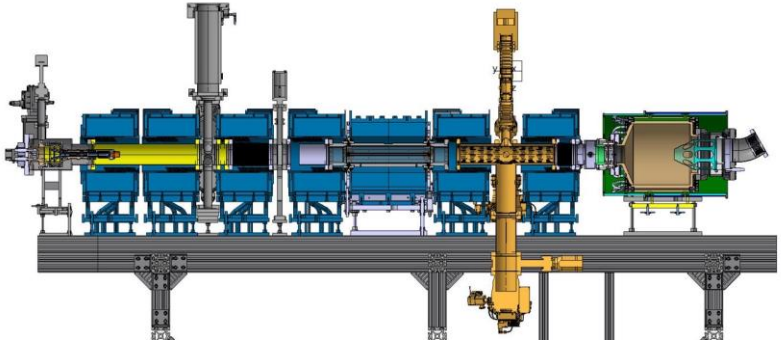
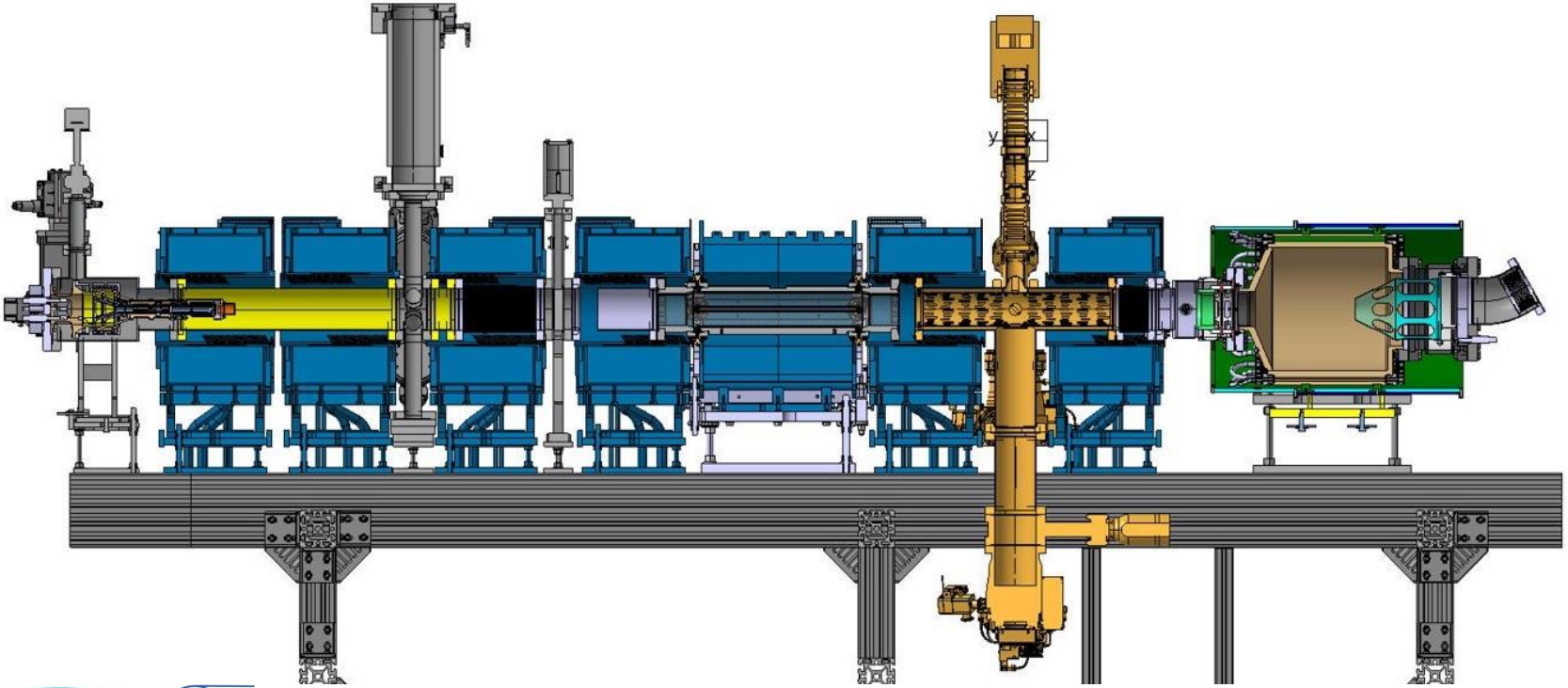


