

Semitaunonic Fits by NP-Japan Fitter

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Combined analysis by NP-Japan Fitter

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Calculation Tools & Statistical Method

Calculation Tools : SuperIso

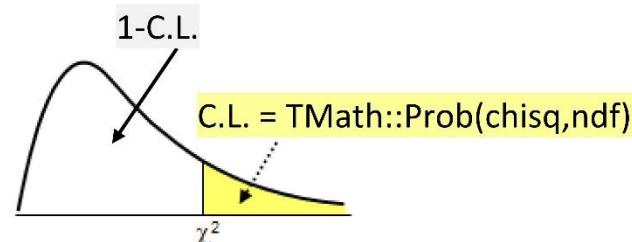
- One of the public codes to calculate observables.
- Since $B \rightarrow D^* \tau v$ is not implemented in SuperIso, calculation code for $\mathcal{B}(B \rightarrow D^* \tau v)$ in Type-II 2HDM is separately prepared, based on Y. Sakaki, R. Watanabe, and M. Tanaka [PRD87, 034028 (2013)].

Statistical Method : Chi-squared approach

$$\chi^2 = \sum_i \chi_i^2, \quad \chi_i^2 = \frac{|x_i^{\text{exp}} - x_i^{\text{theory}}|^2}{(\sigma_i^{\text{exp}})^2 + (\sigma_i^{\text{theory}})^2} = \frac{|\Delta x_i|^2}{\sigma_i^2}$$

$(x_i : i^{\text{th}} \text{ observable})$

- χ^2 is translated to confidence level (C.L.), and allowed/excluded region is estimated.

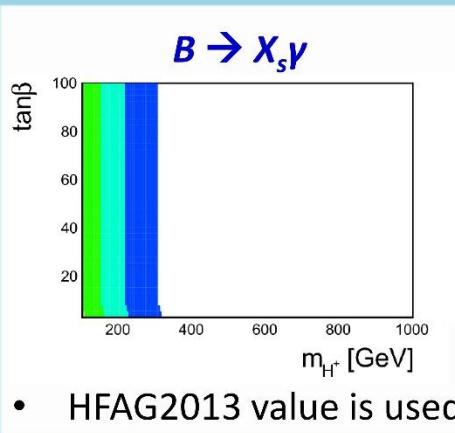
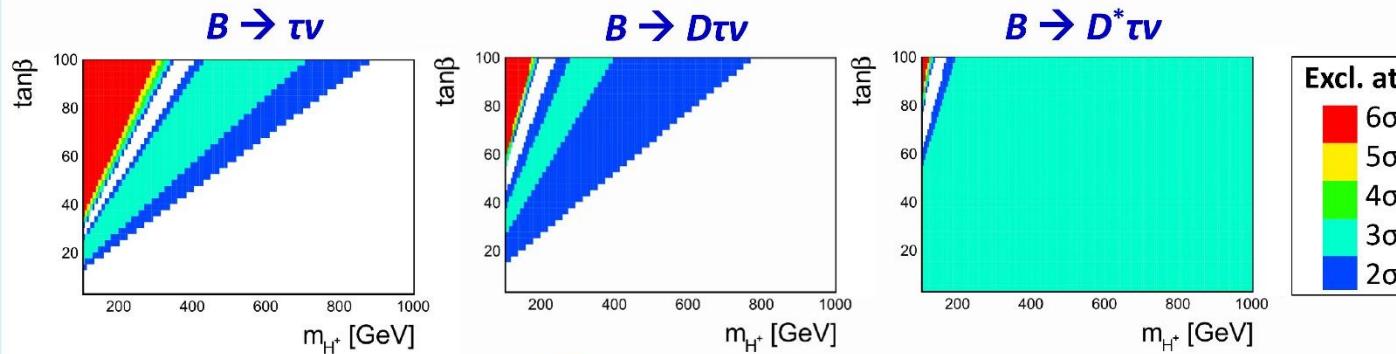


Exclusion Plots on type-II 2HDM

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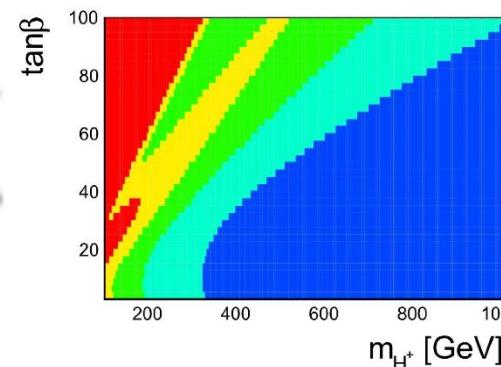
Combined constraint on type-II 2HDM

- Only Belle results described in previous page.



