HEPfit: The Analysis Toolkit

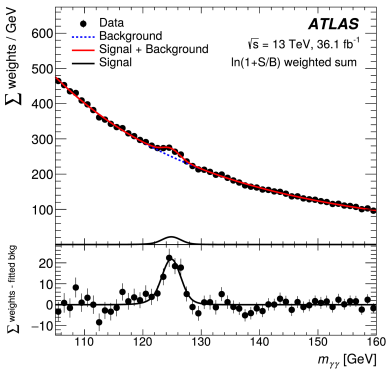
ICHEP 2018

Seoul, July 7 2018

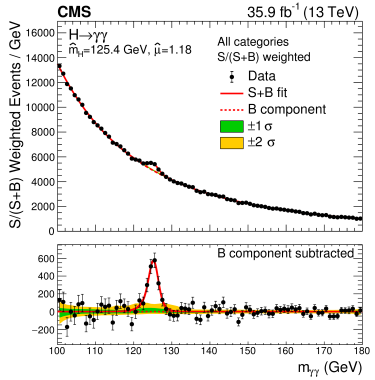
Otto Eberhardt

IFIC, Universitat de València-CSIC

SM seems to be the correct description of most physics at LHC scales and below.

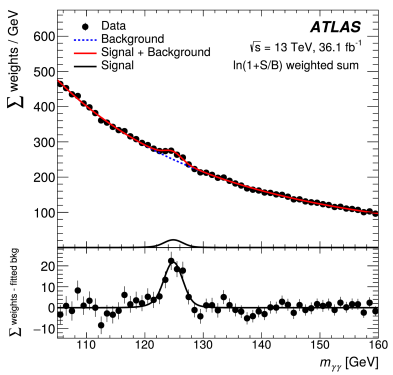


[1806.00242]

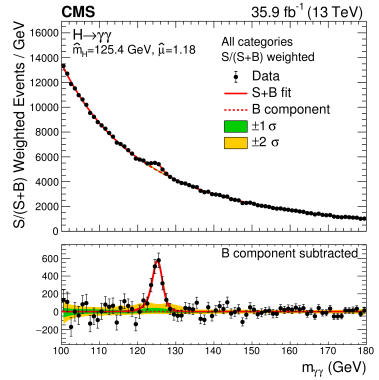


[1804.02716]

SM seems to be the correct description of most physics at LHC scales and below.

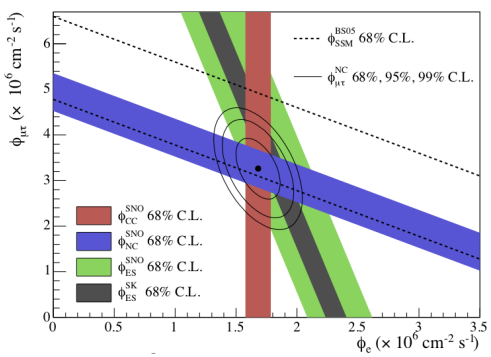


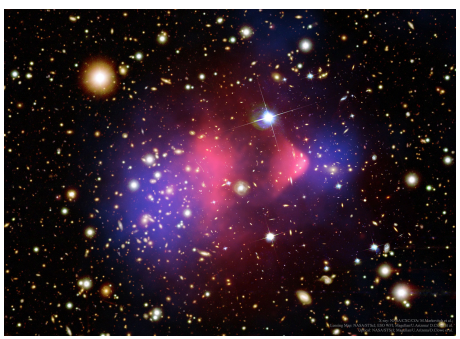
[1806.00242]

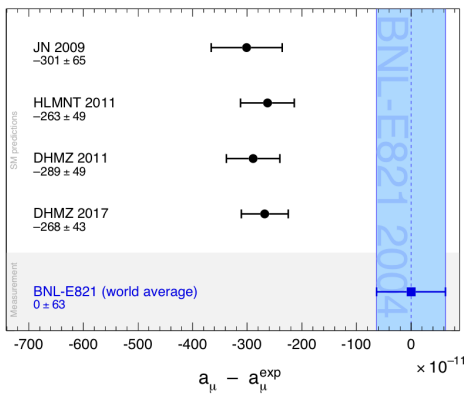


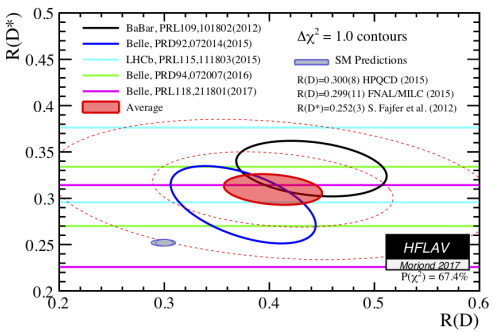
[1804.02716]

Yet, we know there is more to nature.
Which way to take from this point?

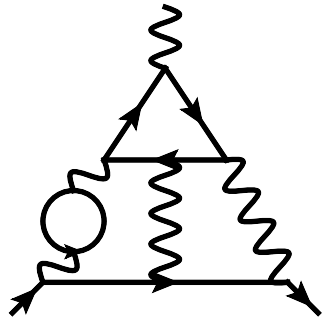








Theory calculations get more precise
and more complicated



We have a lot of experimental data to compare to,
but the comparison is not always trivial and model dependent

The more results we combine with a certain theory, the better we can tell about the possible realisation of that theory.

Several codes on the market have one or more of the following disadvantages:

- Not public
- Slow (no fit possible)
  either due to sloppy implementation or external dependencies
- Not flexible: only one model or one set of constraints

Our idea:

Write an open-source code which can combine all experimental data and compare them to theory in a fit at best available precision, in as many models as possbile.

Our idea:

Write an open-source code which can combine all experimental data and compare them to theory in a fit at best available precision, in as many models as possbile.

IFIC
INSTITUT DE FÍSICA CORPUSCULAR

General overview

Model $\longrightarrow$ Parameters & Observables

Priors $\pi(\boldsymbol{\theta})$ Likelihoods $L(\boldsymbol{x}|\boldsymbol{\theta})$

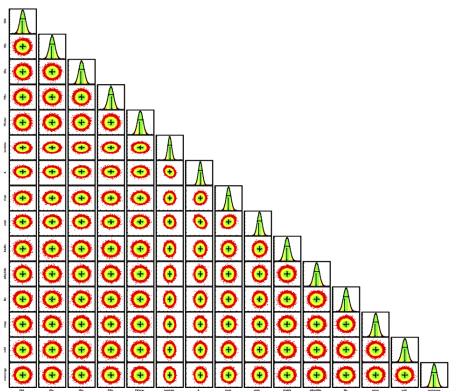
Output:

General overview

Model $\longrightarrow$ Parameters & Observables

Priors $\pi(\boldsymbol{\theta})$ Likelihoods $L(\boldsymbol{x}|\boldsymbol{\theta})$

Output: Parameter and observable posterior distributions

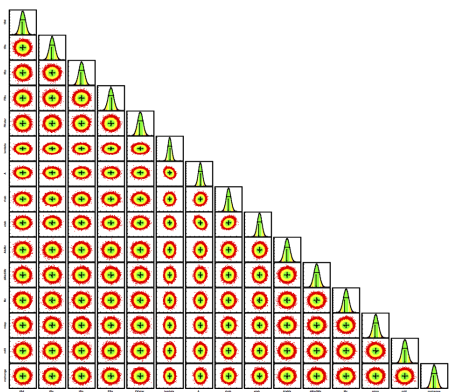


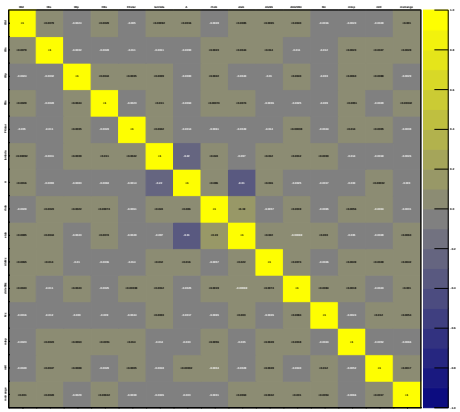
General overview

Model ⟶ Parameters & Observables

Priors $\pi(\boldsymbol{\theta})$ Likelihoods $L(\boldsymbol{x}|\boldsymbol{\theta})$

Output: Parameter and observable posterior distributions
Parameter correlations



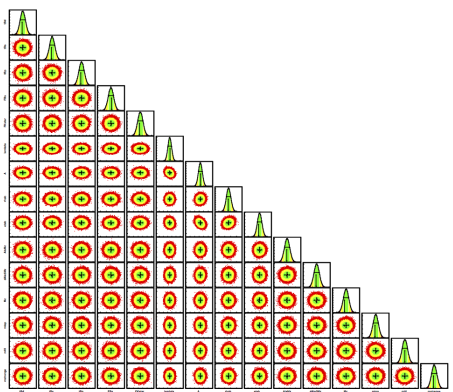


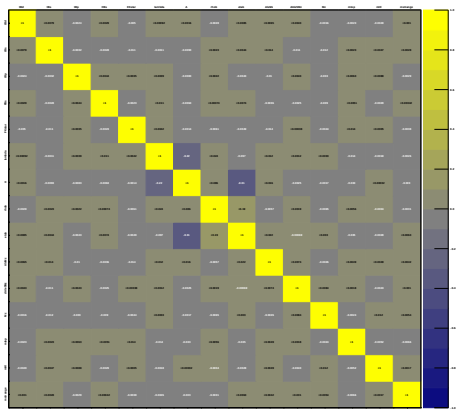
General overview

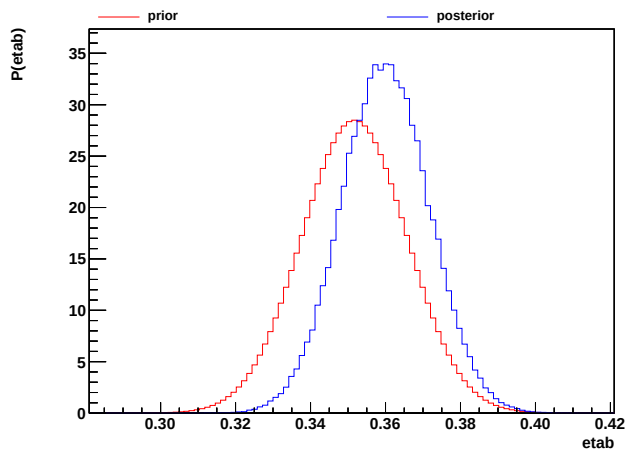
Model ⟶ Parameters & Observables

Priors $\pi(\boldsymbol{\theta})$ Likelihoods $L(\boldsymbol{x}|\boldsymbol{\theta})$

Output: Parameter and observable posterior distributions
Parameter correlations
Comparison of prior and posterior





