BR Report and Plans for YR4

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CERN, 01/2015

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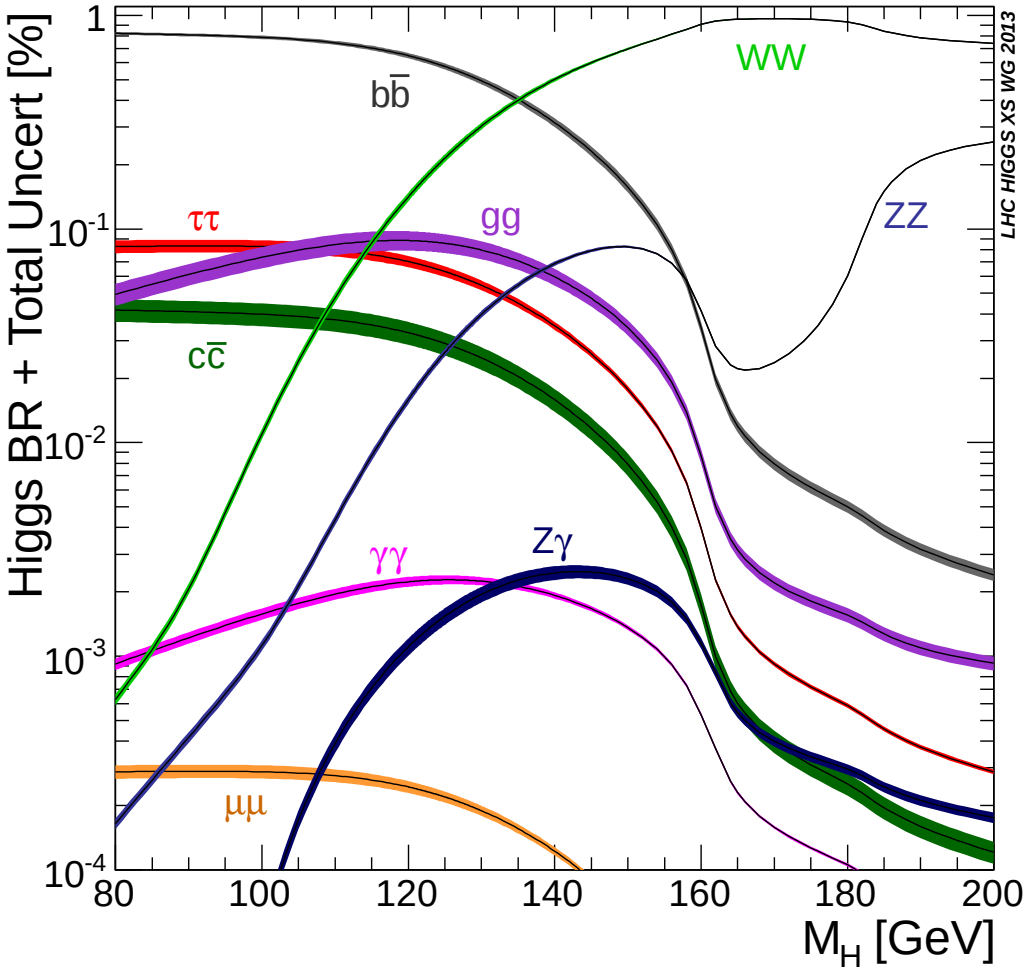
- SM Higgs decays
- MSSM Higgs decays
- Higgs decays in other BSM models

$\Rightarrow$ based on our write-up! :-)

SM Higgs Decays



Status:

Predictions for SM decay channels based on `Hdecay` and `Prophecy4f`

Update:

`Hdecay` now with full EW corrections

$\Rightarrow$ re-evaluation,
incl. uncertainty update

Update of SM predictions:

→ using the latest `Hdecay` version

– using improved quark mass uncertainties ?
– using improved intrinsic uncertainties !