- HFAG2013 value is used.

Constraints from **four** observables.



Exclude with 98.7% C.L. for any value of $\tan\beta/m_{H^+}$.

Prospect of Exclusion Plots on type-II 2HDM

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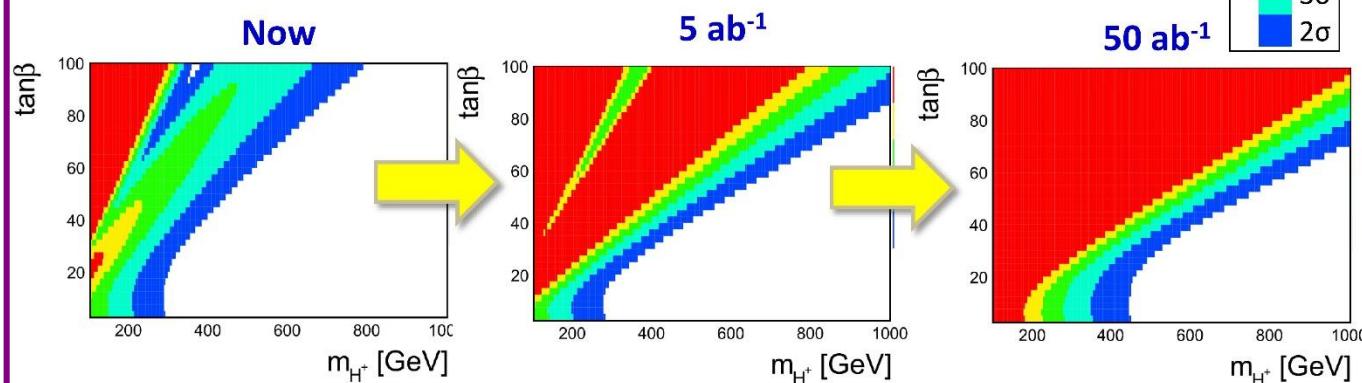
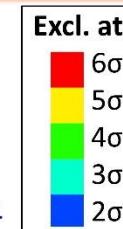
Prospect of constraint on type-II 2HDM@ Belle II

- Constraint from **four** observables at Belle II.
 - All experimental inputs are assumed to be SM values.
 - Experimental uncertainties are estimated based on **Belle II TDR**.
 - Improvement of theory side is not included except for $B \rightarrow \tau\nu$.**

	Exp.			Th.
	Now	5 ab^{-1}	50 ab^{-1}	Now
$B \rightarrow \tau\nu$	25%	10%	3%	-7+14%
$B \rightarrow D\tau\nu$	30%	11%	4%	4%
$B \rightarrow D^*\tau\nu$	19%	7%	2%	2%
$B \rightarrow X_s\gamma$	7%	5%	4%	7%

Will improved by precise V_{ub} measurements.
 My naive estimation assuming $\sigma_{fB} \sim 1\% :$
 $\sim 5\% @ \text{Belle II era}$

