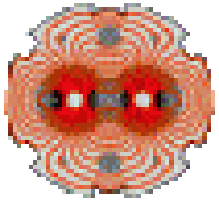


HIGHLIGHTS OF LAST MONTHS OF LCU ACTIVITIES

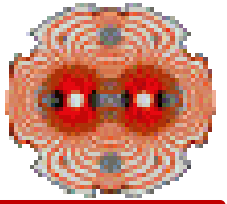
ALWAYS AN EXCITING PERIOD

WITH: COMMISSIONING, PHYSICS, MDs, UPGRADE!

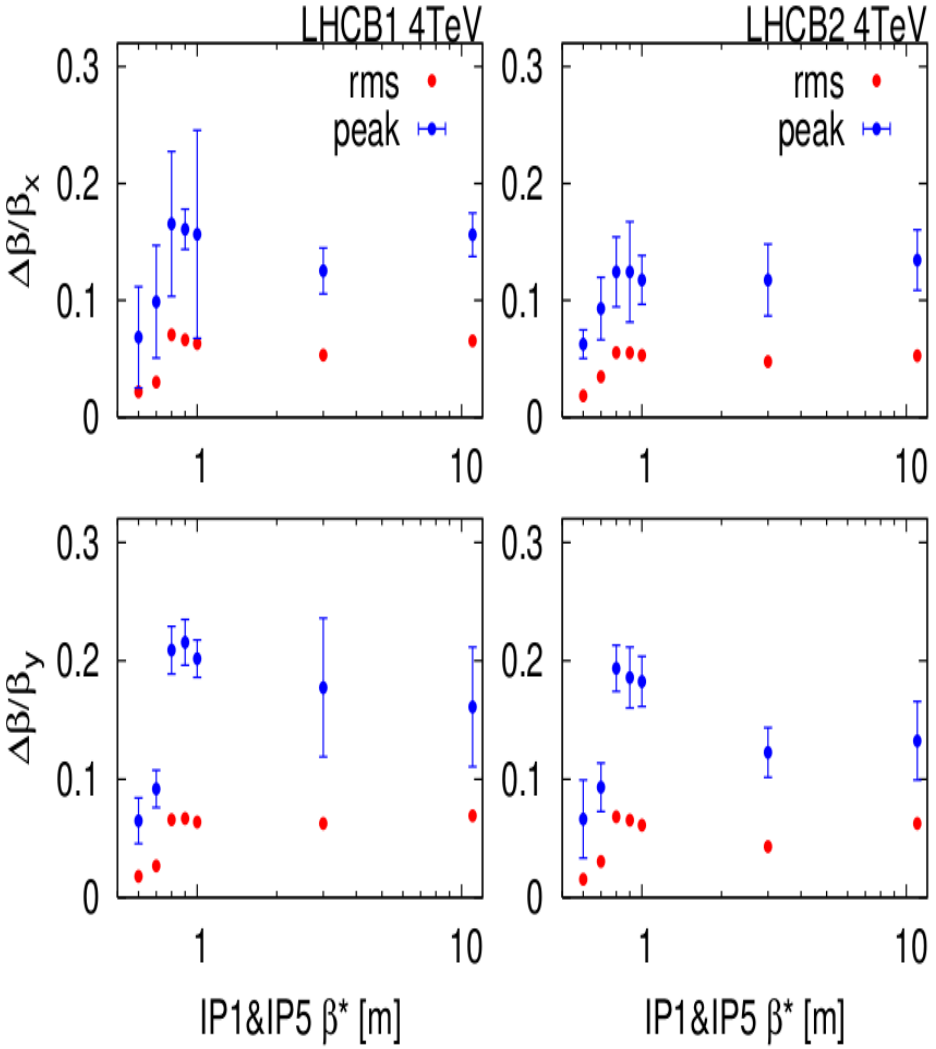
AND…

Phys. Rev. ST Accel. Beams 15, 091001 (2012) [7 pages]