To-do:

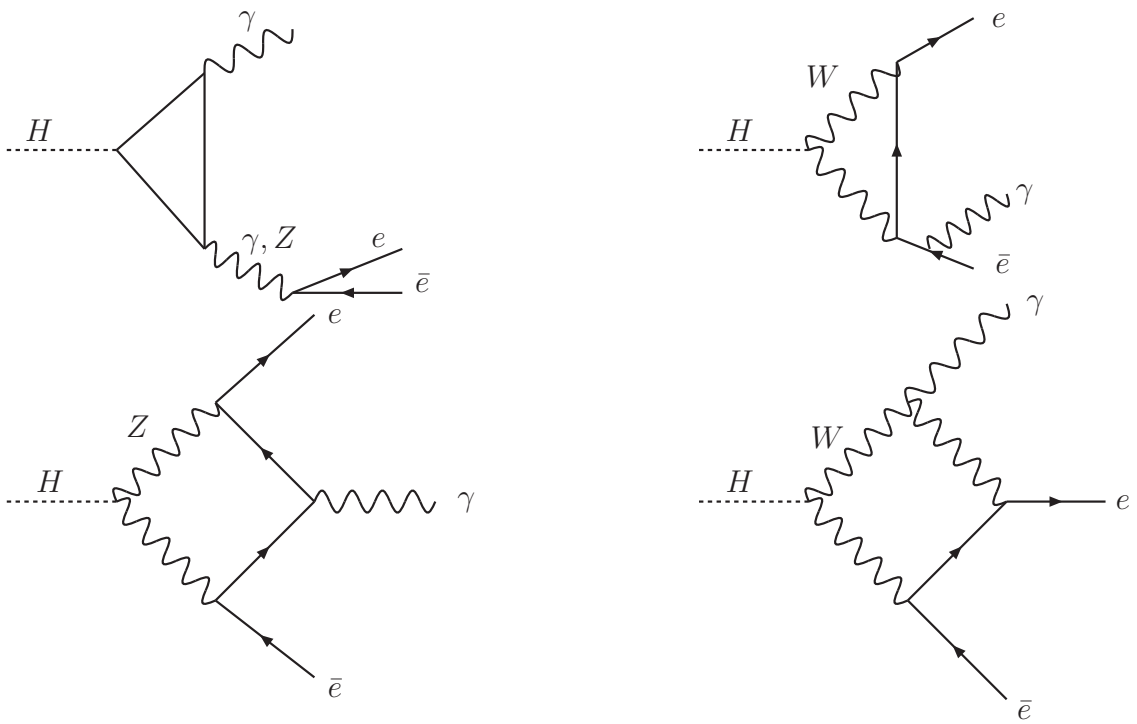
– estimate reduced intrinsic uncertainties
– clarify quark mass uncertainties
  → conservative? realistic? optimistic (a la Peskin)?
– redo runs :-)

Question:

Concentrate on $M_H = 122 \ldots 128$ GeV?

Proper inclusion of Dalitz decays:

$H \to e^+e^-\gamma$ not Yukawa suppressed at 1-loop



To-do:

$H \to e^+e^-\gamma$ to be defined by suitable cuts $\Rightarrow$ affects $H \to Z\gamma$

$\Rightarrow$ agree on definition with ATLAS/CMS

$\Rightarrow$ include Dalitz decays into evaluation
(implementation in `Hdecay` in progress)

(Other) Rare SM decays:

What we thought:

- get input from ATLAS/CMS/TH which rare decays are interesting
- ask theorists to provide predictions
- example under discussion: $H \to J/\Psi\,\gamma$

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Solution:

