

# Activités à Tanger

Presenté par Abdesslam Arhrib

“Journées scientifiques du GDRI P2IM – Lancement  
Faculté des Sciences, Rabat 17-18 Décembre 2015



# Groupe de Tanger: Lab mathématiques et applications

Memberes enseignants chercheurs

- Abdesslam Arhrib
- Said Hadj Nassar

Etudiants en thèse:

- Jaouad El-Falaki
- Adil Jueid

# thèmes:

- Radiative corrections, rare decays...
- On-shell renormalisation;
- Unitarity constraint and BFB for extended Higgs models,
- Tools for loop calculations: FeynArts, FormCalc.

# Missions

- Adil Jueid: Tanger → Annecy 20 Novembre au 16 Décembre 2015
- Abdesslam Arhrib: Tanger → Montpellier ? 2016
- Jaouad El Falaki: Tanger → Montpellier ? 2016

# Activités: 1. Triple Higgs coupling

"Radiative corrections to the Triple Higgs Coupling in the inert Higgs Doublet Model," A. A, R. Benbrik, J. El Falaki and A. Jueid JHEP'15

- Corrections to  $hhh$ ,  $hZZ$  and  $hWW$  couplings
- Corrections to  $hhh$  could be extremely large.
- If the invisible decay  $h \rightarrow HH$  is open, the constraints from DM could reduce these corrections, but they can still be of the order of 100% for heavy  $H^\pm$  or  $A^0$ .
- loop-corrections to  $e^+e^- \rightarrow Zhh$  through  $hhh$  one loop coupling are also large

# Activités: 1. Triple Higgs coupling

- “Higgs Phenomenology in the Two-Singlet Model”  
Amine Ahriche, A. Arhrib and Salah Nasri JHEP’14
- “Triple Higgs Coupling as a Probe of the Twin-Peak Scenario,”  
A. Ahriche, A. Arhrib and S. Nasri,  
PLB 743, 279 (2015)

# Activitiés récentes (cont.)

- Type see-saw Model: (Gilbert talk)  
A.A, R. Benbrik, M. Chabab, G. Moultaqa,  
M. C. Peyranere, L. Rahili and J. Ramadan,  
“The Higgs Potential in the Type II Seesaw Model,”  
PRD84, 095005 (2011)
- A.A, R. Benbrik, M. Chabab, G. Moultaqa and L. Rahili,  
“Higgs boson decay into 2 photons in the type II Seesaw  
Model,”  
JHEP 1204, 136 (2012)
- “Type II Seesaw Higgsology and LEP/LHC constraints,”  
A.A, R. Benbrik, G. Moultaqa and L. Rahili,  
arXiv:1411.5645

# Inert Higgs Doublet Model

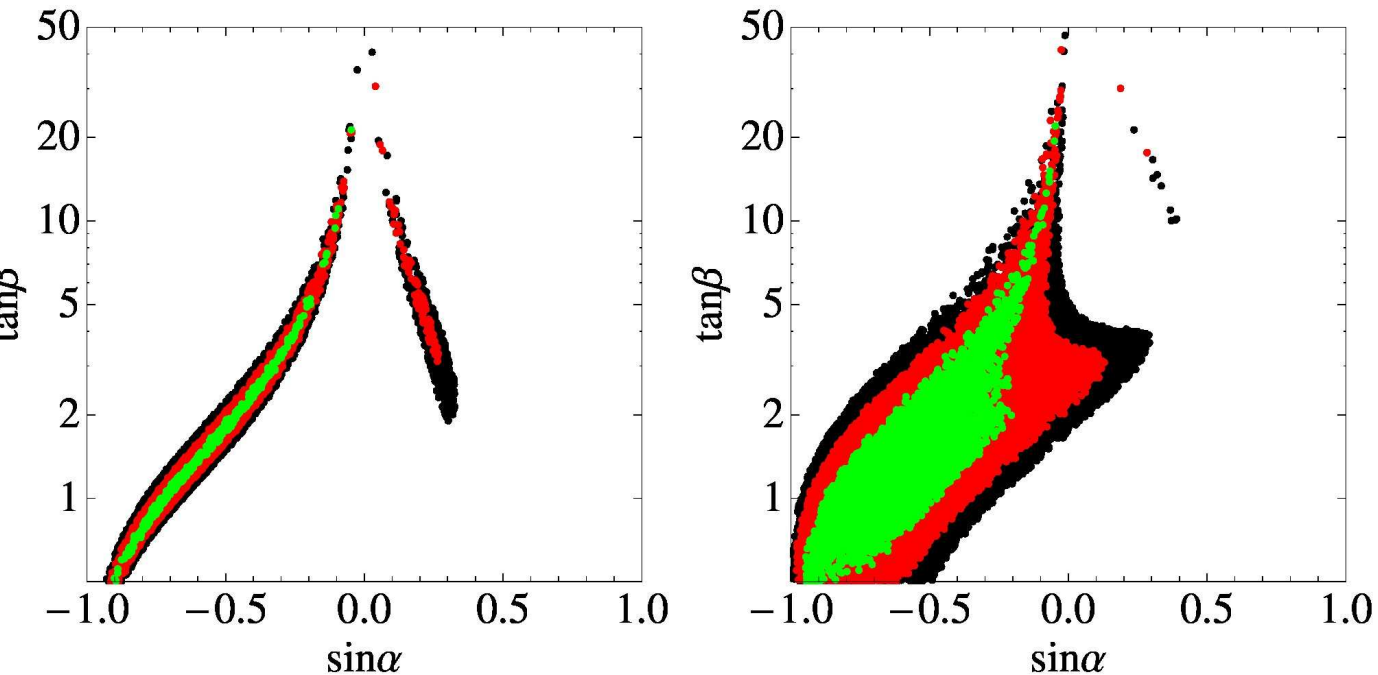
- \* A. Arhrib, Y. L. S. Tsai, Q. Yuan and T. C. Yuan,  
“An Updated Analysis of Inert Higgs Doublet Model in  
light of the Recent Results from LUX, PLANCK,  
AMS-02 and LHC,”  
JCAP **1406**, 030 (2014)
  