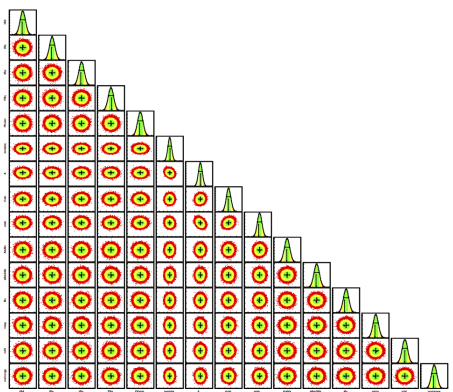


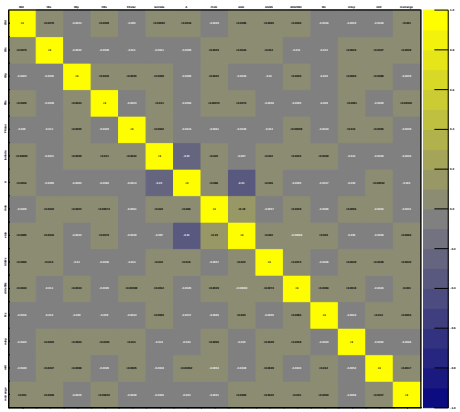
General overview

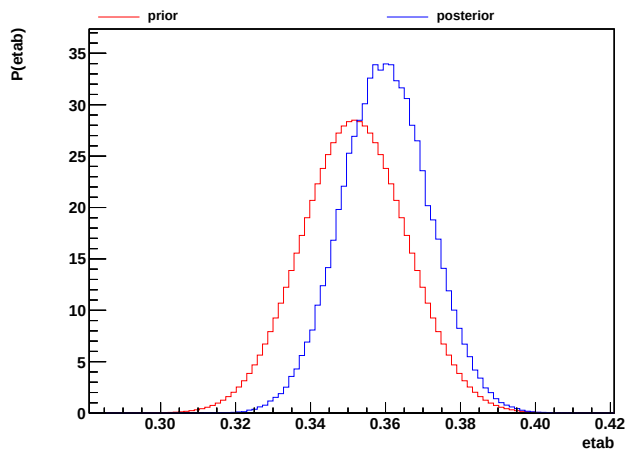
Model ⟶ Parameters & Observables

Priors $\pi(\boldsymbol{\theta})$ Likelihoods $L(\boldsymbol{x}|\boldsymbol{\theta})$

Output: Parameter and observable posterior distributions
Parameter correlations
Comparison of prior and posterior
Global mode and normalisation, (D)IC values

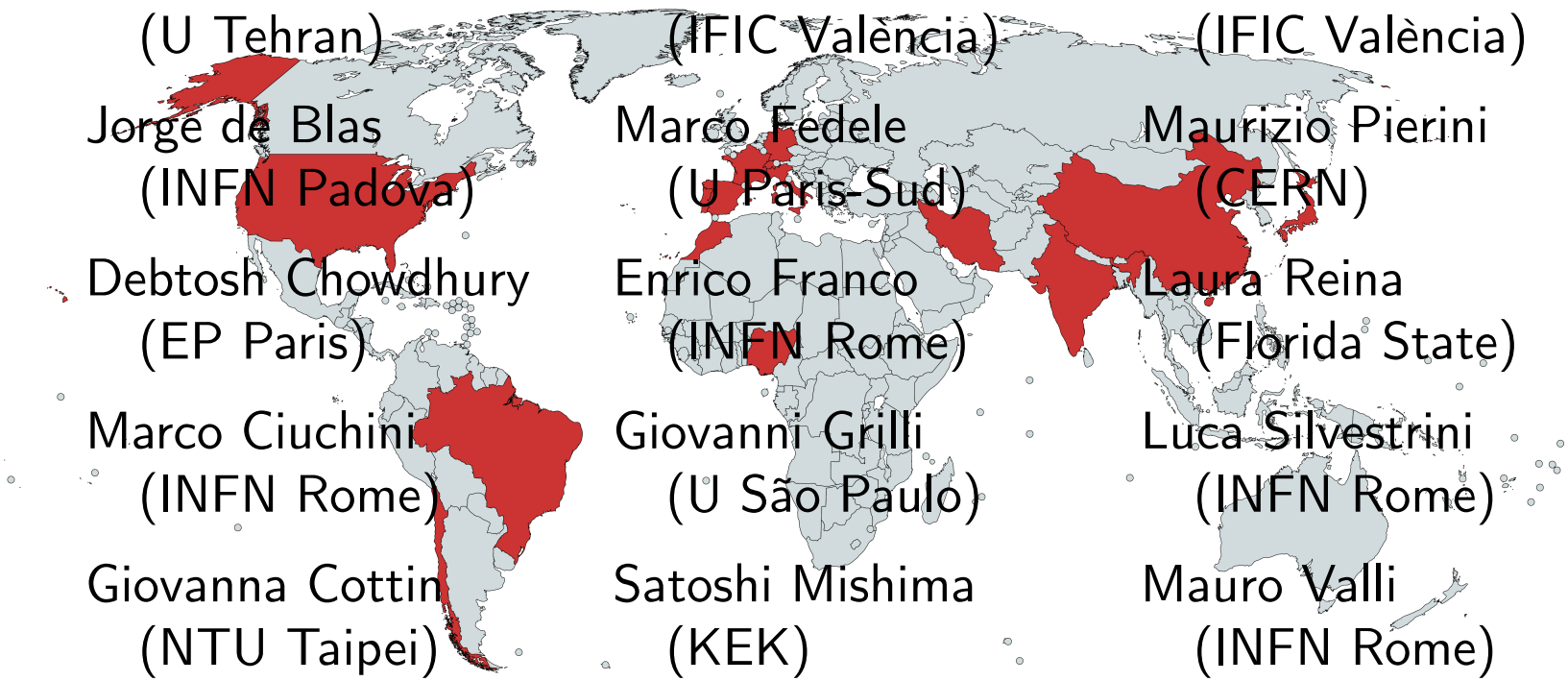






Users and policies

Open-source project, but NO "HEPfit collaboration"



Shehu AbdusSalam (U Tehran)
Otto Eberhardt (IFIC València)
Ana Peñuelas (IFIC València)
Jorge de Blas (INFN Padova)
Marco Fedele (U Paris-Sud)
Maurizio Pierini (CERN)
Debtosh Chowdhury (EP Paris)
Enrico Franco (INFN Rome)
Laura Reina (Florida State)
Marco Ciuchini (INFN Rome)
Giovanni Grilli (U São Paulo)
Luca Silvestrini (INFN Rome)
Giovanna Cottin (NTU Taipei)
Satoshi Mishima (KEK)
Mauro Valli (INFN Rome)
António Coutinho (INFN Rome)
Ayan Paul (HU Berlin)
Norimi Yokozaki (Tohoku U)

IFIC INSTITUT DE FÍSICA CORPUSCULAR

Dependencies and Usage

C++ compiler

GSL, boost – numerical solutions to integration, algebra, differential equations etc.

BAT – statistics

ROOT – graphical output of the results (histograms)

openMPI – only for parallelized fits

Once installed:

```
./analysis StandardModel.conf MonteCarlo.conf
```

IFIC INSTITUT DE FÍSICA CORPUSCULAR

Dependencies and Usage

C++ compiler

GSL, boost – numerical solutions to integration, algebra, differential equations etc.

BAT – statistics

ROOT – graphical output of the results (histograms)

openMPI – only for parallelized fits

Once installed:

```
./analysis StandardModel.conf MonteCarlo.conf
```

StandardModel.conf

```
StandardModel
# Model parameters:
ModelParameter  mtop        173.2       0.9         0.
ModelParameter  mHl         125.6       0.3         0.
...
CorrelatedGaussianParameters   V1_lattice 2
ModelParameter  a_0V    0.496    0.067    0.
ModelParameter  a_1V   -2.03     0.92     0.
1.00     0.86
0.86     1.00

<All the model parameters have to be listed here>

# Observables:
Observable  Mw         Mw         M_{W}       80.3290 80.4064 MCMC weight 80.385 0.015 0.
Observable  GammaW     GammaW     #Gamma_{W} 2.08569 2.09249 MCMC weight 2.085  0.042 0.
#
# Correlated observables:
CorrelatedGaussianObservables Zpole2 7
Observable  Alepton    Alepton    A_{l}       0.143568 0.151850 MCMC weight 0.1513  0.0021  0.
Observable  Rbottom    Rbottom    R_{b}       0.215602 0.215958 MCMC weight 0.21629 0.00066 0.
Observable  Rcharm     Rcharm     R_{c}       0.172143 0.172334 MCMC weight 0.1721  0.0030  0.
Observable  AFBbottom  AFBbottom  A_{FB}^{b} 0.100604 0.106484 MCMC weight 0.0992  0.0016  0.
Observable  AFBcharm   AFBcharm   A_{FB}^{c} 0.071750 0.076305 MCMC weight 0.0707  0.0035  0.
Observable  Abottom    Abottom    A_{b}       0.934320 0.935007 MCMC weight 0.923   0.020   0.
Observable  Acharm     Acharm     A_{c}       0.666374 0.670015 MCMC weight 0.670   0.027   0.
1.00    0.00    0.00    0.00    0.00    0.09    0.05
0.00    1.00   -0.18   -0.10    0.07   -0.08    0.04
0.00   -0.18    1.00    0.04   -0.06    0.04   -0.06
0.00   -0.10    0.04    1.00    0.15    0.06    0.01
0.00    0.07   -0.06    0.15    1.00   -0.02    0.04
0.09   -0.08    0.04    0.06   -0.02    1.00    0.11
0.05    0.04   -0.06    0.01    0.04    0.11    1.00
#
# Output correlations:
Observable2D  MwvsGammaW Mw M_{W} 80.3290 80.4064 noMCMC noweight GammaW #Gamma_{W} 2.08569 2.09249
...
Observable2D Bd_Bsbar_mumu noMCMC noweight
Observable   BR_Bdmumu      BR(B_{d}#rightarrow#mu#mu)    1. -1.  1.05e-10   0.   0.
Observable   BRbar_Bsmumu   BR(B_{s}#rightarrow#mu#mu)    1. -1.  3.65e-9    0.   0.
...
Observable2D S5_P5 noMCMC noweight
BinnedObservable   S_5      S_5    1. -1.  0.   0.   0.   4.   6.
BinnedObservable   P_5      P_5    1. -1.  0.   0.   0.   4.   6.
#
# Including other configuration files
IncludeFile Flavour.conf
```

StandardModel.conf

```
StandardModel
# Model parameters:
ModelParameter  mtop        173.2       0.9         0.
ModelParameter  mHl         125.6       0.3         0.
...
CorrelatedGaussianParameters   V1_lattice 2
ModelParameter  a_0V    0.496    0.067    0.
ModelParameter  a_1V   -2.03     0.92     0.
1.00     0.86
0.86     1.00

<All the model parameters have to be listed here>

# Observables:
Observable  Mw         Mw         M_{W}       80.3290 80.4064 MCMC weight 80.385 0.015 0.
Observable  GammaW     GammaW     #Gamma_{W} 2.08569 2.09249 MCMC weight 2.085  0.042 0.
#
# Correlated observables:
CorrelatedGaussianObservables Zpole2 7
Observable  Alepton    Alepton    A_{l}       0.143568 0.151850 MCMC weight 0.1513  0.0021  0.
Observable  Rbottom    Rbottom    R_{b}       0.215602 0.215958 MCMC weight 0.21629 0.00066 0.
Observable  Rcharm     Rcharm     R_{c}       0.172143 0.172334 MCMC weight 0.1721  0.0030  0.
Observable  AFBbottom  AFBbottom  A_{FB}^{b} 0.100604 0.106484 MCMC weight 0.0992  0.0016  0.
Observable  AFBcharm   AFBcharm   A_{FB}^{c} 0.071750 0.076305 MCMC weight 0.0707  0.0035  0.
Observable  Abottom    Abottom    A_{b}       0.934320 0.935007 MCMC weight 0.923   0.020   0.
Observable  Acharm     Acharm     A_{c}       0.666374 0.670015 MCMC weight 0.670   0.027   0.
1.00    0.00    0.00    0.00    0.00    0.09    0.05
0.00    1.00   -0.18   -0.10    0.07   -0.08    0.04
0.00   -0.18    1.00    0.04   -0.06    0.04   -0.06
0.00   -0.10    0.04    1.00    0.15    0.06    0.01
0.00    0.07   -0.06    0.15    1.00   -0.02    0.04
0.09   -0.08    0.04    0.06   -0.02    1.00    0.11
0.05    0.04   -0.06    0.01    0.04    0.11    1.00
#
# Output correlations:
Observable2D  MwvsGammaW Mw M_{W} 80.3290 80.4064 noMCMC noweight GammaW #Gamma_{W} 2.08569 2.09249
...
Observable2D Bd_Bsbar_mumu noMCMC noweight
Observable   BR_Bdmumu      BR(B_{d}#rightarrow#mu#mu)    1. -1.  1.05e-10   0.   0.
Observable   BRbar_Bsmumu   BR(B_{s}#rightarrow#mu#mu)    1. -1.  3.65e-9    0.   0.
...
Observable2D S5_P5 noMCMC noweight
BinnedObservable   S_5      S_5    1. -1.  0.   0.   0.   4.   6.
BinnedObservable   P_5      P_5    1. -1.  0.   0.   0.   4.   6.
#
# Including other configuration files
IncludeFile Flavour.conf
```

