

Weekly report

Xiaohu Sun

13-10-2015

IHEP

DiHiggs workshop 2016

- Planning to have a dedicated ATLAS workshop on hh
 - Will focus on BSM but also cover longer-term SM hh
 - 18th – 20th Jan 2016 in Orsay, Paris
- Doodle to get a rough idea of numbers who may attend
 - <http://doodle.com/poll/s6qevubdgv2pbrzp>
 - Not a registration yet



double Higgs production

Workshop **HH** ATLAS

January 18-20, 2016
Laboratoire de l'Accélérateur Linéaire, Orsay

<http://events.lal.in2p3.fr/conferences/Workshop-HH-ATLAS/>

Organization committee :

Jahred Adelman, Irit Barak, Massimiliano Valério Broglioni, Magda Ch. Michael Dushresen-Deblin, Marc Escallier, Louis Fayard, Carl Gwilliam, Kenta Hanawa, Mich. Katharine Leney, Bruno Mansoulié, Alessandro Nisati, Pire Markus Schumacher, David Wardrop

LHC Higgs XS working group

- Time line for CERN Report 4 (YR4)
 - An outline by July 31, 2015
 - *A first draft* by **Nov. 15**, 2015
 - CERN Report 4 should be finished by **Jan. 31**, 2016

Next General Meeting

The 11th Workshop of the LHC Higgs Cross Section Working Group

13-15 January 2016
CERN
Europe/Zurich timezone

General Assembly Meeting of LHC Higgs Cross Section Working Group

Overview

- LHCXSWG Twiki page
- Subscribing to the XSWG mailing list
- Agenda
- Registration
- Participant List
- Entrance to CERN
- Videoconference Rooms

The LHC Higgs cross-section working group (HXSWG) was created in January 2010. The aim of this group was to provide recommendations on cross-sections, branching ratios and search observables relevant to the discovery of the Higgs boson and the determination of its properties. In the past few years, the group has been successful in providing recommendations on the Higgs boson cross-sections and branching ratios. In 2011, the group was reorganized to include the Higgs boson cross-sections and branching ratios. In 2012, the group was reorganized to include the Higgs boson cross-sections and branching ratios. In 2013, the group was reorganized to include the Higgs boson cross-sections and branching ratios. In 2014, the group was reorganized to include the Higgs boson cross-sections and branching ratios. In 2015, the group was reorganized to include the Higgs boson cross-sections and branching ratios. In 2016, the group was reorganized to include the Higgs boson cross-sections and branching ratios.

In this 11th general assembly meeting, we shall review the progress made in the various groups for the Higgs physics in LHC Run-2 and beyond.

Starts 13 Jan 2016 09:00
Ends 15 Jan 2016 17:00
Europe/Zurich

CERN
Main Auditorium

Anastasiou, Charalampos
de Florian, Daniel
Grazzini, Christophe
Maitani, Fabio
Marzetti, Chiara
Nikitenko, Alexandre
Savard, Pierre
Schumacher, Markus

Registration for this event is now open
Deadline: 6 Jan 2016

Register now >

JAN 13-15 2016

SM parameters
have been frozen in
LHCHXSWG-INT-2015-006
Oct 12

**which is used as inputs for
various BSM studies**

- I focus on WG3, i.e. **neutral extended scalar**
- We cover:
 - singlet
 - doublet
 - triplet
 - as well as CP-violating cases