- \* A. Arhrib, R. Benbrik and T. C. Yuan,  
“Associated Production of Higgs at Linear Collider in  
the Inert Higgs Doublet Model:  $e^+e^- \rightarrow H\gamma$ ”  
Eur. Phys. J. C **74**, 2892 (2014)



# Activitiés récentes (cont.)

4. “Two-Higgs-Doublet type-II and -III models and  $t \rightarrow ch$  at the LHC,”;

A. Arhrib, R. Benbrik, C. H. Chen, M. Gomez-Bock and S. Semlali, arXiv:1508.06490.

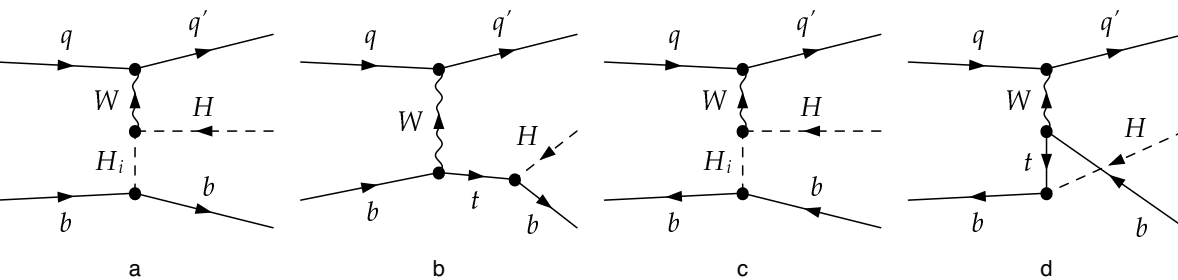


The allowed regions in  $(\sin\alpha, \tan\beta)$ , left: 2HDM-II, right 2HDM-III. The errors for  $\chi$ -square fit are 99.7% CL (black), 95.5% CL (red) and 68% CL (green).

# Activitiés récentes (cont.)

## 4. “Enhanced Charged Higgs Production through $W^\pm$ -Higgs Fusion,”

A. Arhrib, K. Cheung, J. S. Lee and C. T. Lu,  
arXiv:1509.00978 [hep-ph].



# En cours

## 1. Anomalous $tbW$ couplings in 2HDM

- New physics might induce non-trivial tensorial couplings.

$$\mathcal{L} = \frac{ig}{\sqrt{2}} \bar{u}_b(p_b) \left[ (V_L P_L + V_R P_R) \gamma^\mu - \frac{\sigma^{\mu\nu} q_\nu}{M_W} (g_L P_L + g_R P_R) \right] u_t(p_t) \epsilon_\mu^*$$

- In SM, the effects are dominated by QCD corrections.