Model definition (currently 35)

StandardModel.conf

```
StandardModel
# Model parameters:
ModelParameter  mtop        173.2       0.9         0.
ModelParameter  mHl         125.6       0.3         0.
...
CorrelatedGaussianParameters   V1_lattice 2
ModelParameter  a_0V    0.496    0.067    0.
ModelParameter  a_1V   -2.03     0.92     0.
1.00     0.86
0.86     1.00

<All the model parameters have to be listed here>

# Observables:
Observable  Mw         Mw         M_{W}       80.3290 80.4064 MCMC weight 80.385 0.015 0.
Observable  GammaW     GammaW     #Gamma_{W} 2.08569 2.09249 MCMC weight 2.085  0.042 0.
#
# Correlated observables:
CorrelatedGaussianObservables Zpole2 7
Observable  Alepton    Alepton    A_{l}       0.143568 0.151850 MCMC weight 0.1513  0.0021  0.
Observable  Rbottom    Rbottom    R_{b}       0.215602 0.215958 MCMC weight 0.21629 0.00066 0.
Observable  Rcharm     Rcharm     R_{c}       0.172143 0.172334 MCMC weight 0.1721  0.0030  0.
Observable  AFBbottom  AFBbottom  A_{FB}^{b} 0.100604 0.106484 MCMC weight 0.0992  0.0016  0.
Observable  AFBcharm   AFBcharm   A_{FB}^{c} 0.071750 0.076305 MCMC weight 0.0707  0.0035  0.
Observable  Abottom    Abottom    A_{b}       0.934320 0.935007 MCMC weight 0.923   0.020   0.
Observable  Acharm     Acharm     A_{c}       0.666374 0.670015 MCMC weight 0.670   0.027   0.
1.00    0.00    0.00    0.00    0.00    0.09    0.05
0.00    1.00   -0.18   -0.10    0.07   -0.08    0.04
0.00   -0.18    1.00    0.04   -0.06    0.04   -0.06
0.00   -0.10    0.04    1.00    0.15    0.06    0.01
0.00    0.07   -0.06    0.15    1.00   -0.02    0.04
0.09   -0.08    0.04    0.06   -0.02    1.00    0.11
0.05    0.04   -0.06    0.01    0.04    0.11    1.00
#
# Output correlations:
Observable2D  MwvsGammaW Mw M_{W} 80.3290 80.4064 noMCMC noweight GammaW #Gamma_{W} 2.08569 2.09249
...
Observable2D Bd_Bsbar_mumu noMCMC noweight
Observable   BR_Bdmumu      BR(B_{d}#rightarrow#mu#mu)    1. -1.  1.05e-10   0.   0.
Observable   BRbar_Bsmumu   BR(B_{s}#rightarrow#mu#mu)    1. -1.  3.65e-9    0.   0.
...
Observable2D S5_P5 noMCMC noweight
BinnedObservable   S_5      S_5    1. -1.  0.   0.   0.   4.   6.
BinnedObservable   P_5      P_5    1. -1.  0.   0.   0.   4.   6.
#
# Including other configuration files
IncludeFile Flavour.conf
```

Parameter values

StandardModel.conf

```
StandardModel
# Model parameters:
ModelParameter  mtop        173.2       0.9         0.
ModelParameter  mHl         125.6       0.3         0.
...
CorrelatedGaussianParameters   V1_lattice 2
ModelParameter  a_0V    0.496    0.067    0.
ModelParameter  a_1V   -2.03     0.92     0.
1.00     0.86
0.86     1.00

<All the model parameters have to be listed here>

# Observables:
Observable  Mw         Mw         M_{W}       80.3290 80.4064 MCMC weight 80.385 0.015 0.
Observable  GammaW     GammaW     #Gamma_{W} 2.08569 2.09249 MCMC weight 2.085  0.042 0.
#
# Correlated observables:
CorrelatedGaussianObservables Zpole2 7
Observable  Alepton    Alepton    A_{l}       0.143568 0.151850 MCMC weight 0.1513  0.0021  0.
Observable  Rbottom    Rbottom    R_{b}       0.215602 0.215958 MCMC weight 0.21629 0.00066 0.
Observable  Rcharm     Rcharm     R_{c}       0.172143 0.172334 MCMC weight 0.1721  0.0030  0.
Observable  AFBbottom  AFBbottom  A_{FB}^{b} 0.100604 0.106484 MCMC weight 0.0992  0.0016  0.
Observable  AFBcharm   AFBcharm   A_{FB}^{c} 0.071750 0.076305 MCMC weight 0.0707  0.0035  0.
Observable  Abottom    Abottom    A_{b}       0.934320 0.935007 MCMC weight 0.923   0.020   0.
Observable  Acharm     Acharm     A_{c}       0.666374 0.670015 MCMC weight 0.670   0.027   0.
1.00    0.00    0.00    0.00    0.00    0.09    0.05
0.00    1.00   -0.18   -0.10    0.07   -0.08    0.04
0.00   -0.18    1.00    0.04   -0.06    0.04   -0.06
0.00   -0.10    0.04    1.00    0.15    0.06    0.01
0.00    0.07   -0.06    0.15    1.00   -0.02    0.04
0.09   -0.08    0.04    0.06   -0.02    1.00    0.11
0.05    0.04   -0.06    0.01    0.04    0.11    1.00
#
# Output correlations:
Observable2D  MwvsGammaW Mw M_{W} 80.3290 80.4064 noMCMC noweight GammaW #Gamma_{W} 2.08569 2.09249
...
Observable2D Bd_Bsbar_mumu noMCMC noweight
Observable   BR_Bdmumu      BR(B_{d}#rightarrow#mu#mu)    1. -1.  1.05e-10   0.   0.
Observable   BRbar_Bsmumu   BR(B_{s}#rightarrow#mu#mu)    1. -1.  3.65e-9    0.   0.
...
Observable2D S5_P5 noMCMC noweight
BinnedObservable   S_5      S_5    1. -1.  0.   0.   0.   4.   6.
BinnedObservable   P_5      P_5    1. -1.  0.   0.   0.   4.   6.
#
# Including other configuration files
IncludeFile Flavour.conf
```

Observables and predictions

IFIC INSTITUT DE FÍSICA CORPUSCULAR

Observable list

The release candidate 2 contains more than 1000 observables

HEPfit name	Model(s)	Comments
MtMSbar	SM	
Mw	SM	
GammaW	SM	
GammaZ	SM	
sigmaHadron	SM	
sin2thetaEff	SM	
PtauPol	SM	
Alepton	SM	
Acharm	SM	
Abottom	SM	
AFBlepton	SM	
AFBcharm	SM	
AFBbottom	SM	
Rlepton	SM	
Rcharm	SM	
Rbottom	SM	
ggHx	SM	$x \in 7, 8, 13, 14, 100, 196$; without x default is 8
VBFx	SM	$x \in 7, 8, 13, 14, 100, 196$; without x default is 8
WHx	SM	$x \in 7, 8, 13, 14, 100$; without x default is 8
ZHx	SM	$x \in 7, 8, 13, 14, 100$; without x default is 8
VHx	SM	$x \in 7, 8, 13, 14, 100, 196$; without x default is 8
ggH+ttHx	SM	$x \in 8, 13, 14, 100$; without x default is 8
VBF+VHx	SM	$x \in 8, 13, 14, 100$; without x default is 8
ttHx	SM	$x \in 7, 8, 13, 14, 100, 196$; without x default is 8
eeZHx	SM	$x \in 240, 250, 500, 1000$
eeWBFx	SM	$x \in 250, 350, 500, 1000$
eettHx	SM	$x \in 500, 1000$
BrHggRatio	SM	
BrHWWRatio	SM	
BrHZZRatio	SM	
BrHZgaRatio	SM	
BrHgagaRatio	SM	
BrHmumuRatio	SM	
BrHtautauRatio	SM	
BrHccRatio	SM	
BrHbbRatio	SM	
epsilonx	SM	$x = 1, 2, 3, b$
DmBd	SM	
DmBs	SM,THDM	
SJPsiK	SM	
Betas_JPsiPhi	SM	
EpsilonK	SM	
DmK	SM	
Vij	SM	$i = u, c, t$; $j = d, s, b$
alpha	SM	
alpha_2a	SM	
gamma	SM	
beta	SM	
betas	SM	
2betapgamma	SM	
s2beta	SM	
c2beta	SM	
CKM_rho	SM	
CKM_eta	SM	
sintheta12	SM	
sintheta13	SM	
sintheta23	SM	
ckmdelta	SM	
J_CP	SM	
Rt	SM	
Rts	SM	
Rb	SM	
VtdoVts	SM	
Abslam_x	SM	$x \in u, c, t, ud, cd, td, us, cs, ts$
Relam_x	SM	$x \in u, c, t, ud, cd, td, us, cs, ts$
Imlam_x	SM	$x \in u, c, t, ud, cd, td, us, cs, ts$
BR_Bdmumu	SM	
BRbar_Bdmumu	SM	
Amumu_Bd	SM	
Smumu_Bd	SM	
BR_Bsmumu	SM	
BRbar_Bsmumu	SM	
Amumu_Bs	SM	
Smumu_Bs	SM	
BR_BdmumuOBR_Bsmumu	SM	

HEPfit name	Model(s)	Comments
BR_bsgamma	SM	
ACP_bsgamma	SM	
BR_bdgamma	SM	
ACP_bdgamma	SM	
BR_bqgamma	SM	
ACP_bqgamma	SM	
P_i_BdKstmu	SM	$i \in 1, 2, 3, 4p, 5p, 6p, 8p$
P_i_BdKste	SM	$i \in 1, 2, 3$
Gammap_BdKstmu	SM	
A_FB_BdKstmu	SM	
BR_BdKstmu	SM	
BR_BdKste	SM	
RKst_BdKstll	SM	
RKstL_BdKstll	SM	
RKstT_BdKstll	SM	
R6_BdKstll	SM	
ACP_BdKstmu	SM	
P3CP_BdKstmu	SM	
F_L_BdKstmu	SM	
F_L_BdKste	SM	
M_i_BdKstmu	SM	$i \in 1p, 2p$
S_i_BdKstmu	SM	$i \in 3, 4, 5, 7, 8, 9$
A_i_BdKstmu	SM	$i \in 6, 9$
P_if_BdKstmu	SM	$i \in 1, 2, 3, 4p, 5p, 6p, 8p$
Gammapf_BdKstmu	SM	
BRf_BdKstmu	SM	
A_FBf_BdKstmu	SM	
F_Lf_BdKstmu	SM	
S_if_BdKstmu	SM	$i \in 3, 4, 5, 7, 8, 9$
P_relationf	SM	
P_relation_exactf	SM	
Vx_BdKstmu	SM	$x \in 0, p, m$
Tx_BdKstmu	SM	$x \in 0, p, m$
S_BdKstmu	SM	
QCDfC9_if_BdKstmu	SM	$i \in 1, 2, 3$
QCDfC9p_if_BdKstmu	SM	$i \in 1, 2, 3$
Regtilde_i_BdKstmu	SM	$i \in 1, 2, 3$
Imgtilde_i_BdKstmu	SM	$i \in 1, 2, 3$
Absgtilde_i_BdKstmu	SM	$i \in 1, 2, 3$
Arggtilde_i_BdKstmu	SM	$i \in 1, 2, 3$
Reh_x_BdKstmu	SM	$x \in 0, p, m$
Imh_x_BdKstmu	SM	$x \in 0, p, m$
Absh_x_BdKstmu	SM	$x \in 0, p, m$
Argh_x_BdKstmu	SM	$x \in 0, p, m$
A_FB_BpKstmu	SM	
F_L_BpKstmu	SM	
BR_BpKstmu	SM	
BR_BKstgamma	SM	
C_BKstgamma	SM	
S_BKstgamma	SM	
ADG_BKstgamma	SM	
DC7_i	SM	$i \in 1, 2$
AbsDC7_x	SM	$x \in L, R$
ReDC7_x	SM	$x \in L, R$
ImDC7_x	SM	$x \in L, R$
hp0_hm0	SM	
BR_BpKstgamma	SM	
P_i_Bsphimu	SM	$i \in 1, 2, 3, 4p, 5p, 6p, 8p$
Gammap_Bsphimu	SM	
A_FB_Bsphimu	SM	
BR_Bsphimu	SM	
Rphi_Bsphill	SM	
RphiL_Bsphill	SM	
RphiT_Bsphill	SM	
R6_Bsphill	SM	
ACP_Bsphimu	SM	
P3CP_Bsphimu	SM	
F_L_Bsphimu	SM	
M_i_Bsphimu	SM	$i \in 1p, 2p$
S_i_Bsphimu	SM	$i \in 3, 4, 5, 7, 8, 9$
A_i_Bsphimu	SM	$i \in 6, 9$
BR_Bsphigamma	SM	
C_Bsphigamma	SM	
S_Bsphigamma	SM	
ADG_Bsphigamma	SM	
BR_BKmu	SM	
BR_BKe	SM	
RK_BK11	SM	
btaunu	SM,THDM	

