Towards a Flavour Les Houches Accord

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What is Flavour Les Houches Accord?

Standard format for flavour related quantities, providing:

- A model independent parametrization
- A stand-alone flavour output in the ***FLHA*** format
- Based on the existing ***SLHA*** structure
- A clear and well-defined structure for interfacing computational tools of "New Physics" models with low-energy flavour calculations

That will allow different programs to talk and to be interfaced, and users to have a clear and well-defined result that can eventually be used for different purposes.

SUSY Les Houches Accord (SLHA)

Main idea:

Many models, conventions, tools,... for Supersymmetry

→ **One unique standard:** a set of self–consistent conventions for supersymmetric spectrum and decay calculations

→ ascii file based transfers SUSY parameters, spectra, and decay tables

→ definite file structures for model input, mass and coupling spectra, and decay tables

SUSY Les Houches Accord (SLHA)

Main considerations:

- Consistency
  Parameters must be consistently and unambiguously defined
- Flexibility
  Structure should be general enough to be easily extended
  → files built of modular data "blocks"
- User friendly
  Easy to implement and use
  → keep basic structure simple

Flavour Les Houches Accord (FLHA)

- Based on the same considerations as *SLHA*
- Not only for Supersymmetry
- Consistent structure and definitions
- Flavour quantities are defined in blocks
- *FLHA* can contain *SLHA* blocks
- *FLHA* block names start with "***F***" to avoid confusion
- *FLHA* will not modify *SLHA* blocks
- Avoiding ambiguities, no double blocks,...

General structure

BLOCK FCINFO

Calculator information, including the name of the program and the version.

BLOCK FMODSEL

Switches and options for model selection, extending the SLHA MODSEL block to Beyond SUSY models (e.g. extradim,...).

BLOCK SMINPUTS

`BLOCK SMINPUTS` is the same as in the SLHA format, which includes the measured values of SM parameters.

General structure

BLOCK FMASS

Mass spectrum using PDG codes. More general than SLHA MASS BLOCK, including the renormalization scheme and the scale at which the masses are calculated.

```
Block FMASS  # Mass spectrum in GeV
#PDG code  mass              scheme  scale     particle
     3     1.05000000e-01    1       2.0e+00   # s
     5     4.68000000e+00    3       0         # b
   211     1.39600000e-01    0       0         # pi+
   313     8.91700000e-01    0       0         # K*
   321     4.93700000e-01    0       0         # K+
   421     1.86484000e+00    0       0         # D0
   431     1.96849000e+00    0       0         # D_s+
   521     5.27950000e+00    0       0         # B+
   531     5.36630000e+00    0       0         # B_s
```

Schemes:

- 0: pole
- 1: MSbar
- 2: DRbar
- 3: 1S
- 4: kin

General structure

BLOCK FLIFE, FCONST, FCONSTRATIO

Life time of the particles and decay constants using PDG codes of the particles. The ratio of the decay constants are given in a separate block, with the PDG numbers of the two particles.

```
Block FLIFE  # Lifetime in sec
#PDG code  lifetime          particle
   211     2.60330000e-08    # pi+
   321     1.23800000e-08    # K+
   431     5.00000000e-13    # D_s+
   521     1.63800000e-12    # B+
   531     1.42500000e-12    # B_s
Block FCONST  # Decay constant in GeV
#PDG code  decay constant    particle
   431     2.41000000e-01    # D_s+
   521     2.00000000e-01    # B+
   531     2.45000000e-01    # B_s
Block FCONSTRATIO  # Ratio of decay constant
#PDG code1 code2  ratio              comment
   321     211    1.18900000e+00    # f_K/f_pi
```

General structure

BLOCK FBAG FFORM, FSHAPE

Bag parameters, form factors and shape factors.

```
Block FBAG  # Bag parameters
#PDG code B-parameter       particle
   511    1.26709794e+00   # B_d
   531    1.23000000e+00   # B_s
Block FFORM  # Form Factors in GeV
#number    value            name
     1    4.6000000e-01    # Delta(w) in B->D 1 nu
     2    1.026e+00        # G(1) in B->D 1 nu
     3    1.170e+00        # rho^2 in B->D 1 nu
     4    3.1e-01          # T1(B->K*)
Block FSHAPE  # Shape factors
#number    value            name
     1    5.80000000e-01   # C (b->s gamma)
```

General structure

Wilson Coefficients

$b \to s\,\gamma$ transitions:

8+8 operators: $O_1 \cdots O_8$ + prime operators (with L ↔ R exchange)

Problem: 2 bases

- Standard (Misiak et al.) ✓
- Traditional (Buras et al.)