BSM Working Group installed Higgs Exotic decay group

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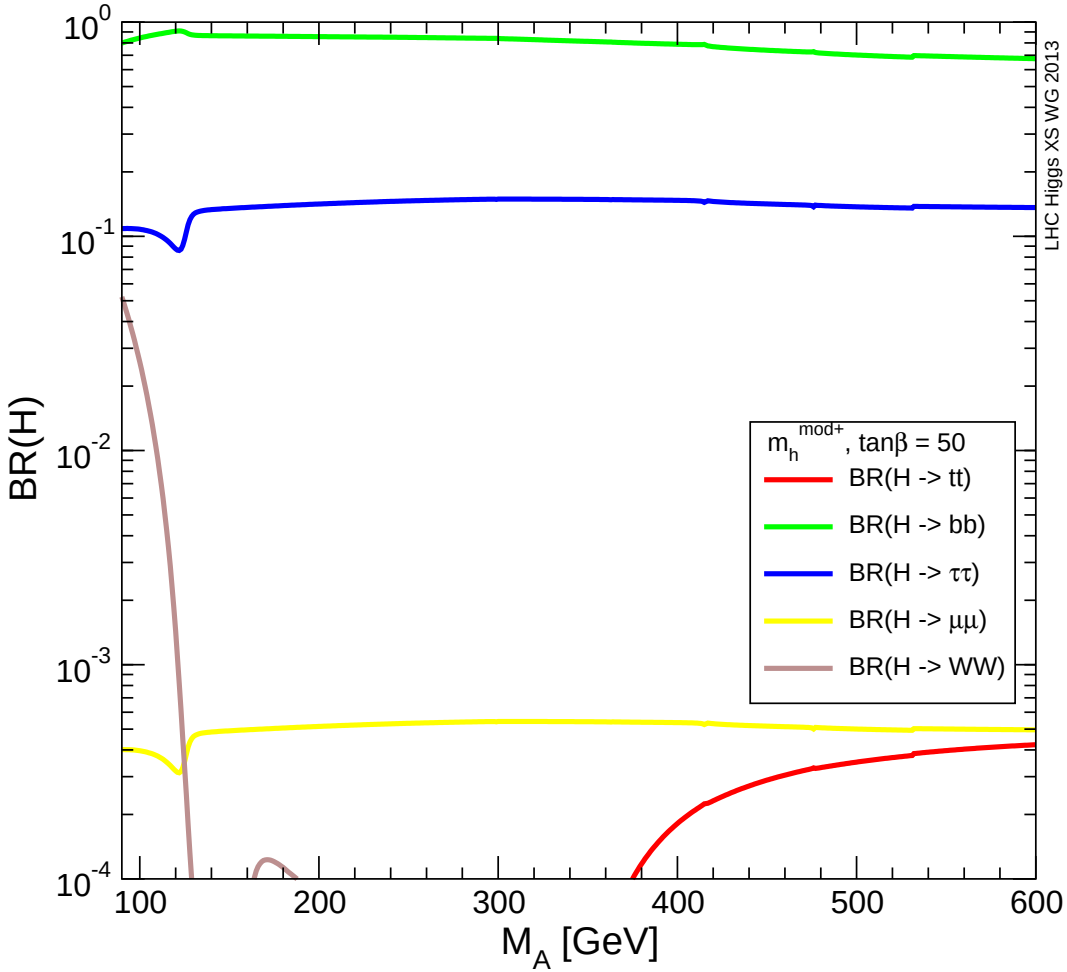
Question:

Inclusion in SM decay results?

MSSM Higgs Decays



Status:

Predictions for MSSM decay channels based on `FeynHiggs` and `Hdecay`

Results: "classic benchmarks"

- $m_h^{\text{max}-\text{up}}$
- $m_h^{\text{mod}+}$
- $m_h^{\text{mod}-}$
- light-stop
- light-stau
- tau-phobic
- low-M_H

New additions:

- $H \to hh$ and $A \to hZ$ included
  $\to$ request by ATLAS/CMS

- Extended range of $M_A = 5 \ldots 90$ GeV included
  $\to$ request for light charged Higgs searches

- BR$(t \to H^{\pm} b)$ included (in a preliminary way!)
  $\to$ request for light charged Higgs searches

  To-do: agree on code, redo runs!

- Extended range of $\mu = \pm 1000, \pm 500, \pm 200$ GeV (wip)
  $\to$ request by the $\phi \to b\bar{b}$ group

