

An aerial photograph of a rural landscape, showing a patchwork of agricultural fields in various shades of brown and green. A network of roads and a railway line are visible. A large, semi-transparent blue rectangle with a white border is centered over the image, containing white text. The text is arranged in two lines: the first line reads 'HL-PLC Glossary' and the second line reads 'Update and additional definitions'.

# HL-PLC Glossary

## Update and additional definitions

# Glossary and Definitions

## Glossary and Definitions

- $\beta^*$ : Optical  $\beta$ -function at the IP.
- $\eta$ : Machine slip factor.
- $\eta_D$ : Normalized dispersion:  $\eta_D = D\sqrt{\beta}$ , where  $D$  is the machine dispersion.
- $\gamma$ : Optic gamma function:  $\gamma(s) = (1 + \alpha^2(s))\beta(s)$  where  $\beta(s)$  is the optical betatron function along the machine and  $\alpha(s) = \frac{d\beta}{2 ds}$ .
- $\gamma$ : The relativistic gamma factor.
- abort gap:**  
Area without any bunches in the bunch train that fits the time required for building up the nominal field of the LHC dump kicker.
- arc:**  
The part of the ring occupied by regular half-cells. Each arc contains 46 half cells. The arc does not contain the dispersion suppressor.
- arc cell:**  
It consists of two arc half-cells and presents the basic period of the optic functions.
- arc half-cell:**  
Periodic part of the LHC arc lattice. Each half-cell consists of a string of three twin aperture main dipole magnets and one short straight section. The cryo magnets of all arc half-cells follow the same orientation with the dipole lead end pointing upstream of Beam 1 (downstream of Beam 2).
- batch:**
- PS batch:**  
Train of 72 bunches that is injected into the SPS in one PS to SPS transfer.
  - SPS batch:**  
Train of  $4 \times 72$  or  $3 \times 72$  bunches that is injected into the LHC in one SPS to LHC transfer.
- Beam 1 and Beam 2:**  
Beam 1 and Beam 2 refer to the two LHC beams. Beam 1 circulates clockwise in Ring 1 and Beam 2 circulates counter clockwise in Ring 2. If colors are used for

HL-PLC Glossary & Definitions based on LHC Design report:

[https://espace.cern.ch/HiLumi/PLC/SiteAssets/LHC\\_Glossary\\_high\\_resolution.pdf](https://espace.cern.ch/HiLumi/PLC/SiteAssets/LHC_Glossary_high_resolution.pdf)

Progressing HL-LHC Design (and future operation) requires maintenance/extension of glossary and definitions to ensure coherence across activities + prepare future integration into existing Layout Database

Discussion started to revisit existing EDMS Structure & Baseline and build-up an HL-LHC branch for archiving of HL-LHC related data

Detailed presentation of existing EDMS Structure, Layout DB,... for next PLC meeting (March)

# Using consistent definitions – an example

**LHC Design - Parameters & Layouts**

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*ZERLAUTH*

- LHC Design - Parameters & Layouts
  - General Parameters
    - Overview
    - Beam Performances
    - Transv. Beam Param.
    - Long. Beam Param.
  - Naming & Conventions
    - Definitions & Numbering**
    - Quadrupole Polarities
    - Equipment Codes
    - Circuit and PC Naming
    - Magnet Polarity Definition
    - Field Errors
    - Beam Coding
  - Layout Optics v6.4
    - General
    - Mechanical
    - Assemblies v6.4
    - Source Drawings v6.4
  - Lattice & Optics
  - Correction Schemes & Field Errors
  - Beam Dynamics
    - Injections & Filling Scheme
    - Ejection & Dump
    - Beam Cleaning
  - RF & Feedback
  - Magnets for the Ring
  - Magnets for the Injection Lines
  - Powering & Quench Protection
  - Cryogenics
  - Vacuum System
  - Beam Instrumentation
  - Geometry & Alignment
  - Controls & Operational Aspects
  - Injectors & Transfer Lines

## Definitions & Numbering

LHC Circumference (Trajectories)	26658.883 m
LHC Total Length (Straight Elements)	26658.864 m
<b>ARC</b>	Click <a href="#">Here</a> to display structure    j=12 to 34    2452.230 m
<b>IR</b>	Insertion Region (IR <sub>i</sub> =DSL <sub>i</sub> +LSS <sub>i</sub> +DSR <sub>i</sub> )    j=1 to 11    i odd: 880.5614 m i even: 879.6994 m
<b>DS</b>	Dispersion Suppressor    j=8 to 11    i odd: 171.3767 m i even: 170.4347 m
<b>LSS</b>	Long Straight Section    j=1 to 7    i odd: 537.808 m i even: 538.830 m
<b>MS</b>	Maching Section    j=4 to 7
<b>IT</b>	Inner Triplet    j=1 to 3
<b>IP</b>	Interaction Point
<b>CjL(R)i</b>	C : Half Cell    L/R : Left / Right    j = 1 to 34    i = 1 to 8
<b>QjL(R)i</b>	Q : Quadrupole