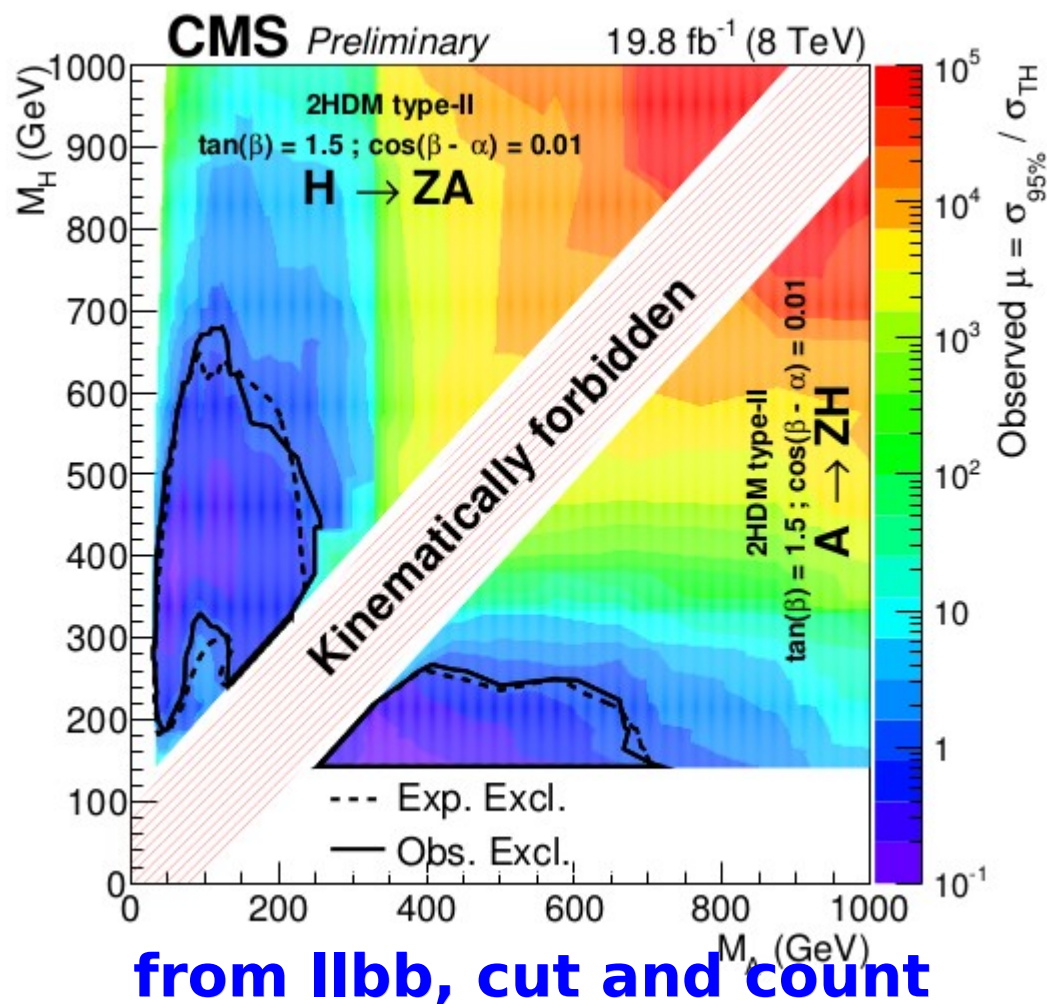
115	3 WG3: BSM Higgs³
116	3.1 Extended scalars
117	<i>3.1.1 Higgs Singlet Extension of SM</i>
118	<i>3.1.2 2HDM</i>
119	<i>3.1.3 CP conservative benchmarks</i>
120	<i>3.1.4 CP violating 2HDM</i>
121	<i>3.1.5 Triplet benchmarks</i>
122	3.2 MSSM
123	<i>3.2.1 Neutral Higgs bosons</i>
124	<i>3.2.2 Inclusive cross-sections and uncertainties in benchmark scenarios</i>
125	<i>3.2.3 Recommendations for MC generation and associated uncertainties</i>
126	<i>3.2.4 $gg \rightarrow f$</i>
127	<i>3.2.5 $b\bar{b}f$</i>
128	<i>3.2.6 Charged Higgs boson</i>
129	<i>3.2.7 Inclusive cross-sections and uncertainties in benchmark scenarios</i>
130	<i>3.2.8 Recommendations for MC generation and associated uncertainties</i>
131	<i>3.2.9 $pp \rightarrow tH^+$</i>
132	<i>3.2.10 s-channel, $q\bar{O}q \rightarrow H^+ \rightarrow tb$</i>
133	3.3 NMSSM
134	<i>3.3.1 NMSSM tools</i>
135	<i>3.3.2 NMSSM benchmarks</i>
136	3.4 Searches for BSM modes of the 125 GeV Higgs boson
137	<i>3.4.1 LFV decays</i>
138	<i>3.4.2 Prompt decays without MET</i>
139	<i>3.4.3 Prompt decays with MET</i>
140	<i>3.4.4 Decays with displaced vertices</i>

