European Organization for Nuclear Research
Organisation européenne pour la recherche nucléaire

LHC Status
OC, June 21, 2013

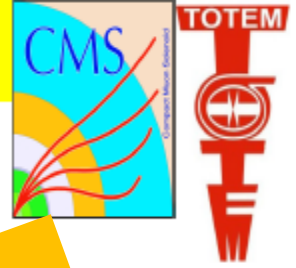
Summary

- 3 years of successful running of all infrastructures ended February 2013
- Excellent scientific results at all facilities including discoveries
- Long Shutdown (LS1) in full swing to maintain and improve infrastructures and accelerators and to overcome the energy limitation at the LHC
- Despite some ‘surprises’ all work is on schedule
- The continuous long-term support of our member states is paying off: Thank you !!

Some recent results from the experiments

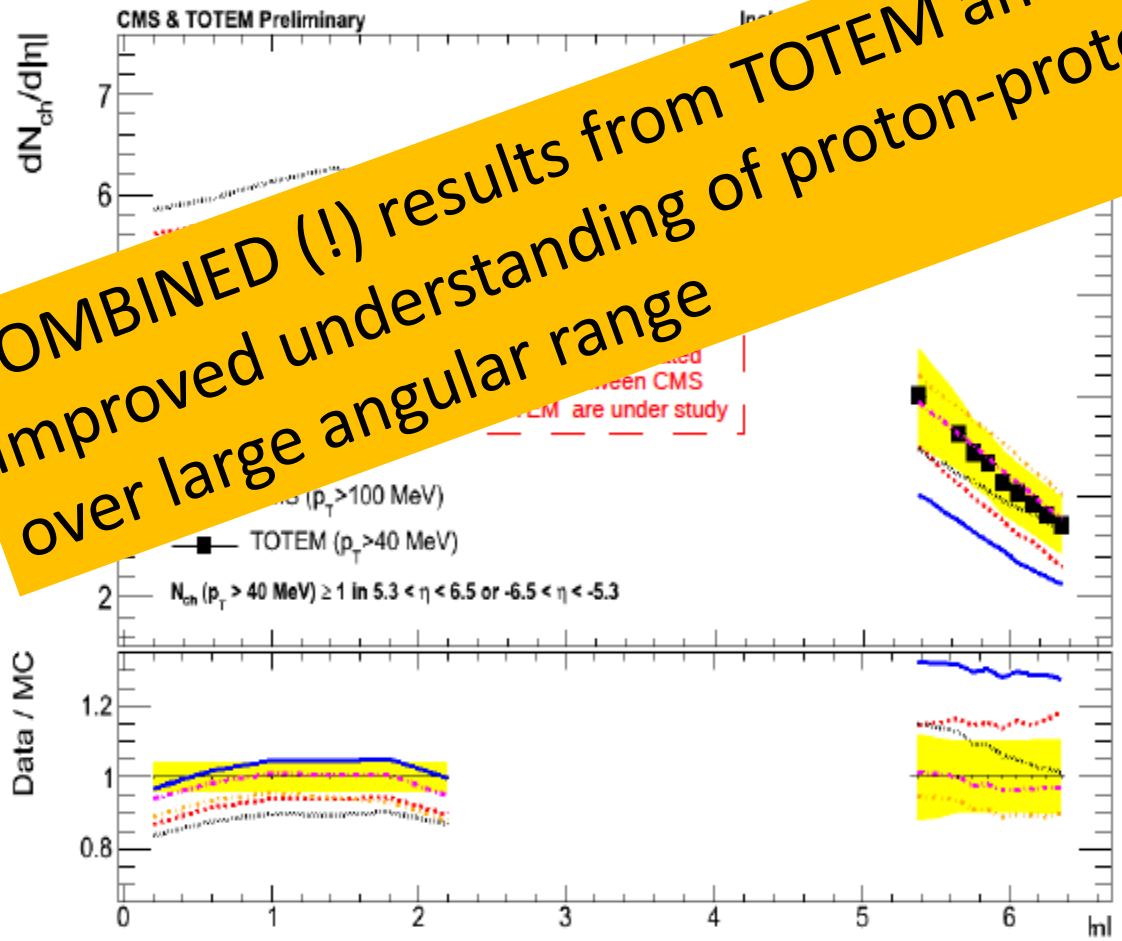
TOTEM

Very forward $dN_{CH}/d\eta$ measurements at 8 TeV (with CMS!)



- Inclusive TOTEM analysis very similar to the 7 TeV case but:
  - Improved simulation of the T2 detector response, secondary particles production, event selection strategy and improved alignment procedures.
  - Uses of the vertex information from CMS to reduce the pile-up corr
  - Better MC tuning to the LHC measurements (important for

COMBINED (!) results from TOTEM and CMS: Improved understanding of proton-proton processes over large angular range



Both CMS and TOTEM analysis obtained triggering with T2, on the same events.

- Same CMS-TOTEM event selection (at least a track reconstructed in T2)
- Measurements are representative for an inelastic event sample with at least a primary charged particle with P_T>40 MeV/c produced in the range $5.3<|\eta|<6.5$.