HEPfit name	Model(s)	Comments
mu_e_gamma	SUSY	
log_meg	SUSY	
tau_mu_gamma	SUSY	
log_tmg	SUSY	
tau_e_gamma	SUSY	
log_teg	SUSY	
mu_3e	SUSY	
tau_3mu	SUSY	
tau_3e	SUSY	
gminus2_mu	SUSY	
Robs_mu_e_gamma	SUSY	
Robs_tau_mu_gamma	SUSY	
Robs_tau_mu_gamma_BelleII	SUSY	
Robs_tau_e_gamma	SUSY	
deltaLLi_f	SUSY	$i = 1, 2, 3$, $f = q, l$
deltaRL_ij_u	SUSY	$ij = 12, 13, 23$
deltaRL_ij_e	SUSY	$ij = 12, 13, 23, 21, 31, 32$
deltaRRi_f	SUSY	$i = 1, 2, 3$, $f = u, d, e$
CCBfij	SUSY	$f = u, d, e$, $ij = 11, 22, 33, 12, 13, 23$
MH1	SUSY	
MHh	SUSY	
MHa	SUSY	
MHp	SUSY	
Msfi	SUSY	$f = u, d, l$, $i = 1, 2, 3, 4, 5, 6$
Msneui	SUSY	$i = 1, 2, 3$
Mchi	SUSY	$i = 1, 2$
Mneui	SUSY	$i = 1, 2, 3, 4$
Mw_dRho	SUSY	
mH1_THDM	THDM	
mHh	THDM	
mA	THDM	
mHp	THDM	
mH1mmA	THDM	
mAmmH1	THDM	
mH1mmHp	THDM	
mHpmH1	THDM	
mHhmmA	THDM	
mAmmHh	THDM	
mHhmmHp	THDM	
mHpmmHh	THDM	
mAmmHp	THDM	
mHpmmA	THDM	
mii_2	THDM	$ii = 11, 22$
lambdai	THDM	$i = 1, 2, 3, 4, 5$
lambda345	THDM	
g_hhh	THDM	
g_hhHh	THDM	
g_hHhHh	THDM	
g_HhHhHh	THDM	
g_hAA	THDM	
g_HhAA	THDM	
g_hHpHm	THDM	
g_HhHpHm	THDM	
Yi_THDM	THDM	$i = 1, 2, 3$
Zi_THDM	THDM	$i = 1, 2, 3, 4, 5, 6, 7$
xin_THDM	THDM	$n = 0, 1, 3$
etax_THDM	THDM	$x = 00, 3$
Eii_THDM	THDM	$ii = 11, 22, 33$
HH1lambdai	THDM	$i = 1, 2, 3, 4, 5, 6$
Q_st	THDM	
DeltaQ_THDM	THDM	
gistQ	THDM	$i = 1, 2, 3$
YtopatQ	THDM	
YbottomatQ	THDM	
YtauatQ	THDM	
mij_2atQ	THDM	$ij = 11, 22, 12$
lambdaiatQ	THDM	$i = 1, 2, 3, 4, 5$
positivityi	THDM	$i = 1, 2$
globalminimum	THDM	
unitarityi	THDM	$i = \{1 \ldots 12\}$
unitarityaiσodd	THDM	$\sigma = 0, 1$
unitarityaioddRe	THDM	$\sigma = 0, 1$
unitarityaioddIm	THDM	$\sigma = 0, 1$
unitarityaYσZ2s	THDM	$Y\sigma = 00, 01, 11$, $\mathbb{Z}_2 = odd, even$, $s = p, m$
unitarityaYσZ2sRe	THDM	$Y\sigma = 00, 01, 11$, $\mathbb{Z}_2 = odd, even$, $s = p, m$
unitarityaYσZ2sIm	THDM	$Y\sigma = 00, 01, 11$, $\mathbb{Z}_2 = odd, even$, $s = p, m$
unitarityRpi	THDM	$i = 1, 2, 3, 4, 5, 6, 9, 10, 13, 14, 19, 20$
unitarityRi	THDM	$i = 1, 2, 3, 4, 5, 6, 9, 10, 13, 14, 19, 20$
ggF_tth_htobb	THDM	
ggF_tth_htoWW	THDM	
ggF_tth_htotautau	THDM	
ggF_tth_htoZZ	THDM	
ggF_tth_htogaga	THDM	
VBF_Vh_htobb	THDM	
VBF_Vh_htoWW	THDM	
VBF_Vh_htotautau	THDM	
VBF_Vh_htoZZ	THDM	
VBF_Vh_htogaga	THDM	
Gamma_h_THDM	THDM	
rh_gaga_THDM	THDM	
rh_gg_THDM	THDM	

HEPfit name	Model(s)	Comments
Robs_Bσ	THDM	$B\sigma \in$ ggF_H_tautau_ATLAS, ggF_H_tautau_CMS, bbF_H_tautau_ATLAS, bbF_H_tautau_CMS, pp_H_gaga_ATLAS, ggF_H_gaga_CMS, mu_pp_H_VV_CMS, ggF_H_ZZ_ATLAS, VBF_H_ZZ_ATLAS, ggF_H_WW_ATLAS, VBF_H_WW_ATLAS, ggF_H_hh_ATLAS, pp_H_hh_CMS, ggF_H_hh_bbtautau_CMS, pp_H_hh_bbbb_CMS, pp_H_hh_gagabb_CMS, ggF_H_tt_ATLAS, bbF_H_bb_CMS
log10_Bσ	THDM	$B\sigma \in$ ggF_H_tautau_TH, bbF_H_tautau_TH, pp_H_gaga_TH, ggF_H_gaga_TH, mu_pp_H_VV_TH, ggF_H_ZZ_TH, VBF_H_ZZ_TH, ggF_H_WW_TH, VBF_H_WW_TH, ggF_H_hh_TH, pp_H_hh_TH, ggF_H_hh_bbtautau_TH, pp_H_hh_bbbb_TH, pp_H_hh_gagabb_TH, ggF_H_tt_TH, bbF_H_bb_TH
Gamma_HH_THDM	THDM	
rHH_gg_THDM	THDM	
BR_HH_hh_THDM	THDM	
BR_HH_AA_THDM	THDM	
BR_HH_HpHm_THDM	THDM	
BR_HH_AZ_THDM	THDM	
BR_HH_HpW_THDM	THDM	
Robs_Bσ	THDM	$B\sigma \in$ ggF_A_tautau_ATLAS, ggF_A_tautau_CMS, bbF_A_tautau_ATLAS, bbF_A_tautau_CMS, pp_A_gaga_ATLAS, ggF_A_gaga_CMS, pp_A_Zga_llga_CMS, ggF_A_hZ_bbll_CMS, ggF_A_hZ_bbZ_ATLAS, ggF_A_hZ_tautaull_CMS, ggF_A_hZ_tautauZ_ATLAS, ggF_A_tt_ATLAS, bbF_A_bb_CMS
log10_Bσ	THDM	$B\sigma \in$ ggF_A_tautau_TH, bbF_A_tautau_TH, pp_A_gaga_TH, ggF_A_gaga_TH, pp_A_Zga_llga_TH, ggF_A_hZ_bbll_TH, ggF_A_hZ_bbZ_TH, ggF_A_hZ_tautaull_TH, ggF_A_hZ_tautauZ_TH, ggF_A_tt_TH, bbF_A_bb_TH
Gamma_A_THDM	THDM	
rA_gg_THDM	THDM	
BR_A_HZ_THDM	THDM	
BR_A_hZ_THDM	THDM	
BR_A_HpW_THDM	THDM	
DeltaS	THDM	
DeltaT	THDM	
DeltaU	THDM	
B_BtoXsgammaTHDM	THDM	Interpolation of tabled values

Observable list

The release candidate 2 contains more than 1000 observables

HEPfit name	Model(s)	Comments
MtMSbar	SM	
Mw	SM	
GammaW	SM	
GammaZ	SM	
sigmaHadron	SM	
sin2thetaEff	SM	
PtauPol	SM	
Alepton	SM	
Acharm	SM	
Abottom	SM	
AFBlepton	SM	
AFBcharm	SM	
AFBbottom	SM	
Rlepton	SM	
Rcharm	SM	
Rbottom	SM	
ggHx	SM	$x \in 7, 8, 13, 14, 100, 196$; without x default is 8
VBFx	SM	$x \in 7, 8, 13, 14, 100, 196$; without x default is 8
WHx	SM	$x \in 7, 8, 13, 14, 100$; without x default is 8
ZHx	SM	$x \in 7, 8, 13, 14, 100$; without x default is 8
VHx	SM	$x \in 7, 8, 13, 14, 100, 196$; without x default is 8
ggH+ttHx	SM	$x \in 8, 13, 14, 100$; without x default is 8
VBF+VHx	SM	$x \in 8, 13, 14, 100$; without x default is 8
ttHx	SM	$x \in 7, 8, 13, 14, 100, 196$; without x default is 8
eeZHx	SM	$x \in 240, 250, 500, 1000$
eeWBFx	SM	$x \in 240, 350, 500, 1000$
eettHx	SM	$x \in 500, 1000$
BrHggRatio	SM	
BrHWWRatio	SM	
BrHZZRatio	SM	
BrHZgaRatio	SM	
BrHgagaRatio	SM	
BrHmumuRatio	SM	
BrHtautauRatio	SM	
BrHccRatio	SM	
BrHbbRatio	SM	
epsilonx	SM	$x = 1, 2, 3, b$
DmBd	SM	
DmBs	SM,THDM	
SJPsiK	SM	
Betas_JPsiPhi	SM	
EpsilonK	SM	
DmK	SM	
Vij	SM	$i = u, c, t$; $j = d, s, b$
alpha	SM	
alpha_2a	SM	
gamma	SM	
beta	SM	
betas	SM	
2betapgamma	SM	
s2beta	SM	
c2beta	SM	
CKM_rho	SM	
CKM_eta	SM	
sintheta12	SM	
sintheta13	SM	
sintheta23	SM	
ckmdelta	SM	
Jcp	SM	
Rt	SM	
Rts	SM	
Rb	SM	
Vts_Vts	SM	
Abslm_x	SM	$x \in u, c, t, ud, cd, td, us, cs, ts$
Relam_x	SM	$x \in u, c, t, ud, cd, td, us, cs, ts$
Imlam_x	SM	$x \in u, c, t, ud, cd, td, us, cs, ts$
BR_Bdmumu	SM	
BRbar_Bdmumu	SM	
Amumu_Bd	SM	
Smumu_Bd	SM	
BR_Bsmumu	SM	
BRbar_Bsmumu	SM	
Amumu_Bs	SM	
Smumu_Bs	SM	
BR_BdmumuOBR_Bsmumu	SM	

