MadAnalysis 5

A framework dedicated to phenomenological investigations @ LHC

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Scope of MadAnalysis 5 v1.1.9

Defining an analysis with a dedicated metalanguage

Reading of signal and background event files

Supporting any event file format (STDHEP, HEPMC, LHE, LHCO, ROOT)

optional

Processing data

- Clustering
- Fast-simulation

Analyzing data

- Selection cuts
- Filling histograms

Analysis report

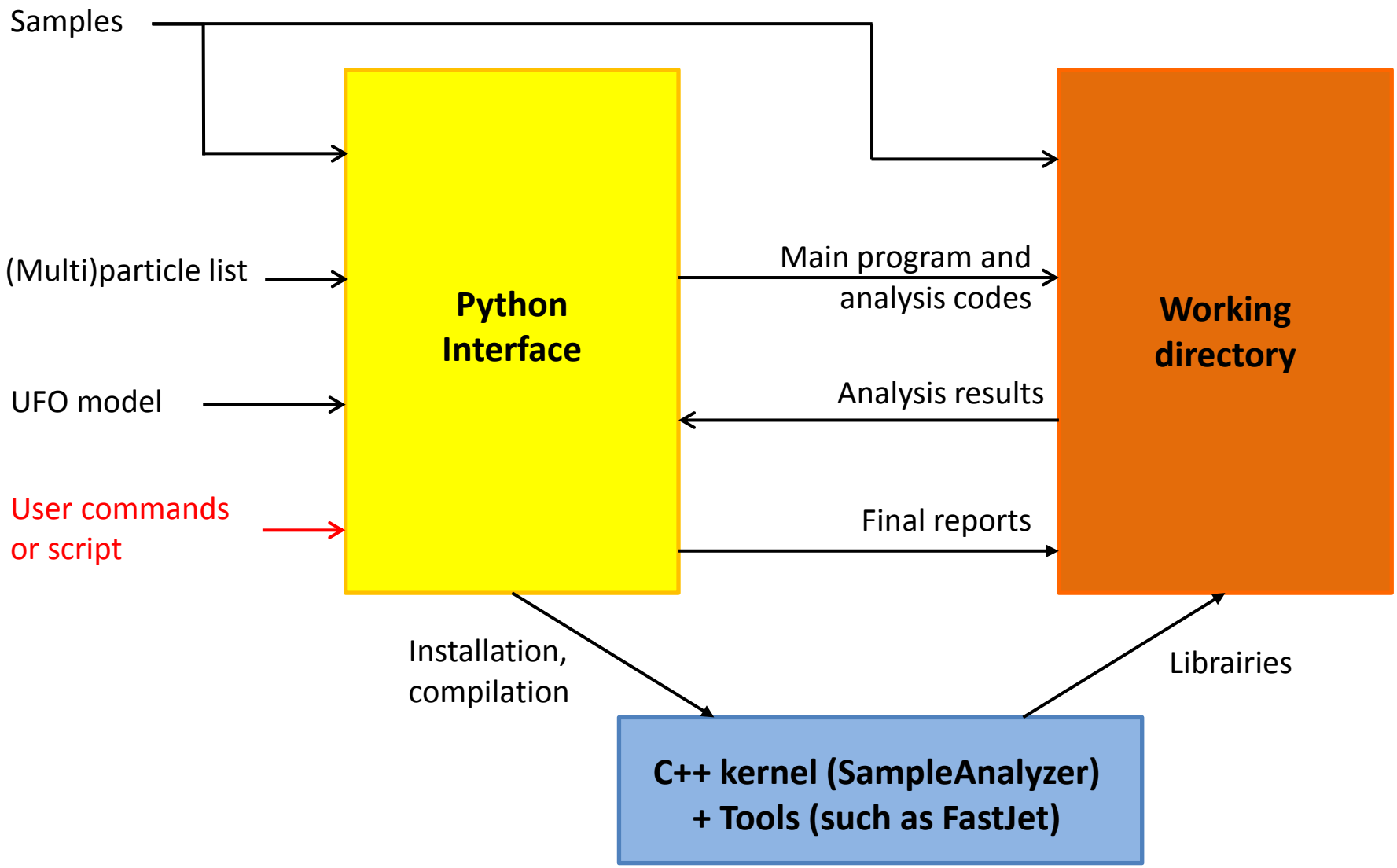
histograms, selection efficiencies, S/B-like ratio table

