S. Bart Pedersen, A. Boccardi, E. Bravin, S. Mazzoni, J. Uythoven, D. Wollman, M. Zerlauth

BSRA: planned changes during LS1

Introduction

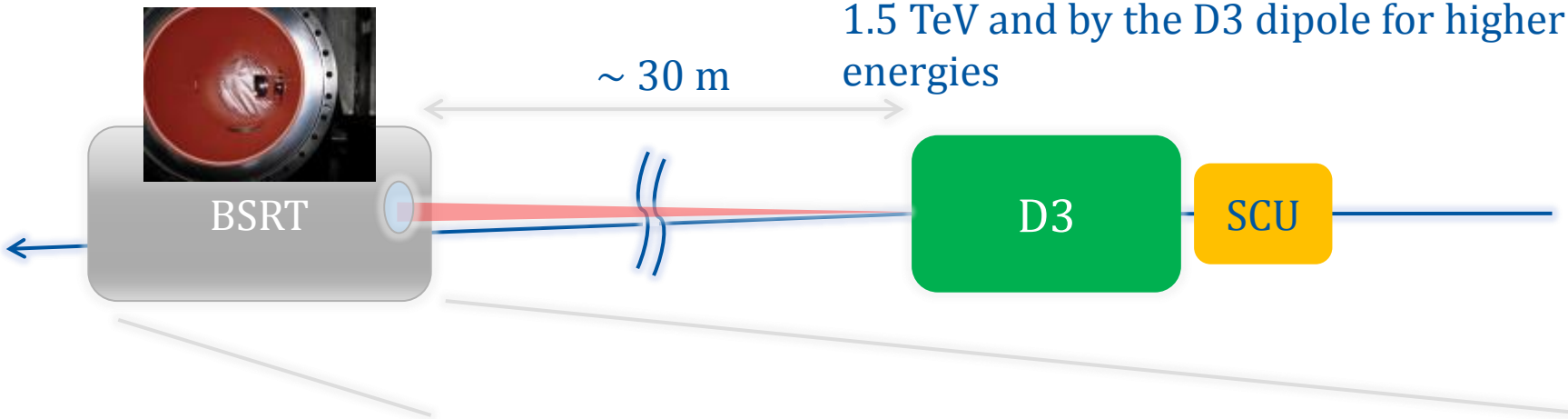
- The Beam Synchrotron Radiation Abort Gap (BSRA) monitors the intensity of synchrotron light measured over the 3us abort gap as a function of time.

- Based on a MCP-PMT, broadband light detection (~200-800 nm).

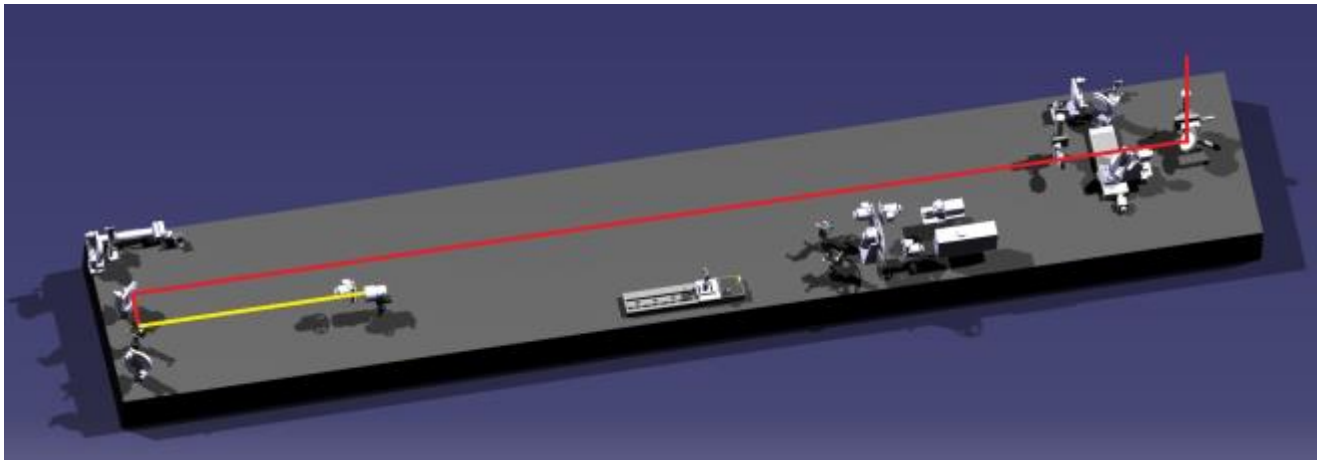
- *From a monitor to a device for controlling AG cleaning / beam dump*. Reliability need to be improved during LS1