CMS

Standard Model: 8 TeV inclusive jets

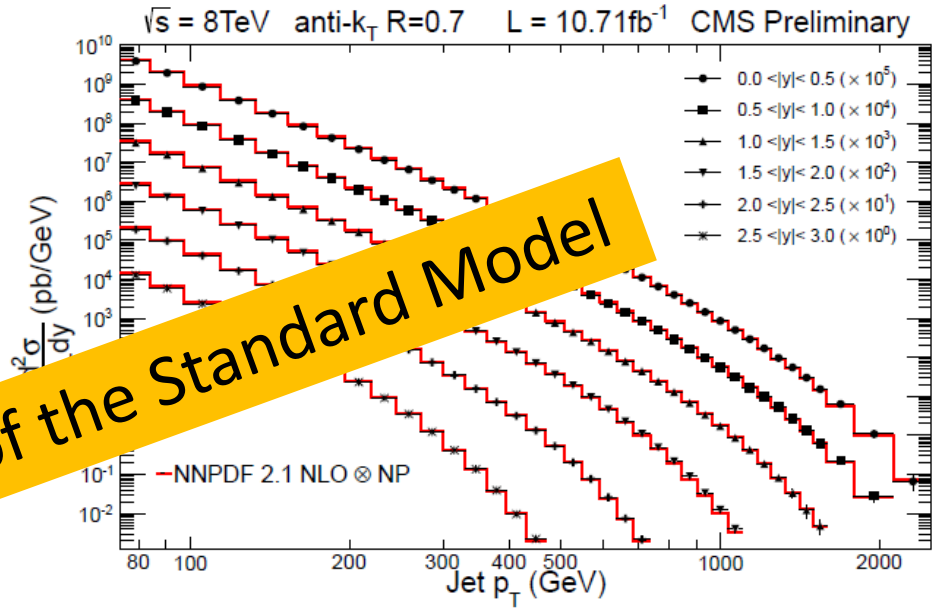
CMS-PAS-SMP-12-012

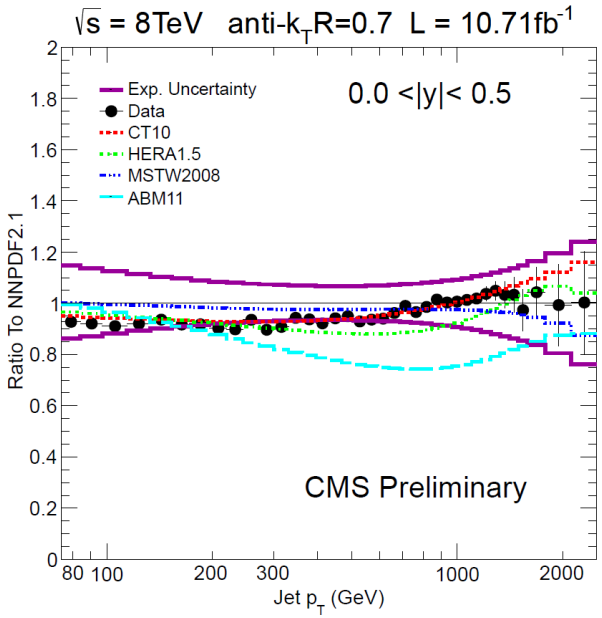
Double-differential inclusive jet cross section obtained with 11/fb at 8 TeV

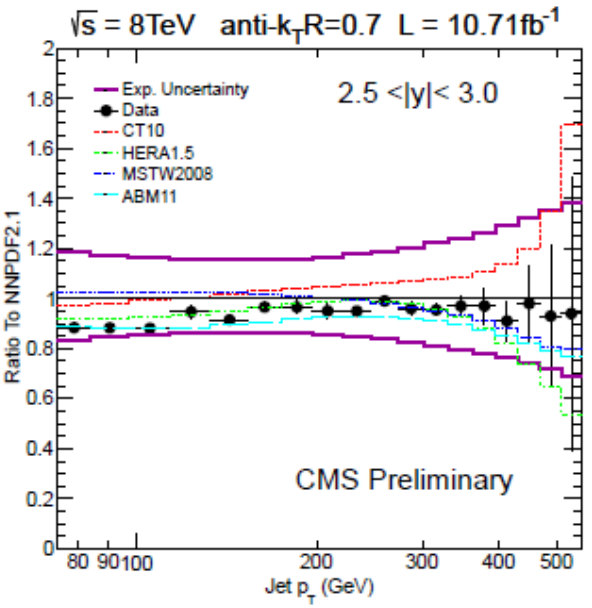
Agreement with NLO QCD over 11 orders of magnitude, with sensitivity beyond 2 TeV

- 2-5% jet energy scale uncertainty f
- 4-8% j ergy resolution
- 10-30% cross section uncertainty per bin
- Improvement to high x q/g PDF expected