optional

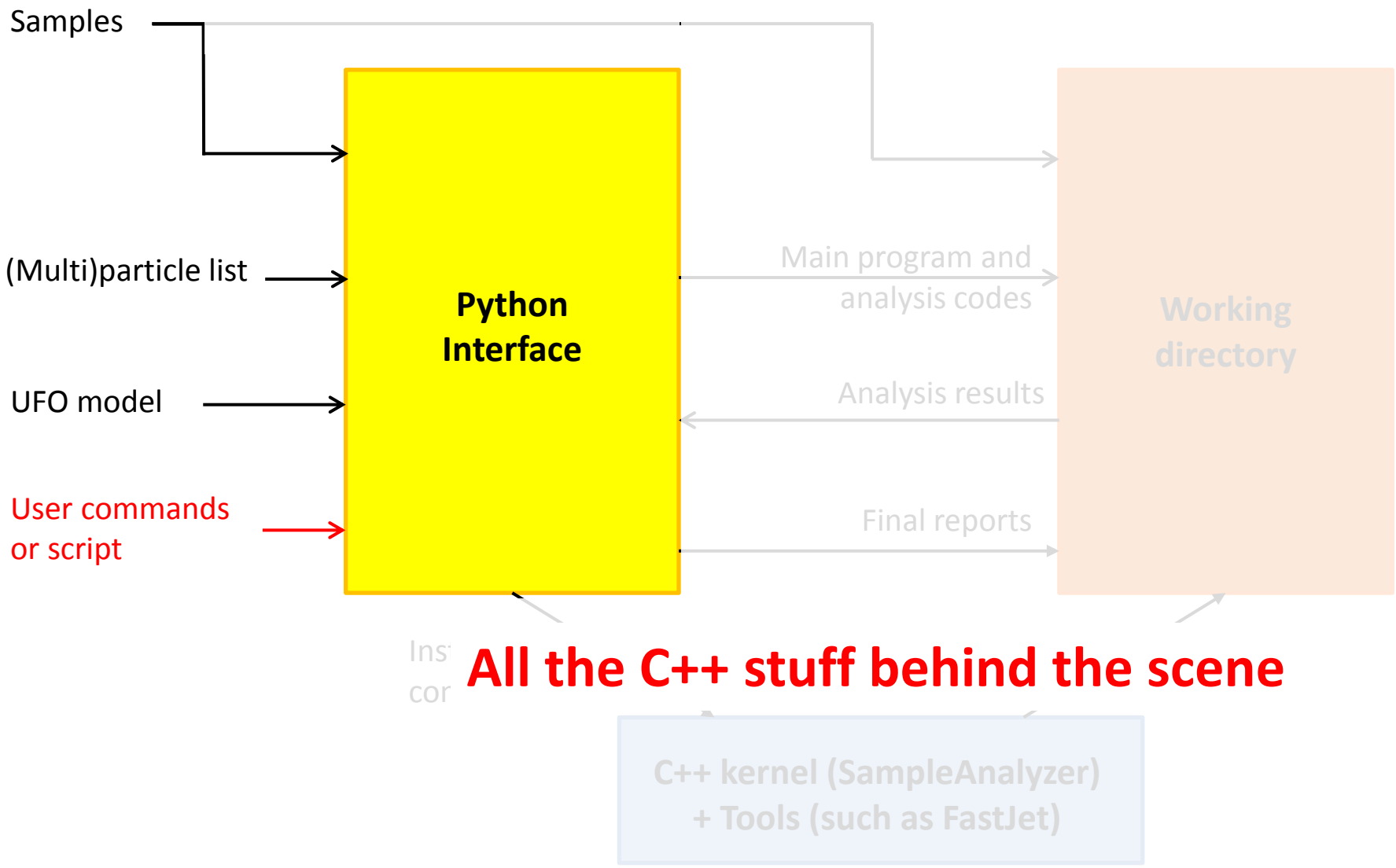
Storing events into output files

LHE and LHCO file formats

Structure of the program



Normal mode = user-friendly



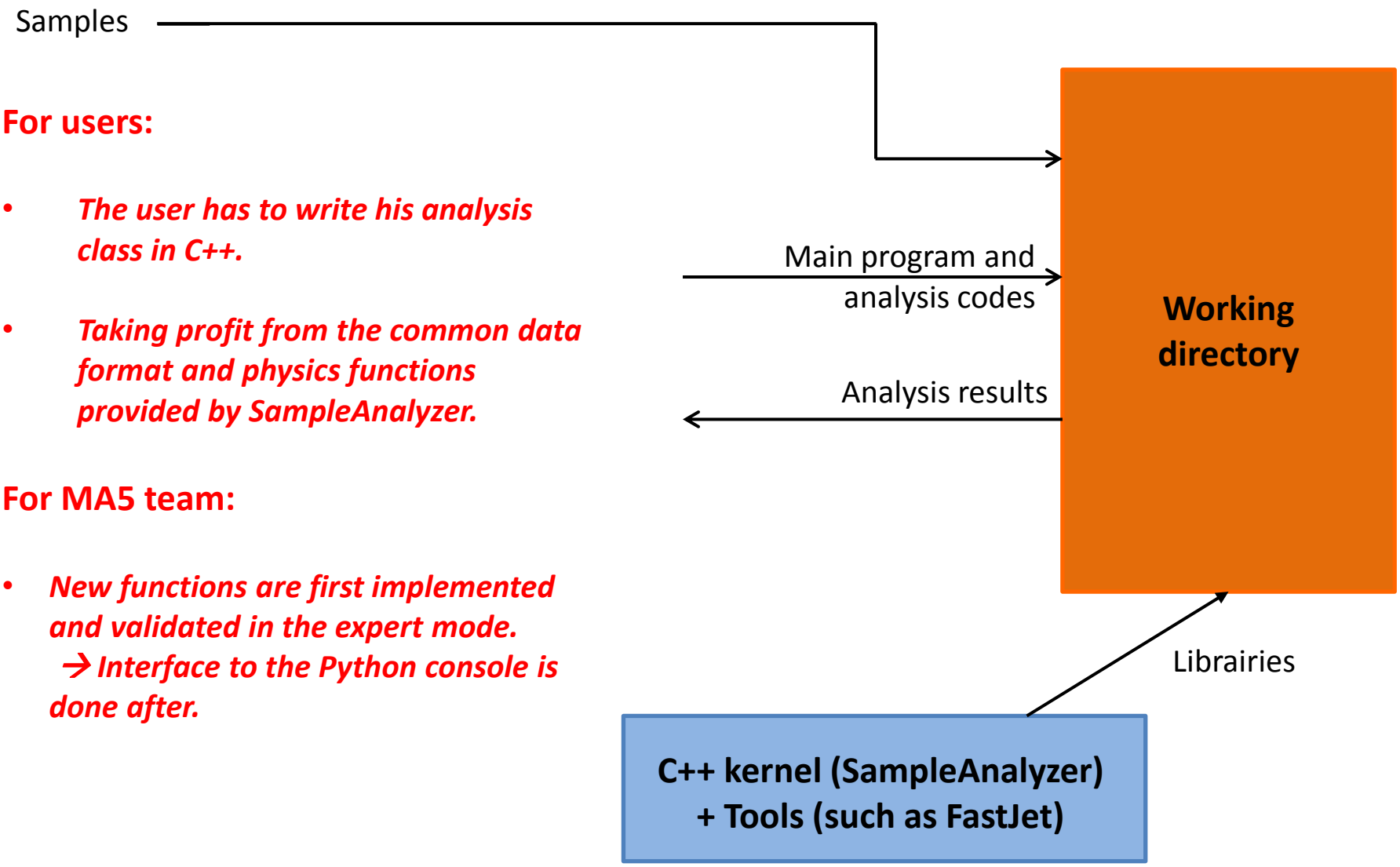
Expert mode = developer-friendly

For users:

- *The user has to write his analysis class in C++.*
- *Taking profit from the common data format and physics functions provided by SampleAnalyzer.*

For MA5 team:

- *New functions are first implemented and validated in the expert mode.*
  → Interface to the Python console is done after.



The MadAnalysis 5 metalanguage

Defining new particles and multiparticles

- Particles are defined by **labels**, which could point to one or several **PDG-id**.
- SM and MSSM labels are automatically loaded at the starting of MadAnalysis.
- The user can define his own labels :

```
ma5> define mu = mu+ mu-
```

- All labels defined in a UFO model can be loaded too.