The Beam Synchrotron Radiation Monitor

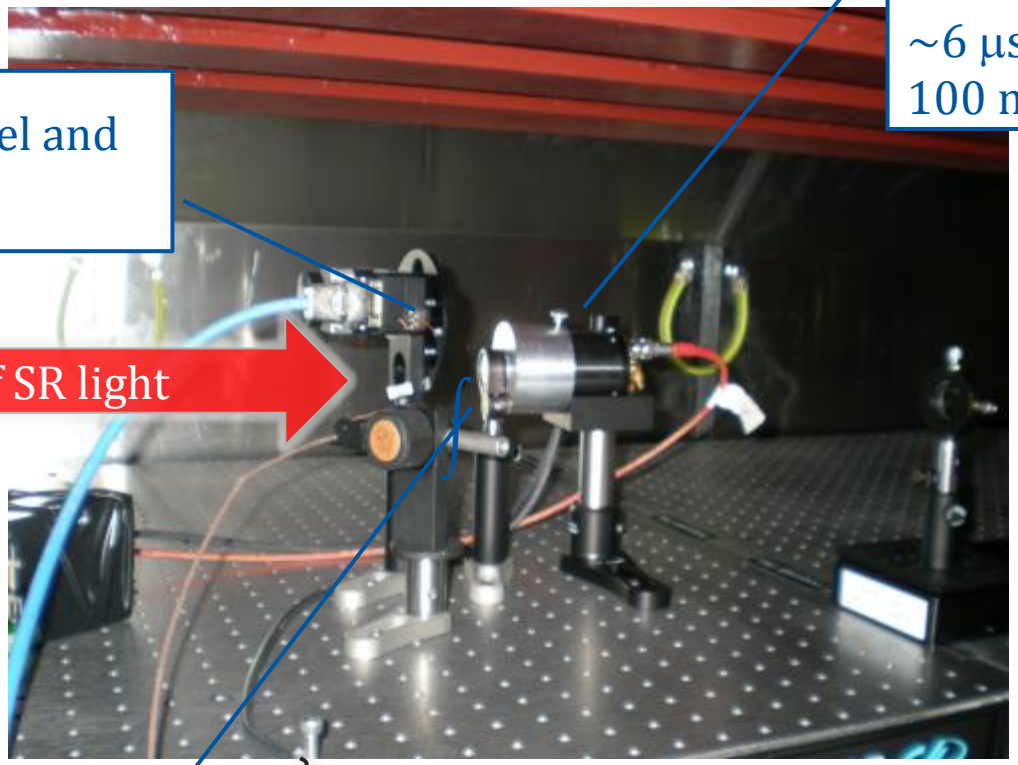
Synchrotron radiation is generated by the SC undulator up to proton energies of ~ 1.5 TeV and by the D3 dipole for higher energies



After extraction mirror, SR light is sent to beam profile instruments: BSRA, LDM, beam imaging.



