LHC power converter setting
A hypercycle contains contexts (see next slide) associated to USERS and **defines the operation of the LHC:**

- Only one hypercycle can be **ACTIVE** at a time
- Only one USER/Context per category can be **RESIDENT** (there could be none resident!)
- Contexts can be associated to users in different hypercycles at the same time!

<table>
<thead>
<tr>
<th>Hyper Cycles</th>
<th>Categories</th>
<th>User:</th>
<th>Beam:</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.51TeV_2015_CR5</td>
<td>ADT, COLLIMATORS, KICKERS, FILL</td>
<td>LHC.USER PRECYCLE</td>
<td>PRECYCLE-3.5TeV-Standard_2016_V1</td>
</tr>
<tr>
<td>4TeV_10Aps_0.8m_pPb</td>
<td>POWERCONVERTERS</td>
<td>LHC.USER RAMPDOWN</td>
<td>RAMPDOWN-5.5TeV_V1</td>
</tr>
<tr>
<td>4TeV_2016_pPb</td>
<td></td>
<td>LHC.USER SQUEEZE</td>
<td>SQUEEZE-6.5TeV-30cm-0_1500V</td>
</tr>
</tbody>
</table>
Beam Processes

- It contains segments (ramp, squeeze...)
- It contains the optic table
- It defines:
  - Incorporation rules
  - Length
  - Particle type

**BP type**

**DISCRETE**
- It contains scalars, which are not connected to any functions
- Theoretically it can be trimmed any time *(If resident, the change is propagated to the HW!)*
- It contains “almost-fixed” values (rarely changed)

**FUNCTIONAL**

**NON-MULTIPLEXED**
- It contains only non-multiplexed parameters...they can have ONLY 1 setting

See next slide...
Beam Processes

Context/BP
(it is an instance of a BP type)
Contains functions that can be changed only offline!

Actual BP
(It is generated from a context/BP at a given time)
• It contains scalars (points of the functions at a given time)
• It can be trimmed any time (If resident, the change is propagated to the HW!)

NB: It always maintains the dependency on the original BP
# LHC cycle

<table>
<thead>
<tr>
<th>User</th>
<th>BP type</th>
<th>BP</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>INJECTION</td>
<td>Actual</td>
<td>RAMP@START</td>
<td>It contains all settings in the RAMP + exp compensators</td>
</tr>
<tr>
<td>FIDEL_START</td>
<td>Actual</td>
<td>SPOOLS@START</td>
<td>It contains all spools (RCS, RCD, RCO) injection settings</td>
</tr>
<tr>
<td>RAMP FIDEL</td>
<td>Functional</td>
<td>RAMP</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>RAMP-SPOOLS</td>
<td></td>
</tr>
<tr>
<td>FLAT-TOP</td>
<td>Actual</td>
<td>RAMP@END</td>
<td></td>
</tr>
<tr>
<td>QCHANGE</td>
<td>Functional</td>
<td>QCHANGE</td>
<td></td>
</tr>
<tr>
<td>QCHANGE_END</td>
<td>Actual</td>
<td>QCHANGE@END</td>
<td>These might change position or even disappear</td>
</tr>
<tr>
<td>SQUEEZE</td>
<td>Functional</td>
<td>SQUEEZE</td>
<td></td>
</tr>
<tr>
<td>SQUEEZE_END</td>
<td>Actual</td>
<td>SQUEEZE@END</td>
<td></td>
</tr>
<tr>
<td>PHYSICS</td>
<td>Functional</td>
<td>PHYSICS</td>
<td>Still to be decided:</td>
</tr>
<tr>
<td></td>
<td></td>
<td>PHYSICS@END</td>
<td>- One or two PHYSICS BP</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>- Totem bump or not</td>
</tr>
<tr>
<td>COLLISIONS(1,2,3)</td>
<td>Actual</td>
<td>PHYSICS@END</td>
<td></td>
</tr>
<tr>
<td>RAMPDOWN</td>
<td>Actual</td>
<td>RAMPDOWN@START</td>
<td></td>
</tr>
<tr>
<td>RAMPDOWN</td>
<td>Functional</td>
<td>RAMPDOWN</td>
<td></td>
</tr>
</tbody>
</table>
The parameter hierarchy

- **Momentum**
  - **Dipoles’ multipoles**

- **Optics**

- **KNOB**
  - **K**
    - **K_SMOOTH**
      - **I**
        - **I_REF**
        - **I_REF NESTED** (only for triplets)
      - **I_AP** (only for RB, RQs)

** NON-trimmable parameters

** Trimable parameters

- **Trims are ALWAYS to be done on KNOB level!!**
Incorporation

CONSTANT_DECAY_IR @XX sec

DELTAIR

CONSTANTIR
Incorporation (backwards)

BACKWARD INCORPORATION RULE

CONSTANT_DECAY_IR @XX sec
DELTAIR
CONSTANTIR
Incorporation (middle)

\[\text{FORWARD: CONSTANT\_DECAY\_IR} \]
\[\text{BACKWARD: CONSTANT\_DECAY\_IR} \]

\[\text{FORWARD: CONSTANT\_DECAY\_IR} \]
\[\text{BACKWARD: DELTAIR} \]
The squeeze commissioning – an example

FORWARD rule:
DELTAIR

BACKWARD rule:
CONSTANT_DECAY_IR to previous optics
Standard incorporation

The sequencer takes care of incorporating the settings at each stage of the cycle:
- Injection into RAMP
- Flat-top into QCHANGE
- ...

The sequencer does **NOT** check/care the incorporation rules, it just execute it
- The sequencer incorporates **ONLY** the settings defined in the task!
- Sequencer does **NOT** know about BP, but **ONLY** users
Standard incorporation (injection -> ramp)

Q' COSTANT_DECAY_IR to 30 sec
Q CONSTANT_DECAY_IR to 30 sec
Coupling CONSTANT_DECAY_IR to 200 sec

Orbit (K) DELTAIR (rarely trimmed)

Special incorporations (only from injection into ramp)

b3 (amplitude dependent)
Q_FiDeL (amplitude dependent)
Q_INT (energy dependent)
# Standard incorporation

<table>
<thead>
<tr>
<th>Parameter</th>
<th>BP</th>
<th>Incorporation rule</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Q</strong> Q’ COUPLING OCTOPULES</td>
<td>All but SQUEEZE</td>
<td>DELTAIR</td>
</tr>
<tr>
<td></td>
<td>SQUEEZE</td>
<td>CONSTANT_DECAY_IR (next optic)</td>
</tr>
<tr>
<td>ORBIT (K level)</td>
<td>All</td>
<td>CONSTANT_DECAY_IR (end of BP)</td>
</tr>
<tr>
<td>LUMI SCAN</td>
<td>PHYSICS (BACKWARD)</td>
<td>CONSTANT_DECAY_IR (start of BP)</td>
</tr>
</tbody>
</table>
Manual incorporation

Sometimes, during commissioning incorporation might need to be done manually.

Incorporation has **ONLY** to be done on KNOB level (but ORBIT@K, which is normally done very few times in the year)!!

If modified the incorporation rules should always set back to the original ones.