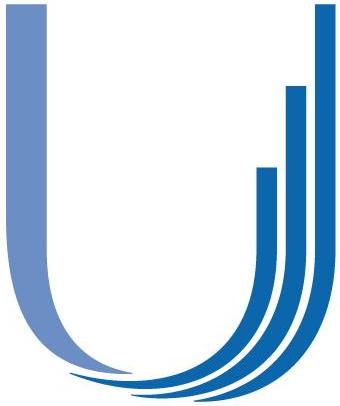


LHC Injectors Upgrade

LHC Injectors Upgrade

Injector Wire Scanner project

CERN

Specifications

Functional Specification

(EDMS n. 772786) 2006 not released

MEASUREMENT OF THE TRANSVERSE BEAM DISTRIBUTION IN THE LHC INJECTORS

5.1.3.1 PROFILE MONITOR FOR EMITTANCE COMPARISON AND CALIBRATION

The main use of the circulating beam profile monitors is to provide accurate profile measurements to determine accurately the beam emittance for comparison purposes between different machines to detect possible blow-up during extraction and/or injection.

The required accuracy in the beam size measurement is of few percents if accuracies in the range of 5% have to be achieved for the emittance measurement as required for the LHC proton and ion beams with nominal intensity. This level of accuracy requires a very good measurement of the optics properties at the beam profile monitor which might demand the

