BGC Planning for v3 and v4

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v3 in the Laboratory Building 8 and on EBTS

- Change from CI vacuum system to LHC compatible vacuum system
  - Objective: September 2022.
- Operate BGC with gas curtain on EBTS
  - Objective: September 2022.

- Open question: Operation of BGC on EBTS with CI or LHC compatible vacuum system

v3 Tunnel operation with distributed gas

- Ready
- Operation in 2022 (and 2023?)

v3 Phase 2 tunnel operation with gas curtain

- Objective: Installation in CERN Year End Technical Stop (YETS) 2022/23
  - A lot of work on the way
  - Stay optimistic

v4 Timeline

- 2022: Mechanical and vacuum engineering
- 2023: Design and preparation of manufacture
- 2024: Manufacture and test
- 2025: Ready for LHC installation

Thank you !

Questions?

Extra Slides

- Signal is defined as the total intensity in the highest amplitude region of the background subtracted final image corresponding to an area of 0.1 mm^2 in the source plane. Noise is defined as the standard deviation of the intensity in regions without signal in the final image corresponding an area of 0.1 mm^2 in the source plane.

- This value is calculated by scaling the intensity and beam size of the electron beam used to qualify the performance at the Cockcroft Institute, and taking into account the relative difference in expected proton/ electron fluorescence cross section.

Collaboration Contract is the Basis

- Delivery of Gas-Curtain Beam Profile Monitors (BGC) for HL-LHC (Task 2); Collaboration contract between CERN, the Cockcroft Institute and Liverpool University
  - CERN EDMS document No. 2369616 LHC-BGC-ES-0001

Design Performance criteria V4

The instrument shall be designed to:

- determine the beam centroid of a nominal intensity and emittance HL-LHC proton beam at 7 TeV to better than 100 μm within a fixed, 2D image plane in less than 10 seconds
- simultaneously produce the 2D image of a hollow electron beam, with the nominal operating parameters of 15keV, 5A an inner/outer beam diameter of 4/9 mm, in the same frame of reference as the proton beam image, within 1 second.
- cope with an orbit variation of $\pm$ 4 mm in either transverse dimension away from the central axis of the device.

Reference Parameters V4

Reference parameters for nominal HL-LHC proton and electron beams

Particle Type	Energy (eV)	Current (A)	Size (mm)	Distribution
Electron	15×10^{3}	5	ID: 4 OD: 9	Quasi - uniform
Proton	7×10^{12}	1.1	s : 0.37	Gaussian

Key Performance Criteria V4

Criterion	Units	Value
Minimum gas density in the curtain	$mol.m^{-3}$	$2x10^{16}$
Minimum transverse curtain dimension	mm	20
Variation in transverse density over the central 10mm of the gas curtain	%	20
Maximum deviation from the central transverse density at ± 10mm from the gas curtain centre	%	50
Maximum through-thickness curtain dimension	mm	1.5
Maximum residual gas pressure in the interaction chamber, 24h after a 24h bakeout at 250 °C and pumping with nominal system and beam aperture blanked-off.	mbar	$1x10^{-9}$
Signal to noise ratio* of the image area corresponding to 0.1 mm^2 at the source plane for the highest intensity signal region of a nominal proton beam as measured at the imaging plane in 10 seconds*.	Ratio	10

* See Extra Slides for detailed definition

Target Performance Criteria V4

Criterion	Units	Value
Gas density in the curtain	$mol.m^{-3}$	$1x10^{17}$
Transverse curtain dimension	mm	40
Variation in transverse density over the central 20mm of the gas curtain	%	10
Maximum deviation from the central transverse density at ± 20mm from the gas curtain centre	%	30
Through-thickness curtain dimension	mm	0.5
Maximum residual gas pressure in the interaction chamber, 24h after a 24h bakeout at 250 °C and pumping with nominal system and beam aperture blanked-off.	mbar	$1x10^{-9}$
Signal to noise ratio of the image area corresponding to 0.1 mm^2 at the source plane for the highest intensity signal region of a nominal proton beam as measured at the imaging plane in 10 seconds.	Ratio	100

Timeline V4: UK Deliverables

Deliverable Number	Deliverable Description	Type
D3.2.1	Get-jet monitor engineering design: report that shows proposed design fits specification and can be built	Document
D3.2.2	Final design: report with final drawing, integration, costs production and commissioning plan	Document
D3.2.3	Delivery of interaction chambers for integration in Hollow Electron Lens build-up	Hardware
D3.2.4	Delivery of gas-curtain monitor unit 1, pre-tested at the Cockcroft Institute, for integration in Hollow Electron Lens and testing, participation in commissioning tests	Hardware
D3.2.5	Delivery of gas-curtain monitor unit 2 for integration at CERN, pre-tested at the Cockcroft Institute	Hardware

Timeline V4: CERN Deliverables

Deliverable Number	Deliverable Description	Type
DC.1	Integration Drawings	Document
DC.2	Nozzle manufacturing • Flat-divergent nozzles for units 1 and 2	Hardware
DC.3	Compliance of the Cockcroft Institute design to 2 T stray magnetic fields	Document
DC.4	Vacuum valves required for HL-LHC operation	Hardware
DC.5	HL-LHC Infrastructure: • Off-instrument cabling • Any electronics not forming part of the instrument • Gas lines and bottles for LHC integration • LHC vacuum control hardware and software • LHC operational software	Hardware