BGC on the HEL test stand (EBTS)

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HL-LHC BGC Collaboration meeting, December 2020

Significance of the EBTS programme for the BGC

- This will be the only opportunity to test the BGC before the final design is frozen:
  - …with a high intensity electron beam, approaching nominal HEL
    - Scale-up from 0.7mA at CI to 5A for the final instrument!
  - …in an environment with ‘strong’ solenoid magnets on both sides of the instrument
- This will also be the opportunity to validate the whole instrument at CERN before installation in the LHC
  - Demonstrate the safe (to machine) operation of the vacuum control system and interlocks
    - VSC ‘buy-in’ is essential
  - Learn how to operate this instrument at CERN and how to acquire data
    - Team work (plus documentation) from CERN (BGC+HEL+VSC), CI, and GSI are key here

A word on working gas choice and the EBTS

- We chose Ne as our ‘baseline’ gas, based on:
  - Good emission in a wavelength that is efficient for optical systems and short emission decay time, improving resolution
  - The target wavelength is emitted from a neutral atom, so should not be subject to distortion in the magnetic field
  - Not pumped by NEG, so will not saturate local NEG surfaces
- However,
  - We have simulations, but need to confirm how significant this distortion effect will be in practice, or if it can easily be compensated
  - We don’t know if we can reliably operate turbo-molecular pumps in the magnet stray field and other (entrapment) pumps such as Sputter-ion or NEG cartridge do not pump Ne
  - The fact that Ne is not NEGed means that gas which we do not capture in our system may end-up pumped on nearby cryomagnets, so it is not clear if this is a ‘feature’ or a ‘bug’…
- We need to answer these questions in the EBTS and stay flexible for possible changes
  - We still have the option to use N2 as a working gas, which would solve these issues, but perhaps with some impact on performance (+ve and –ve)

Limitations of the EBTS programme for the BGC

- Although the peak intensity is high, the duty factor for the e-beam will be low
  - We will need to understand how to gate, pulse or integrate the BGC to account for this
- The e-gun will be 'in-line' with the vacuum chamber (not offset as in the final instrument)
  - The light background will be different and possibly much higher than in the final device, so we need to find a way around this
- The magnetic field will be lower than in the final device
  - The performance effect on pumps and distortion of signal may not be the same, so we need to extrapolate/interpret results
  - The e-beam will be larger (??)

Required tests

Description	Estimated Duration (d)	Operational requirements	Personnel / comments
Validation of the instrument			
General operational tests and optimization for the environment	10	Passive	Operator, CI expert,
Testing of the CERN control system	10	Passive	Operator, VSC, CI expert,
Field mapping of the HEL stray field	2	Dedicated	Technician, Engineer,
Operating modes with the pulsed e- beam (gas pulsing?)	5	Dedicated	Operator, CI expert
SR background from the e-gun	5	Passive	Operator, physicist, GSI,
Gas transport in the HEL vacuum system	5	Dedicated	VSC,
Vacuum system performance in the stray magnetic fields	3	Passive	Engineer, VSC,
Electron-specific tests			
Estimation of fluorescence cross-section for e-	5	Dedicated	Physicist, GSI, CI expert
Electron trapping study	5	Dedicated	Experiment design needed
Ionised gas transport in the HEL?	3	Dedicated	Experiment design needed
Neutral and ionized emission lines (N vs. Ne), effect of distortion or focussing	10	Passive	GSI, physicist, CI expert
Design improvement tests			
Possible improvements to SR background	15	Dedicated	Marton, physicist, engineer, technician
Using N2 and NEG cartridges	15	Passive	VSC, engineer, operator, CI expert,

Project management aspects

- Preparing and testing the BGC on the EBTS is clearly a PROJECT
  - It needs a ‘project manager’ and a ‘team’ with clear roles
    - This would be specifically for the BGC and would interface with the EPTS team
- Preparation phase
  - Follow-up of instrument integration and delivery
    - Space, additional supports, racks etc
  - Define and organize the necessary logistics and infrastructure
    - Cables, services, computing and acquisition hardware etc.
  - Associated documentation
    - Schedule, safety requirements, manpower plan etc
- Implementation phase
  - Agree how long we need and when with the EBTS team
  - Prepare a manpower plan for who is at CERN and when
  - Agree what we want to document and how we do it

Summary

- BGC v3 is currently planned to be ready for installation on the EBTS in May 2021
- We have (just) moved to a baseline installation of the BGC v3 in the LHC end 2022
  - This leaves ~18 months for this programme
- We need to nominate a project manager and a team to make sure that this happens…

End

Backup slides follow

Draft milestones for the v3 instrument from CI

- Assemble the system and vacuum test without baking. Dec 2020.
- Gas jet quantification. Jan 2021.
- Measurement of Lab electron beam. Feb 2021.
- Report the device and preparing to ship. March 2021.
- Devices arrived at CERN and installed to HEL test stand. May 2021