Status of EBTS and Plans for 2024-2025

A. Rossi,
work by M. Sameed, M. Ady, C. Castro, O. Stringer, H. Zhang, …

12 December 2023 @ BGC Collaboration Meeting

Electron Beam Test Stand (EBTS)
Quick Recap



S. Sadovich, A. Kolehmainen

Outline

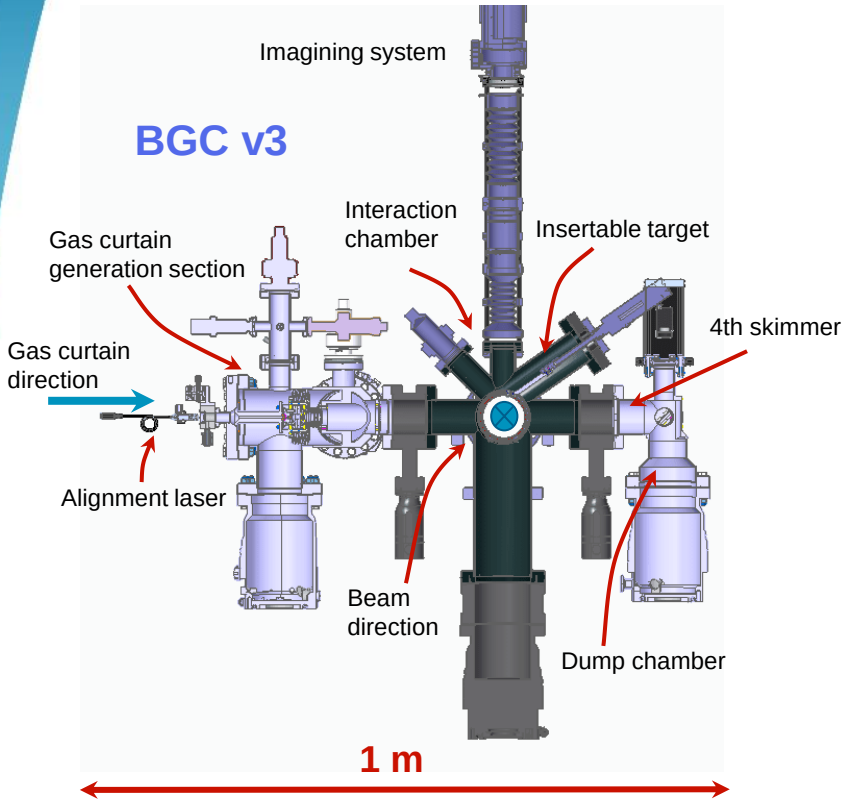
- Status of Future BGC on EBTS
  - Final Design and Integration
- Status of HEL Collector
  - Fabrication, Assembly and Installation
- Summary