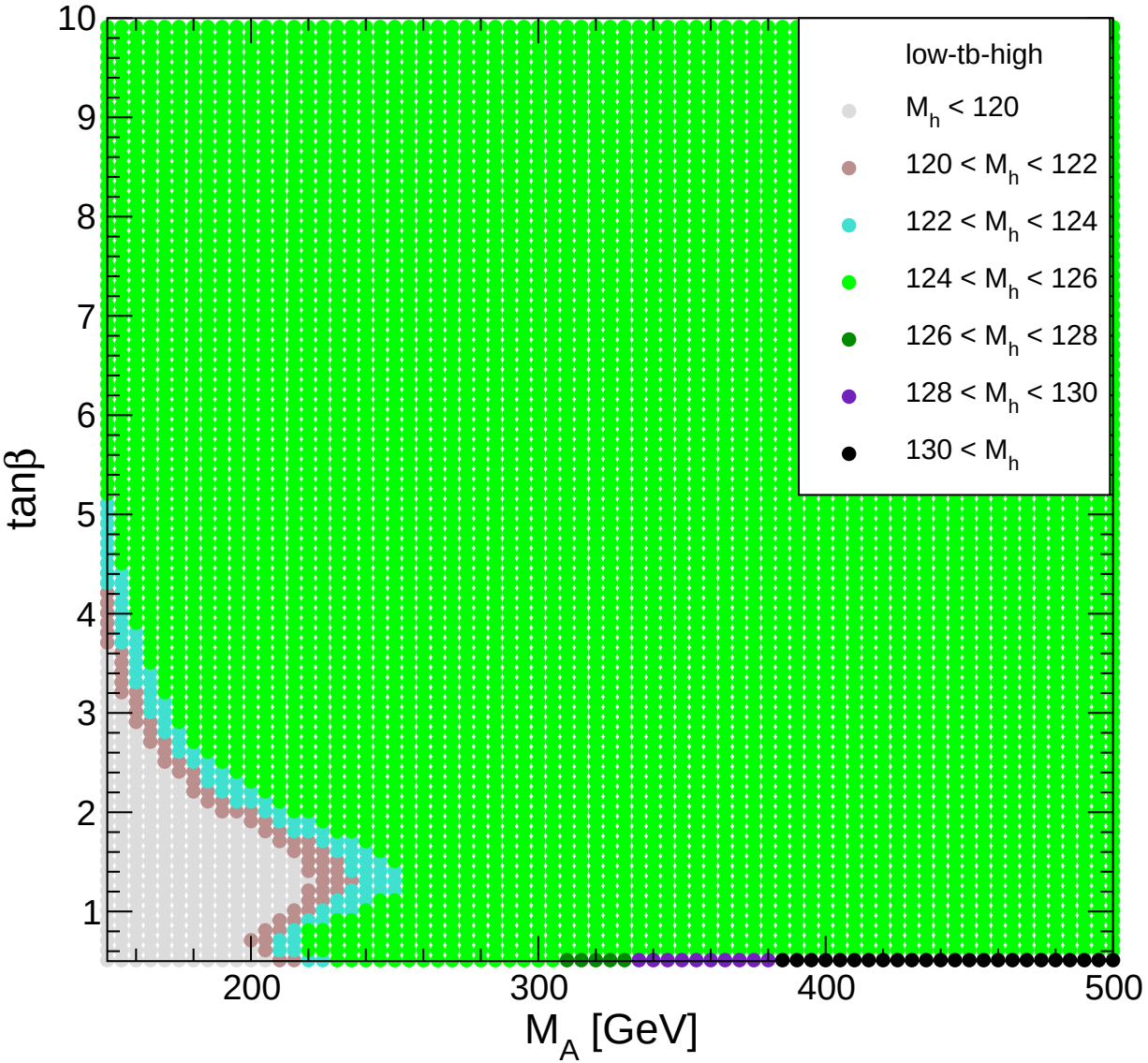
- proposal for a new benchmark scenario: "low-tb-high"
  $\to$ request by ATLAS/CMS to have a scenario valid at low $\tan\beta$
  to get large BR$(H \to hh)$, BR$(A \to Ah)$

  $\Rightarrow$ to be scrutinized/approved/rejected by MSSM subgroup ...

  $\Rightarrow$ new parameter spaces, new problems, ... but we got it right!

New benchmark proposal: "low-tb-high" [*S.H. (LHCHXSWG??) '14*]

M_{SUSY} and X_t adjusted to give $M_h \sim 125$ GeV "everywhere" [*FeynHiggs 2.10.2*]