HEPfit name	Model(s)	Comments
BR_bsgamma	SM	
ACP_bsgamma	SM	
BR_bdgamma	SM	
ACP_bdgamma	SM	
BR_bqgamma	SM	
ACP_bqgamma	SM	
P_i_BdKstmu	SM	$i \in 1, 2, 3, 4p, 5p, 6p, 8p$
P_i_BdKste	SM	$i \in 1, 2, 3$
Gammap_BdKstmu	SM	
A_FB_BdKstmu	SM	
BR_BdKstmu	SM	
BR_BdKste	SM	
RKst_BdKstll	SM	
RKstL_BdKstll	SM	
RKstT_BdKstll	SM	
R6_BdKstll	SM	
ACP_BdKstmu	SM	
P3CP_BdKstmu	SM	
F_L_BdKstmu	SM	
F_L_BdKste	SM	
M_i_BdKstmu	SM	$i \in 1p, 2p$
S_i_BdKstmu	SM	$i \in 3, 4, 5, 7, 8, 9$
A_i_BdKstmu	SM	$i \in 6, 9$
P_if_BdKstmu	SM	$i \in 1, 2, 3, 4p, 5p, 6p, 8p$
Gammapf_BdKstmu	SM	
BRF_BdKstmu	SM	
A_FBf_BdKstmu	SM	
F_Lf_BdKstmu	SM	
S_if_BdKstmu	SM	$i \in 3, 4, 5, 7, 8, 9$
P_relationf	SM	
P_relation_exactf	SM	
Vx_BdKstmu	SM	$x \in 0, p, m$
Tx_BdKstmu	SM	$x \in 0, p, m$
S_BdKstmu	SM	
QCDfC9_if_BdKstmu	SM	$i \in 1, 2, 3$
QCDfC9p_if_BdKstmu	SM	$i \in 1, 2, 3$
Regtilde_i_BdKstmu	SM	$i \in 1, 2, 3$
Imgtilde_i_BdKstmu	SM	$i \in 1, 2, 3$
Absgtilde_i_BdKstmu	SM	$i \in 1, 2, 3$
Argtilde_i_BdKstmu	SM	$i \in 1, 2, 3$
Reh_x_BdKstmu	SM	$x \in 0, p, m$
Imh_x_BdKstmu	SM	$x \in 0, p, m$
Absh_x_BdKstmu	SM	$x \in 0, p, m$
Argh_x_BdKstmu	SM	$x \in 0, p, m$
A_FB_BpKstmu	SM	
F_L_BpKstmu	SM	
BR_BpKstmu	SM	
BR_BKstgamma	SM	
C_BKstgamma	SM	
S_BKstgamma	SM	
ADG_BKstgamma	SM	
DC7_i	SM	$i \in 1, 2$
AbsDC7_x	SM	$x \in L, R$
ReDC7_x	SM	$x \in L, R$
ImDC7_x	SM	$x \in L, R$
hp0_hm0	SM	
BR_BpKstgamma	SM	
P_i_Bsphimu	SM	$i \in 1, 2, 3, 4p, 5p, 6p, 8p$
Gammap_Bsphimu	SM	
A_FB_Bsphimu	SM	
BR_Bsphimu	SM	
Rphi_Bsphill	SM	
RphiL_Bsphill	SM	
RphiT_Bsphill	SM	
R6_Bsphill	SM	
ACP_Bsphimu	SM	
P3CP_Bsphimu	SM	
F_L_Bsphimu	SM	
M_i_Bsphimu	SM	$i \in 1p, 2p$
S_i_Bsphimu	SM	$i \in 3, 4, 5, 7, 8, 9$
A_i_Bsphimu	SM	$i \in 6, 9$
BR_Bsphigamma	SM	
C_Bsphigamma	SM	
S_Bsphigamma	SM	
ADG_Bsphigamma	SM	
BR_BKmu	SM	
BR_BKe	SM	
RK_BK11	SM	
btaunu	SM,THDM	

HEPfit name	Model(s)	Comments
mu_e_gamma	SUSY	
log_meg	SUSY	
tau_mu_gamma	SUSY	
log_tmg	SUSY	
tau_e_gamma	SUSY	
log_teg	SUSY	
mu_3e	SUSY	
tau_3mu	SUSY	
tau_3e	SUSY	
gminus2_mu	SUSY	
Robs_mu_e_gamma	SUSY	
Robs_tau_mu_gamma	SUSY	
Robs_tau_mu_gamma_BelleII	SUSY	
Robs_tau_e_gamma	SUSY	
deltaLLi_f	SUSY	$i = 1, 2, 3$, $f = q, l$
deltaRL_ij_u	SUSY	$ij = 12, 13, 23$
deltaRL_ij_e	SUSY	$ij = 12, 13, 23, 21, 31, 32$
deltaRR_i_f	SUSY	$i = 1, 2, 3$, $f = u, d, e$
CCBfij	SUSY	$f = u, d, e$, $ij = 11, 22, 33, 12, 13, 23$
MH1	SUSY	
MHa	SUSY	
MHp	SUSY	
Msfi	SUSY	$f = u, d, l$, $i = 1, 2, 3, 4, 5, 6$
Msneui	SUSY	$i = 1, 2, 3$
Mchi	SUSY	$i = 1, 2$
Mneui	SUSY	$i = 1, 2, 3, 4$
Mw_dRho	SUSY	
mH1_THDM	THDM	
mHh	THDM	
mA	THDM	
mHp	THDM	
mH1mmA	THDM	
mAmmH1	THDM	
mH1mmHp	THDM	
mHpmmH1	THDM	
mHhmmA	THDM	
mAmmHh	THDM	
mHhmmHp	THDM	
mHpmmHh	THDM	
mAmmHp	THDM	
mHpmmA	THDM	
mii_2	THDM	$ii = 11, 22$
lambda_i	THDM	$i = 1, 2, 3, 4, 5$
lambda345	THDM	
g_hhh	THDM	
g_hHh	THDM	
g_hHhHh	THDM	
g_HHhHh	THDM	
g_hAA	THDM	
g_HhAA	THDM	
g_hHpHm	THDM	
g_HHpHm	THDM	
Yi_THDM	THDM	$i = 1, 2$
Zi_THDM	THDM	$i = 1, 2, 3, 4, 5, 6, 7$
xin_THDM	THDM	$n = 0, 1, 2$
etax_THDM	THDM	$x = 00, 3$
Eii_THDM	THDM	$ii = 11, 22, 33$
lambda_i	THDM	$i = 1, 2, 3, 4, 5, 6$
Q6	THDM	
DeltaQ_THDM	THDM	
gHtQ	THDM	$i = 1, 2, 3$
YtopatQ	THDM	
YbotcomatQ	THDM	
YtopcomatQ	THDM	
mHpatQ	THDM	$ij = 11, 22, 12$
lambdatatQ	THDM	$i = 1, 2, 3, 4, 5$
positivity_i	THDM	$i = 1, 2$
globalminimum	THDM	
unitarity_i	THDM	$i = \{1 \ldots 12\}$
unitarityal_sigmaodd	THDM	$\sigma = 0, 1$
unitarityal_sigmaoddRe	THDM	$\sigma = 0, 1$
unitarityal_sigmaoddIm	THDM	$\sigma = 0, 1$
unitarityaY_sZ_s	THDM	$Y\sigma = 00, 01, 11$, $\mathbb{Z}_2 = odd, even$, $s = p, m$
unitarityaY_sigmaZ_sRe	THDM	$Y\sigma = 00, 01, 11$, $\mathbb{Z}_2 = odd, even$, $s = p, m$
unitarityaY_sigmaZ_sIm	THDM	$Y\sigma = 00, 01, 11$, $\mathbb{Z}_2 = odd, even$, $s = p, m$
unitarityRpi	THDM	$i = 1, 2, 3, 4, 5, 6, 9, 10, 13, 14, 19, 20$
unitarityRi	THDM	$i = 1, 2, 3, 4, 5, 6, 9, 10, 13, 14, 19, 20$
ggF_tth_htobb	THDM	
ggF_tth_htoWW	THDM	
ggF_tth_htotautau	THDM	
ggF_tth_htoZZ	THDM	
ggF_tth_htogaga	THDM	
VBF_Vh_htobb	THDM	
VBF_Vh_htoWW	THDM	
VBF_Vh_htotautau	THDM	
VBF_Vh_htoZZ	THDM	
VBF_Vh_htogaga	THDM	
Gamma_h_THDM	THDM	
rh_gaga_THDM	THDM	
rh_gg_THDM	THDM	

HEPfit name	Model(s)	Comments
Robs_Bsigma	THDM	$B\sigma \in$ ggF_H_tautau_ATLAS, ggF_H_tautau_CMS, bbF_H_tautau_ATLAS, bbF_H_tautau_CMS, pp_H_gaga_ATLAS, ggF_H_gaga_CMS, mu_pp_H_VV_CMS, ggF_H_ZZ_ATLAS, VBF_H_ZZ_ATLAS, ggF_H_WW_ATLAS, VBF_H_WW_ATLAS, ggF_H_hh_ATLAS, pp_H_hh_CMS, ggF_H_hh_bbtautau_CMS, pp_H_hh_bbbb_CMS, pp_H_hh_gagabb_CMS, ggF_H_tt_ATLAS, bbF_H_bb_CMS
log10_Bsigma	THDM	$B\sigma \in$ ggF_H_tautau_TH, bbF_H_tautau_TH, pp_H_gaga_TH, ggF_H_gaga_TH, mu_pp_H_VV_TH, ggF_H_ZZ_TH, VBF_H_ZZ_TH, ggF_H_WW_TH, VBF_H_WW_TH, ggF_H_hh_TH, pp_H_hh_TH, ggF_H_hh_bbtautau_TH, pp_H_hh_bbbb_TH, pp_H_hh_gagabb_TH, ggF_H_tt_TH, bbF_H_bb_TH
Gamma_H_THDM	THDM	
rHH_ggTHDM	THDM	
BR_HH_hh_THDM	THDM	
BR_HH_AA_THDM	THDM	
BR_HH_HpHm_THDM	THDM	
BR_HH_AZ_THDM	THDM	
BR_HH_HpW_THDM	THDM	
Robs_Bsigma	THDM	$B\sigma \in$ ggF_A_tautau_ATLAS, ggF_A_tautau_CMS, bbF_A_tautau_ATLAS, bbF_A_tautau_CMS, pp_A_gaga_ATLAS, ggF_A_gaga_CMS, pp_A_Zga_llga_CMS, ggF_A_hZ_bbll_CMS, ggF_A_hZ_bbZ_ATLAS, ggF_A_hZ_tautaull_CMS, ggF_A_hZ_tautauZ_ATLAS, ggF_A_tt_ATLAS, bbF_A_bb_CMS
log10_Bsigma	THDM	$B\sigma \in$ ggF_A_tautau_TH, bbF_A_tautau_TH, pp_A_gaga_TH, ggF_A_gaga_TH, pp_A_Zga_llga_TH, ggF_A_hZ_bbll_TH, ggF_A_hZ_bbZ_TH, ggF_A_hZ_tautaull_TH, ggF_A_hZ_tautauZ_TH, ggF_A_tt_TH, bbF_A_bb_TH
Gamma_A_THDM	THDM	
rA_gg_THDM	THDM	
BR_A_HZ_THDM	THDM	
BR_A_hZ_THDM	THDM	
BR_A_HpW_THDM	THDM	
DeltaS	THDM	
DeltaT	THDM	
DeltaU	THDM	
B_BtoXsgammaTHDM	THDM	Interpolation of tabled values