BGC v4.1 Requirements

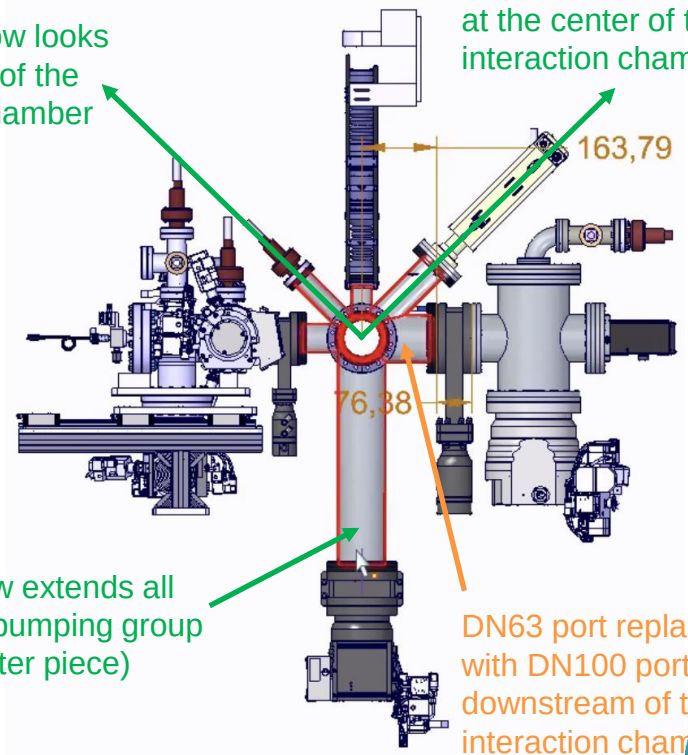
1. **Gas**
   - Ability to operate with all **three gases** (N2, Ne, Ar)
   - Provision of appropriate gas bottles and pneumatic equipment
2. **Gas jet**
   - Gas jet density same as v3 instrument (**10^{16} m^{-3}**) or larger
   - Curtain length to be able to see the beam with 40 mm OD (so **60 mm curtain at 45 degrees**).
   - Curtain width same as v3 instrument (**0.5 mm**) or smaller –
   - Curtain variation same as v3 instrument (5%) or less
   - IC background pressure same as v3 instrument (**10^{-7} mbar**) or less
   - Replaceable/adjustable skimmer 3.
3. **Image Acquisition**
   - Provision of laser + camera for alignment and target/grid for camera focusing
   - Provision of optics, image intensifier(s), filter(s), and camera(s), for 3 gases + BTV
   - **Addition of BTV on the DN63 port** (design can be done by CERN)
4. **Performance Evaluation**
   - Maximum **1 s integration** for electron beam of **10 keV, 5 A, 40 mm** diameter
   - Aiming for **100 µm image resolution** at the above parameters