$b \to s\,l^+ l^-$ transitions:

O_9 & O_{10} + prime operators

O_S & O_P for annihilation processes

$b \leftrightarrow s$ oscillations:

Q^{VLL} , Q^{VRR} , Q_1^{LR} , Q_2^{LR} , Q_1^{SLL} , Q_2^{SLL} , Q_1^{SRR} , Q_2^{SRR}

Vector, scalar and tensor operators...

Others?

General structure

BLOCK FWCOEF

```
Block FWCOEF Q= 1.60846e+02  M= 2
#Effective Wilson coefficients in the standard basis
#order    number  value
     0      2     1.00000000e+00
     0      7     -1.82057567e-01
     0      8     -1.06651571e-01
     1      1     2.33177662e+01
     1      4     5.29677461e-01
     1      7     1.35373179e-01
     1      8     -6.94496405e-01
     2      1     3.08498153e+02
     2      2     4.91587899e+01
     2      3     -7.01872509e+00
     2      4     1.25624440e+01
     2      5     8.76122785e-01
     2      6     1.64273022e+00
     2      7     7.05439463e-01
     2      8     -4.65529650e+00
```

Models:

- 0: SM
- 1: NP
- 2: SM+NP

General structure

Flavour observables

The decay is defined by the PDG number of the parent, the type of the observable, the value of the observable, the number of daughters, PGD IDs of the daughters.

Type of the observables:

1: branching ratio
2: ratio of the branching ratio to the SM value
3: asymmetry - CP
4: asymmetry - isospin
5: asymmetry - forward-backward
6: asymmetry - lepton-flavor
7: mixing

type>10: user defined

General structure

BLOCK FOBS

```
Block FOBS  # Flavor observables
# ParentPDG type value              NDA  ID1  ID2  ID3 ...  comment
     5       1    2.97350499e-04   2    3    22        # BR(b->s gamma)
   521       4    8.25882011e-02   2  313    22        # Delta0(B->K* gamma)
   531       1    3.46978963e-09   2   13   -13        # BR(B_s->mu+ mu-)
   521       1    1.09699841e-04   2  -15    16        # BR(B_u->tau nu)
   521       2    9.96640362e-01   2  -15    16        # R(B_u->tau nu)
   431       1    4.81251996e-02   2  -15    16        # BR(D_s->tau nu)
   431       1    4.96947301e-03   2  -13    14        # BR(D_s->mu nu)
   521       1    6.96556180e-03   3  421   -15  16   # BR(B+->D0taunu)
   521      11    2.97261612e-01   3  421   -15  16   # BR(B+->D0taunu)/BR(B+->D0enu)
   321      11    6.45414388e-01   2  -13    14        # BR(K->mu nu)/BR(pi->mu nu)
   321      12    9.99985822e-01   2  -13    14        # R_123
```

General structure

BLOCK FOBSERR

2 columns for the uncertainties: minus and plus.

```
Block FOBSERR  # Theoretical error for flavor observables at 68% C.L.
# ParentPDG type -ERR      +ERR     NDA  ID1 ID2 ID3 ···  comment
     5       1    0.3e-04   0.3e-04 2    3   22       # BR(b->s gamma)
```

BLOCK FnameERR

For every block, we can define a corresponding block for the errors.

BLOCK FOBSSM

Standard Model values of the flavour observables.

```
Block FOBSSM  # SM prediction for flavor observables
# ParentPDG type value              NDA  ID1 ID2 ID3 ···  comment
     5       1    2.97350499e-04    2    3   22       # BR(b->s gamma)
```