Standard Model

Full flexibility in the Standard Model:

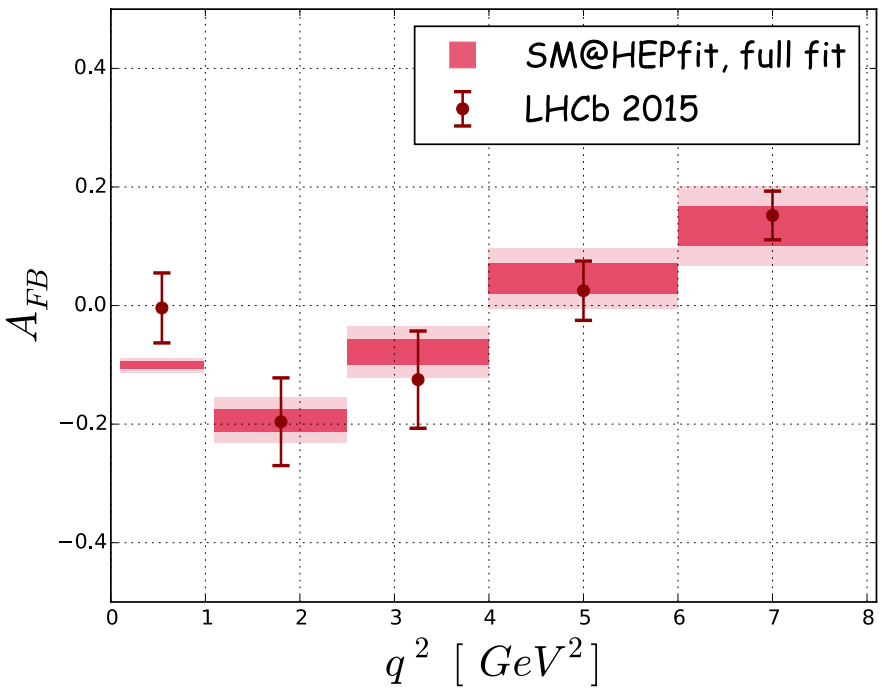
- 3 gauge couplings: g_1, g_2, g_3 (or $\Delta\alpha^{(5)}_{\rm had}$, M_Z, α_s)
- m_h and λ (or v or G_F)
- 9 fermion masses: m_u, m_d, m_s, m_c, m_b, m_t, m_e, m_μ, m_τ
- λ, A, $\bar{\rho}$, $\bar{\eta}$ (or θ_{12}, θ_{13}, θ_{23}, and δ)

18 (real) parameters

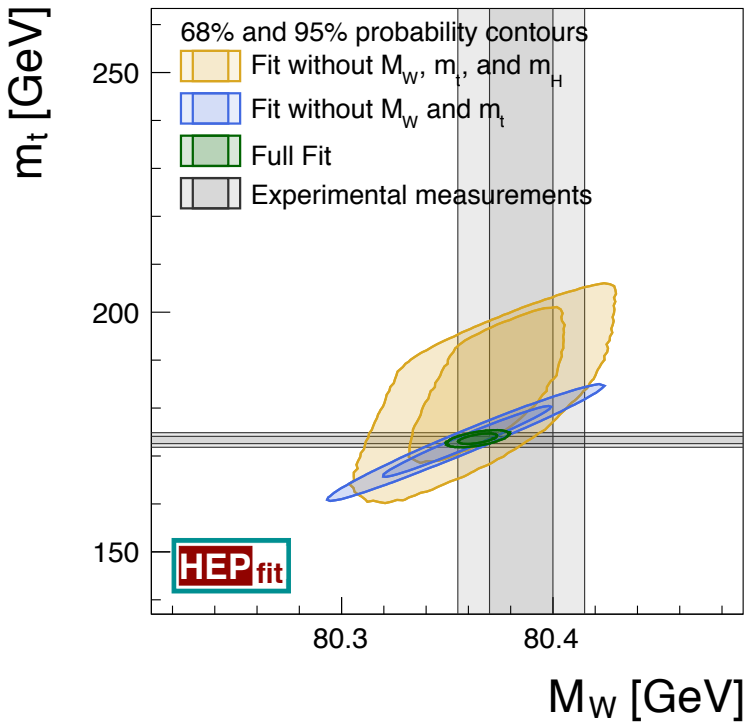
IFIC INSTITUT DE FÍSICA CORPUSCULAR

Standard Model – observables

Many flavour and electroweak observables



[Ciuchini et al. '15]



[de Blas et al. '16]

Generic SM extensions in HEPfit

Modified $Zb\bar{b}$ couplings
($\delta g^b_{R,L}$)

EW pseudo-observables
($S, T, U/\delta\varepsilon_i, \delta\varepsilon_b$)

Modified Higgs couplings
($\kappa_{u,d,\ell,W,Z}$)

SM effective theory
(59 c_i)

Electroweak chiral Lagrangian
(9 c_i)

IFIC INSTITUT DE FÍSICA CORPUSCULAR

Generic SM extensions in HEPfit

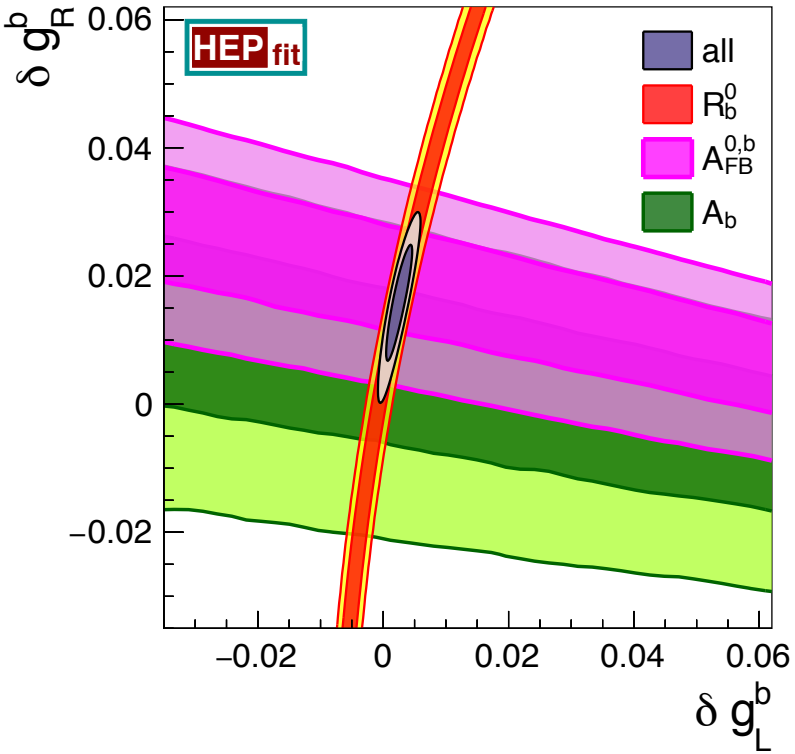
Modified $Zb\bar{b}$ couplings
($\delta g^b_{R,L}$)

EW pseudo-observables
($S, T, U/\delta\varepsilon_i, \delta\varepsilon_b$)

Modified Higgs couplings
($\kappa_{u,d,\ell,W,Z}$)

SM effective theory
(59 c_i)

Electroweak chiral Lagrangian
(9 c_i)



[de Blas et al. '16]

Generic SM extensions in HEPfit

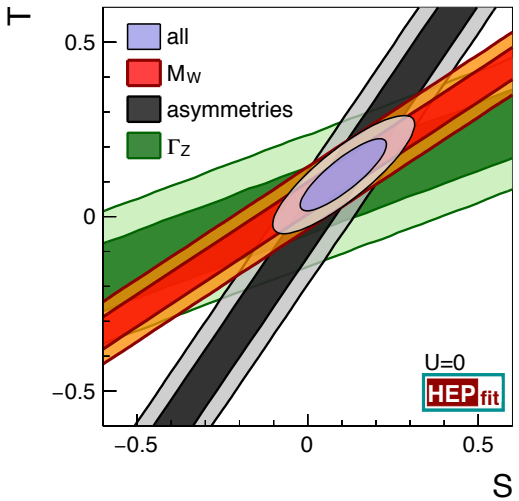
Modified $Zb\bar{b}$ couplings
($\delta g^b_{R,L}$)

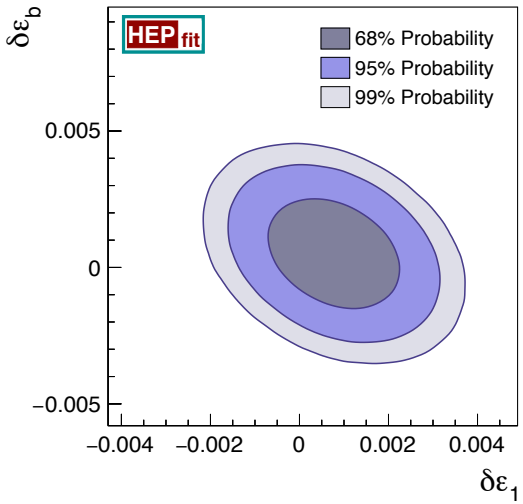
EW pseudo-observables
($S, T, U/\delta\varepsilon_i, \delta\varepsilon_b$)

Modified Higgs couplings
($\kappa_{u,d,\ell,W,Z}$)

SM effective theory
(59 c_i)

Electroweak chiral Lagrangian
(9 c_i)





[de Blas et al. '16]

Generic SM extensions in HEPfit

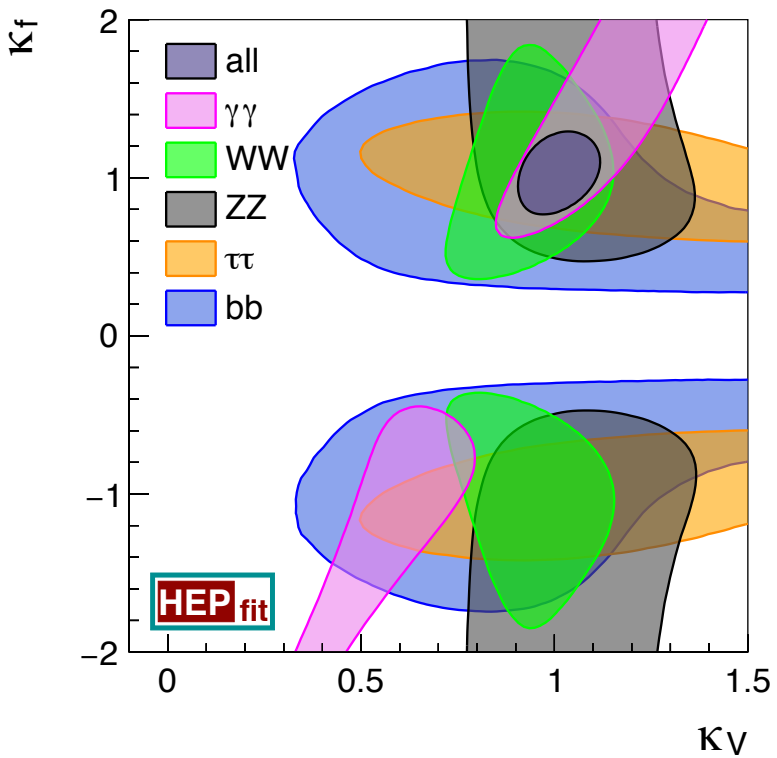
Modified $Zb\bar{b}$ couplings
($\delta g^b_{R,L}$)

EW pseudo-observables
($S, T, U/\delta\varepsilon_i, \delta\varepsilon_b$)

Modified Higgs couplings
($\kappa_{u,d,\ell,W,Z}$)

SM effective theory
(59 c_i)