BGC Design @EBTS

BGC v3



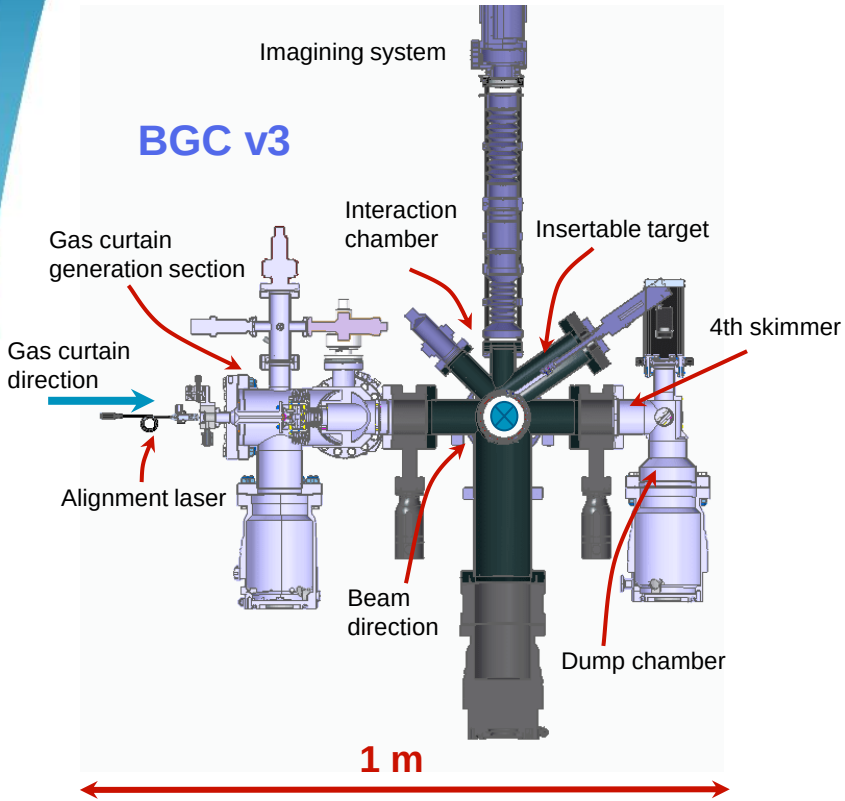
BGC v4.1



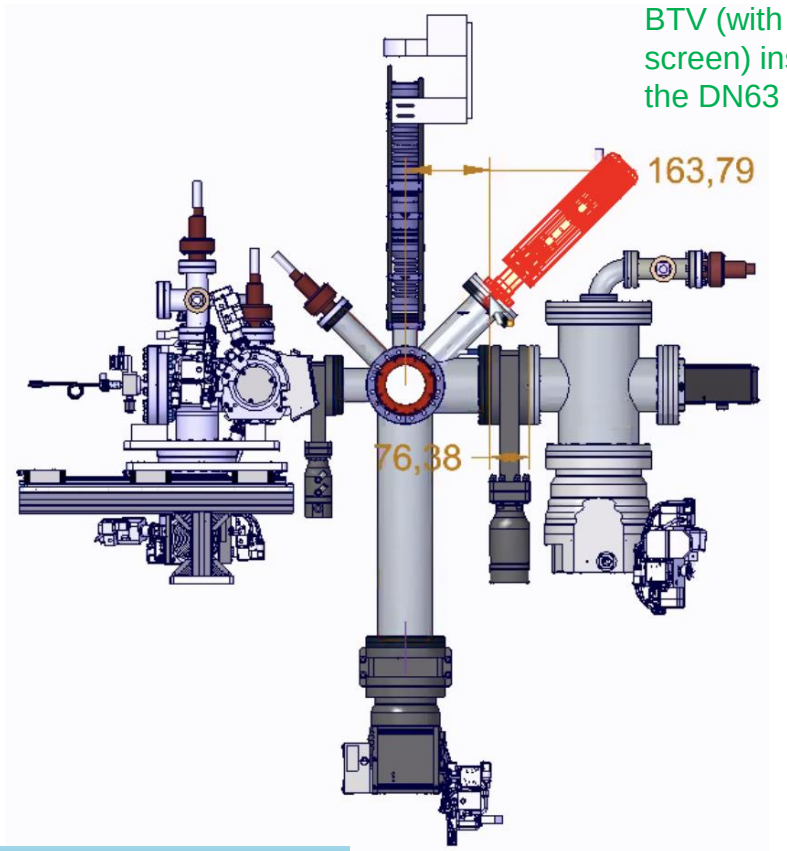
M. Ady, O. Sedlacek, C. Castro Sequiero, O. Stringer, H. Zhang