Importing datasets

- For MadAnalysis, a **dataset** is a collection of samples which will be merged.
- All sample files are stored in a dataset.

```
ma5> import tt*.lhe
```

```
ma5> import tt*.lhe as ttbar
ma5> import Wj*.lhe as Wjets
```

- Possibility to tag datasets as **signal** or **background**.

Defining an analysis: plots and/or cuts

- **Histograms**
  - Observable can be related to the event or the properties of a particle
  - Plethora of observables: N, E, ET, M, MT, P, PT, PX, PY, PZ, THETA, ETA, …, ALPHAT
  - Combining particles

```
ma5> plot MET
ma5> plot PT(mu)
```

```
ma5> plot M(mu+ mu-)
```

- **Cuts : selecting / rejecting events**

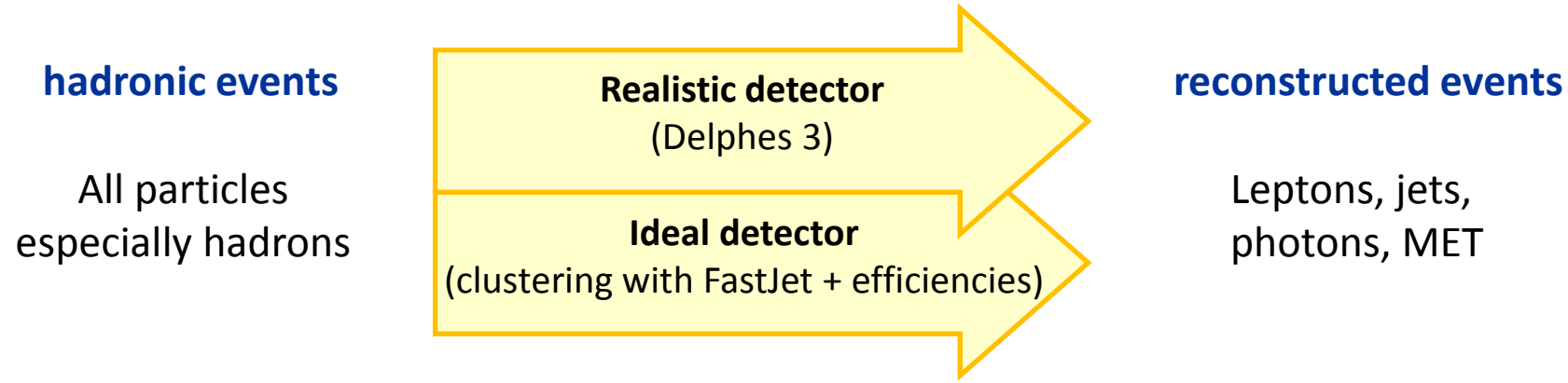
```
ma5> reject MHT < 50
ma5> select N(mu) >= 2
```

- **Cuts : selecting / rejecting a particle or a combination**

```
ma5> select (mu) PT > 50
ma5> select 80 < M (mu+ mu-) < 100
```

MadAnalysis = a multipurpose interface

Case of the fast-simulation:



- **Assisted installation**

```
ma5> install fastjet
ma5> install delphes
```

- **Selecting the fast-simulation package**

```
ma5> set main.fastsim.package = fastjet
ma5> set main.fastsim.package = delphes
```

- **Choosing a fast-simulation package gives access to options of the parameters**
  Besides, in the case of Delphes, MadAnalysis 5 invites the user to edit the configuration card.

Summary and perspectives

- **MadAnalysis 5 = a unique framework with two ways to use it:**
  - **Normal mode:** python interface with intuitive commands.
  - **Expert mode:** requiring programming skills (C++, ROOT).

- **Relevant features of MadAnalysis 5 design:**
  - **User-friendly** → professional analyses in a simple way.
  - **Flexible:** no limit on the analysis complexity.
  - **Easy** to maintain and to validate.

- **Interface to physics-relevant tools:**
  - **Fast-Jet** for clustering and for generating ME/PS merging validation.
  - **Delphes 3** for fast-simulation.
  - Expected soon: shower programs.

MadAnalysis 5

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