LHC Abort Gap Monitor



Gated MCP-PMT, ~6 μs window, 100 ns bins

Filter wheel and diffuser

~10 % of SR light

Intermediate SR image (OptMag = 0.2)

36 dB
1.5 GHz BW

INT

ADC

Data published at 1 Hz through CMW

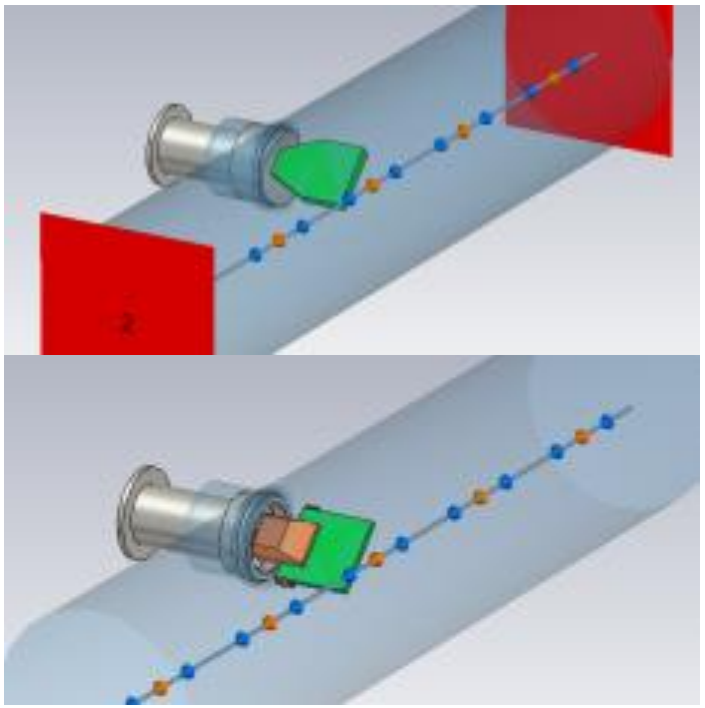
Summary of planned modifications

- Three directions:
  1. *Hardware*/system: BSRT optical line and components, improvement of installation.
  2. *Software:* better calibration procedures, management of alarms.
  3. *Automated actions:* automatic start / stop cleaning the abort gap or to dump the beam

Hardware: BSRT mirror

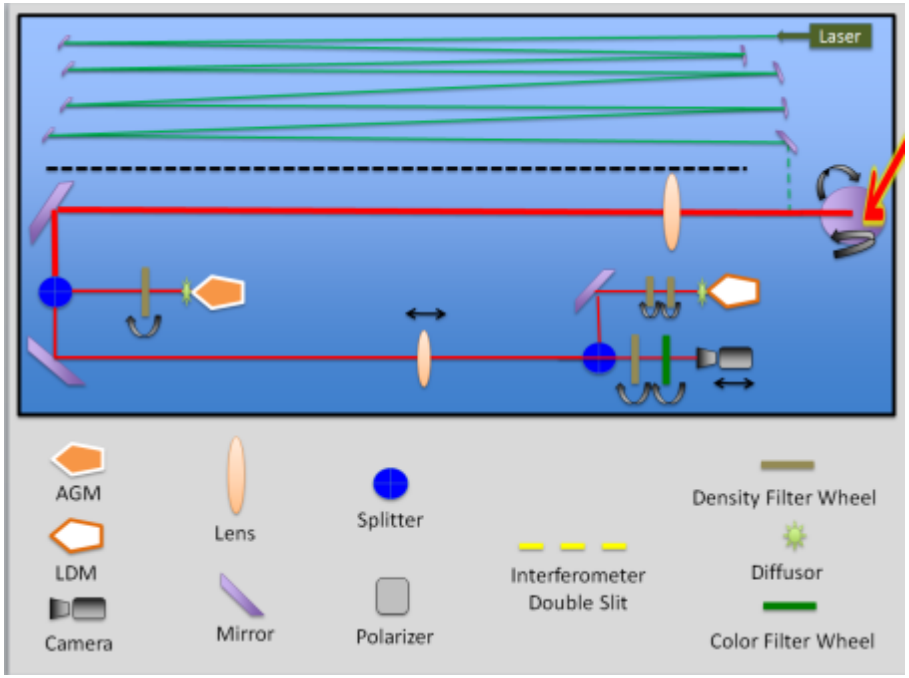
- 2011-2012: degradation of extraction mirror (both B1 and B2) due to excessive heating.