Conclusions

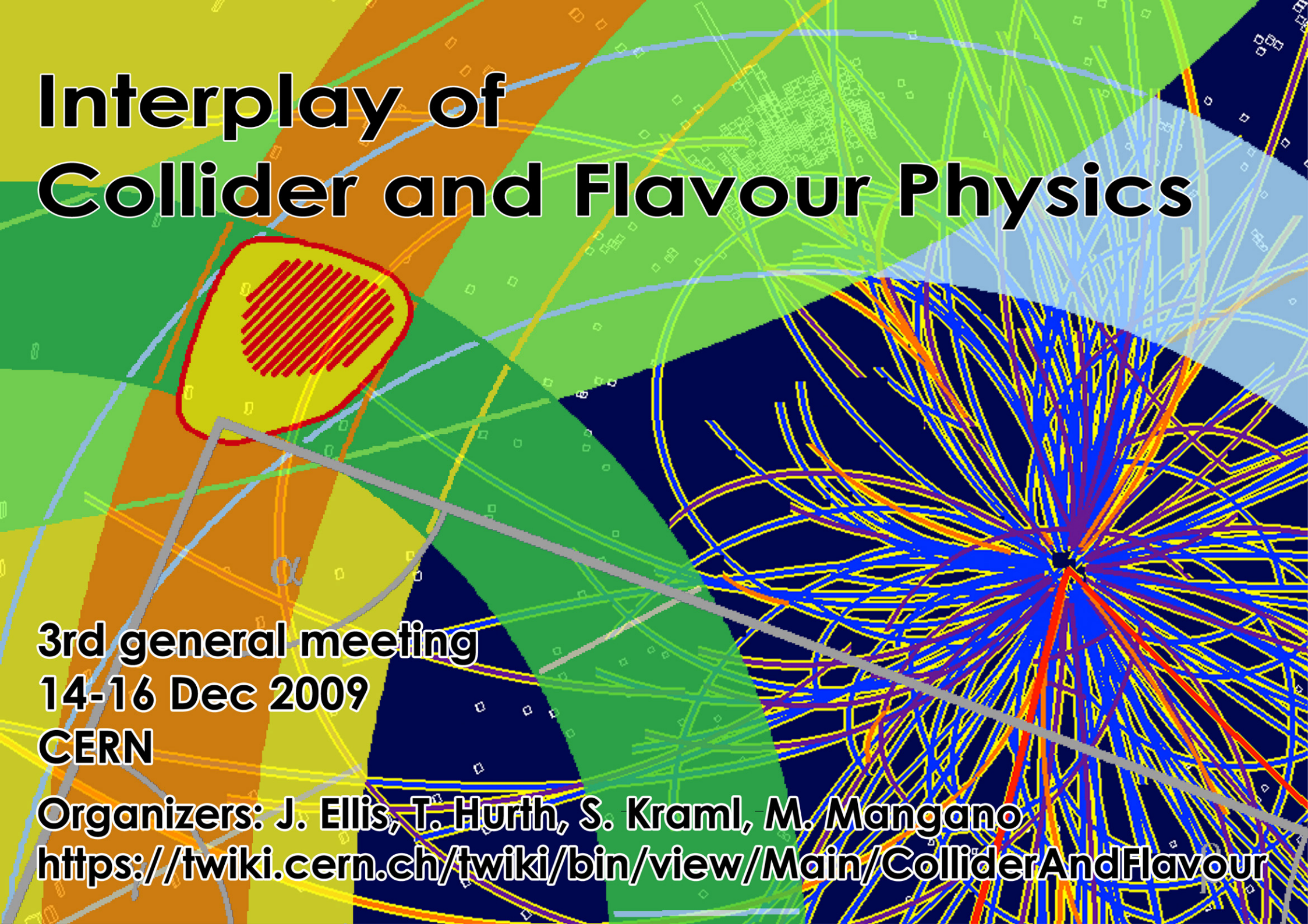
- This is still work in progress...
- **Everybody is welcome to join** in the discussions and Development of the format
- More details can be found at:

http://www.lpthe.jussieu.fr/LesHouches09Wiki/index.php/Flavour_Les_Houches_Accord

Open questions

- Model selection
- `FMASS Block`: conflict with the SLHA blocks??
- Definition of the Wilson Coefficients (complete list, imaginary parts,...)
- Other parameters, blocks?

Interplay of Collider and Flavour Physics



3rd general meeting
14-16 Dec 2009
CERN

Organizers: J. Ellis, T. Hurth, S. Kraml, M. Mangano

https://twiki.cern.ch/twiki/bin/view/Main/ColliderAndFlavour