High precision tests of the Standard Model





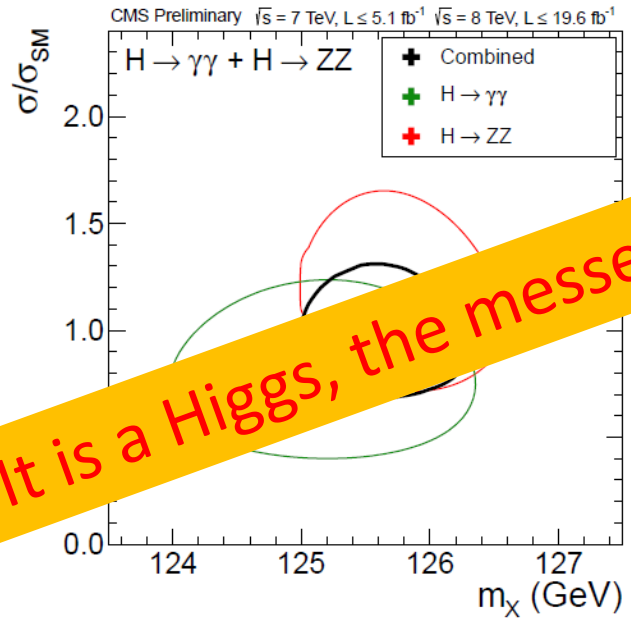


Higgs: Moriond 2013 combination

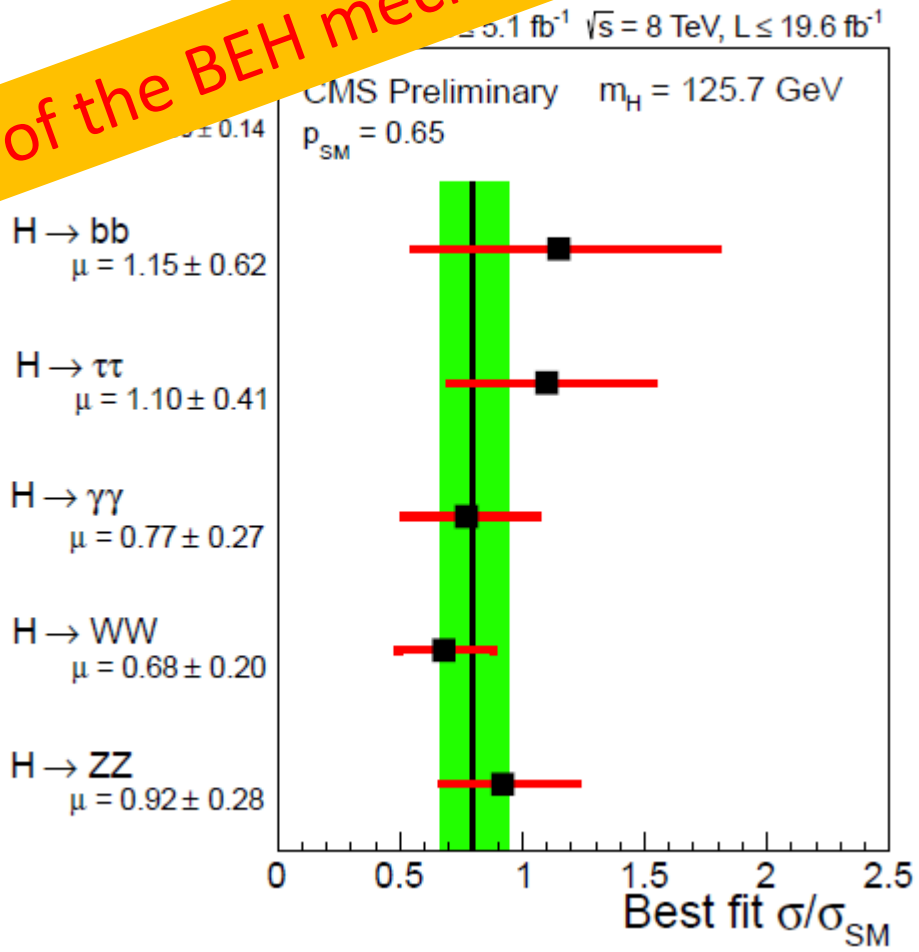
CMS-PAS-HIG-13-005

A consistent mass is measured for ZZ* and γγ: 125.7±0.3±0.3 GeV

A consistent signal strength is measured for 5 dec… s
μ = 0.80±…



It is a Higgs, the messenger of the BEH mechanism



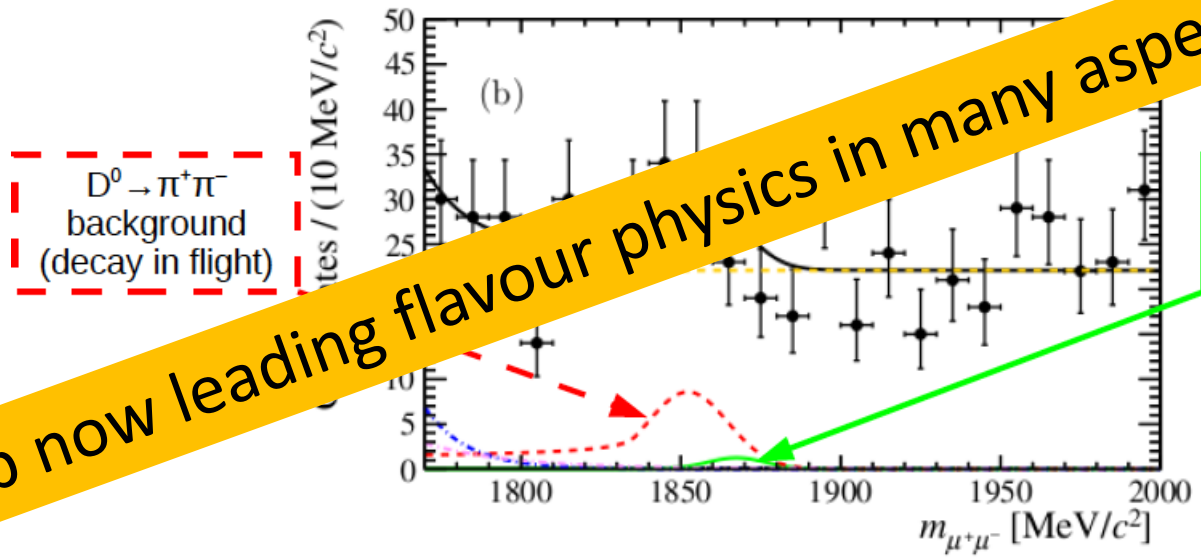
- A consistent signal strength is measured w.r.t production mode, fermion vs. boson couplings, and custodial symmetry
- JCP 2++/0-+ disfavored at 2.8/3.3 σ level

LHCb

Search for the rare decay $D^0 \to \mu\mu$

LHCb-PAPER-2013-013
arXiv:1305.5059

- One of several preliminary results on 2011 data improved and submitted for publication



LHCb now leading flavour physics in many aspects

$$\mathcal{B}(D^0 \to \mu^+\mu^-) < 6.2\,(7.6) \times 10^{-9} \text{ at } 90\%\ (95\%)\ \text{CL.}$$

Branching ratios of dimuon decays of flavoured neutral mesons!

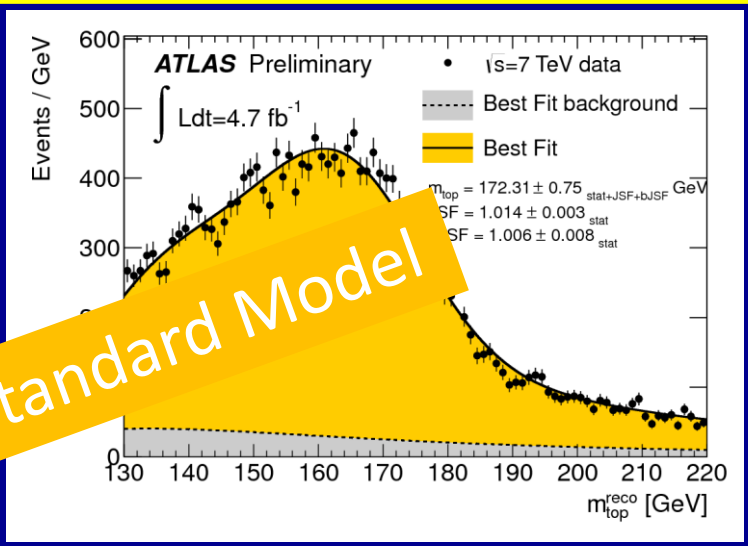
K_S!	K_L!	D^0!	B^0!	B_s!
< 9 10^{-9}! (90% CL)!	6.8 ± 0.1 10^{-9}!	< 6.2 10^{-9}! (90% CL)!	$3.2\pm^{0.15}_{0.12}$ 10^{-9}! !	< 8 10^{-10}! (90% CL)! !
LHCb!	BNL E871!	LHCb!	LHCb!	LHCb!