✕ Send Mail to EDMS Support
✕ LHC Pages Statistics

Last update: 11-NOV-99

# Additional definitions – 1/6

- Event pile-up:

Number of inelastic proton-proton interactions in a given bunch crossing

- Average pile-up:

Mean value of the pile-up over a fill (averaged over all bunch crossings)

- Peak pile-up:

Maximum pile-up in any bunch crossing at any time (usually at the start of the fill)

Courtsey F.Gianotti

- Peak average pile-up:

Mean pile-up at the beginning of the fill. It corresponds to the peak luminosity of the fill. In practice, it is determined as the maximum of the pile-up values obtained by averaging over all bunch crossings within time intervals of typically one minute

- Luminous region:

The 3-dimensional distribution of the collision event vertices

- Average pile-up density:

Number of inelastic proton-proton interactions in a given bunch-crossing divided by the size of the luminous region in Z

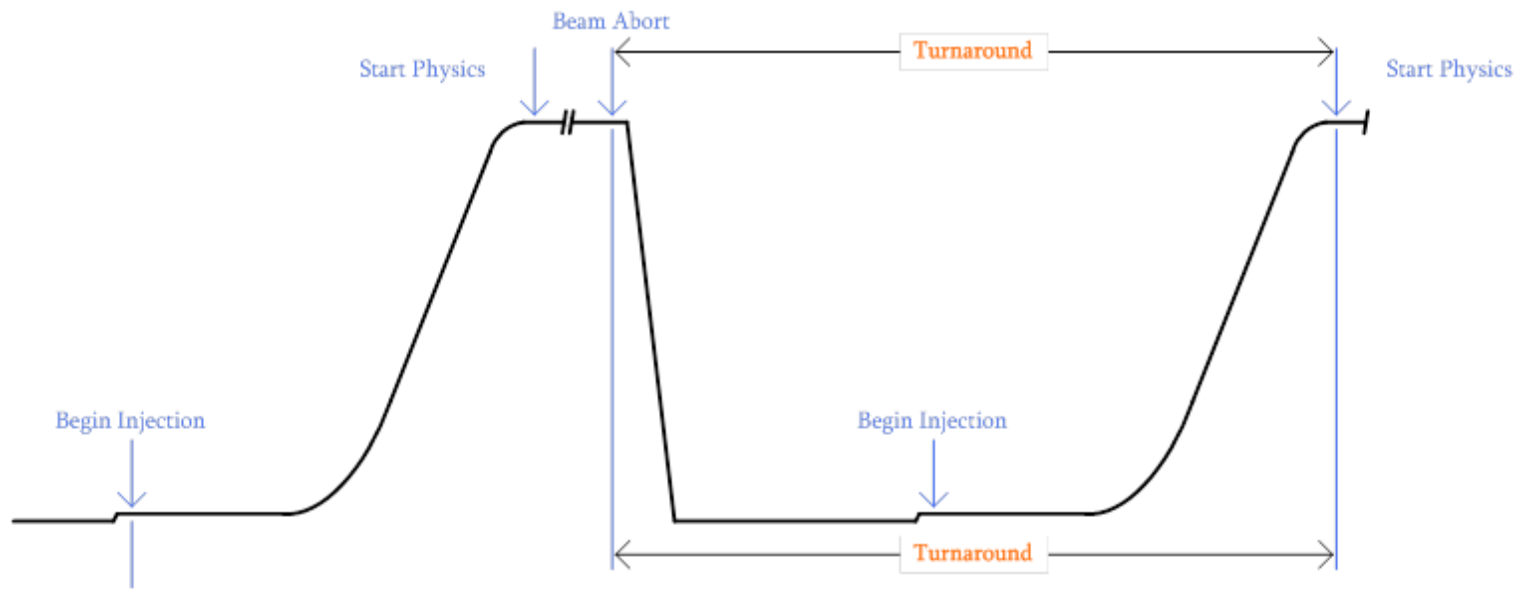
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- Hourglass effect 'H':  
Luminosity loss due to longitudinal modulation of beta function over the length of the bunch for small  $\beta^*$
- Geometric luminosity reduction factor due to beam offset 'R':  
Reduced beam overlap due to transversal offset of collisions, frequently used for reduction of luminosity (leveling) and VdM scans
- Luminosity reduction factor due to crossing angle 'S':  
Reduced beam overlap due to tilted bunch shape due to crossing angle
- Total geometric luminosity reduction factor 'F' =  $R \cdot H \cdot S$
- Piwinsky parameter: Quantification of reduced beam overlap due to finite crossing-angle

