Tauola development

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- TAUOLA is a specific generator for τ decays.
- The only one that takes all the spin correlation into account.
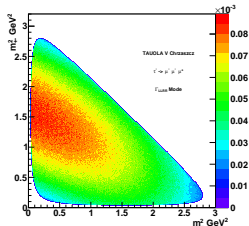- For few months I have been working on new release.

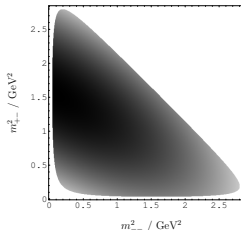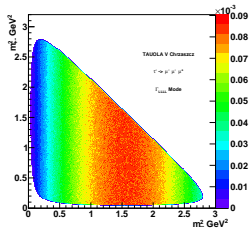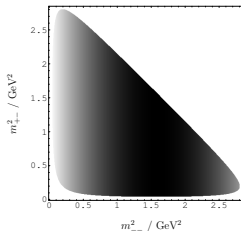University of
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New decays

- Till now TAUOLA was focused on precise SM decays.
- Added ALL LFV channels ever searched(now we have ~ 200 channels.
- Especially for $\tau \rightarrow \ell\ell\ell$ added different NP models.
- Needed to do hacking: TAUOLA wants always matrix elements...
- From some time also available in LHCb(although not extensively used).

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$$\tau^- \to \mu_1^- \mu_2^- \mu_3^+$$
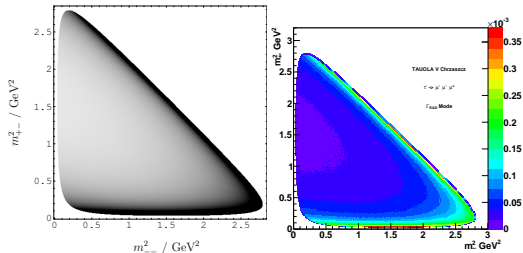$$m_{--} = m_{12} = (p_{\mu_1^-} + p_{\mu_2^-})^2$$
$$m_{+-} m_{23} = (p_{\mu_2^-} + p_{\mu_3^+})^2$$
$$m_{13} = (p_{\mu_1^-} + p_{\mu_3^+})^2$$

$$\Gamma_{LLLL} = Const \frac{(m_\tau^2 - m_\mu^2)^2}{256\pi m_\tau^3}$$
$$- \frac{(2m_{12}^2 - m_\tau^2 - 3m_\mu^2)^2}{256\pi m_\tau^3} \quad (1)$$

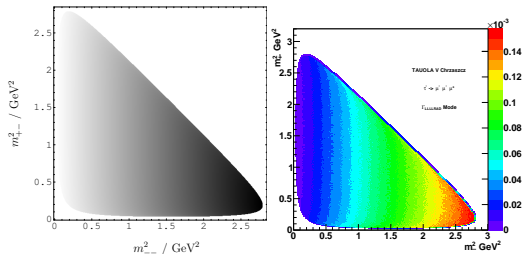See 0707.0988. I don't want to latex all the equations here :P

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$\tau^- \to \mu_1^- \mu_2^- \mu_3^+$
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$$\tau^- \to \mu_1^- \mu_2^- \mu_3^+$$
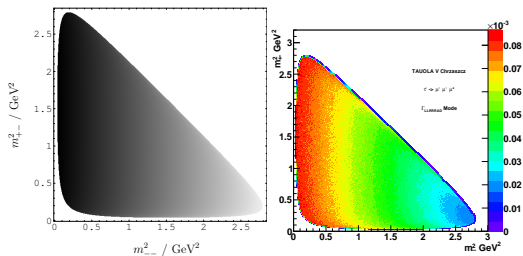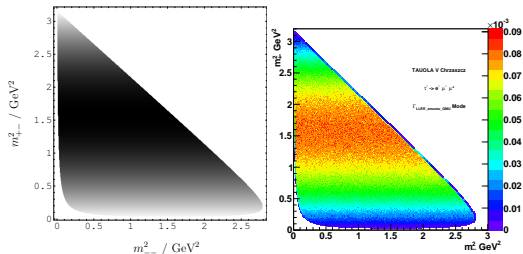$$m_{--} = m_{12} = (p_{\mu_1^-} + p_{\mu_2^-})^2$$
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New decays: $\tau^- \rightarrow e^- \mu^- \mu^+$