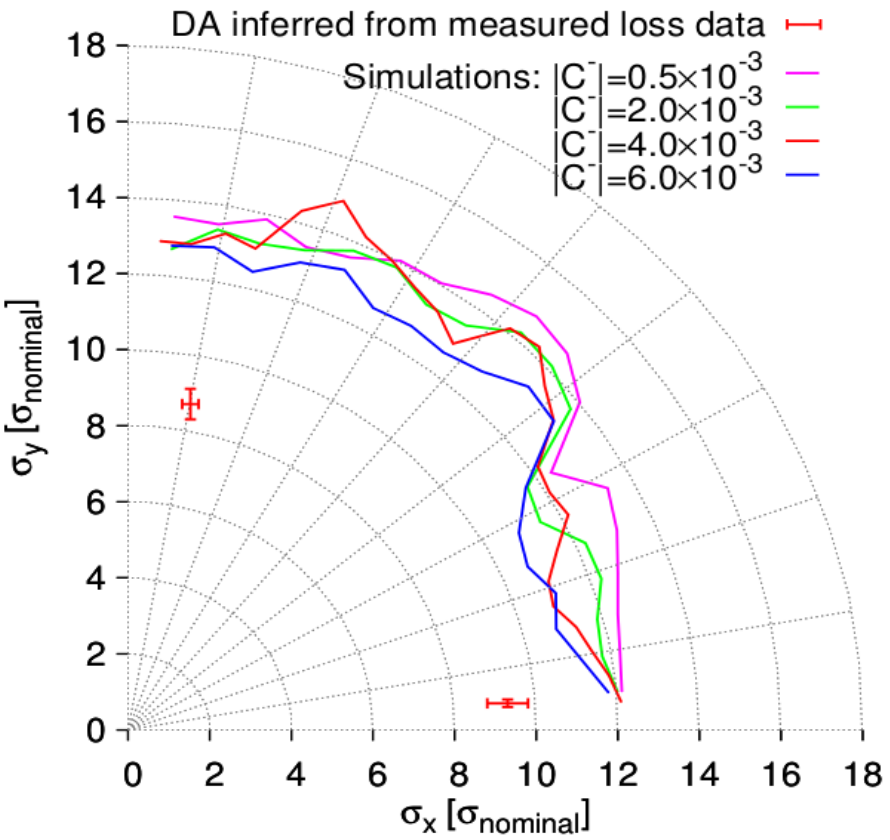
Record low β beating in the LHC



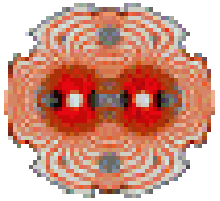
Courtesy R. Tomás et al.



DA measurement with Beam 2



LHC commissioning: preparing for 2015



CERN EuCARD High Luminosity LHC OMC

LHC Optics Measurement and Corrections review

17-18 June 2013
CERN
Europe/Zurich timezone

- Overview
- Timetable
- Registration
  - Registration Form
- List of registrants
- Previous OMC workshop
- HL-LHC

Secretary

m Delphine.Rivoiron@ce...

The LHC will resume operation in 2015 with an increased collision energy and new operational scenarios galore. Optics measurement and corrections will be challenged by dynamic beam processes as ramp & squeeze, collide & squeeze and beta* leveling. Furthermore the correction accuracy and the measurement resolution will continue to be challenged by the emittance measurement and the particle detectors requirements. This workshop aims at reviewing the status and progress in all fronts to ensure the high resolution measurement and correction for 2015. This review is within the HL-LHC and HighLumi framwork regarded as a general preparatory study for coming efficiently out of a long shutdown that features major machine modifications.

t Starts 17 Jun 2013 08:00
Ends 18 Jun 2013 18:00
Europe/Zurich

l CERN
BE Auditorium Meyrin
6-2-24

c Dr. Bruning, Oliver
Dr. Giovannozzi, Massimo
Dr. Lamont, Mike
Dr. Tomas Garcia, Rogelio
Dr. Zimmermann, Frank

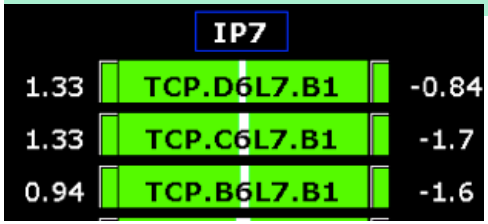
LHC collimation in 2012

2012: "tight settings" (TCP's at 7 TeV gaps) made possible a $\beta^* = 60$ cm.

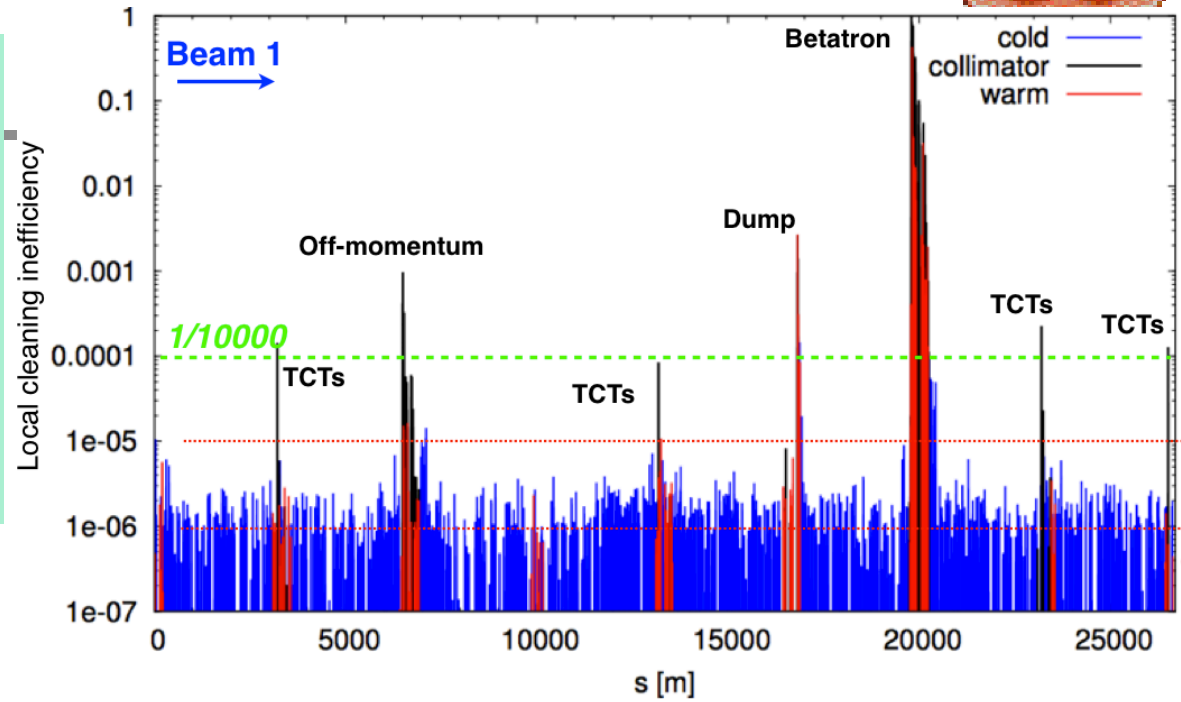
Achieved cleaning in cold regions better than 2e-4: > **99.98%**! (>99.999% in arcs)