2HDM xsec calculation

- Having produced series of 2HDM xsec for RUN I analyses, I continued to take responsibility of **2HDM ntuple production for RUN II** for both ATLAS and the LHC
- <https://twiki.cern.ch/twiki/bin/viewauth/AtlasProtected/HiggsBSM2HDMRecommendations>
- <https://twiki.cern.ch/twiki/bin/view/LHCPhysics/LHCHXSWG2HDM>
- **13TeV Update:**
 - **SM** parameters follow latest recommendation from LHC Higgs working group:
<https://cds.cern.ch/record/2047636/files/LHCHXSWG-INT-2015-006.pdf>
 - Latest sw versions: **2HDMC** version 1.7.0, **SusHi** version 1.5.0
 - Latest **SM WH/ZH** xsec that will be rescaled to BSM
 - Latest **4FS (gb+gt interference) + 5FS** matching for b-associated productions

2HDM xsec ntuples (AH split)

- A test production for AH mass split: A-ZH and H-ZA
- for Ch, in A-ZH, $m_H < m_A$, setting two cases $m_{Ch} = \min\{m_A, m_H\}$ and $m_{Ch} = \max\{m_A, m_H\}$



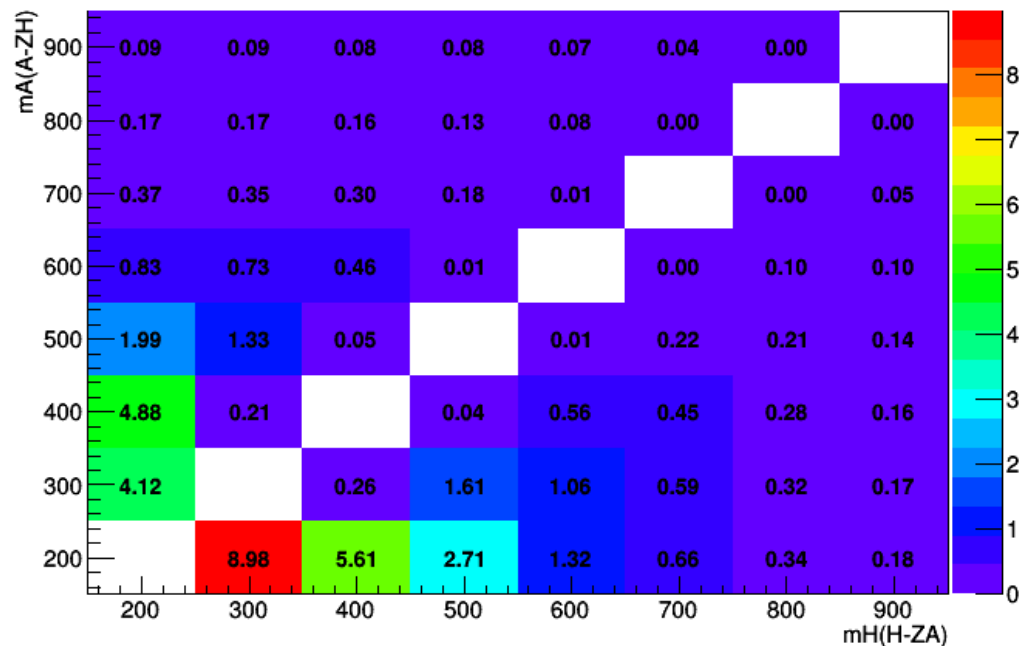
**RUN I from CMS
 PAS HIG-15-001
 (Z \rightarrow ll, A/H \rightarrow bb or $\tau\tau$)**