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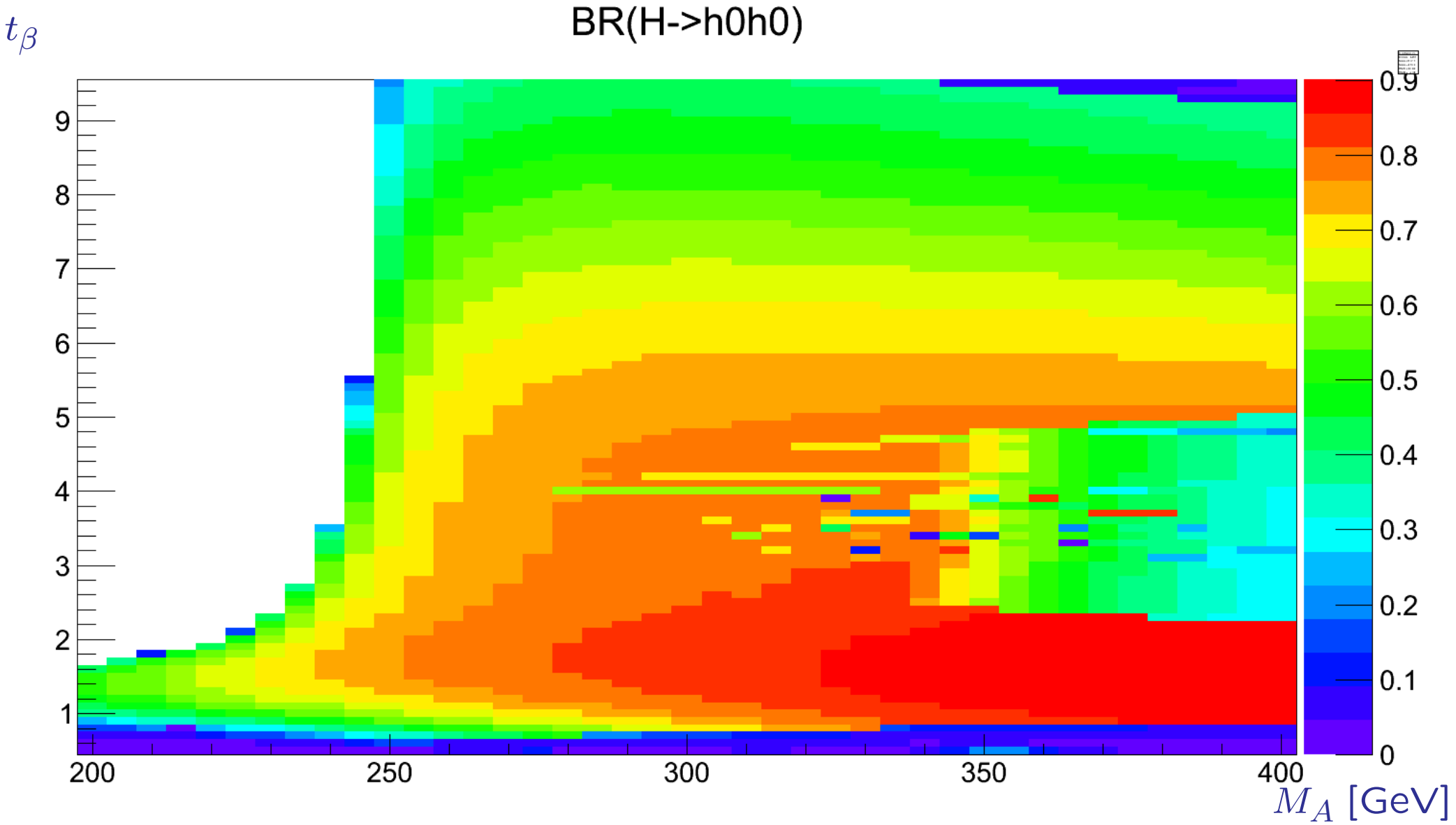