ATLAS

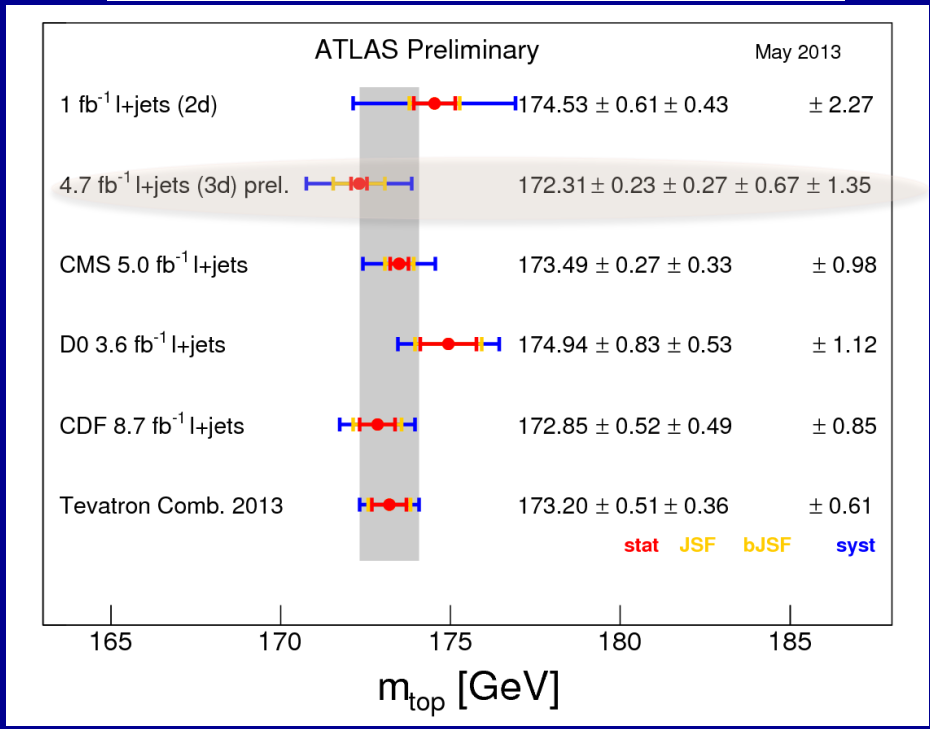
New Top Mass Measurement: l+jets

- New Top Mass measurement using a 3D template fit
  - Fitted Distributions:
    - M_{top}^{reco}, M_{W}^{reco} ar…
  - Reduces …atics by 4…
    - Main improvement on the relative scale Bjet-Light Jets
- M_{top}=172.31±0.75(stat+JSF+bJSF) ±1.35 (Syst) GeV

ATLAS-CONF 2013-046



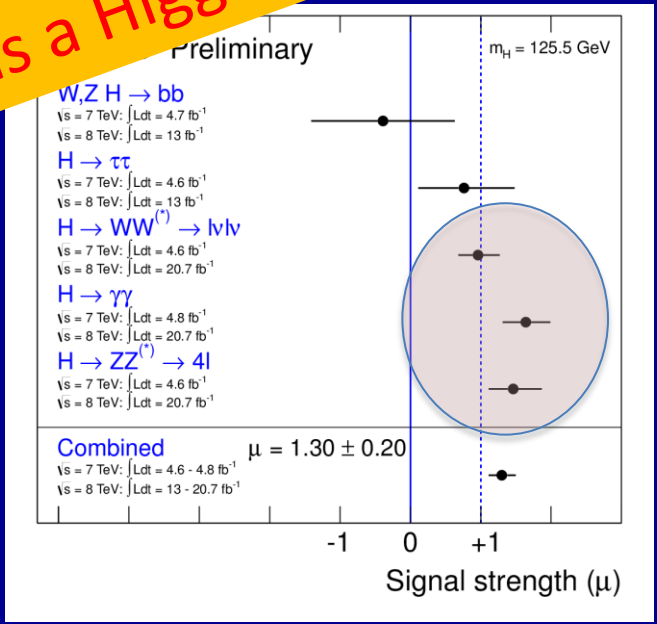
High precision tests of the Standard Model

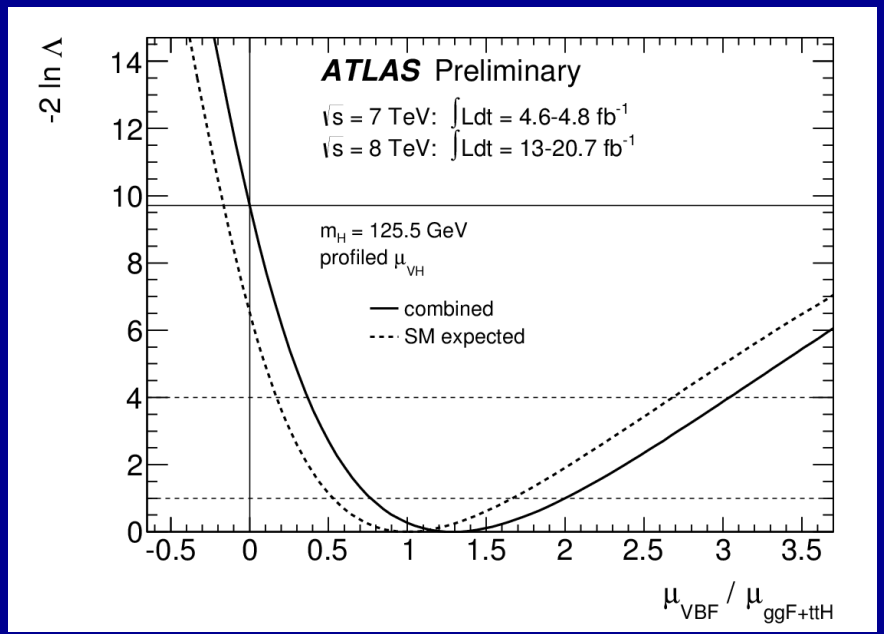


Higgs: Update on Couplings

- New combined coupling determination including:
  - H->γγ, H->ZZ* (4l) , H->WW* ->lνlν (Full 2011+2012 Data)
  - H->ττ, H->bb (Full 2011+13 fb^{-1}2012 Data)
- Combined signal strength:
  - μ= 1.30±0.13(stat) ±0.14((M_H=125.5 GeV)
- 3 σ evidence for VBF H production:
  - μ_{VBF}/μ_{ggF} -0.5