**it was missing in ATLAS
 we would like to look at it
 in RUN II**

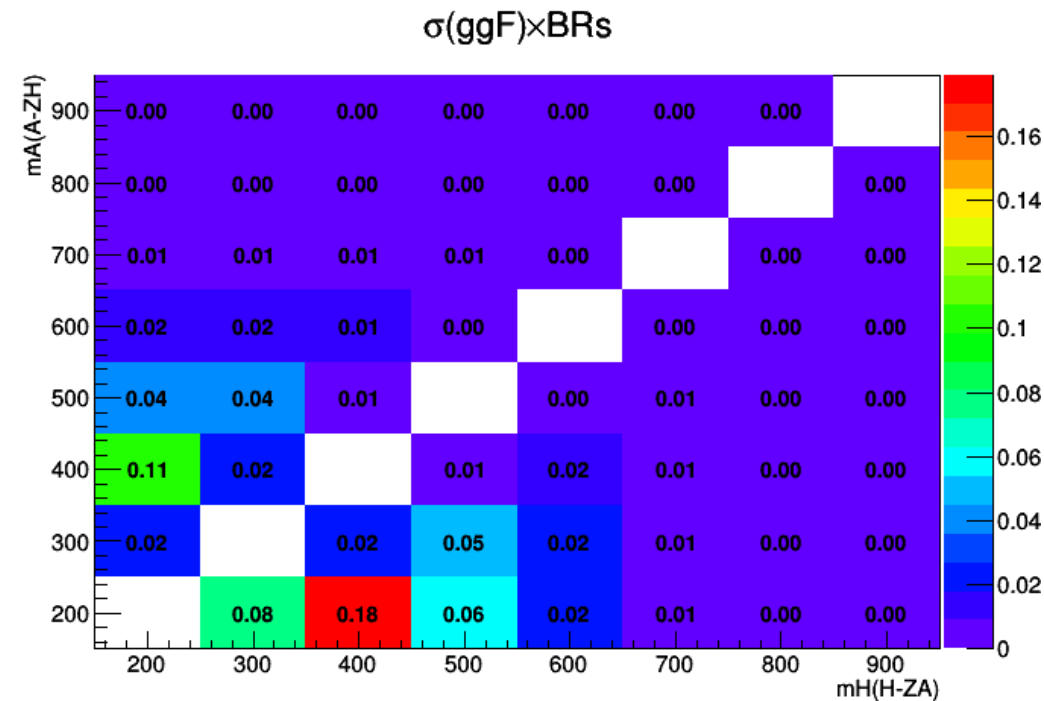
2HDM AZH HZA ($m_{\text{Ch}} = \max\{m_A, m_H\}$)

7

- Type II, both close in SM alignment, different $t\bar{b}$
- Look at **only $x_{\text{sec}} \times \text{BRs}$**