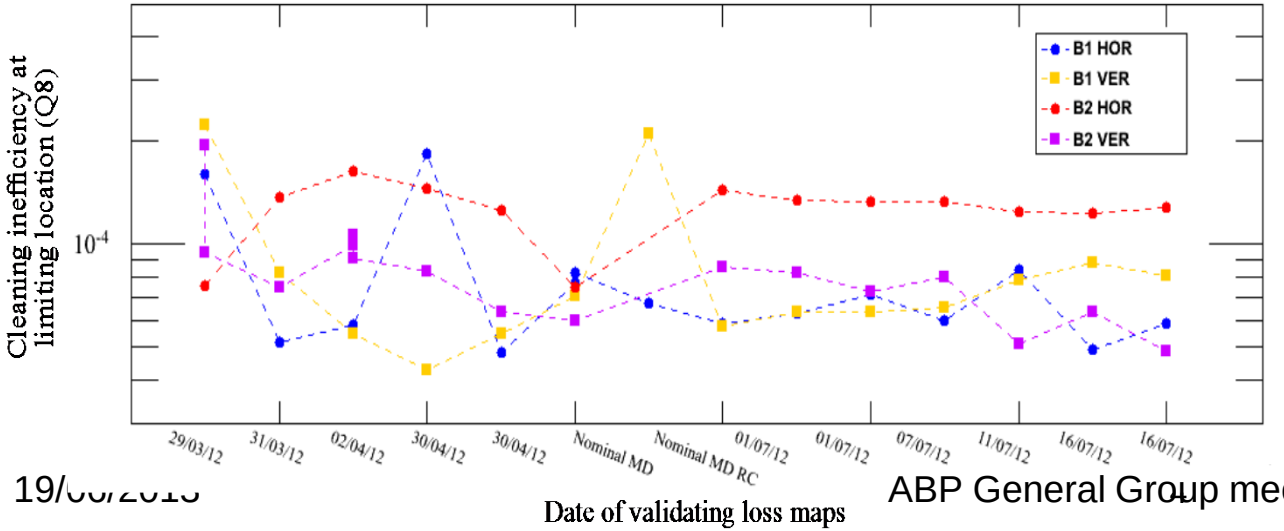
Fast setup: **less than 5 min/collimator**.

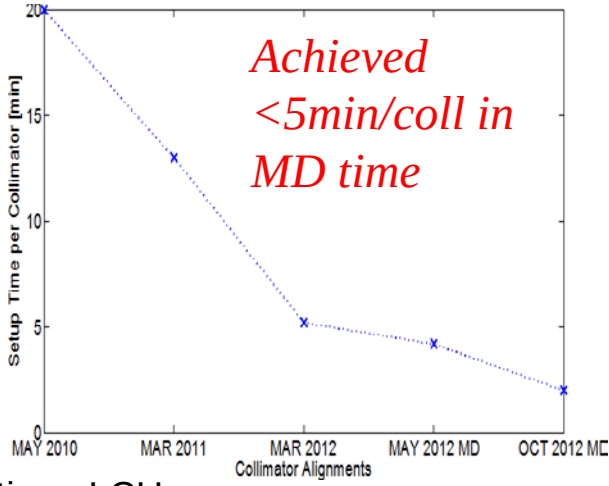
Remarkable **stability of performance** during the year with 1 single alignment.



140MJ in gaps of +1.1 mm!

