Tauola development

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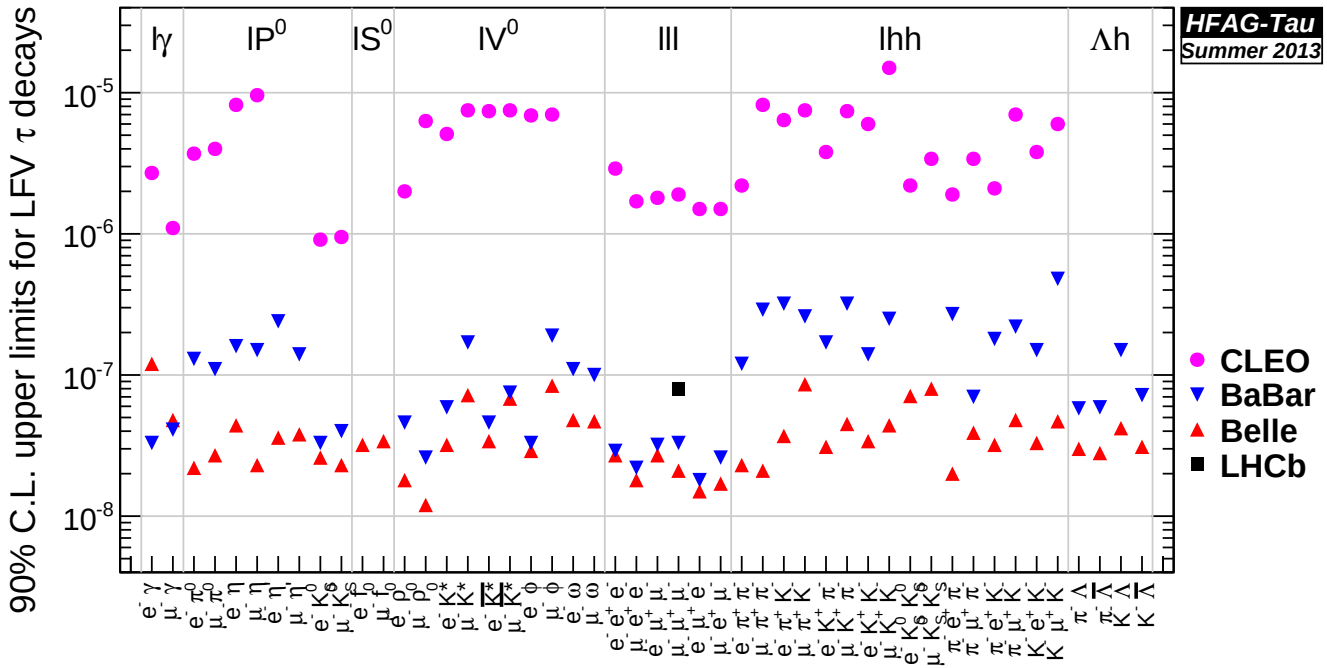
Where are we?


90% C.L. upper limits for LFV τ decays
lγ
lP0
lS0
lV0
lll
lhh
Λh
HFAG-Tau
Summer 2013
CLEO
BaBar
Belle
LHCb

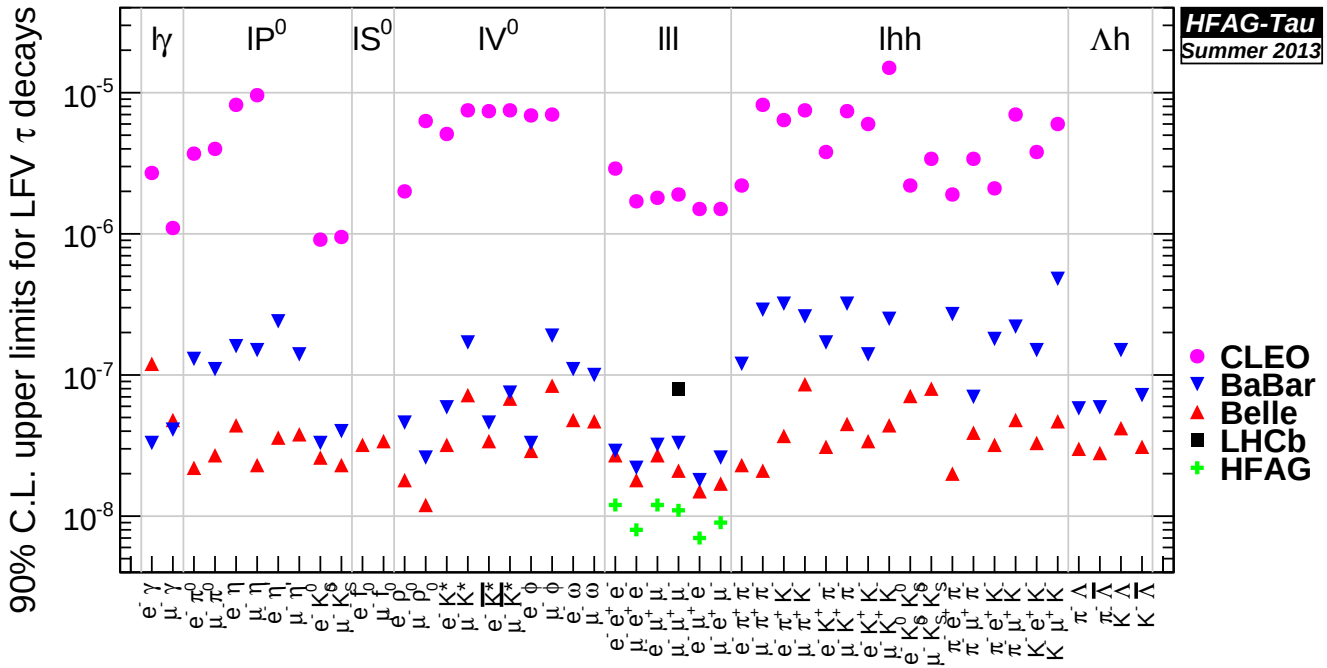
Where are we?