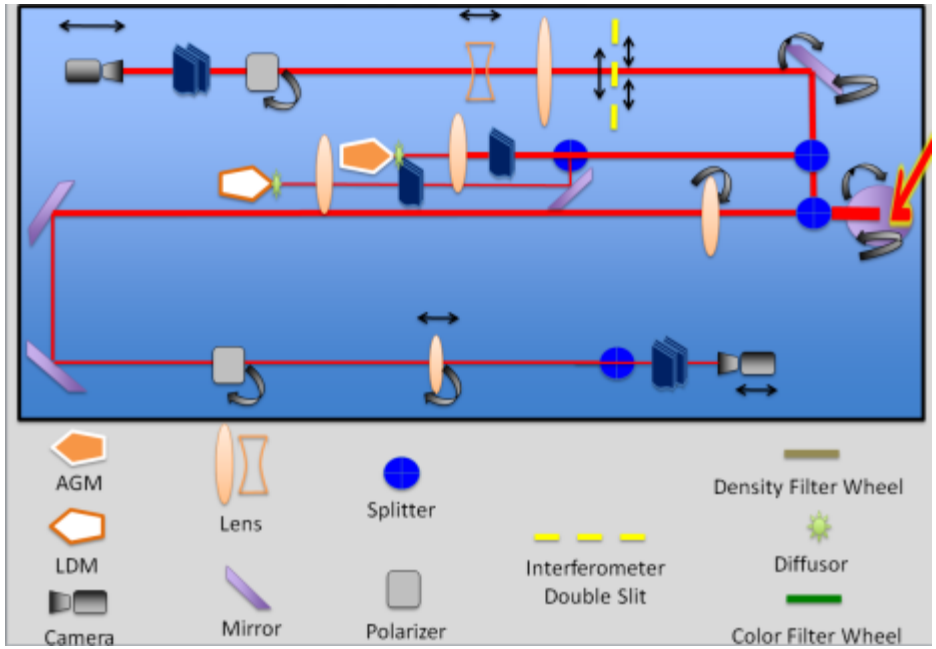
- Plan during LS1: install new extraction mirror with reduced heating due to RF coupling. Two solutions:
  - Metallic holder, longer mirror, no protruding parts (baseline)
  - Replace metallic parts with Ceramic (shapal)



Hardware: BSRT optical line

- New design of optical line for both B1 and B2. Central wavelength adapted to beam energy (350-550 nm , 250 nm).
- Principle: de-couple BSRA line from imaging.





