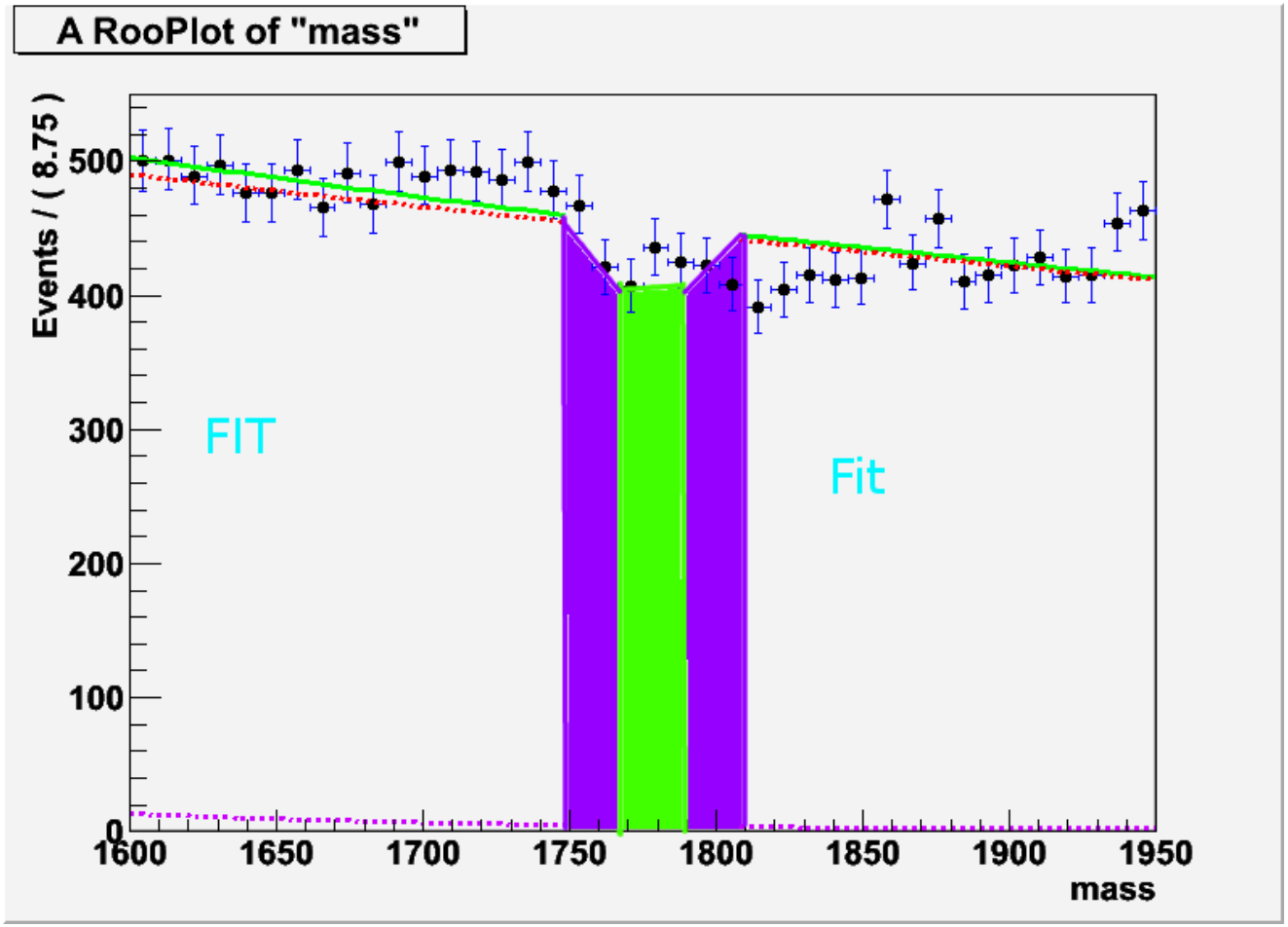
Callibration sample

We have unsued space =)



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Callibration sample

Study to determiny how big can we have the callibration sample:

- Changing the size purple of the purple mass windws.
- Fit (simple exponent this time) and calculate the new PDF.
- Calculate the limit expected limit(no systematics).