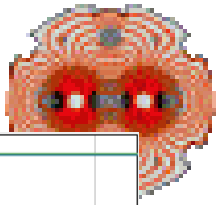




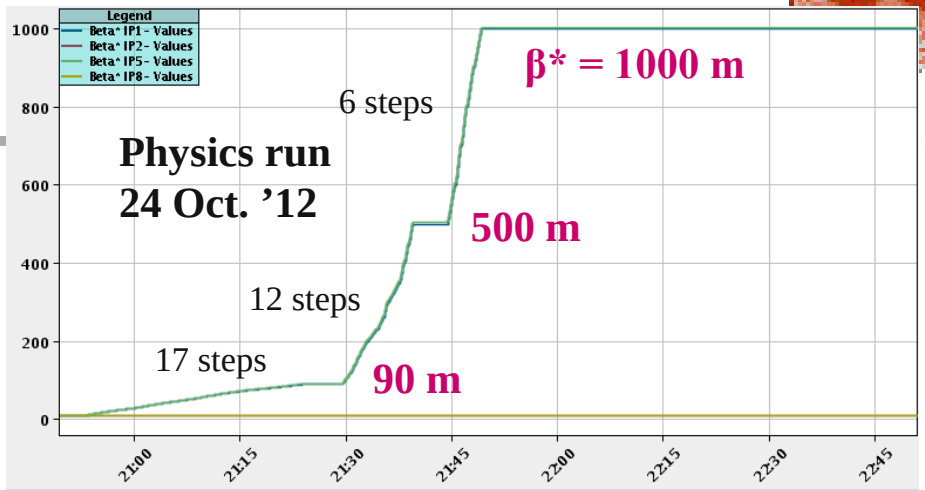


Achieved <5min/coll in MD time

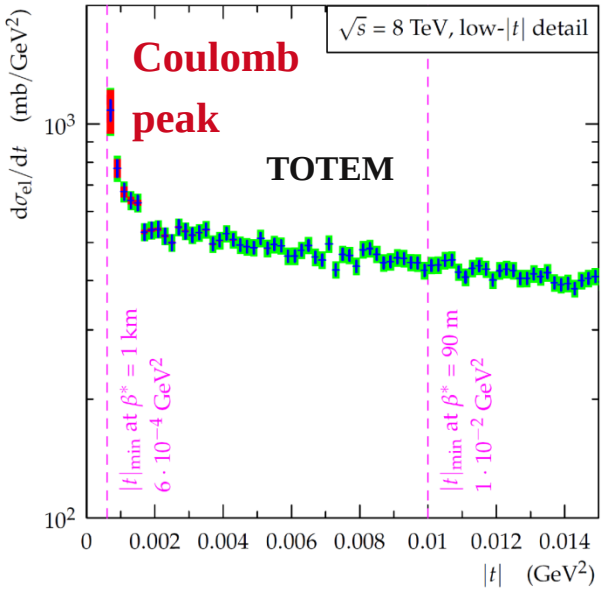
New record high β* = 1000 m



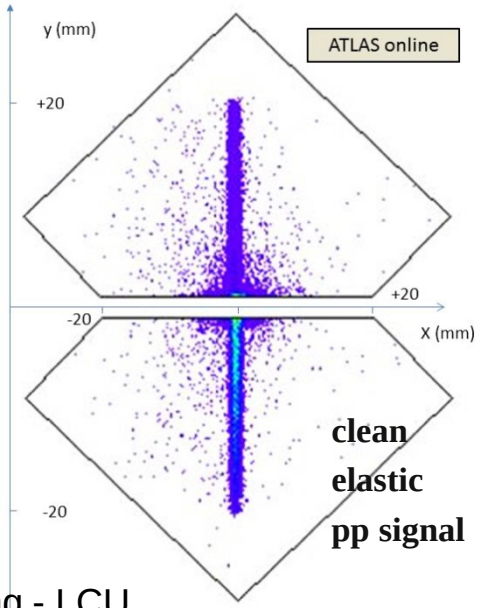
De-squeeze to β* = 1000 m to get very parallel beams.
Beam-divergence at IP1&5 reduced 40 × compared to normal physics to
0.7 µrad (0.7 mm spread in 1 km)
Collimators (2σ) and
Roman Pot detectors very close to the beam
(0.87 mm, 3σ,)
within tight constrains in beam time, power convertors, return cables



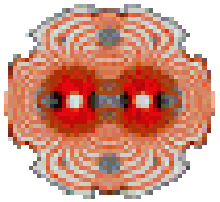
Beta* IP1 [m]	1,000.9	Beta* IP2 [m]	9.9
Beta* IP5 [m]	1,003.1	Beta* IP8 [m]	10.0



measure pp scattering down to ~ 5 µrad, reaching the Coulomb interference region (120 µrad in UA4 SPS)



Proton-nucleus collisions in LHC



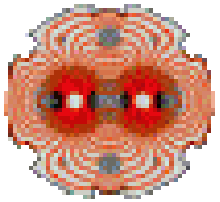
- Pilot run in September 2012
  - New operational scheme not foreseen in LHC Design Report
    - Unequal revolution frequencies, RF cogging, etc.
  - Single fill to commission, set up optics and collimation, and do physics with 4 experiments
    - Stable beams twice more with IP moved $\pm$ 0.5 m
  - Largest increase in centre-of-mass energy (for a given collision type) in the history of particle accelerators

$$\sqrt{s_{NN}} = 5.02 \text{ TeV (c.f. 0.2 TeV for RHIC D-Au)}$$

  - New physics discoveries from 4.5 h of stable beams!
    - Most productive fill ever!