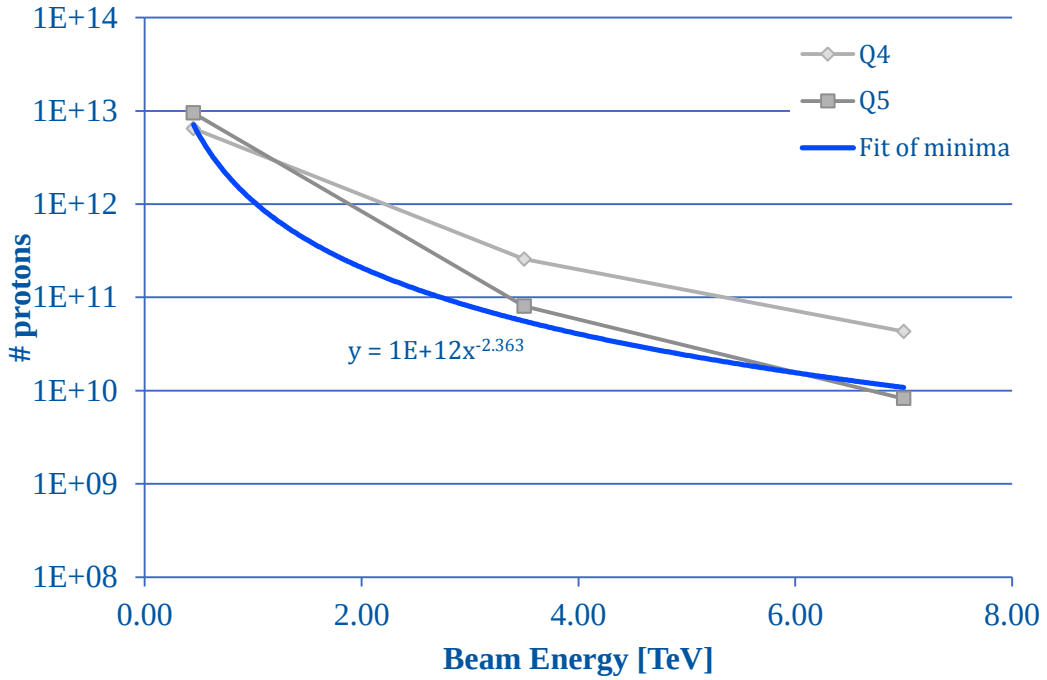
Hardware: installation

- Possible replacement of PMT amplifier with lower BW (currently 1.5 GHz).

- Improvement of installation: grounding, cable shielding, power supplies …

Software: new quench limits

- New quench limit estimates of Q4 and Q5 (behind TCDQ) based on FLUKA simulations with new TCDQ (see pres by G. Steele) and QP3 simulations by B. Auchmann and A. Verweij



AG population to reach expected quench level

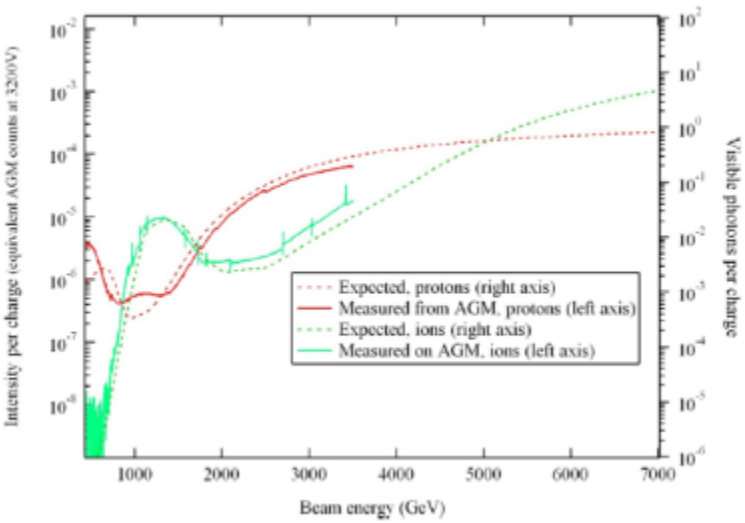
Software: thresholds

- Automated actions based on BSRA reading:
- New thresholds:
  - Warning (0.1 x quench) > start cleaning
  - Dump (2 x quench) > beam dump
  - No dump (20 x quench) > better no to dump (In principle damage limit Q4 and Q5 never to be reached with beam intensities foreseen for HL-LHC)
- (Previously: single threshold alarm, no automated actions)
- Target: include BSRA “dump” flag in Beam Interlock System and have automatic start of cleaning.

All values TBC

Software: thresholds (cont)

- *Range* (warning-no dump threshold) is 200 > within PMT dynamic range (typ 10^3) BUT below ADC effective range (typ 60)
- *Noise level.* SR power increase compensates lower warning threshold at high E > always above noise (problems at 1-2 TeV)



SRW simul. by A. Jeff

- Min values measured last year:
  - $6x10^{10}$ p+ at 750 GeV (th: ~10^{11})
  - 10^8 p+ at 3.5 TeV (th: $5x10^9$)

Software : calibration

- Calibration/system status monitoring to be included in the sequencer (every machine cycle):
  1. Gain vs voltage calibration: either during setup or rampdown, no beam needed.
  2. Calibration w FBCT: with pilot beam at injection
- Calibration shall be performed at regular intervals to ensure system integrity
- Actions in case of anomalies still to be discussed in detail

Outlook

- Eng. Spec. document ‘Calibration procedures and automated actions for the Abort Gap Monitors of LHC’ will be finalised soon and circulated for comments.
- Hardware: BSRT optical line: first half of 2014
- Software: second half of 2014
- Ready for testing during commissioning: end 2014