It is a Higgs, the messenger of the BEH mechanism



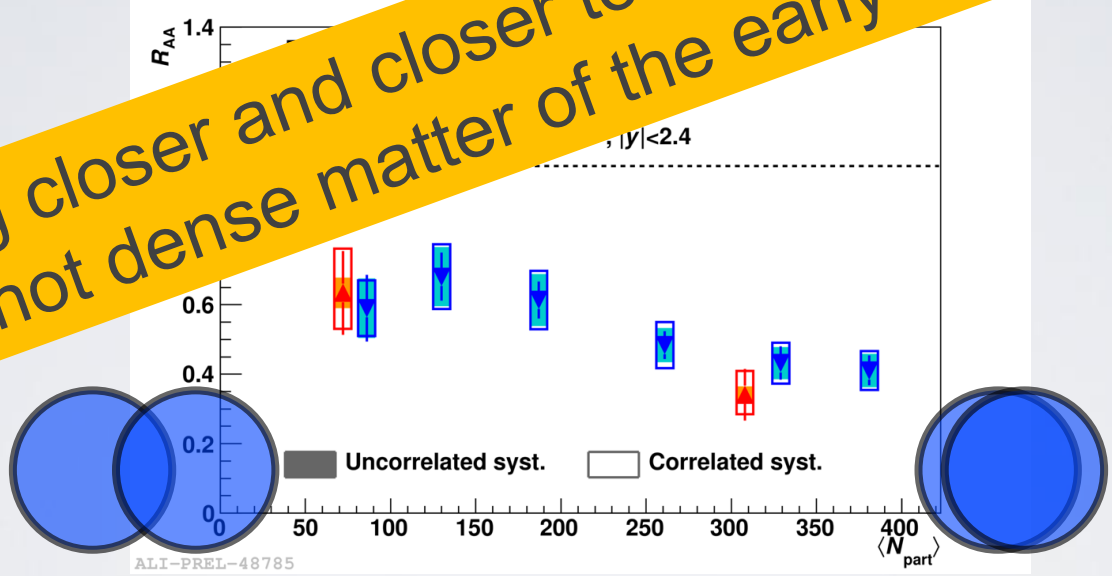


ALICE

Υ(1S) Nuclear Modification Factor

- One Signature of the QGP is the suppression of Quarkonium production.
- R_{AA} is sensitive to the transport coefficients of t… lium.

$$R_{AA}(p_T, y) = \frac{d^2N_{AA}/dydp_T}{\langle N_{coll}\rangle \cdots}$$



Coming closer and closer to an understanding of the hot dense matter of the early universe

Clear suppression below unity!
Despite different rapidity intervals, ALICE & CMS results consistent.

The Experiments during LS1

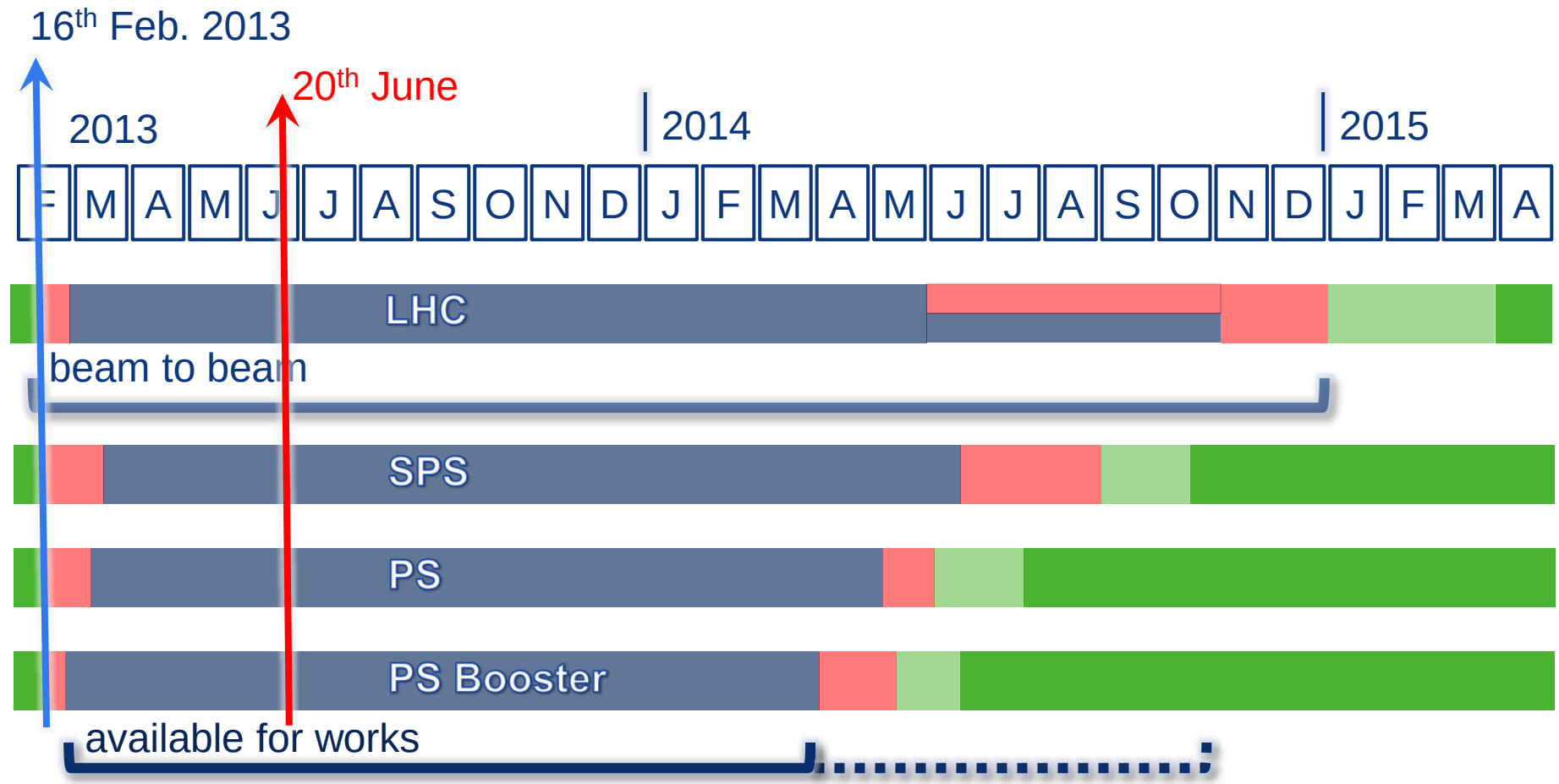
A new mode of operations!

- All busy in repairs, consolidations, first upgrades
- Massive amount of work, with a very tight schedule…
- …while keeping looking at the data, prepare for the next running period at higher energy
- …and proceed to a very substantial progress in their computing models.