$\tau^- \rightarrow e_1^- \mu_2^- \mu_3^+$
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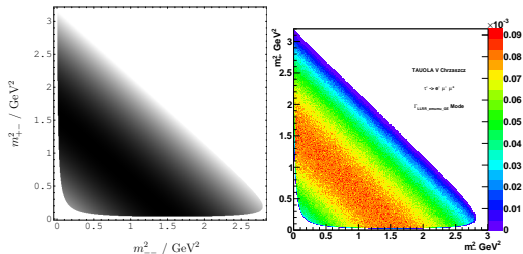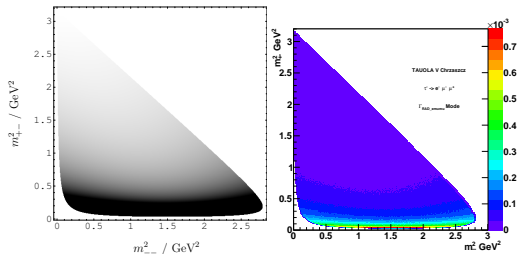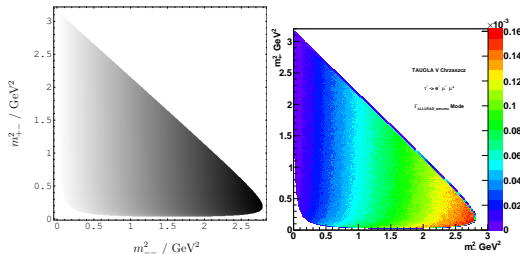
$$\tau^- \to e_1^- \mu_2^- \mu_3^+$$
$$m_{--} = m_{12} = (p_{e_1^-} + p_{\mu_2^-})^2$$
$$m_{+-} m_{23} = (p_{\mu_2^-} + p_{\mu_3^+})^2$$
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New decays: $\tau^- \to e^- \mu^- \mu^+$

$\tau^- \to e_1^- \mu_2^- \mu_3^+$
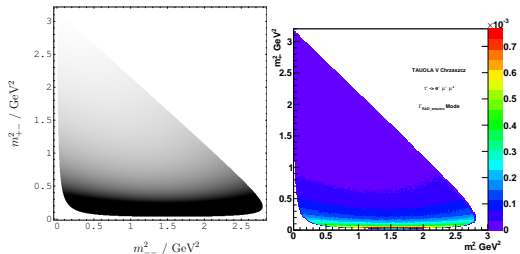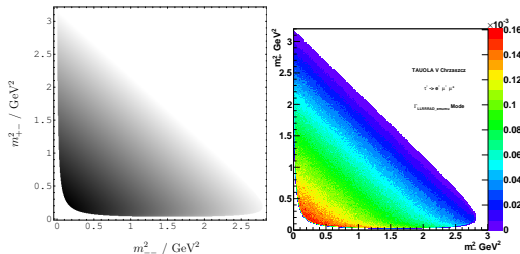
$m_{--} = m_{12} = (p_{e_1^-} + p_{\mu_2^-})^2$
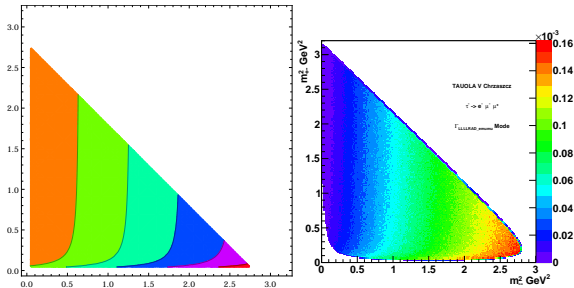
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New decays: $\tau^- \to e^- \mu^- \mu^+$

- This grey plots produced by theorists are next to useless.
- Can't really compare them with my nice ones :P
- I would say there might be disagreement in some tails.
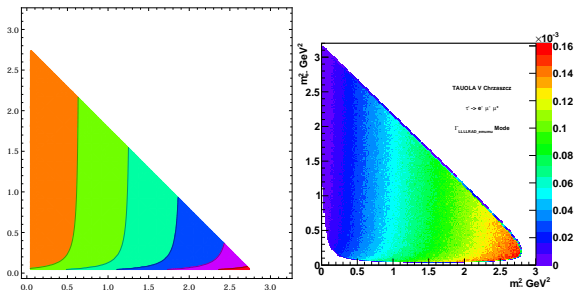- Let's check.

- Does it make sense?

- Yes! this should be there!
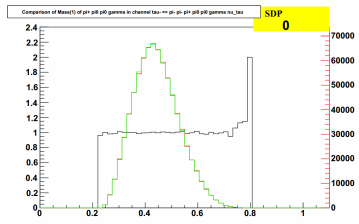
$$\Gamma_{Rad}^{LLLL} = Const(\frac{m_{12}^2 - 2m_\mu^2}{126\pi^3 m_\tau^2} + \frac{m_\mu^2}{128\pi^3 m_{23}^2}) \qquad (2)$$

Updates SM physics

- Both Babar and Belle had their own versions of TAUOLA where they put theirs FF, Br etc.
- It would be good if now their knowledge could be merged and be accessible to public.
- Since Babar was more advanced in this I started from there.
- Ported all FF from Babar to current framework.
- Need to be sure I am doing things the correct way(this if FORTRAN code, so hard core dark side of the force).

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X-checking understanding of FORTRAN

- Generate things with my implementation and take official Babar MC production :)
- Use MC-tester to test if the simulations are compatible.
- And do it with 95 decays.
- This software produces a pdf file with histograms. Just had to compare 500 pages of histograms :)
- I don't want to bore you so just one example:

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Summary

- Starting to prepare a new update and publication of TAUOLA.
- Work will be shown on TAU 2014 conference.

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