Electroweak chiral Lagrangian
(9 c_i)



[de Blas et al. '16]

Generic SM extensions in HEPfit

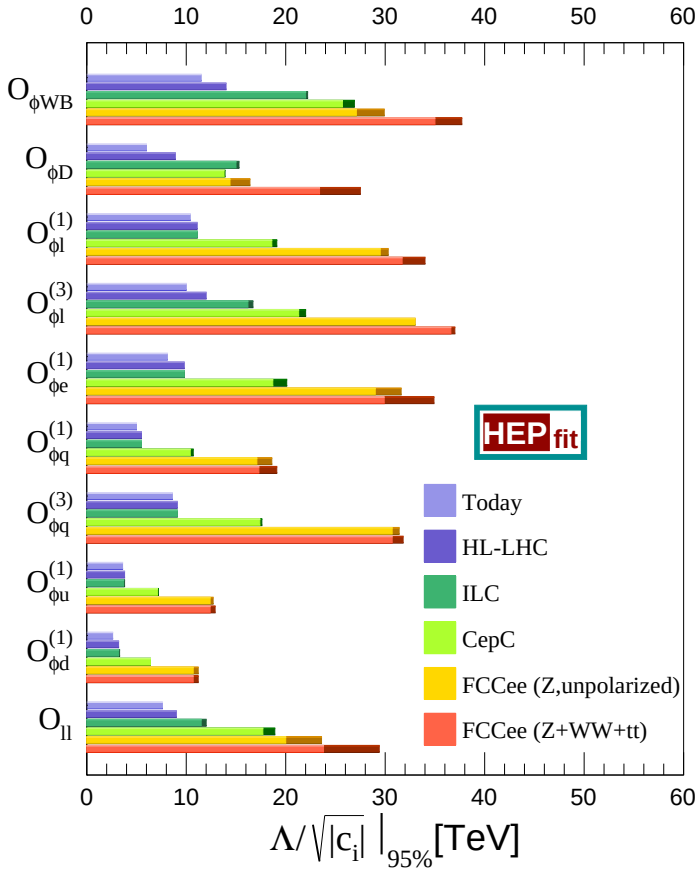
Modified $Zb\bar{b}$ couplings
($\delta g^b_{R,L}$)

EW pseudo-observables
($S, T, U/\delta\varepsilon_i, \delta\varepsilon_b$)

Modified Higgs couplings
($\kappa_{u,d,\ell,W,Z}$)

SM effective theory
(59 c_i)

Electroweak chiral Lagrangian
(9 c_i)



[de Blas et al. '16]

Dedicated ICHEP talk:
Constraints on the SMEFT

Generic SM extensions in HEPfit

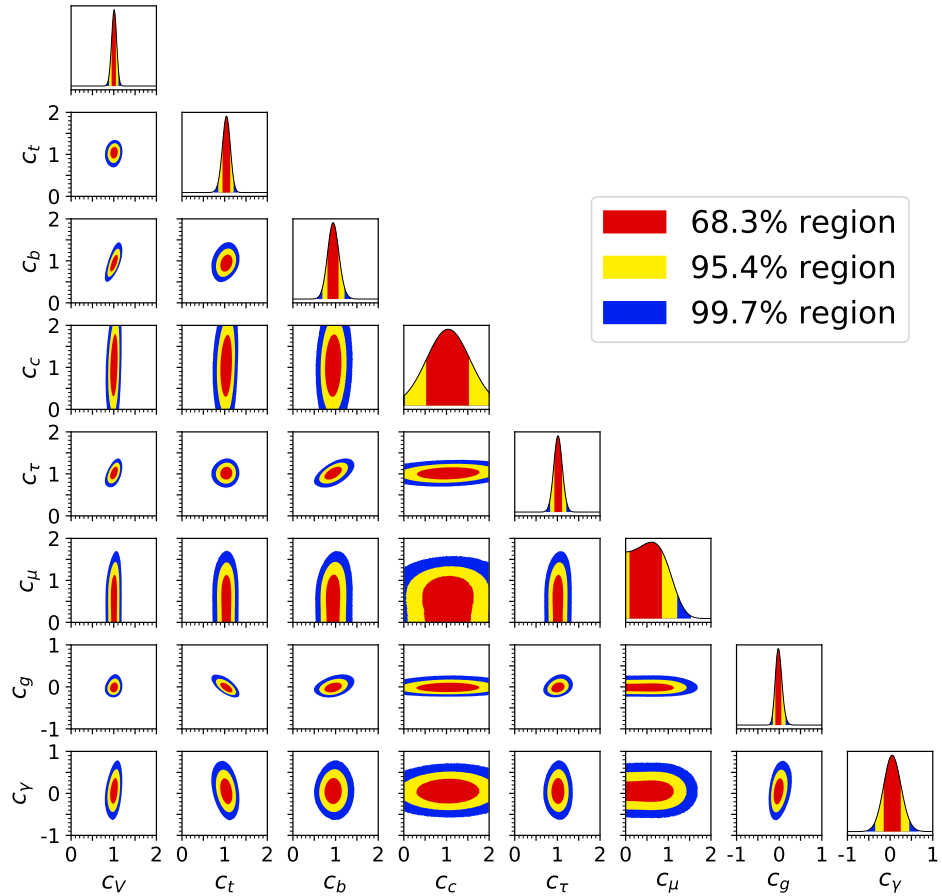
Modified $Zb\bar{b}$ couplings
($\delta g^b_{R,L}$)

EW pseudo-observables
($S, T, U/\delta\varepsilon_i, \delta\varepsilon_b$)

Modified Higgs couplings
($\kappa_{u,d,\ell,W,Z}$)

SM effective theory
(59 c_i)

Electroweak chiral Lagrangian
(9 c_i)



[de Blas, OE, Krause '18]

New physics models in HEPfit

2HDM with(out) Z_2 symmetry
(7 / 66 parameters)

Georgi-Machacek model
(8 parameters)

Manohar-Wise model
(14 parameters)

MSSM with complex couplings
(108 parameters)

Left-Right symmetric model
(13 parameters)

IFIC
INSTITUT DE FÍSICA CORPUSCULAR

New physics models in HEPfit

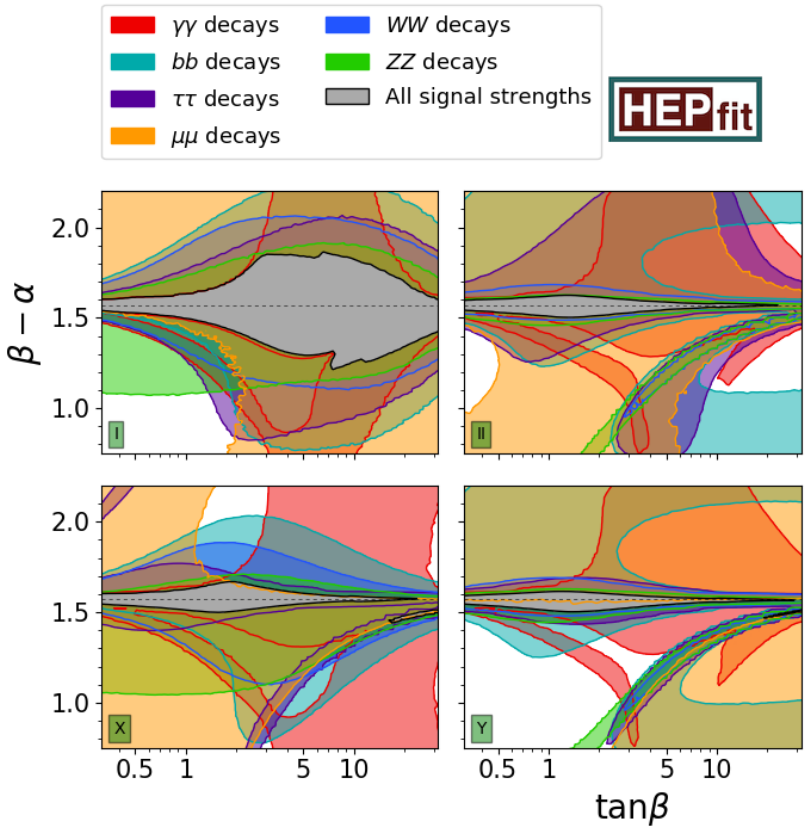
2HDM with(out) Z_2 symmetry
(7 / 66 parameters)

Georgi-Machacek model
(8 parameters)

Manohar-Wise model
(14 parameters)

MSSM with complex couplings
(108 parameters)

Left-Right symmetric model
(13 parameters)



[Chowdhury, OE '17]

Dedicated ICHEP talk:
Current status of 2HDM's

IFIC INSTITUT DE FÍSICA CORPUSCULAR

New physics models in HEPfit

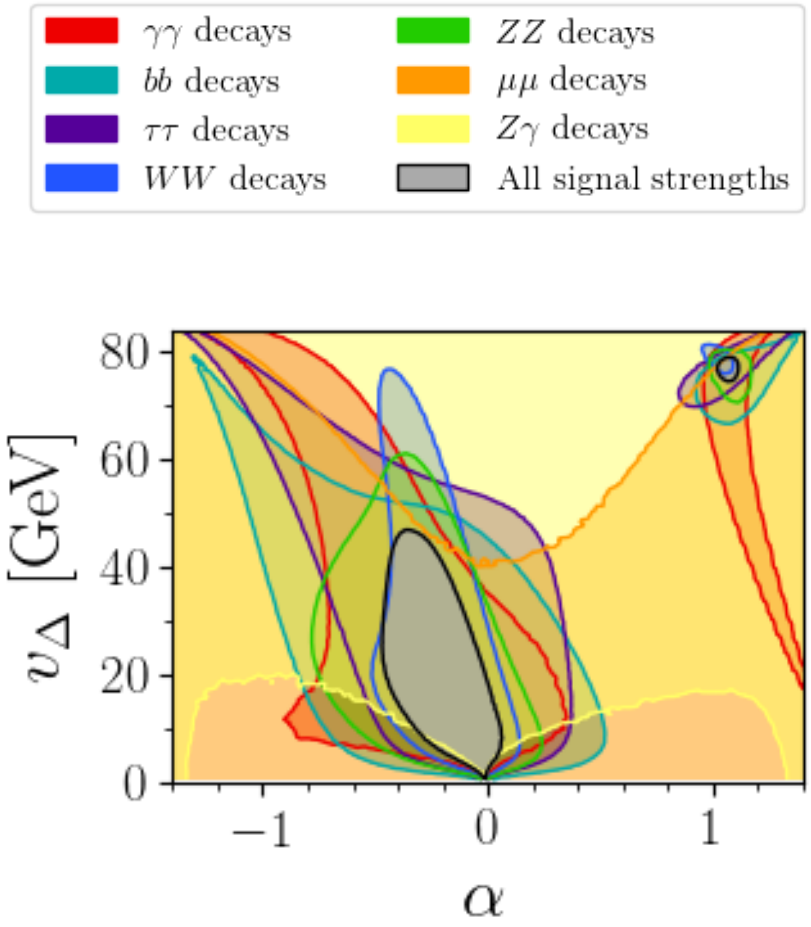
2HDM with(out) Z_2 symmetry
(7 / 66 parameters)

Georgi-Machacek model
(8 parameters)

Manohar-Wise model
(14 parameters)

MSSM with complex couplings
(108 parameters)

Left-Right symmetric model
(13 parameters)



[Chiang, Cottin, OE '18]