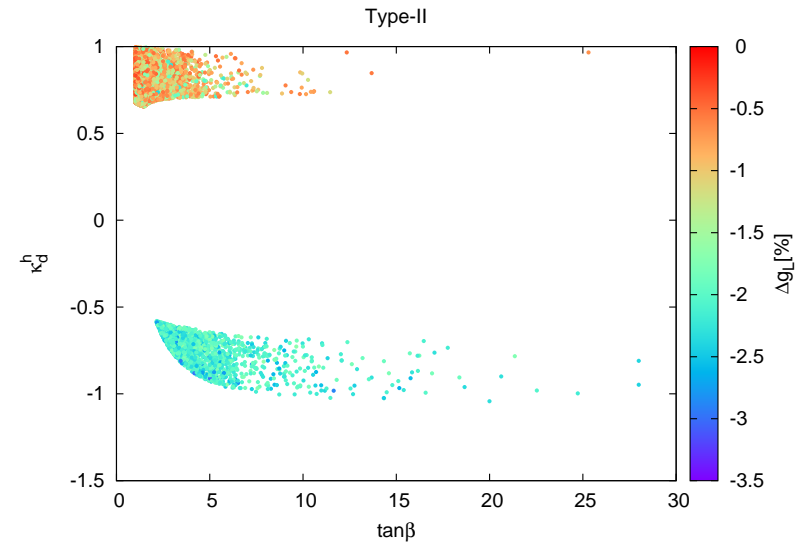
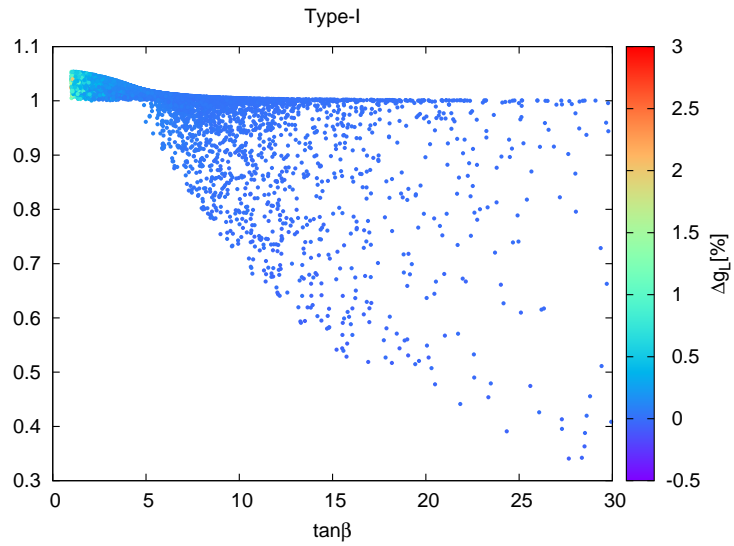
$$g_L = -(1.247 + 0.002747i)10^{-3}, \quad g_R = -(8.6 + 2.05i)10^{-3}$$

$$V_L = -0.0296 + 0.0119i, \quad V_R = (2.911 + 0.9) \times 10^{-3}$$

- We evaluate  $\Delta\mathcal{O}_i$  with LHC constraints

$$\Delta\mathcal{O}_i = \frac{\mathcal{O}_i^{2HDM} - \mathcal{O}_i^{SM}}{\mathcal{O}_i^{SM}}, \quad \mathcal{O}_i = \text{Re}(g_L), \text{Re}(g_R), \text{Re}(V_R), V_{tb} + \text{Re}(V_L)$$

# preliminary Results



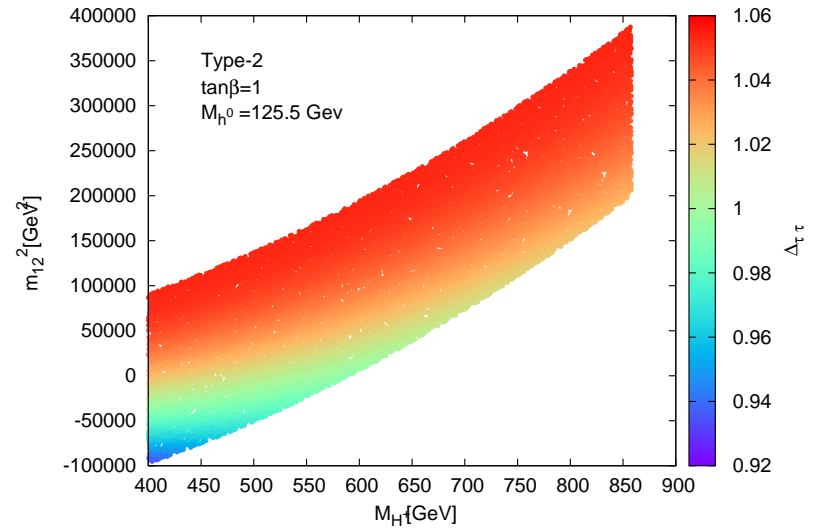
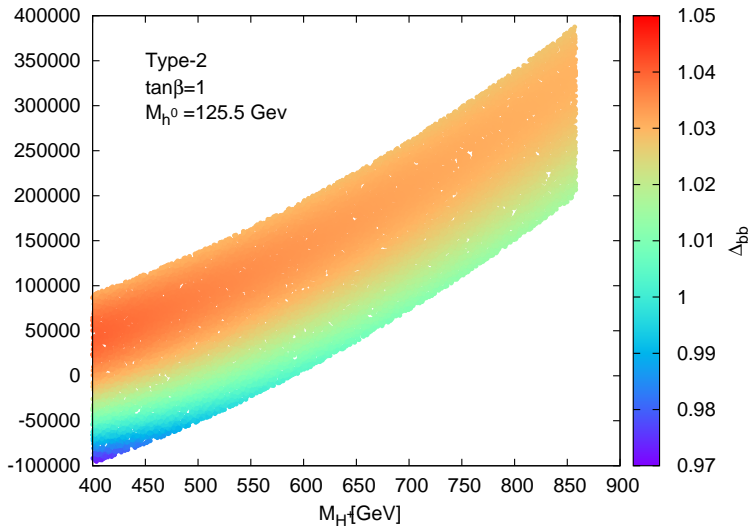
Relative contribution to the  $tbW$  tensorial coupling  $g_L$  in type-I (left) and type-II THDM (right)