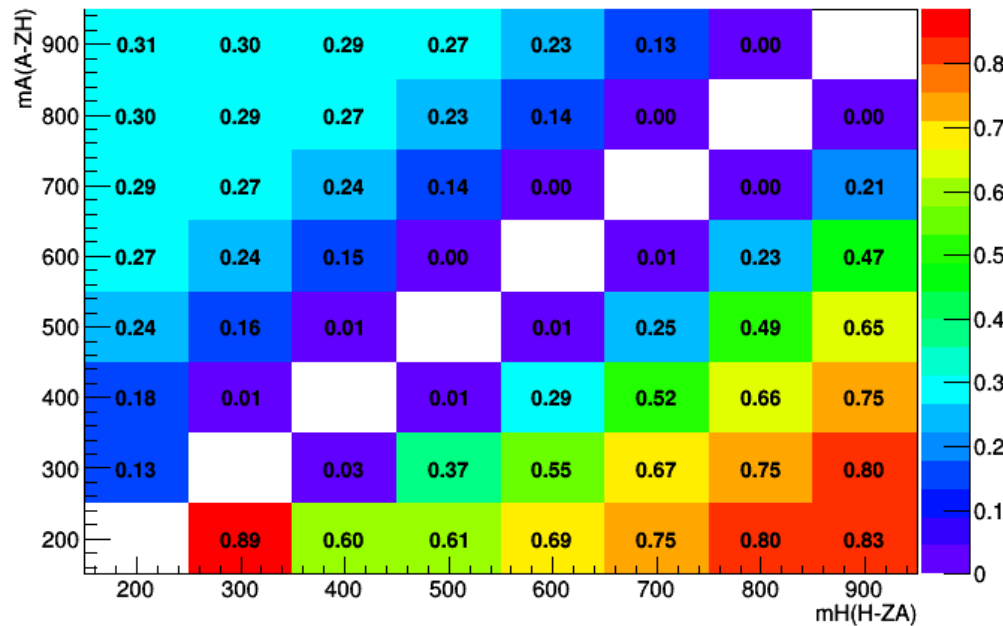
type II, $t\bar{b}=1.0$ $\cos(b-a)=0$



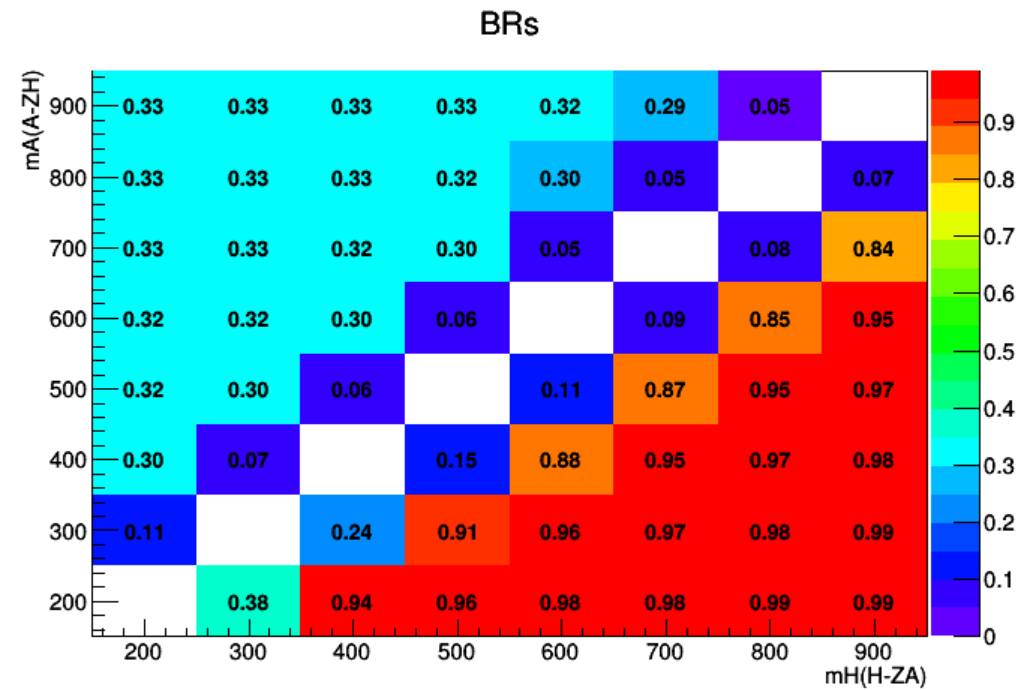
type II, $t\bar{b}=10.0$ $\cos(b-a)=0$

2HDM AZH HZA ($m_{\text{Ch}} = \max\{m_A, m_H\}$)

- Type II, both close in SM alignment, different t_b
- Look at **only BRs**



type II, $t_b=1.0$ $\cos(b-a)=0$

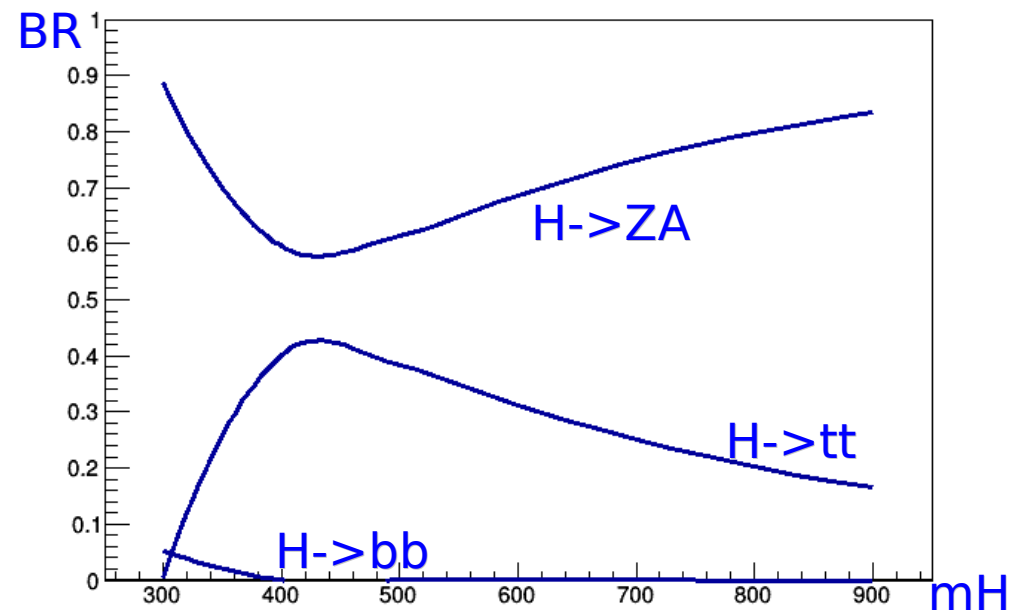


type II, $t_b=10.0$ $\cos(b-a)=0$

The shift of BR peak to higher values when fermion couplings

2HDM AZH HZA ($m_{Ch} = \max\{m_A, m_H\}$)