Results:
Changin the windwo from $\pm 15 to \pm 50$ changes makes the limit fluctuate by: ± 0.05.
Conclusion: We can use this data =)

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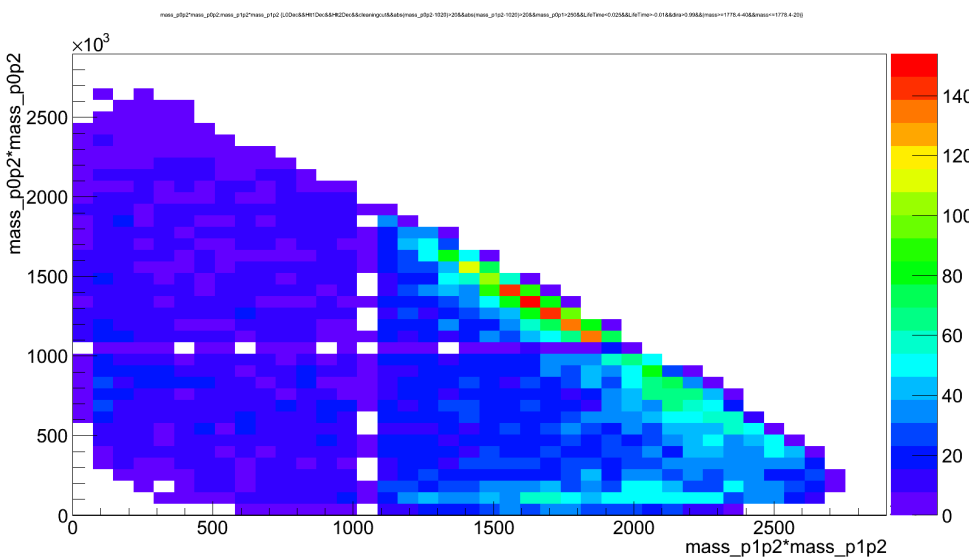
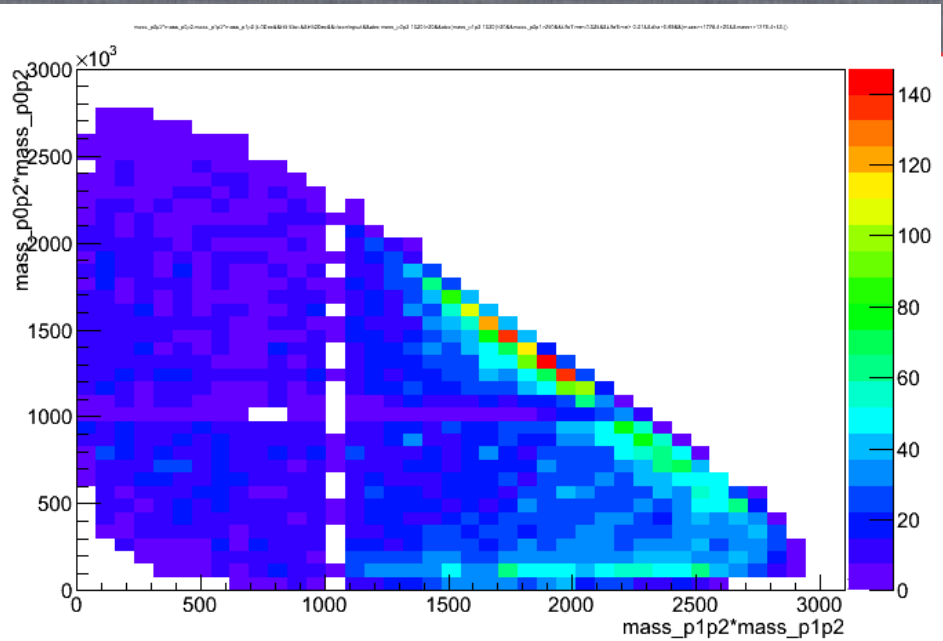
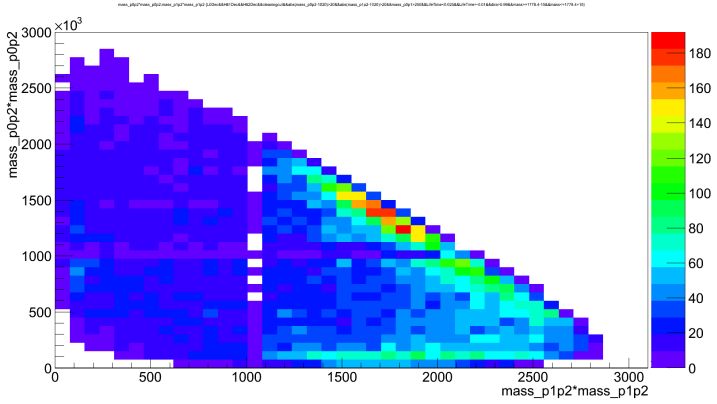
Callibration sample vs signal window



Mass: $(M_\tau - 40, M_\tau - 20)$



Mass: $(M_\tau + 20, M_\tau + 40)$



To be compared with:
Looks good =)