Specification

Accuracy 5 % on emittance

=> 3.5% from beam size and 3.5 % from beta uncertainly

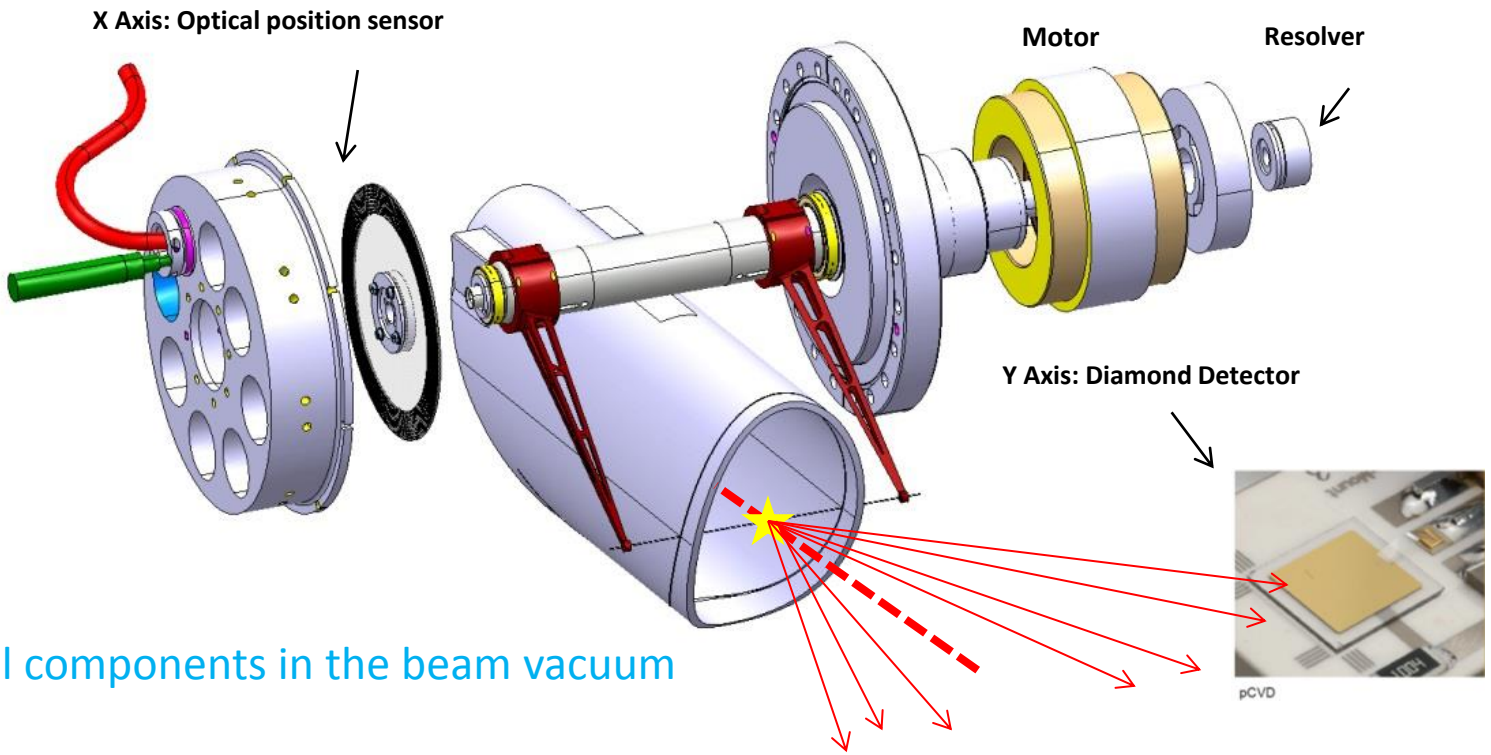
=> 1.8 % beam size accuracy

An updated and more detailed specification for the injectors is planed to be followed up by BI

Design Remarks

- Absolute accuracy of scanner wire position with few micrometer
- Overcome bellow limitations:
  - Low lifetime
- Large dynamic range for secondary particle detection
  - => Usage of sensor with large dynamic (diamond)
    => Automatic electronic switching of gain ranges (**range dynamic 1E4**), subject of PhD thesis
- Optimization of wire, detector position and shielding with aim to increase measurement accuracy, PhD thesis
- Increase MTBF compared with existing systems
  - Minimisation of complexity
  - Separate critical and non-critical functions
  - Early failure detection

Proposed Technology

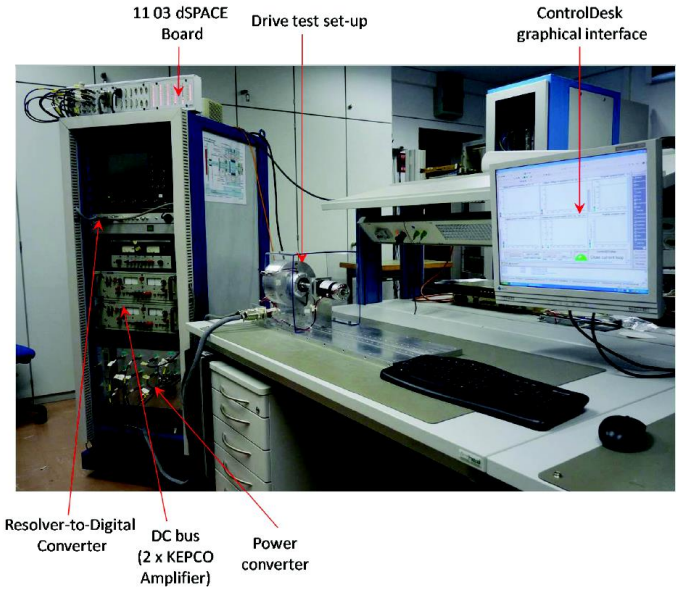


All components in the beam vacuum

- Does it meet all specifications?
  - The design is made to fit the specifications
  - Design review in April indorsed the new principle and shares the expectation of the performance increase

Status of Development

- Lab prototype is under preparation and first parts have been received.
  - Assembly test will start in the next weeks
  - Test bench setup will be prepared for functional test with laboratory feedback controller
  - Impedance measurements in December when vacuum tank available to verify simulations
  - Presently mode damping is based on the usage of ferrites
  - Lab motor control optimisation with development system
- SPS prototype construction needs to be started in January
- Feedback controller in design phase
- Acquisition system in design phase (PhD)