BGC Design @EBTS

BGC v3



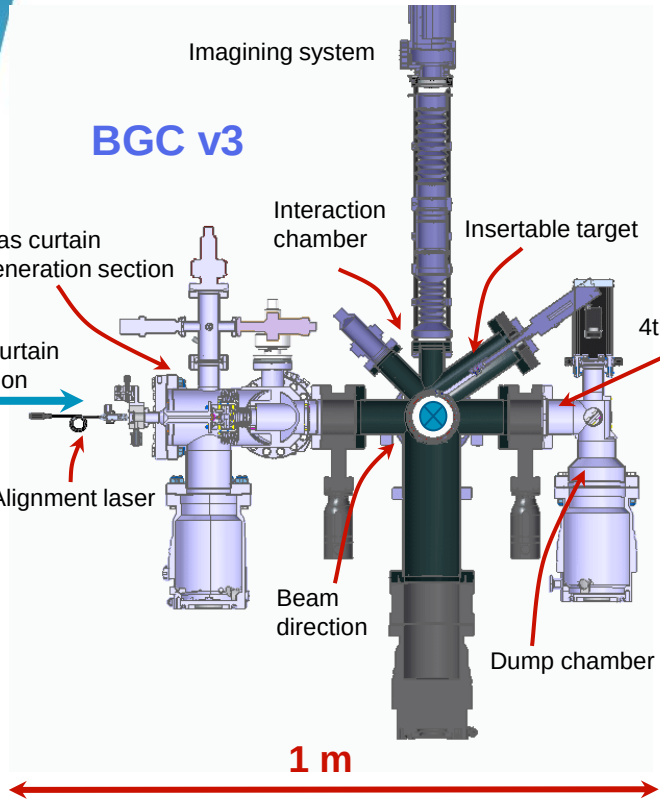
BGC v4.1



BTV (with OTR screen) installed on the DN63 port

M. Ady, O. Sedlacek, C. Castro Sequiero, O. Stringer, H. Zhang

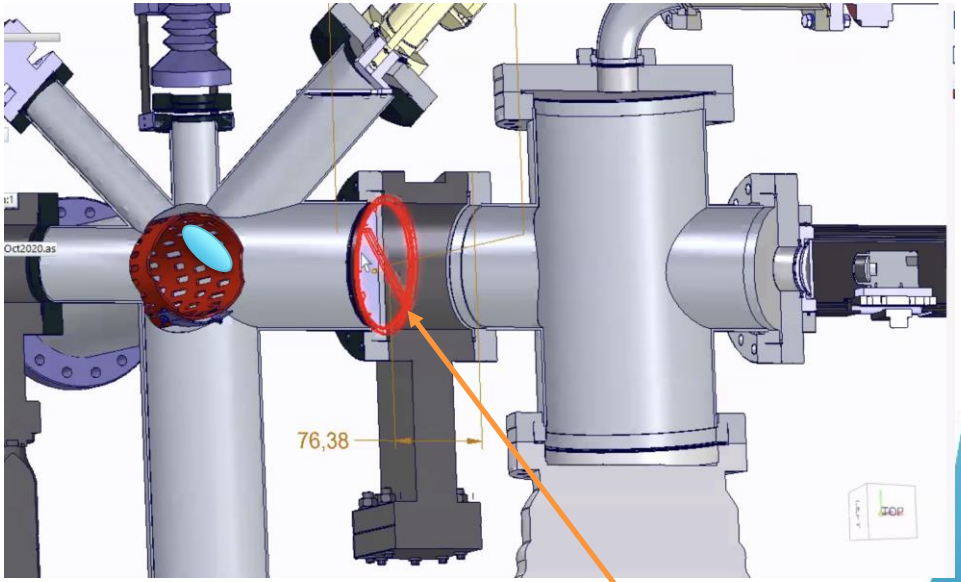
BGC v4.1 Design



BGC v4.1

150 mm

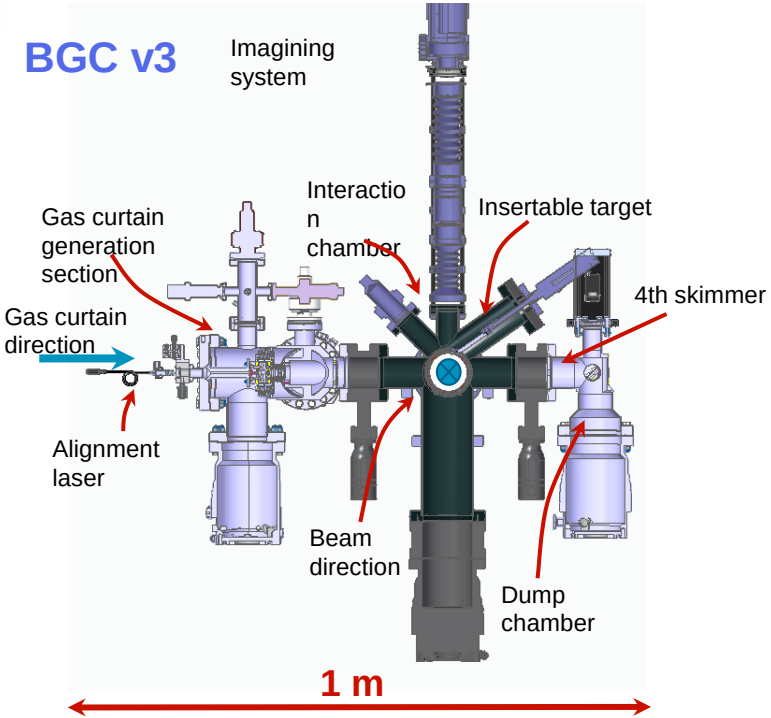