It will need a massive re-commissioning, if they want to be at the same readiness level as in 2010

LS1

from 16th February 2013 to end December 2014



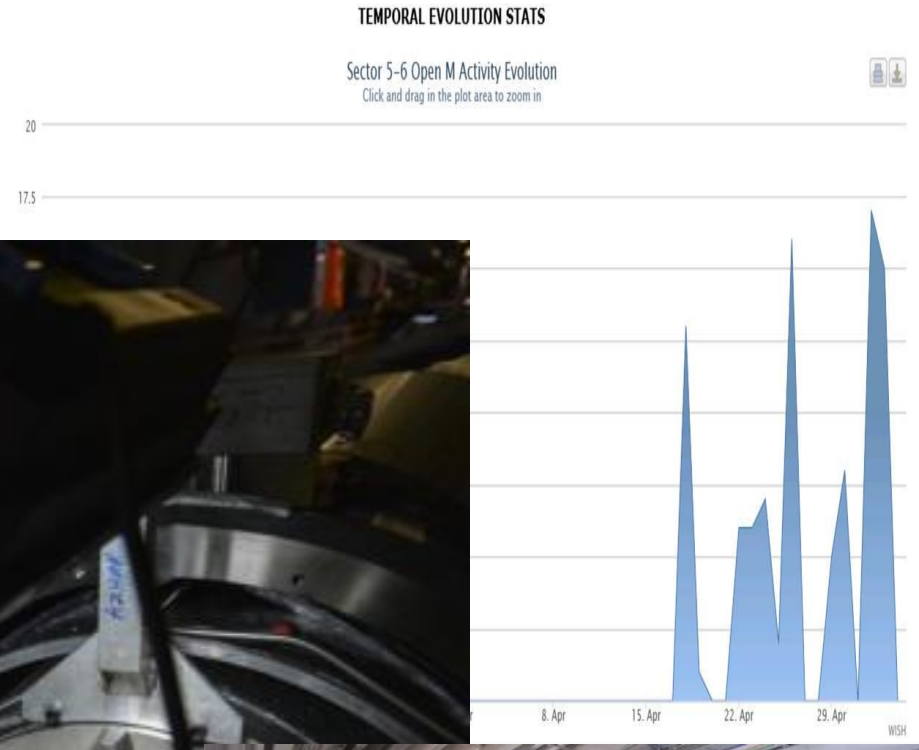
SMACC: Opening of interconnections

Collaborations with NTUA (Athens), WUT (Wroclaw) and support of JINR-DUBNA

SMACC: Opening of busbar lines

Opening of M lines started on 18.04.2013

- measurement of > 1250 splices so about 100% of S56
- Rate according to plan after 1 week of learning = 10.6 IC/day



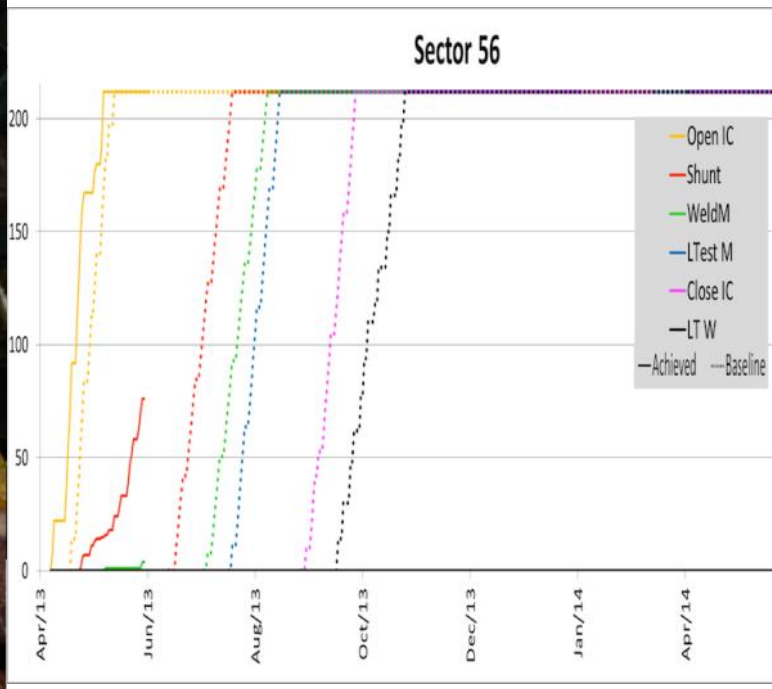
Collaborations with PAEC-NCP

(Pakistan Atomic Energy Commission – National Centre for Physics)

SMACC: Installation of shunts

First shunt soldered on 24.04.2013

- >160 IC in sector 56 (75% of one sector) are now equipped with shunts (almost 10% of the LHC, 2560 shunts)



LHC Injectors

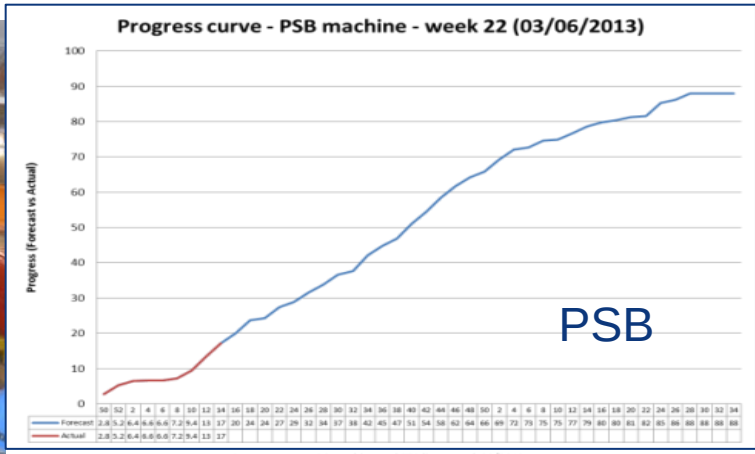
- Main activities
  - Preliminary powering tests completed
  - Full maintenance of all the equipment
  - PS Booster & PS
    - **Installation of the new access systems**
    - **Cooling and ventilation renovation**
    - **Upgrade of the RF systems**
    - Improve the **radiation shielding** over the PS and Septum 16