symmetry of particle physics

A joint Fermilab/SLAC publication



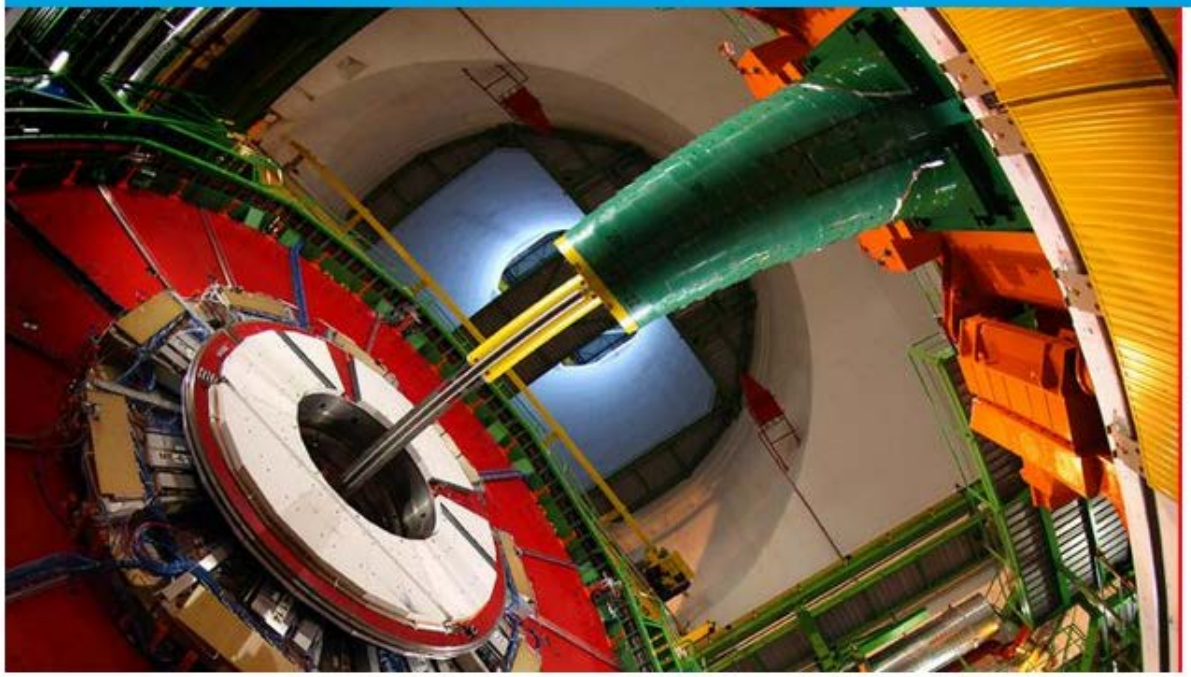


Photo: Michael Hoch / CERN

breaking

May 07, 2013

Smallest lab-made drop of liquid might cause strange particle behavior

A new result from the CMS collaboration takes a step toward revealing the origin of the mysterious 'ridge effect.'

By Kelly Izlar

PDF Download

The Large Hadron Collider is known for a list of impressive facts—it's the world's largest and most powerful particle collider; it accelerates particles to nearly the speed of light; its cryogenic system keeps it colder than outer space.

Now it's under consideration for a new superlative: Scientists there might have created the most minuscule drop of liquid ever formed in a

Related *symmetry* content

most popular

April 30, 2013
Matter, antimatter, we all fall down—right?
Scientists perform the first direct investigation into how antimatter interacts with gravity.

May 7, 2013
Smallest lab-made drop

May 11, 2013
This week's top tweet: Smallest lab-made drop of liquid might be

First results from 2013 run now emerging:

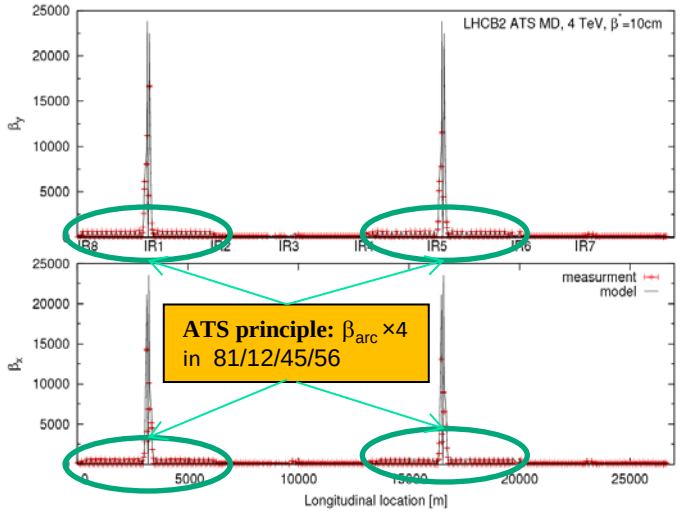
Collective effects on a scale where they were not expected: viscous hydrodynamics of Quark-Gluon Plasma, gluon saturation (colour-glass condensate), …?