4th Skimmer: 85 mm x 1.12 mm



Skimmer 4 is now installed on the interaction chamber

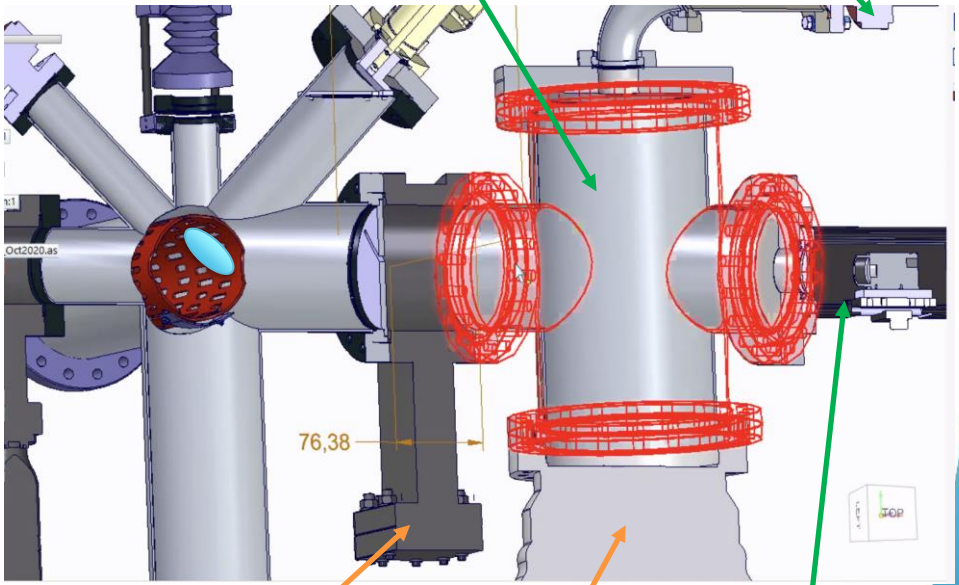
M. Ady, O. Sedlacek, C. Castro Sequiero, O. Stringer, H. Zhang

BGC Design @EBTS



Dump chamber is now made entirely from **standard** parts (DN100-DN160 4-Way Reducing Cross)