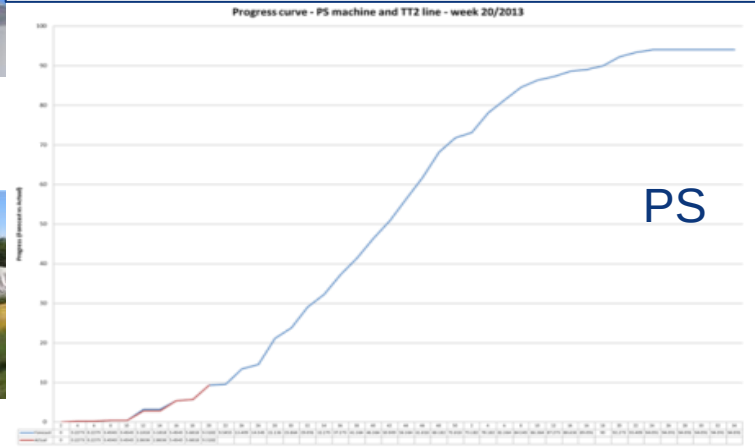
Goward road

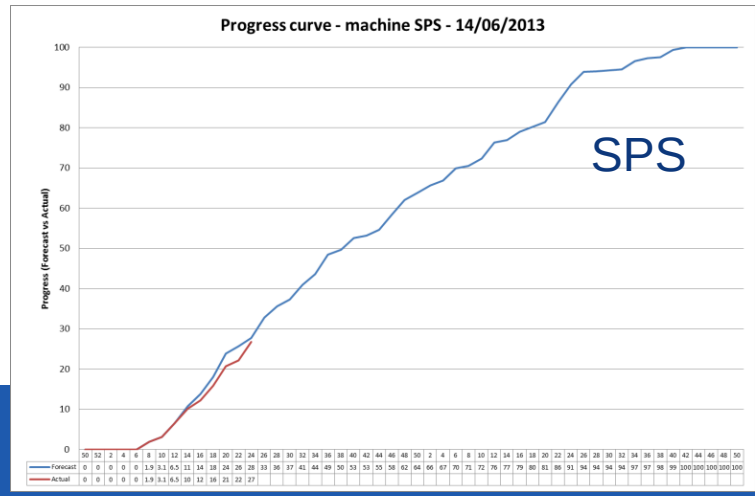
  - SPS
    - Consolidation of **18kV transformers**
    - Replacement of **irradiated cables** in BA1 and in TCC2
    - Installing new Fibres systems in BA5, BA6 and BA1
    - **New coated magnets** in BA5
    - **Major consolidation of the valves – CV**
    - Vertical realignment in BA6