Rapid control prototyping of mathematical model (Simulink)

Installation and Commissioning Plan

- SPS prototype will be used for the validation of the new scanner concept
- Foreseen commissioning phase 2014 and 2015
- LS2 requests: installation the new wire scanner system in the BOOSTER, PS and in the SPS
  - BOOSTER:
    - 8 scanners + 2 spare
    - scanner integration study is foreseen for Q1 2014, depending of outcome more defined estimate of required resources are possible
  - PS
    - 5 scanners + 1 spare
    - Same design as in the SPS (difference fork dimensions, vacuum tube)
  - SPS:
    - 4 scanners + 1 spare
    - Tested design
  - Possible conflict depending on BOOSTER requirements for design and test efforts

- Its is strongly indorsed by the review to keep one design for all machines

Installation and Commissioning Plan, continuation

- Priority SPS - PS - BOOSTER
  - SPS installed scanners are limited by maximum intensity and resolution
    - Intensity limit given by the RF modes building up in the tank and beam heating, RF studies are ongoing
    - Position resolution limit for width determination (# samples / sigma)
  - BOOSTER and PS installed scanners are limited by accuracy and speed
    - Design follow-up (if new for BOOSTER), construction follow-up, test and calibration, installation, commissioning
- The installation of 17 scanners in LS2 is not excluded yet (present scanners (some) parallel operation)
- LS1: bunch by bunch acquisition foreseen to be tested and commission during the PS start up phase

Priority setting only possible if BOOSTER efforts are knows

Budgetary Requirements

- Budgets:

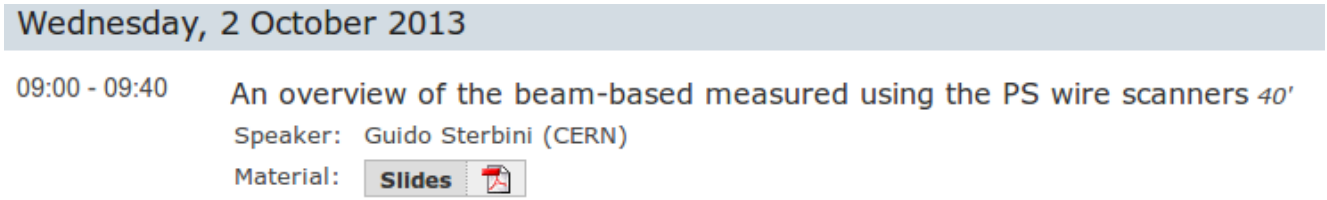
	2013	2014	2015	2016	2017	2018	total
Design (2)	256	180					436
PSB (8+2)		60	100	500	200	110	970
PS (5+1)		125	125	125	125		500
SPS (4+1)		50	300	200	50		650

  - Design budget: allocated 323

- Uncertainties are given by the BOOSTER requirements and final cost for a design. Presently we predict an increase by 25 %

Determination of Scanner Accuracies with Beam

- Establishment of Emittance working group
  - Aim:
    - Establishment of forum for expert
    - Establish common estimators, language and procedures
      - Optimise cross accelerator emittance comparisons
    - Promote synergy effects
      - Software, data bases, ...
  - First meeting 12.09.2012
  - Actually meeting all 4 weeks

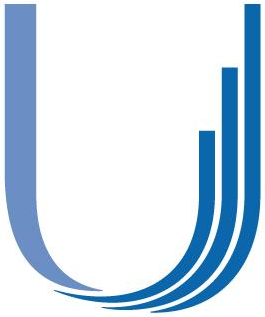

Wednesday, 2 October 2013

09:00 - 09:40 An overview of the beam-based measured using the PS wire scanners *40'*

Speaker: Guido Sterbini (CERN)

Material: Slides

http://indico.cern.ch/categoryDisplay.py?categId=2341



LHC Injectors Upgrade

THANK YOU FOR YOUR ATTENTION!