HiLumi-WP2

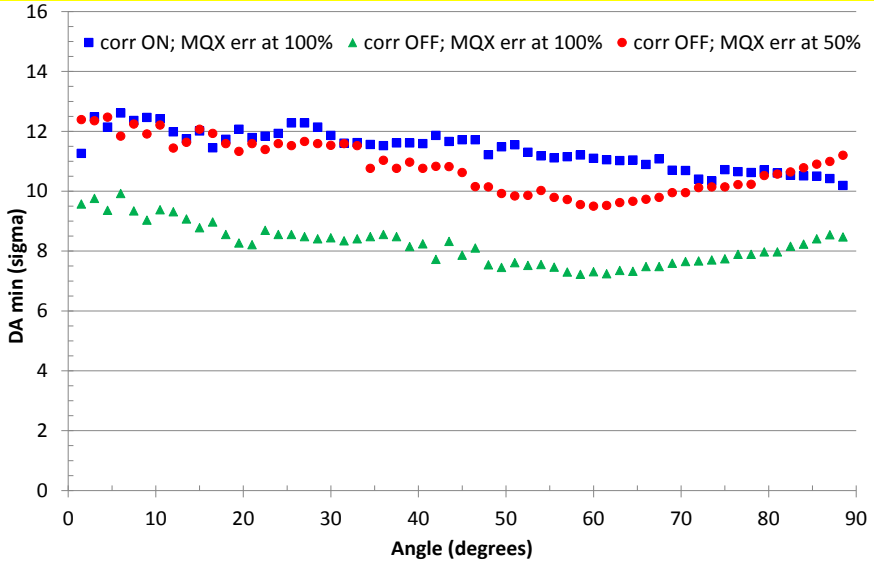
First HL-LHC Target Parameters established

Parameter	Nom. 25 ns	HL 25 ns	HL 50 ns
N_b [10^{11}]	1.15	**2.2**	**3.5**
n_b	2808	2808	1404
I [A]	0.56	1.12	0.89
θc [μrad]	285	590	590
β^* [m]	0.55	**0.15**	**0.15**
ε_n [μm]	3.75	**2.5**	**3.0**
ε_s [eV s]	2.5	2.5	2.5
Piwinski	0.65	3.12	2.85
R red.fact.	0.84	0.31	0.33
b-b/IP[10^{-3}]	3.1	3.3	4.7
L_{peak} (no crab)	1	7.4	8.5
Crabbing	no	yes	yes
$L_{peak\ virtual}$	1	24	26
Lumi level	=	5	2.5
Pileup $L_{lev}=5L_0$	19 (27)	140	140
Eff. for 250 fb^{-1}/year (150 days)	=	**0.59**	**0.98**

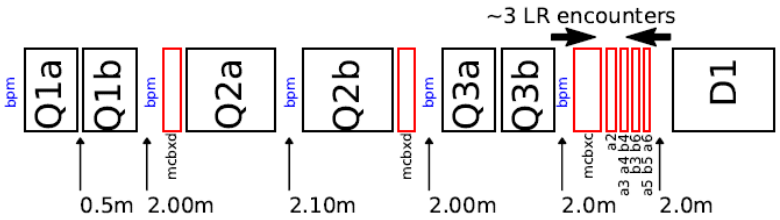
First parameter demonstrated: β*=10 cm (+20/40% β-beat)
... but IT and MS aperture missing to make it operational



First Dynamic Aperture results extremely encouraging
adding new IT corrector and/or tighten the expected IT field quality



HLLHCV1.0: first optics & layout of the HL-LHC ready with 150 mm- 140 T/m Nb3Sn triplet and crab-cavities

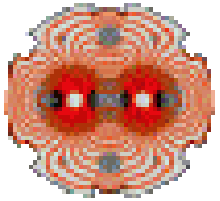


Q1/3 a/b: 3.99m, 140 T/m, 150mm
Q2 a/b: 6.76m, 140 T/m, 150mm
D1: 7.7m, 40 Tm, 160mm

MCBXD: 1.3m, 1.8Tm, h/v nested orbit corrector
MCBXC: 2.00m, 4.5Tm in xing plane(for crab) and 1.8Tm in the other plane
MQSX3: 0.67m, skew quadrupole corrector
MCSTX3: 0.50m, (b3,b6) nested correctors
MCOSSX3: 0.50m, (a3,a4,b4) nested correctors
MCDTSX3: 0.50m, (a5,b5,a6) nested correctors