New physics models in HEPfit

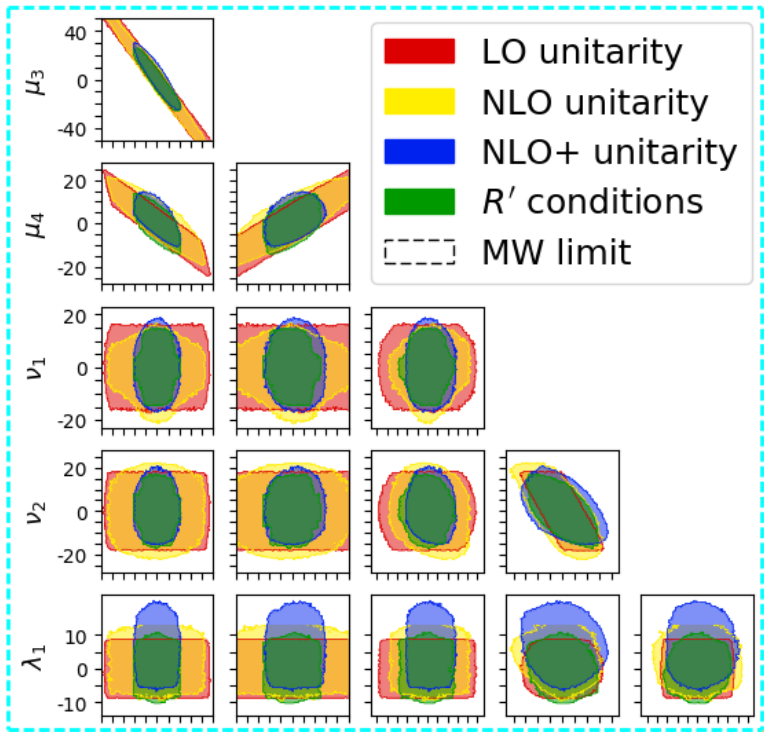
2HDM with(out) Z_2 symmetry
(7 / 66 parameters)

Georgi-Machacek model
(8 parameters)

Manohar-Wise model
(14 parameters)

MSSM with complex couplings
(108 parameters)

Left-Right symmetric model
(13 parameters)



[Cheng, OE, Murphy, '18]

New physics models in HEPfit

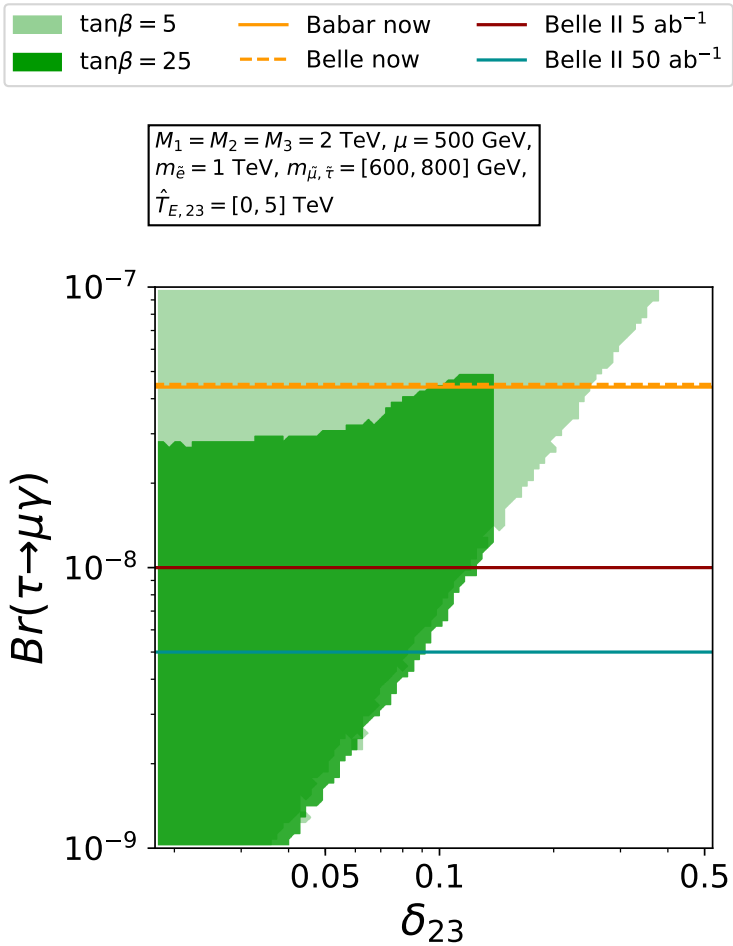
2HDM with(out) Z_2 symmetry
(7 / 66 parameters)

Georgi-Machacek model
(8 parameters)

Manohar-Wise model
(14 parameters)

MSSM with complex couplings
(108 parameters)

Left-Right symmetric model
(13 parameters)



[OE, Paul, '18]

Implementation of your own model

User-defined models and observables can easily be defined as external modules:

Library and Monte Carlo modes

Until here only a collection of formulae,
which can be used as a library.

No analytical treatment, but (very) fast evaluation
as compared to e.g. Mathematica

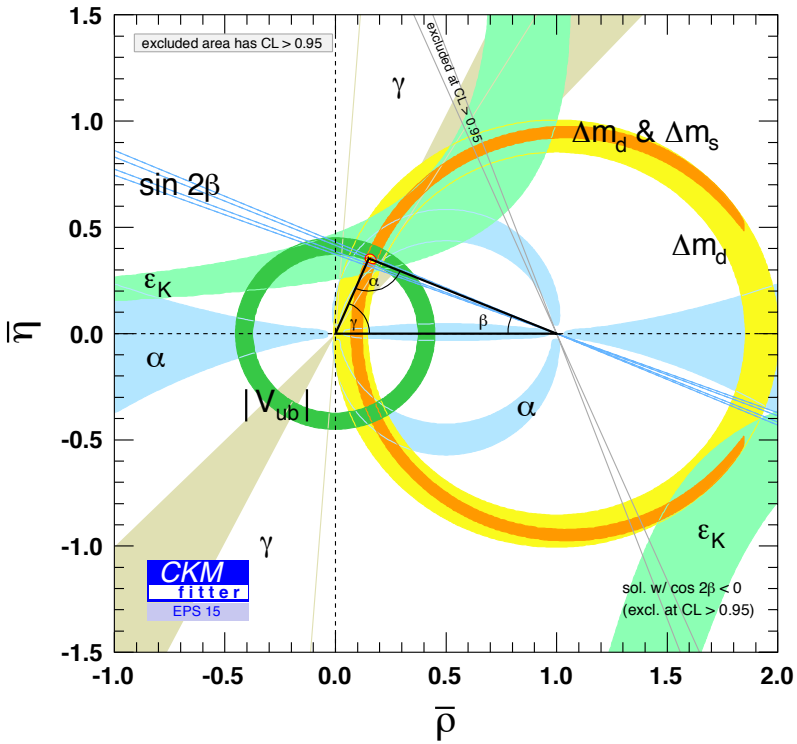
Parallelized Markov Chain Monte Carlo simulations
with the Bayesian Analysis Toolkit (BAT).

Or use your own statistical set-up.

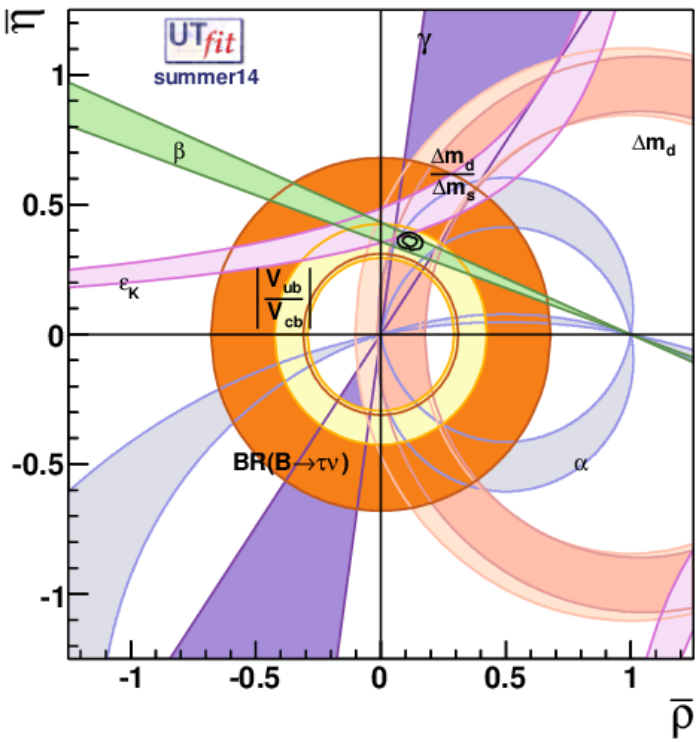
IFIC
INSTITUT DE FÍSICA CORPUSCULAR

Example - Unitarity triangle in the SM

Unitarity triangle fits with run time of at least a few days



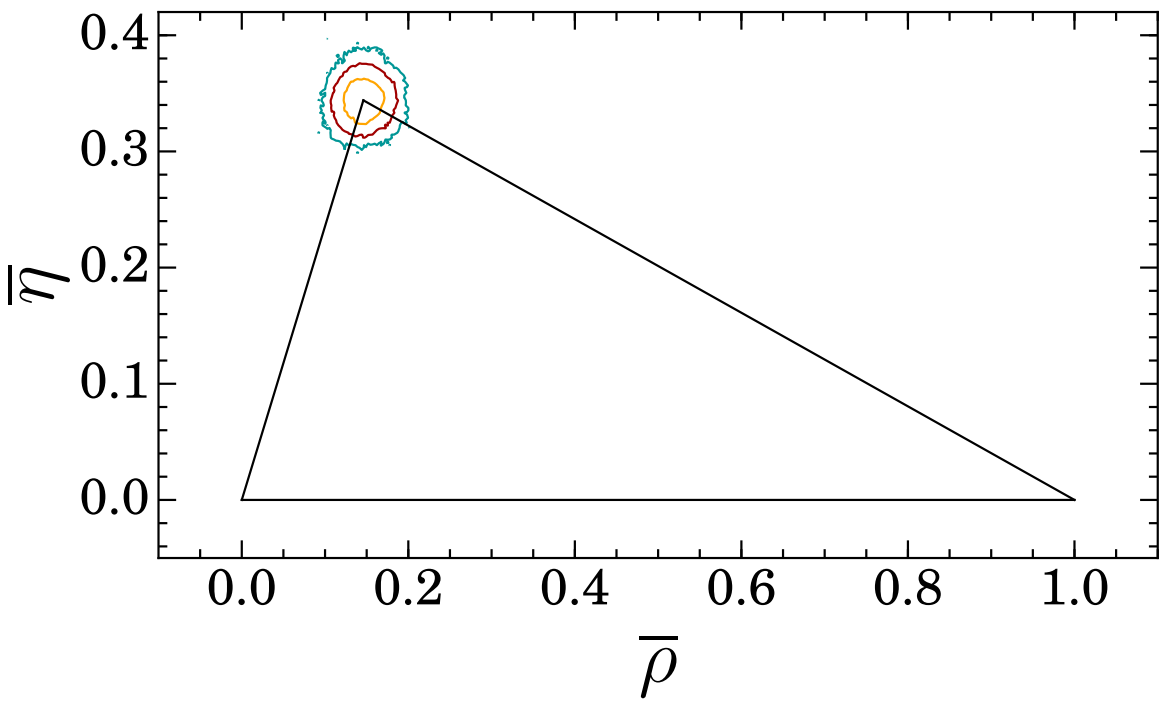
[CKMfitter '15]



[UTfit '14]

Example - Unitarity triangle in the SM

Unitarity triangle fit with `HEPfit` is possible on a laptop:
about 4 hours with two cores



UTfit collaboration decided to use HEPfit in the future!

Summary

http://hepfit.roma1.infn.it

Calculates and fits Higgs, EW and flavour observables in

- Standard Model
- various effective theories
- scalar SM extensions (2HDM, Georgi-Machacek, Manohar-Wise)
- MSSM, Left-Right symmetry

Publications on $B \to K^* \ell^+ \ell^-$, EWPO, SMEFT, ew$\chi\mathcal{L}$, 2HDM.

IFIC
INSTITUT DE FÍSICA CORPUSCULAR