My naive estimation



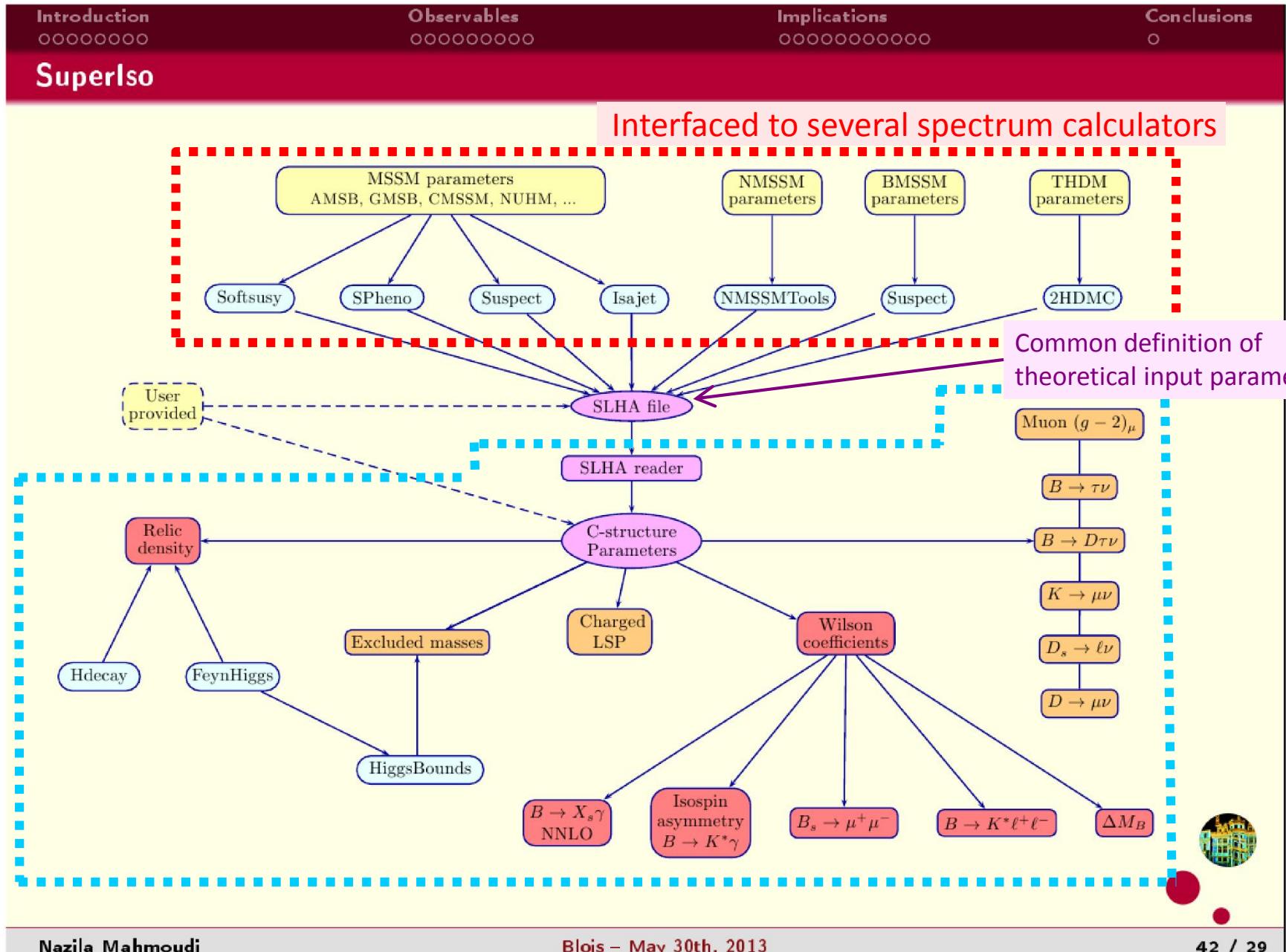
Plot for B2TiP Report

- Scenarios
 - 1. Current exclusion plots (page 3)
 - To be Updated, considering new Belle results on $B \rightarrow D^* \tau v$
 - Include constraints from $B_s \rightarrow \mu\mu$ by LHCb
 - 2. Exclusion plots at Belle II (page 4)
 - Central values assumed to be SM value with extrapolated error at Belle II
 - 3. “Observation” plot, assuming there is NP at a certain parameter point.