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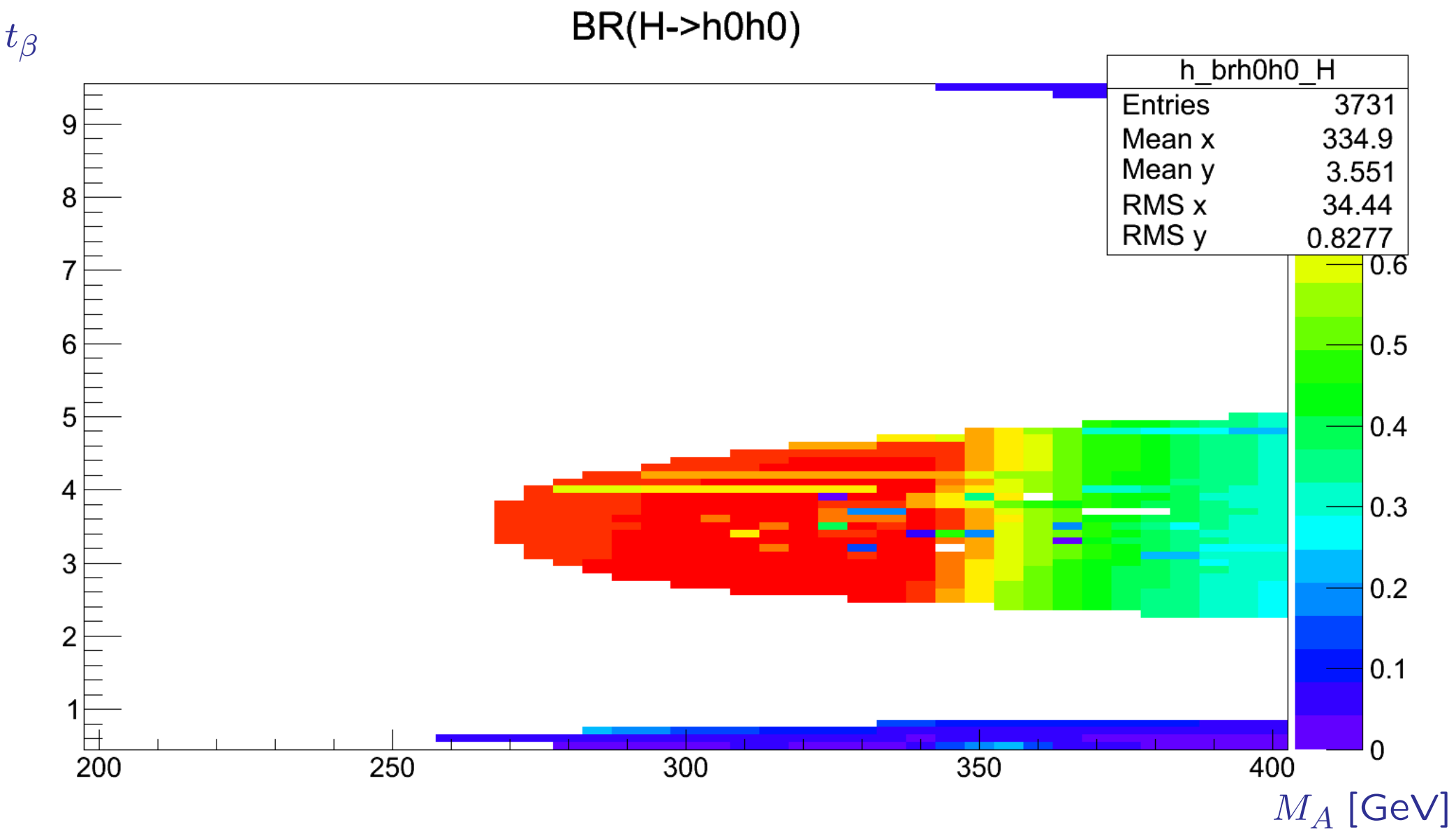