Computing

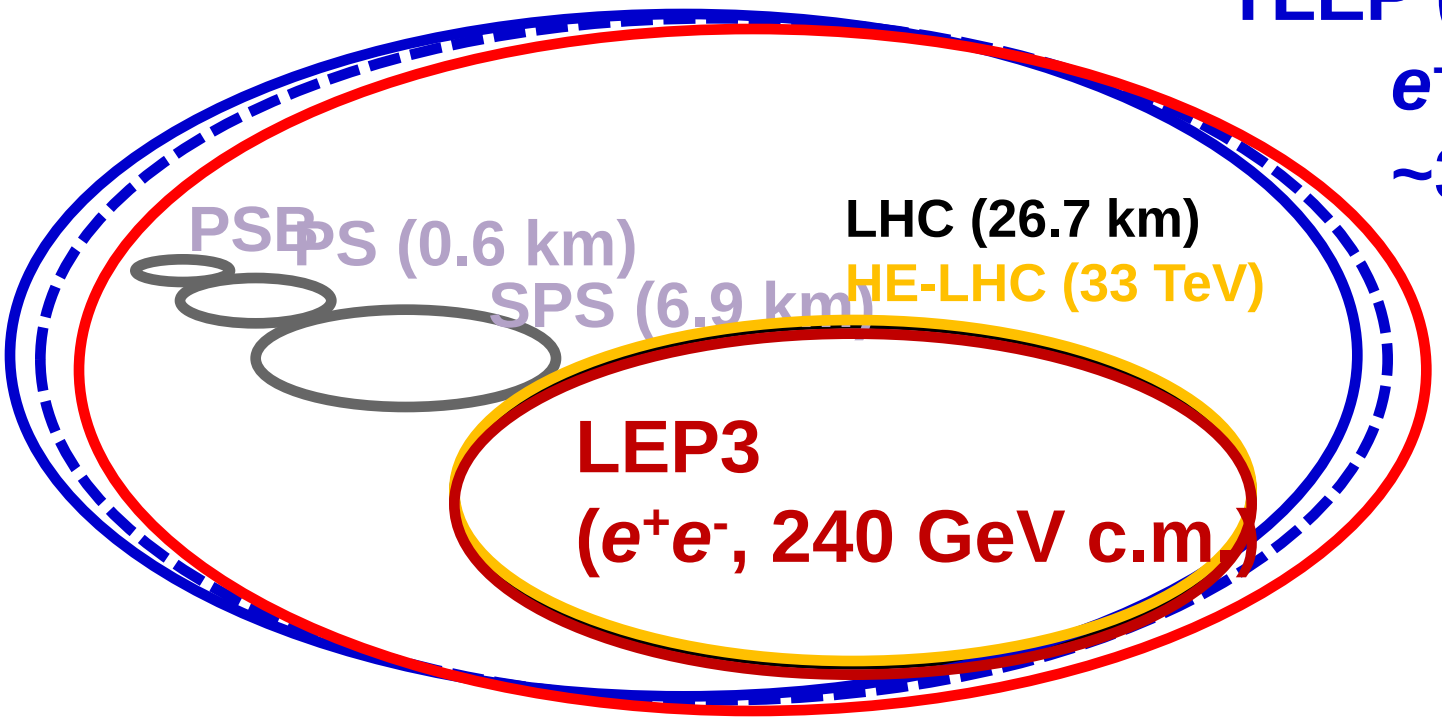
Upgrade studies triggered a new intense development period.



- **MAD-X** Single Particle Beam Dynamic Code
  - Website: http://cern.ch/mad *(Services centric).*
  - Support: mad@cern.ch *(MAD team)*, mad-usr@cern.ch *(MAD community).*
  - New build & test system (regression tests) for Windows, Linux, MacOSX, 32 & 64 bit.
  - Garbage collector (memory management), ~10 requests, ~100 bugs corrected (SVN Trac*ker*).
  - Production release in February 2013 (next pro: July 2013).
- **MAD** (new development)
  - Focus on PTC/FPP approach, collaboration with KEK (E. Forest), June 2013 - June 2017.
  - New PTC/FPP engine, better structured, unified & extended physics *(invariants, envelopes)*.
  - General purpose scripting language, provide access to physics and maths objects *(toolboxes)*.
- **SixTrack**
  - New physics (RF multipoles, e-lens)
  - Fringe fields effects

Not to forget the on-line model activities!

Possible long-term strategy for HEP
emerging from AccNet workshops & studies



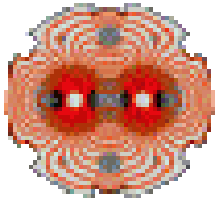
TLEP (80-100 km, e^+e^-, up to ~350 GeV c.m.)

VHE-LHC (pp, up to 100 TeV c.m.)

same detectors!?

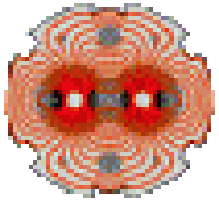
& $e^{\pm}$ (120 GeV) – p (7, 16 & 50 TeV) collisions ([(V)HE-]TLHeC)

≥50 years of e^+e^-, pp, ep/A physics at highest energies



CONGRATULATION TO ALL OF YOU FOR THE GREAT ACHIEVEMENTS!