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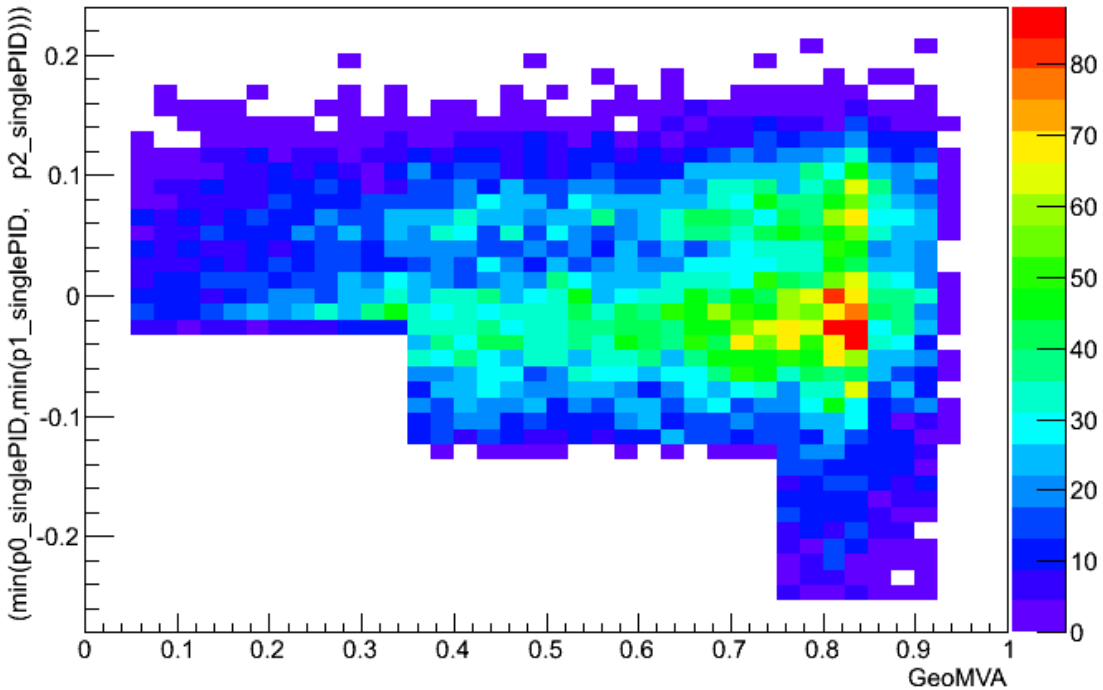
Tricks and tips

Are we really interested in removing η in all bins? As a rule of thumb I choosed the bins in which we have expected η more than 10% of all events. You will end up with bins:



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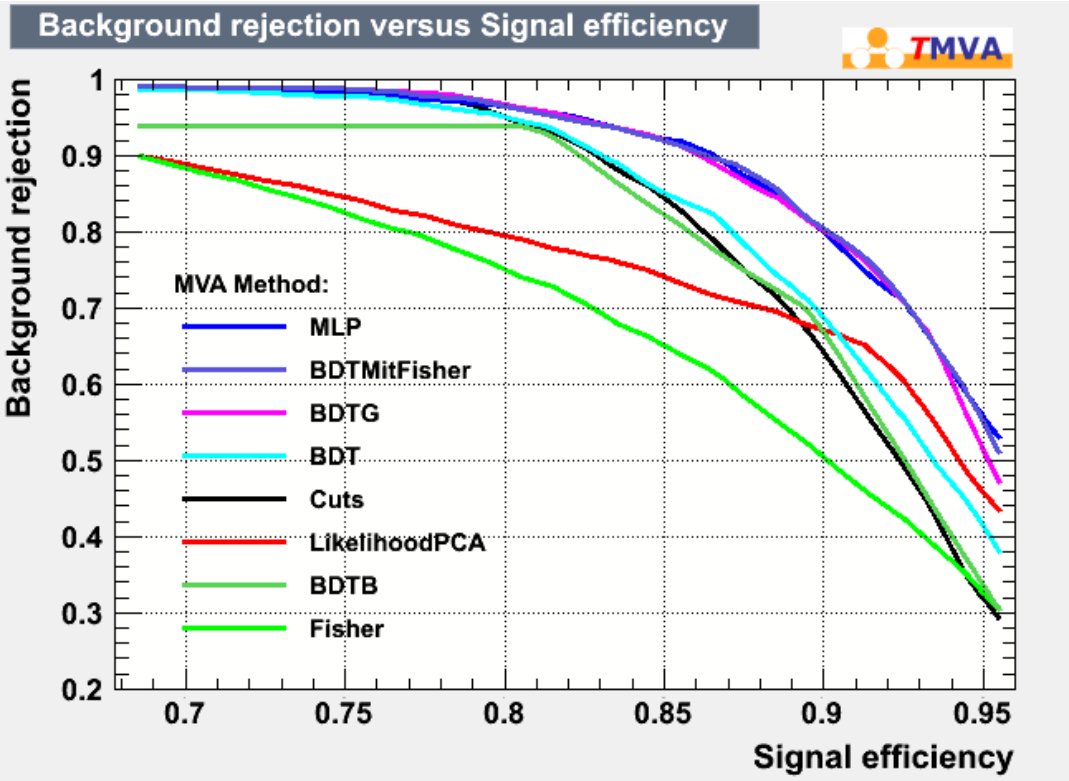
TMVAing

Using data in high bins train MLP:



Very efficient!