Progress status

- overall progress is under schedule

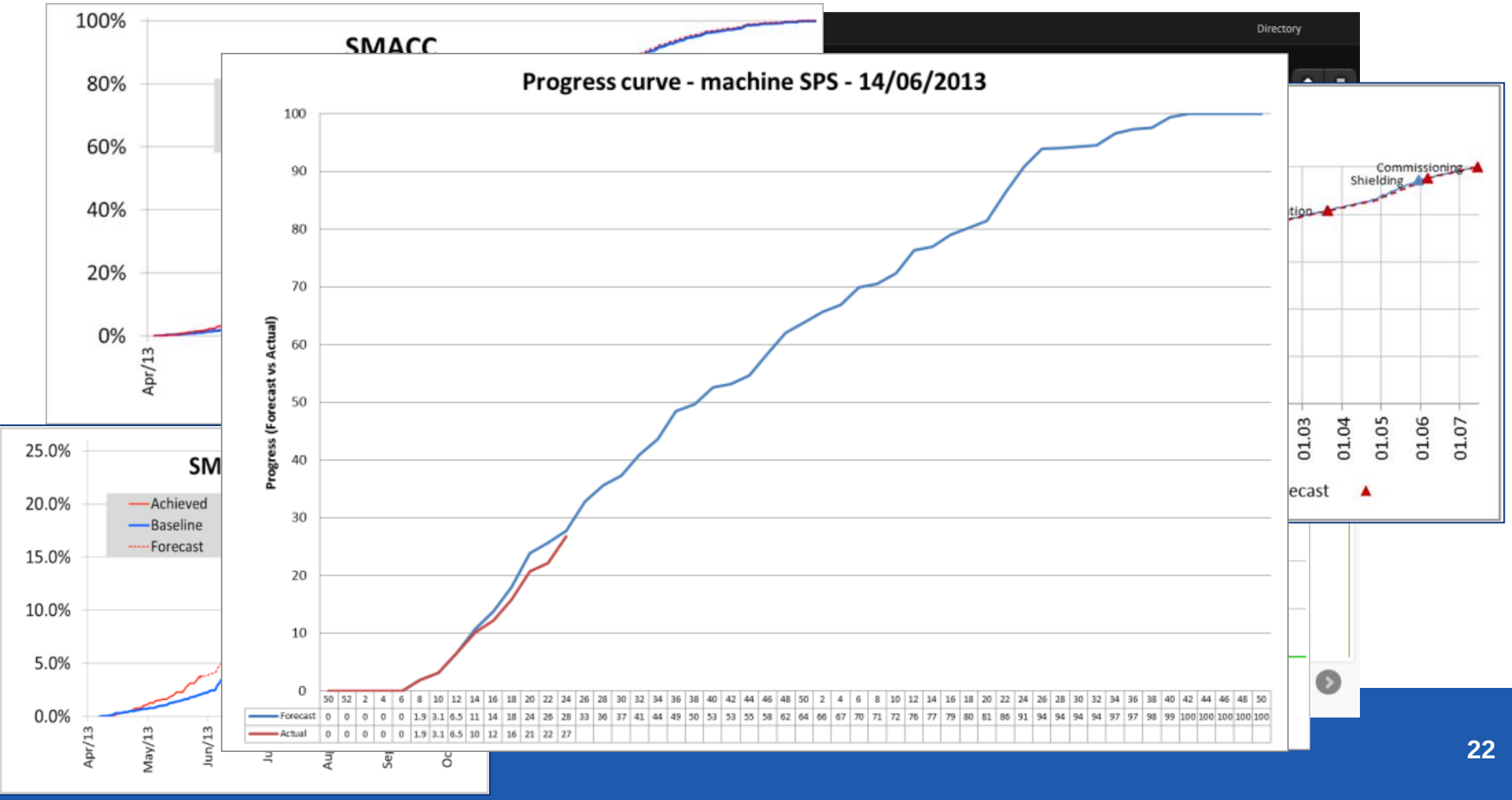


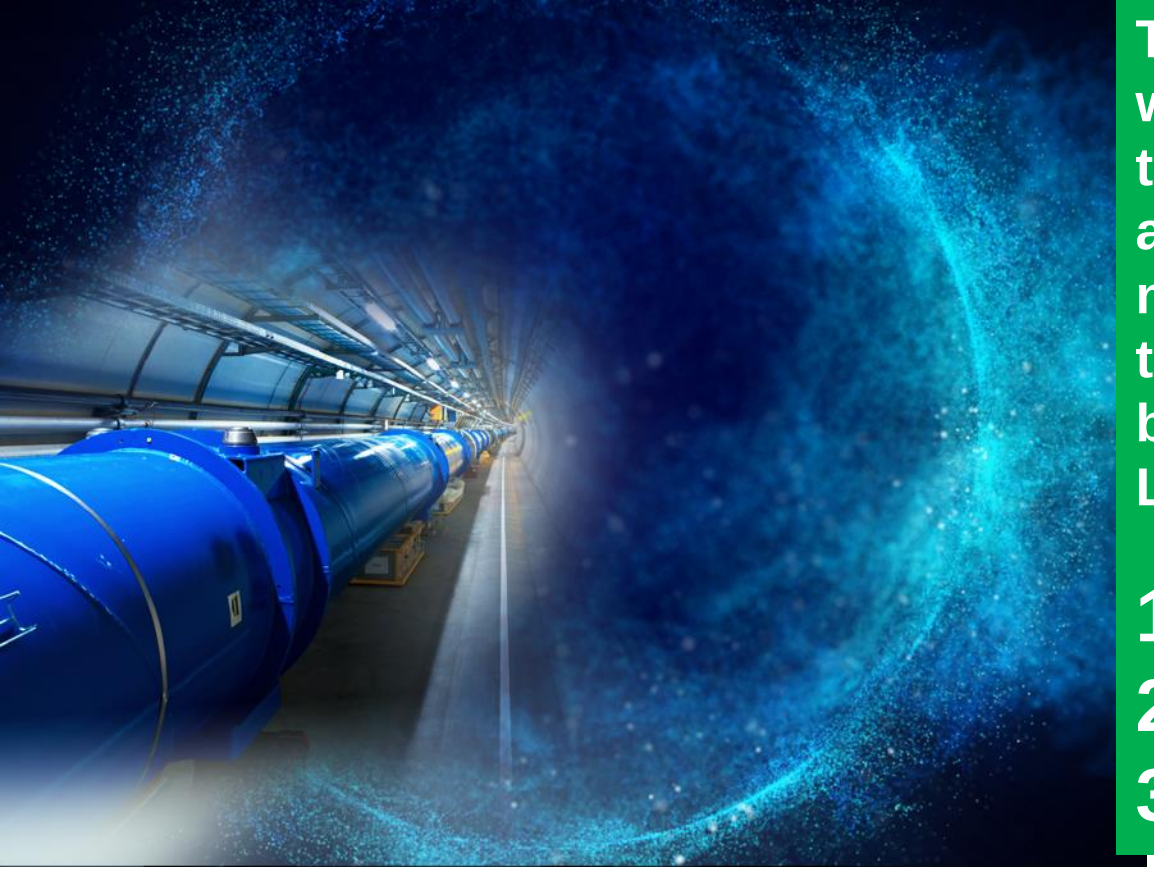




Conclusion concerning LS1

The progress of the LS1 can be followed with dashboards updated every week
http://cern.ch/ls1dashboard



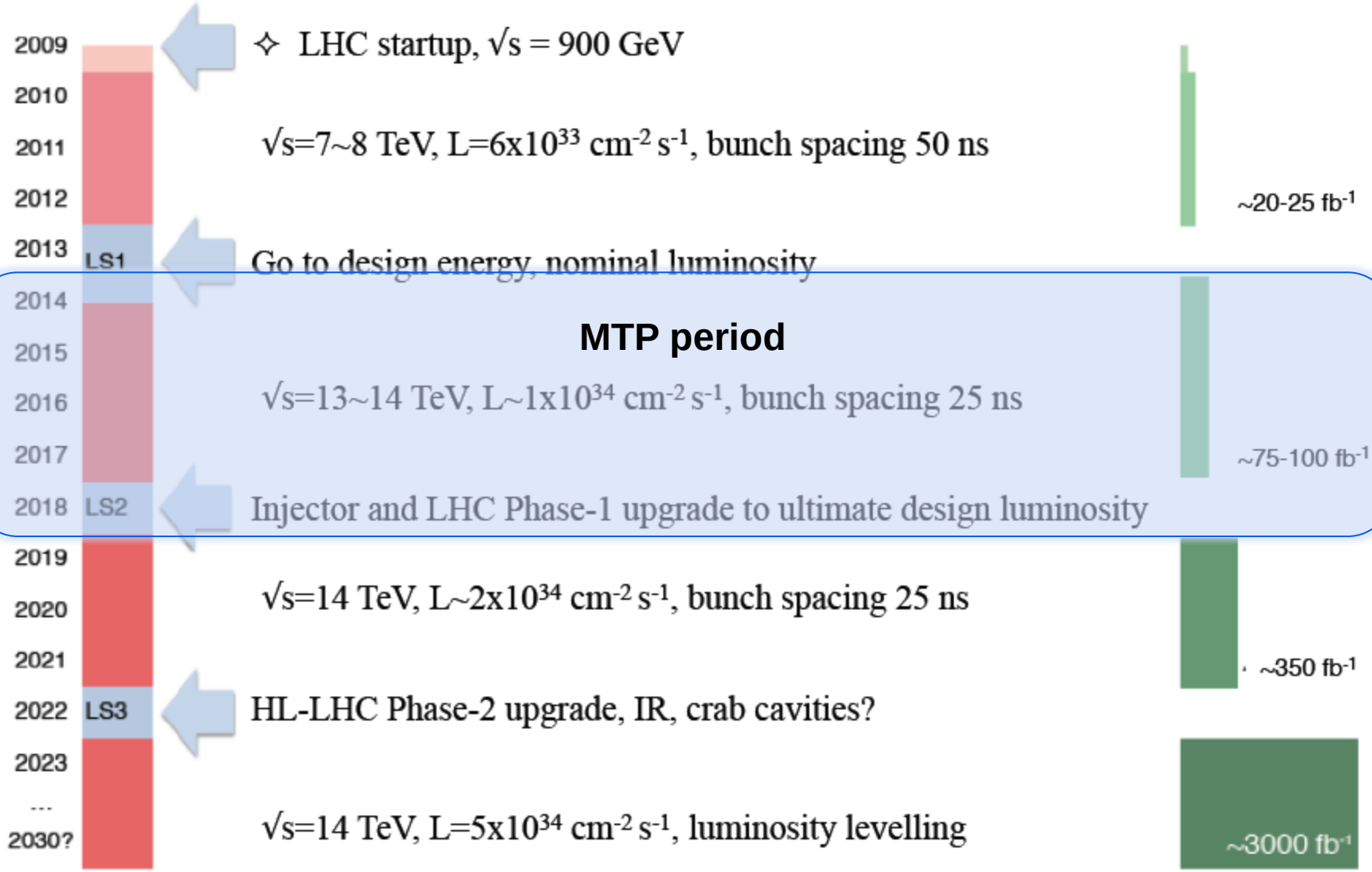


The LS1 is a marathon and will not be all plain sailing but thanks to a solid preparation and to the dedication of numerous persons, crossing the finish line should be done by end of 2014, respecting the LS1 slogan:

1st Safety
2nd Quality
3rd Schedule

Outlook

The LHC roadmap to fully exploit the physics potential



LS2 work programme

- LINAC 4 connection
- complete the PS Booster energy upgrade
- finalise the enhancement of the collimation system
- carry-out LHC detector improvements

- → overcome intensity limitations

Outlook

- **Exciting programme at the energy frontier for the next decade(s)**
- **The approval of the MTP strategy allows the first step of the implementation of the European Strategy, unanimously approved May 30th**