Jose Luis ABELLEIRA FERNANDEZ, Ralph ASSMANN, Frédéric BOULY, Roderik BRUCE, Helmut BURKHARDT, Marija CAUCHI, Riccardo DE MARIA, Daniel DEBOY, Laurent DENIAU, Cesar Octavio DOMINGUEZ SANCHEZ DE LA BLANCA, Stephane FARTOUKH, Miriam FITTERER, Hans Mattias FJELLSTROM, Pascal HERMES, Bernhard HOLZER, Christoph ILGNER, John JOWETT, Luisella LARI, Andrea LATINA, Ewen MACLEAN, Aurelien MARSILI, Humberto MAURY CUNA, Eric MCINTOSH, Daniele MIRARCHI, Elena QUARANTA, Stefano REDAELLI, Thys RISSELADA, Adriana ROSSI, Ghislain ROY, Belen SALVACHUA FERRANDO, Michaela SCHAUMANN, Rogelio TOMÁS, Gianluca VALENTINO, Alessandra VALLONI, Reine VERSTEEGEN, Frank ZIMMERMANN.



HIGHLIGHTS OF LAST MONTHS OF LCU ACTIVITIES

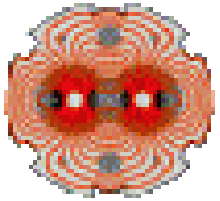
ALWAYS AN EXCITING PERIOD

WITH: COMMISSIONING, PHYSICS, MDs, UPGRADE!

AND…PREPARATION FOR A NEW SECTION:

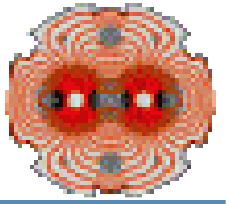
Hadron Synchrotron Single particle dynamics

Section mandate



- Is responsible for optics design and development of CERN's circular hadron colliders and accelerators, present and future.
- Studies the mechanical aperture and magnetic field imperfections of the machines as installed and their effects on beam dynamics.
- Carries out experimental and theoretical beam physics and design studies aimed at improving the performance of CERN's circular hadron colliders and accelerators, present and future, in particular in terms of beam losses management.
- Defines parameters, strategies and measurement procedures for initial beam commissioning and regular operation (in collaboration with other sections and groups).
- Provides coordination and support during both commissioning and routine operation.
- Hosts the Project coordination, and studies, for the LHC collimation system and its upgrade.
- Hosts the coordination, and studies, of ion operation and upgrades of the LHC.
- Hosts the coordination of studies for the PS-LIU project.
- Is responsible, develops and maintains software tools for beam physics, accelerator design and operation.
- Contributes to European-funded networks and studies.
- Provides expertise in advisory bodies for accelerators at other laboratories.
- Provides expertise for educational and outreach activities.

Group Leader:	**O. Brüning** [11]
Deputy GL:	**G. Arduini** [LMC]
Administrative support:	**D. Missiaen**
Group Secretary:	**D. Rivoiron**



SU Large Scale Metrology	HSL Hadrons Sources & Linacs	HSC Hadron Synchrotrons Collective effects	HSS Hadron Synchrotrons Single particle dynamics	LAT Lepton Accelerators & Test Facilities
D. Missiaen	**R. Scrivens** [MS]	**E. Métral**	**M. Giovannozzi** [7]	**R. Corsini** [14]
A. Behrens [T] P. Bestmann A. Beynel P. Dewitte T. Dobers A. Froton J.F. Fuchs J.C. Gayde A. Herty M. Jones F. Klumb H. Mainaud-Durand A. Marin D. Mergelkuhl C. Podevin M. Rousseau P. Sainvitu M. Sosin (J.P. Soucheyre) M. Tortrat M. Troillet 22 staff	P. Andersson G. Bellodi [MS] S. Bertolo D. Kuchler [MS] J.B. Lallement [MS] J. Lettry A. Lombardi [1, MS] C. Mastrostefano [T, MSI] M. O'Neil [T, MS] F. Wenander [MS] 11 staff	E. Benedetto O. Berrig M. Bodendorfer C. Carli [MS, 15] W. Herr K. Li (Feb. 2013) T. Pieloni G. Rumolo [MS, 2] B. Salvant [MS] F. Schmidt G. Sterbini E. Wildner [4] 13 staff	R. Bruce (Dec. 2012) H. Burkhardt [9, 10, 18] R. De Maria [16] L. Deniau [3] S. Fartoukh [17] **S. Gilardoni** [MS, 5] J. Jowett [12] S. Redaelli [8, 19] G. Roy A. Rossi *R. Tomas* F. Zimmermann [13, MD] 12 staff	**B. Holzer** [LMC] J.B. Jeanneret [T] A. Latina I. Papaphilippou [MS] *G. Rumolo* D. Schulte P. Skowronski R. Tomas Add activities related to Plasma acceleration, LEP3, TLEP, LHeC and ERL studies to this section 8 staff