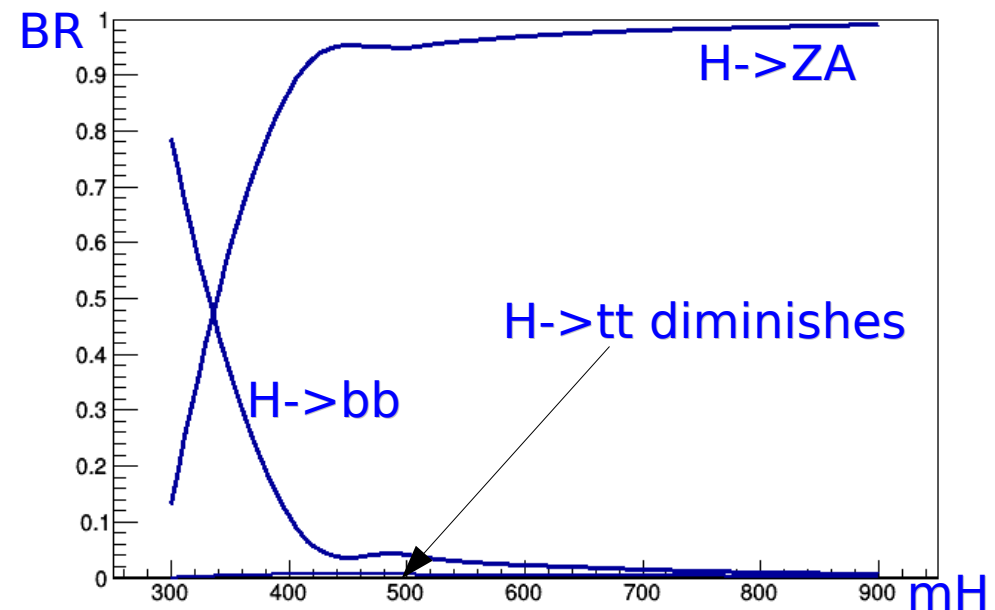
- Type II, both close in SM alignment, different t_b
- Look at $H \rightarrow XX$ BRs



**type II, $t_b=1.0$ $\cos(b-a)=0$
 $m_A=200\text{GeV}$**

$$c_{\beta-\alpha} = s_{\beta-\alpha}/t_\beta$$

coupling between A and up-type quark



**type II, $t_b=10.0$ $\cos(b-a)=0$
 $m_A = 200\text{GeV}$**

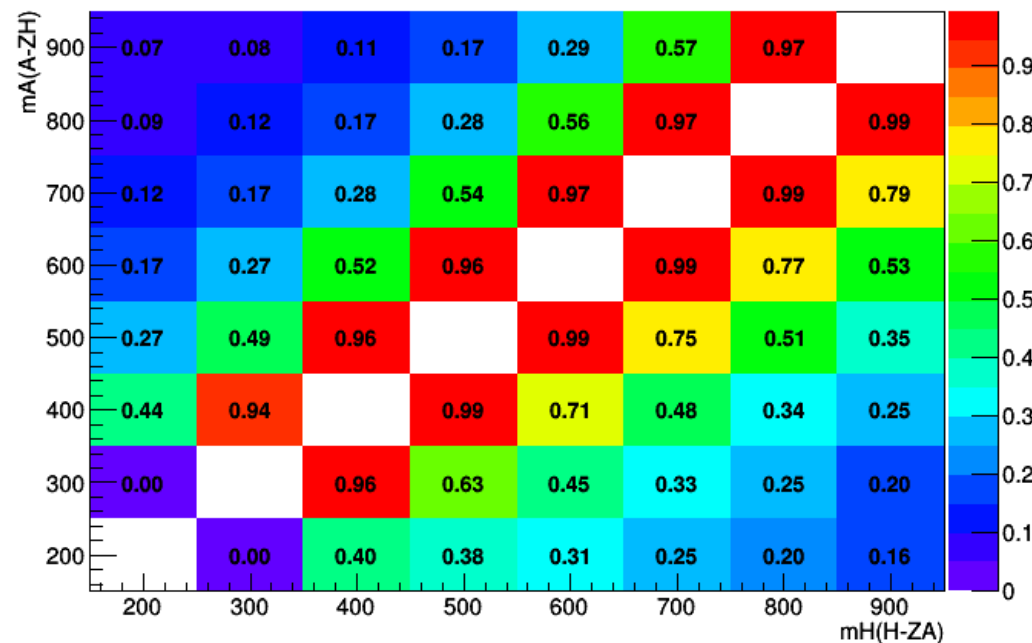
$\cos(b-a)=0$, $\sin(b-a)=1$, coupling $\sim 1/t_b$
low t_b , high coupling, $A/H \rightarrow tt$ contributes
after $m(tt)$ threshold
high t_b , low coupling $A/H \rightarrow tt$ diminishes