# En cours (cont.)

2. Radiative corrections to  $h \rightarrow b\bar{b}$  and  $h \rightarrow \tau^+\tau^-$  in 2HDM.

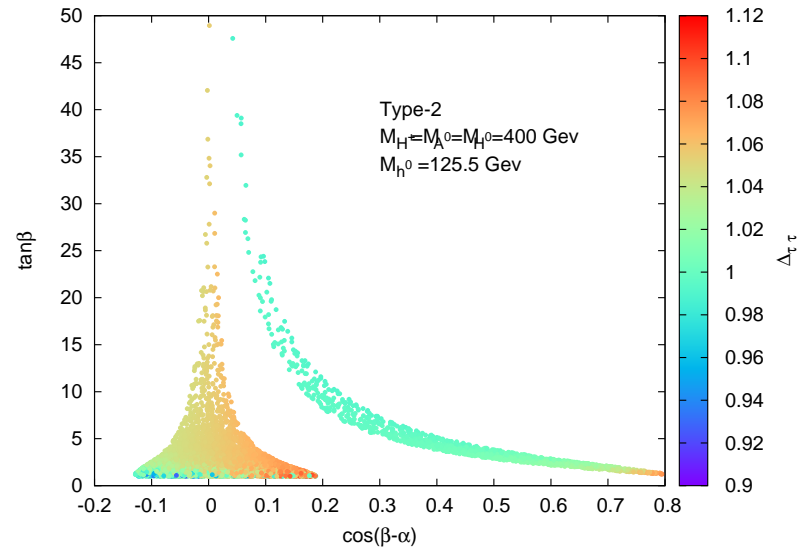
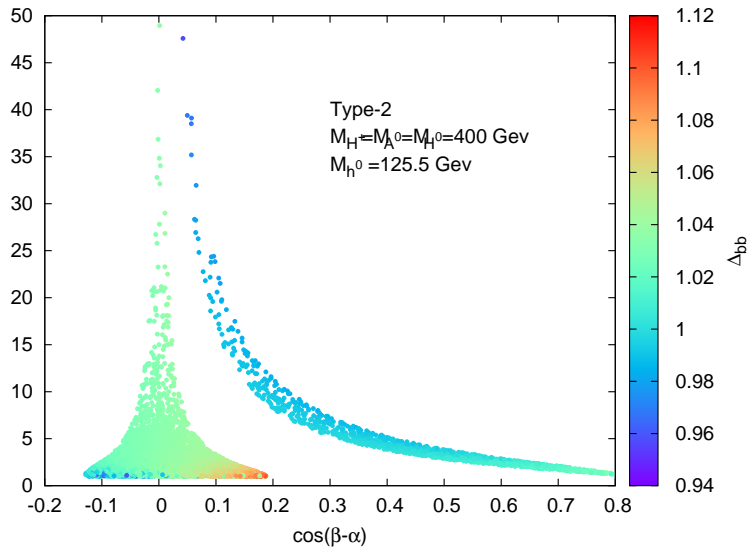
- We use on-shell scheme for determination of the counterterms,
- The field renormalization constants for the two Higgs doublets are determined in the  $\overline{MS}$  scheme.

# Preliminary, Decoupling limit $\cos(\beta - \alpha) = 0$



(left)  $\Delta_{bb}$  (%), (right)  $\Delta_{\tau^+\tau^-}$  (%) in the plane  $(M_{H^+}, m_{12}^2)$  in 2HDM2

# Preliminary, $(\cos(\beta - \alpha), \tan \beta)$



(left)  $\Delta_{bb}$  (%), (right)  $\Delta_{\tau - \tau}$  (%) in the plane  $(\cos(\beta - \alpha), \tan \beta)$  in 2HDM2