- I started from simple FD
- Ultimate goal is to combine it with Bayesian.
- There are fiew tools on the market: RooStats, CLs(tom Junk), BAT, and more.
- One worse then the other....
- Decided: write own toy and check with RooStats(worse decision in my life).

Assumtions:

- Don't combine limits if there is an order of magnitude difference.
- Don't take LHCb yet into account.

Results from FD



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Results from FD

- Don't trust fully this results.
- With to many toys, RooStats is starting to get crazy.
- Also with to large range for scanning the Br.
- After 4 days of banning my head what this idiot does, I scheduled a meeting with an CMS expert.
- With medium range and medium toys I am getting similar results to my toy model.
- Also have feeling RooStats is not doing systematics correct...

TOY model

- For given Br, for each experiment(Babar and Belle) in toy loop:
  - Choose efficiency from Gaussian PDF: $\epsilon, \delta\epsilon$.
  - Choose Background accordingly to Gaussian PDF: $n_{bkg}, \delta n_{bkg}$.
  - Now we have n_{bkg}, and n_{sig}. The can now calculate the probability of two experiments(babar and belle) and multiply it in both cases fixing n_{obs}.
  - After the toys we can calculate the mean probability is taken.
  - Stop procedure when $mean < 0.1$.
- Resonable 0.1×10^{-8} agreement between this and FD in RooStats.
- Bayesian calculator in RooStats gives correct results only assuming no background scenario...
- Lots of understanding on the table.

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Tauola follow up $\tau^- \to \mu^-\mu^- e^+$

- In theory paper they presented explicite new models for $\tau \to 3\mu$ and $\tau \to \mu^-\mu^+ e^-$.
- After sleeping with this I thought it would be bad idea not to have them for remaining 4: $\tau \to \mu^-\mu^- e^+$, $\tau \to 3e$, $\tau \to e^- e^+ \mu^-$, $\tau \to e^- e^- \mu^+$
- For $\tau \to 3e$ it's extremely easy to derive the operator from $\tau \to 3\mu$.
- The same for: $\tau \to e^- e^+ \mu^-$ from $\tau \to \mu^-\mu^+ e^-$.
- For the $\tau\mu^-\mu^- e^+$ and $\tau \to e^- e^- \mu^+$ required more dancing and talking to theorists.
- In the and there are only two operators(radiative ones don't exist for this decays).

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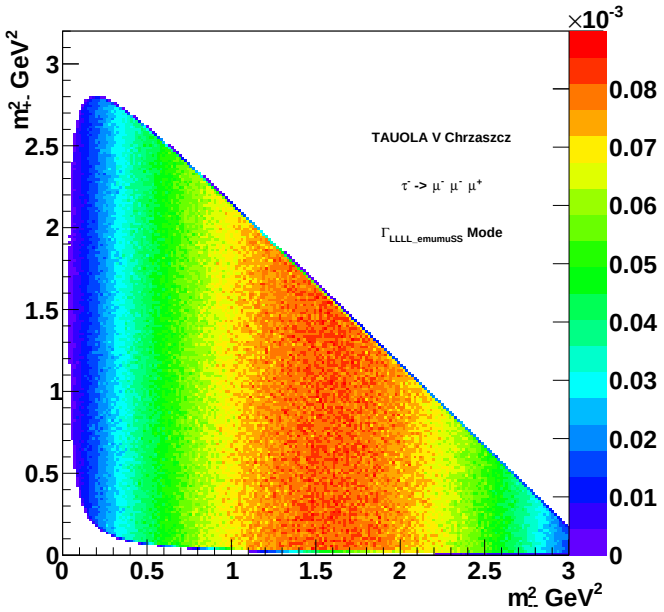
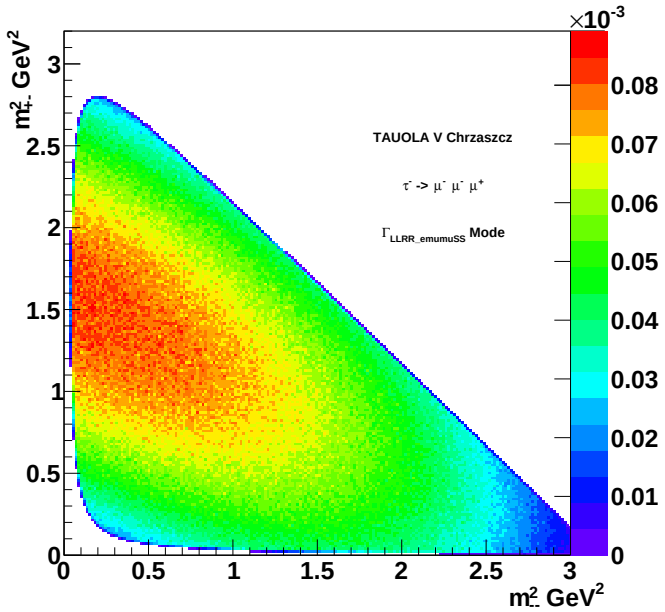
Tauola follow up





- Have all the modes :)
- Can rest in peace from coding in FORTRAN.

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