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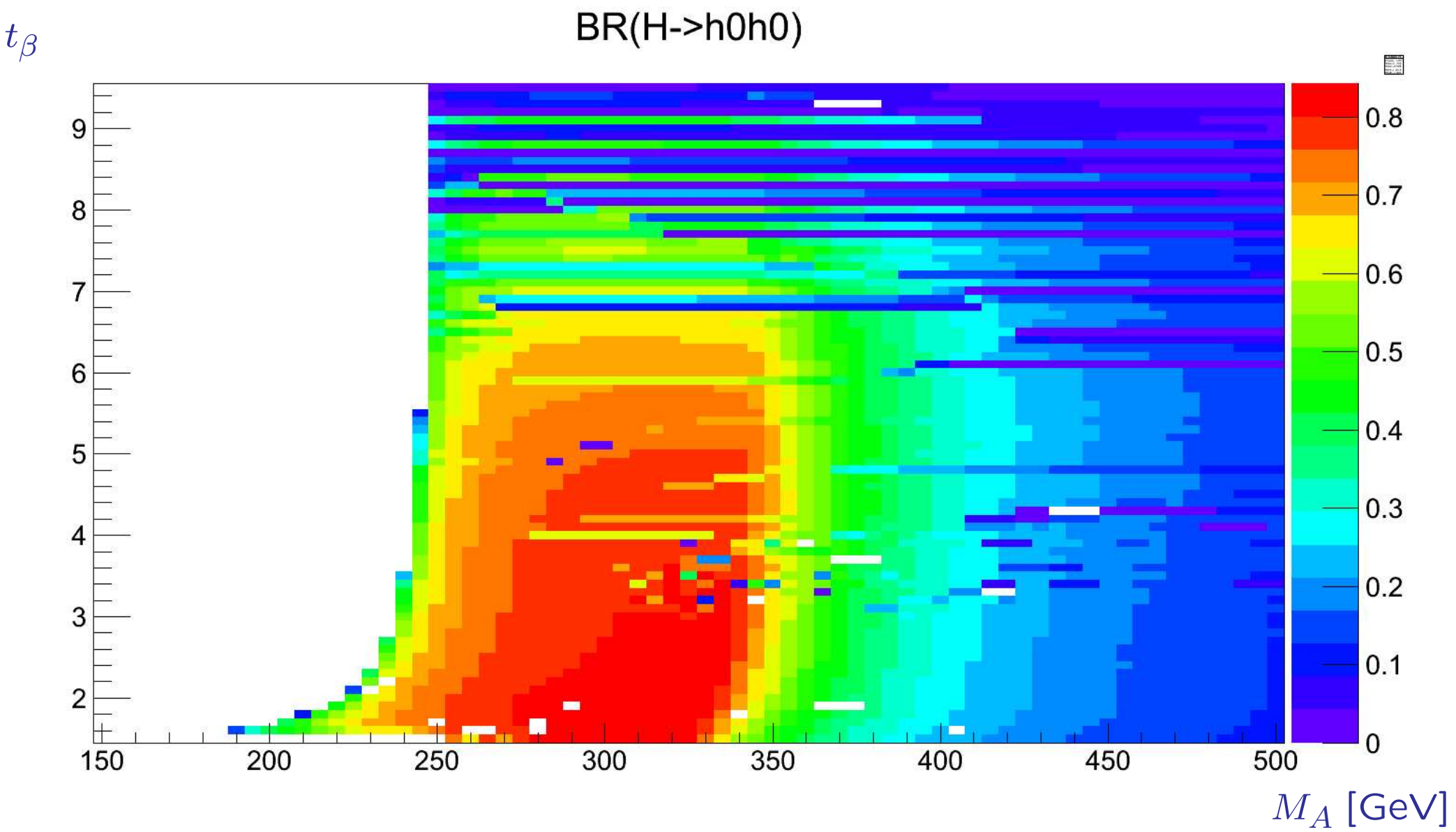