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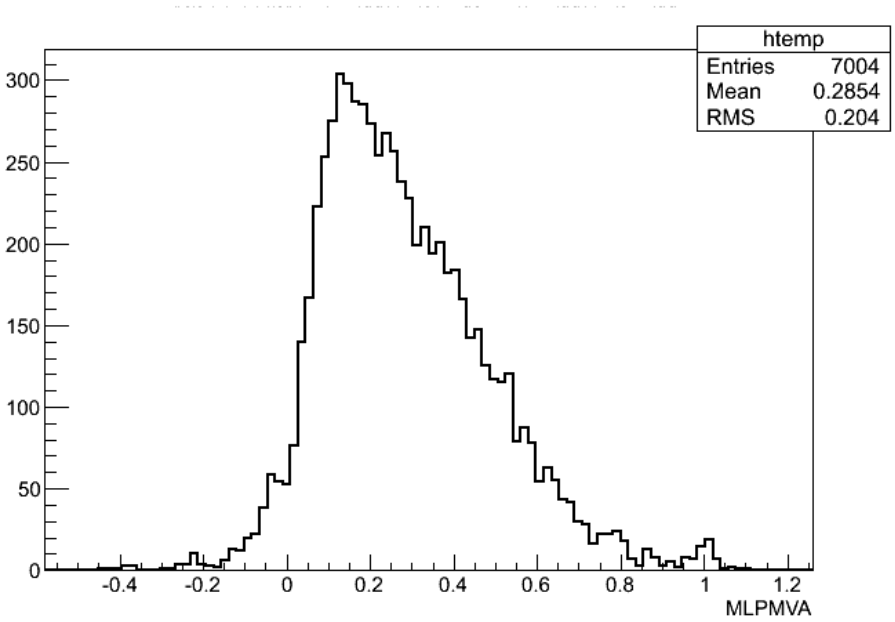
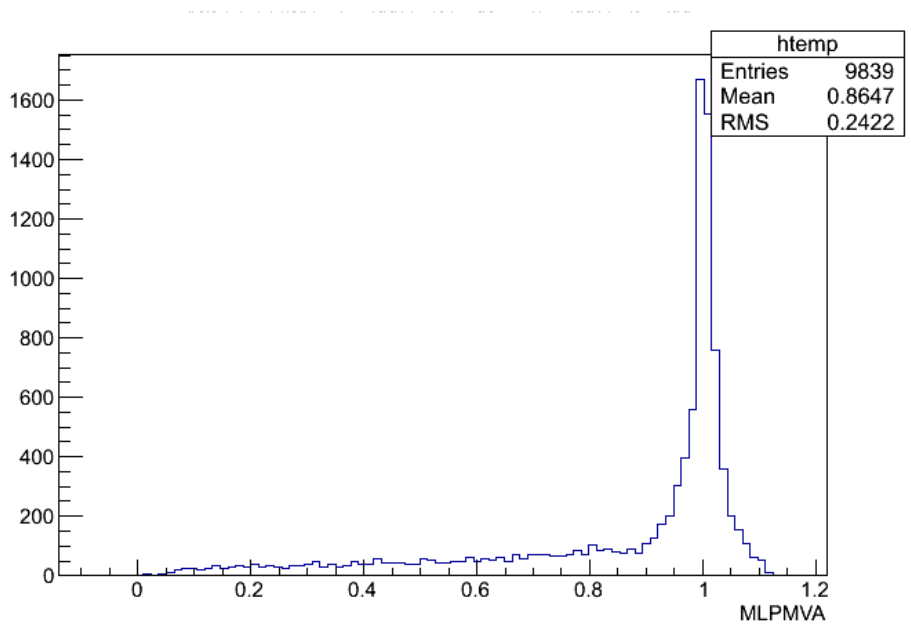
TMVAing





D_s

τ

Looks promissing =)

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Cut

A good cut is found to be: 0.92. Removes 90% of η
ToDo:

- calculate eff from callibration sample
- calculate α and new limit
- pray that it will be better

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