# Additional definitions - 4/6

- Turnaround time [h]:

Time between the end of one and the start of the next physics run / data taking by the experiments (delimited by the loss of beam presence/beam dump back to declaration of STABLE\_BEAMS)

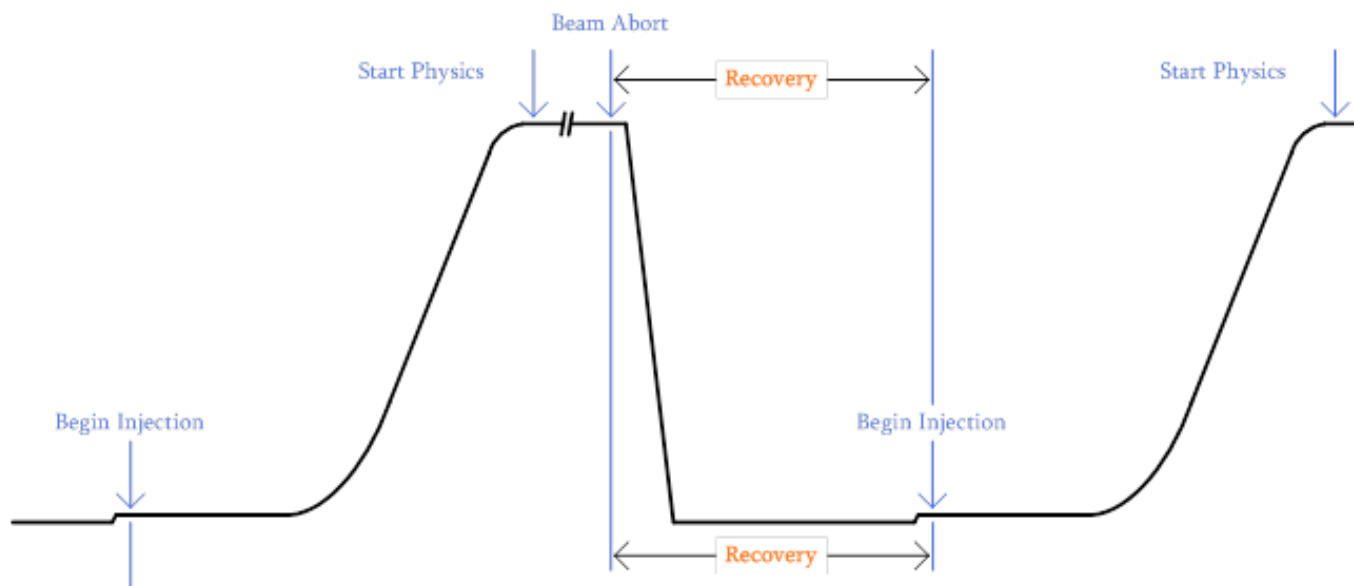


Tbc with OP

# Additional definitions - 5/6

- Recovery time [h]:

Time between the end of one and the readiness for injection of new particles of the next (delimited by the loss of beam presence/beam dump and resuming of the normal operational cycle)



Tbc with OP



- Turnaround time [h]:

Time between the end of one and the start of the next physics run / data taking by the experiments (delimited by the loss of beam presence/beam dump back to declaration of STABLE\_BEAMS)

- Machine efficiency [%]:

Fraction of calendar time spent in physics operation / data taking (ie the time spent in STABLE\_BEAMS)

- Machine availability [%]:

Fraction of calendar time in which the machine is ready to perform the foreseen physics program and accept / accelerate particles

Tbc with OP

# How machine availability is currently defined

- Definition of machine availability requires to clearly delineate normal operational cycle from faults, downtime, technical stops etc. Currently, broken down into three numbers:
  - Availability defined as all the time with at least a pilot injected, and the machine executing the normal operational cycle ( note the fill number changes at the start of the ramp down, so the ramp down is not included.
  - Availability defined as all the time with at least a pilot injected, and the machine executing the normal operational cycle, convoluted with a no-faults flag
  - Availability defined as all the time when there is no access to the machine, convoluted with a no-faults flag. This then includes setup time.
- Should one add/define as well down time?

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