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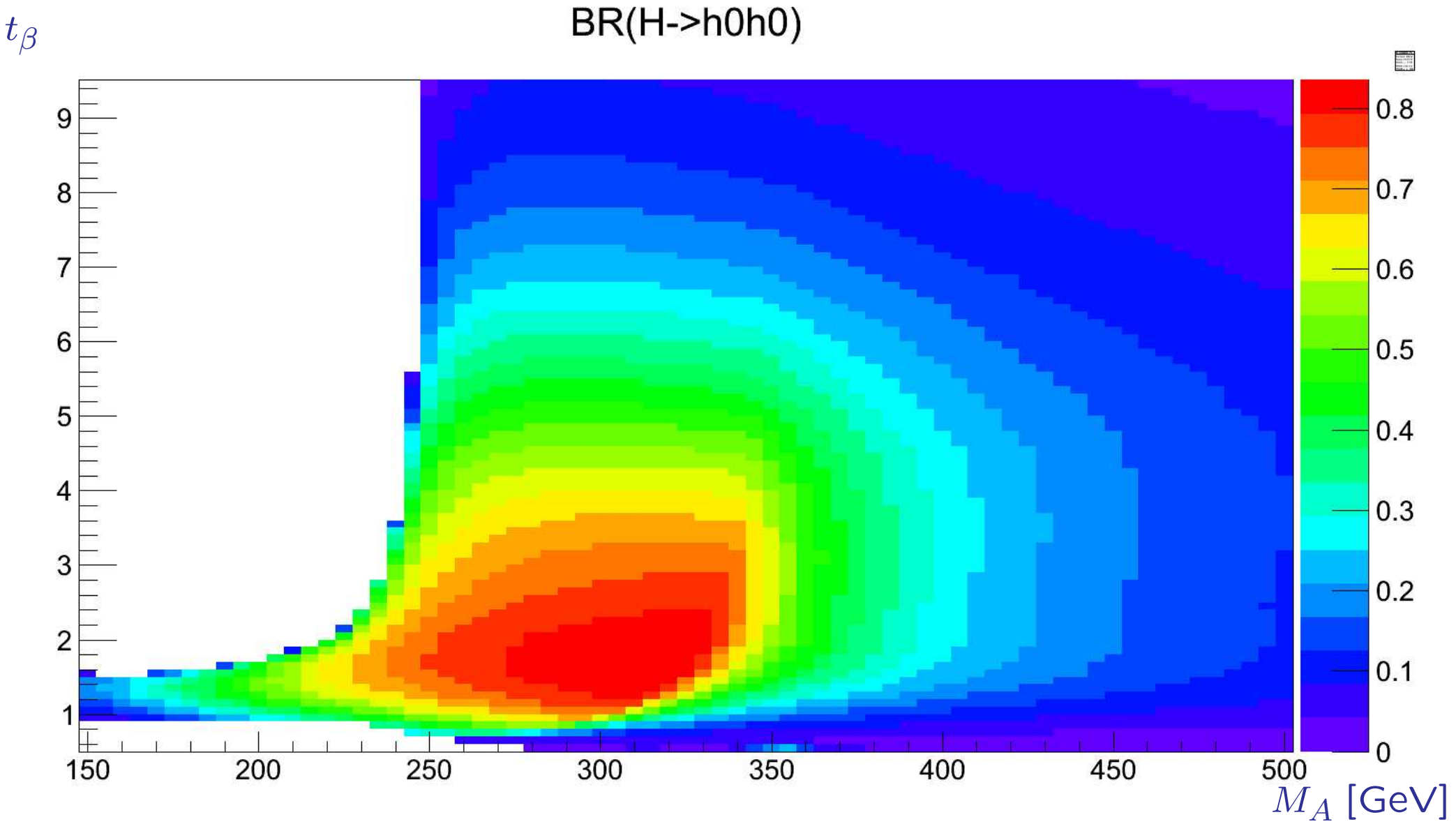

To-do for MSSM Higgs decays:

- Include Higgs decays to SUSY particles
  (scalar fermions, charginos, neutralinos)

- Evaluation of TH uncertainties for decays to SM particles
  - evaluate TH uncertainties in the MSSM
    (add intrinsic SUSY uncertainties, parameter dependent!)
  - take over (new?) parametric uncertainties from the SM
  - $\Rightarrow$ redo runs

Higgs Decays in other BSM Models

Status:

So far nothing has been done by BR group . . .

General idea for the future:

- define interesting models and benchmark scenarios → BSM WG
  example: 2HDM
- organize responsability with BSM WG
- possibly take care on production of numbers for specific benchmark scenarios
  example: 2HDM

Back-up

RHEINISCH-
WESTFÄLISCHE
TECHNISCHE
HOCHSCHULE
AACHEN

RWTH

Input Parameters

Lepage, Mackenzie, Peskin [arXiv:1404.0319]

- How well can the Higgs BRs be predicted in the future?
- Limitation due to parametric errors?
- use lattice gauge theory to improve α_s, m_b, and m_c
  (e.g. using current-current correlators)
  (stated errors already now quite small)
- optimistic projection for lattice improvements:

	$\delta m_b(10)$	$\delta\alpha_s(m_Z)$	$\delta m_c(3)$	δ_b	δ_c	δ_g
current errors [10]	0.70	0.63	0.61	0.77	0.89	0.78
+ PT	0.69	0.40	0.34	0.74	0.57	0.49
+ LS	0.30	0.53	0.53	0.38	0.74	0.65
+ LS^2	0.14	0.35	0.53	0.20	0.65	0.43
+ PT + LS	0.28	0.17	0.21	0.30	0.27	0.21
+ PT + LS^2	0.12	0.14	0.20	0.13	0.24	0.17
+ PT + LS^2 + ST	0.09	0.08	0.20	0.10	0.22	0.09
ILC goal				0.30	0.70	0.60

(errors in %)

time-scale: 10-15 years

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