Backup

SuperIso framework

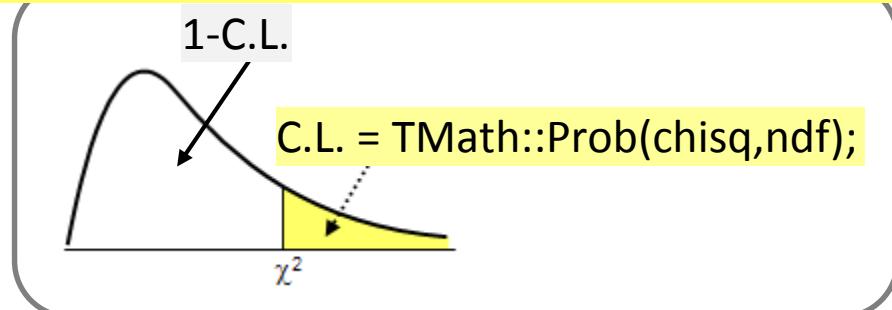
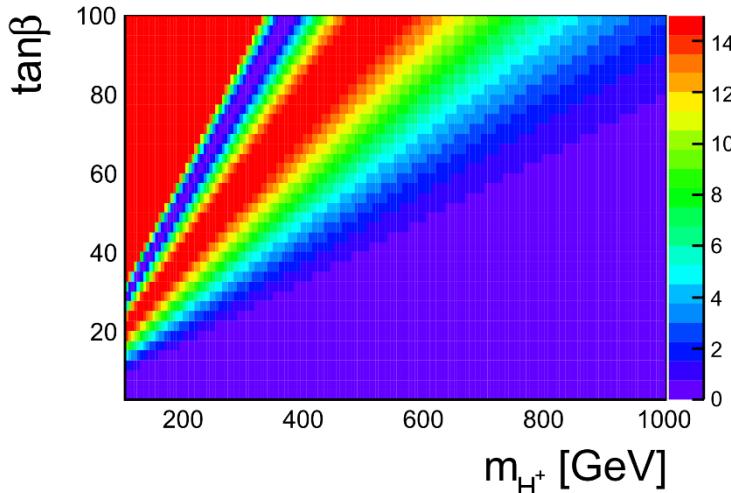
[Homepage](#)
[Manual](#)



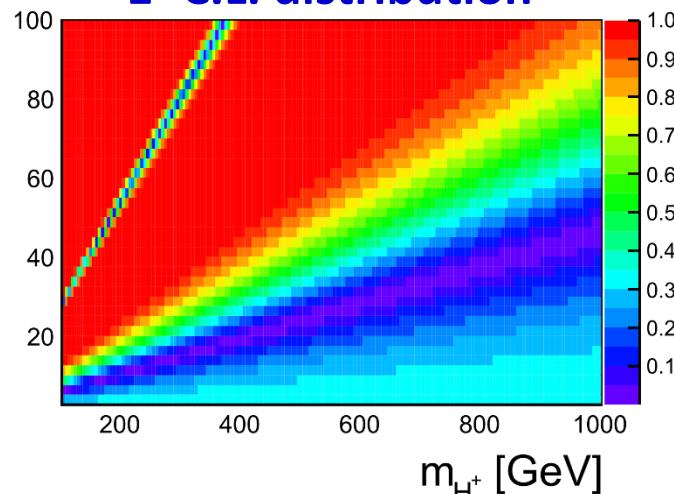
Constraint plots

- e.g. $B \rightarrow \tau\nu$

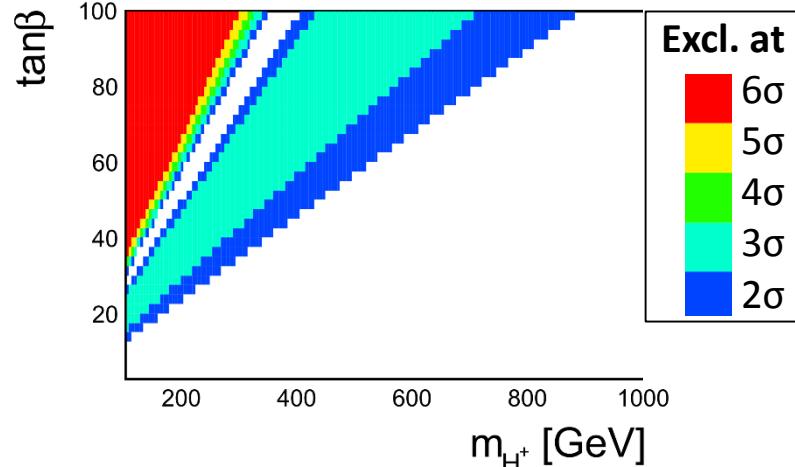
χ^2 distribution



1- C.L. distribution



Constraint plots



PRD 88, 072012 (2013)

$$\chi^2 = (\Delta, \Delta^*) \begin{pmatrix} \sigma_{\text{exp}}^2 + \sigma_{\text{th}}^2 & \rho \sigma_{\text{exp}} \sigma_{\text{exp}}^* \\ \rho \sigma_{\text{exp}} \sigma_{\text{exp}}^* & \sigma_{\text{exp}}^{*2} + \sigma_{\text{th}}^{*2} \end{pmatrix}^{-1} \begin{pmatrix} \Delta \\ \Delta^* \end{pmatrix}$$

$$\Delta^{(*)} = \mathcal{R}(D^{(*)})_{\text{exp}} - \mathcal{R}(D^{(*)})_{\text{th}}$$