Backup

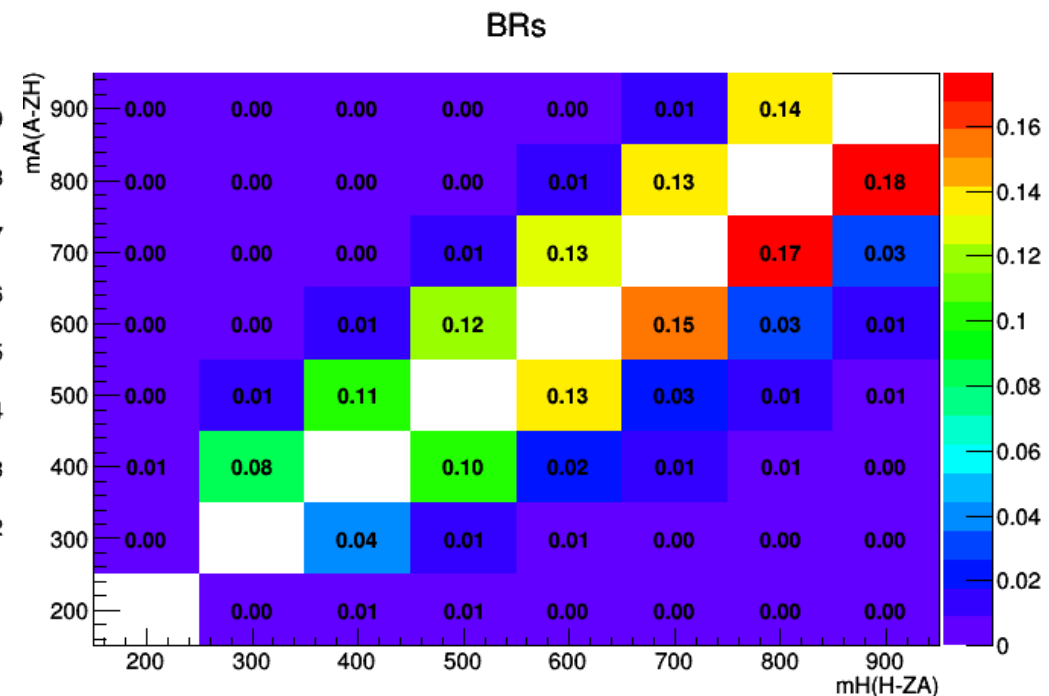
2HDM AZH HZA ($m_{Ch} = \max\{m_A, m_H\}$)

11

- Type II, both close in SM alignment, different t_b
- Look at $A/H \rightarrow tt$ BRs



type II, $t_b=1.0$ $\cos(b-a)=0$



type II, $t_b=10.0$ $\cos(b-a)=0$

$$c_{\beta-\alpha} - s_{\beta-\alpha}/t_\beta$$

coupling between A and up-type quark

$\cos(b-a)=0$, $\sin(b-a)=1$, coupling $\sim 1/t_b$
 low t_b , high coupling, $A/H \rightarrow tt$ contributes
 after $m(tt)$ threshold
 high t_b , low coupling $A/H \rightarrow tt$ diminishes

- bak