Standard Pfeiffer pressure gauges



DN 100 Gate Valve

Pfeiffer TMP HiPace 700

Camera for alignment laser

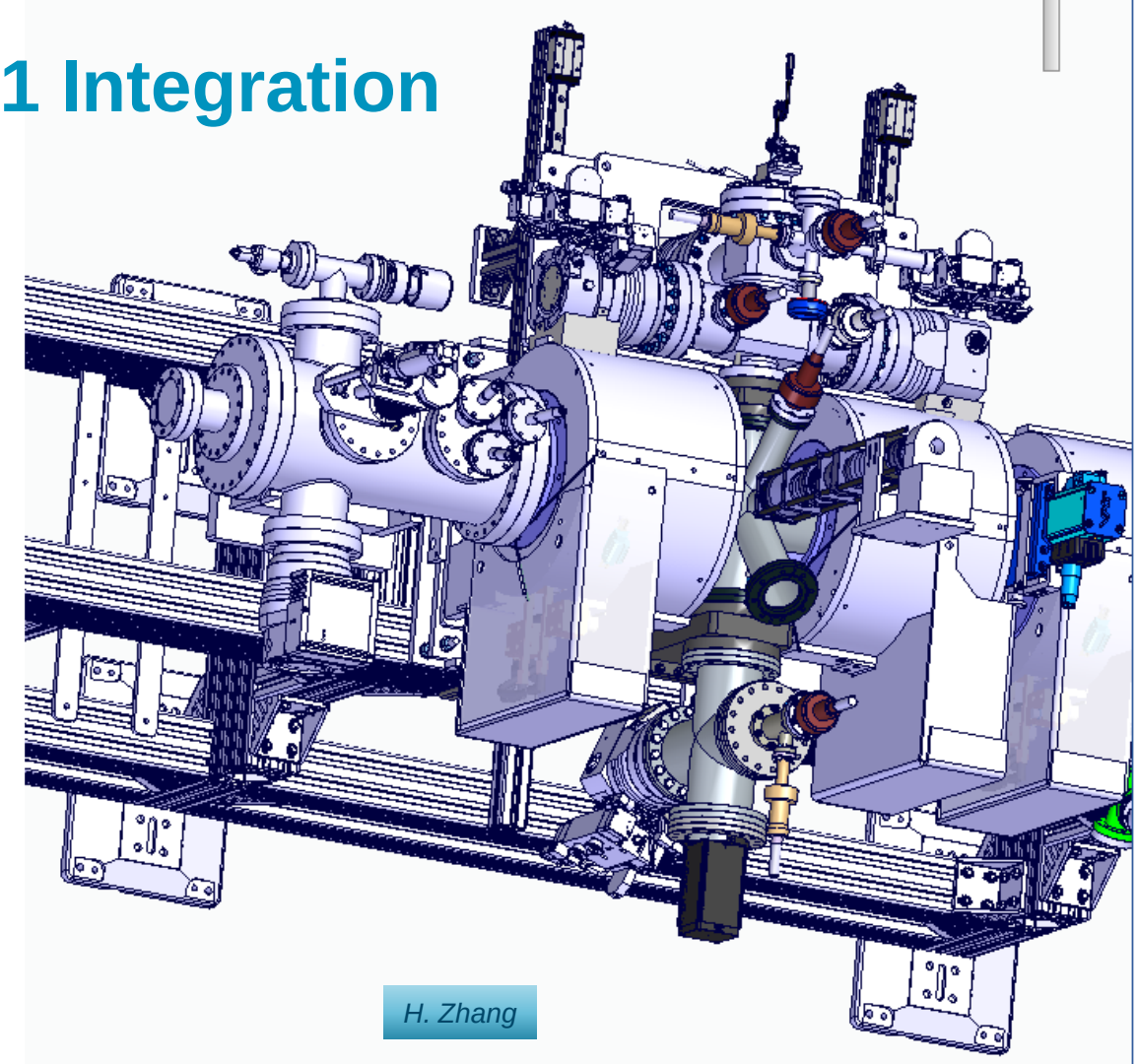
M. Ady, O. Sedlacek, C. Castro Sequiero, O. Stringer, H. Zhang

BGC v4.1 Requirements (Simulation Results)

1. **Gas**
   - Ability to operate with all **three gases** (N2, Ne, Ar)
   - Provision of appropriate gas bottles and pneumatic equipment
2. **Gas jet**
   - Gas jet density same as v3 instrument (**10^{16} m^{-3}**) or larger – **1.3×10^{16} m^{-3}**
   - Curtain length to be able to see the beam with 40 mm OD (so **60 mm curtain at 45 degrees**).
   - Curtain width same as v3 instrument (**0.5 mm**) or smaller – **0.2 mm**
   - Curtain variation same as v3 instrument (5%) or less – **3%**
   - IC background pressure same as v3 instrument (**10^{-7} mbar**) or less – **10^{-8} mbar**
   - Replaceable/adjustable skimmer 3.
3. **Image Acquisition**
   - Provision of laser + camera for alignment and target/grid for camera focusing
   - Provision of optics, image intensifier(s), filter(s), and camera(s), for 3 gases + BTV
   - Addition of BTV on the DN63 port (design can be done by CERN)
4. **Performance Evaluation**
   - Maximum **1 s integration** for electron beam of **10 keV, 5 A, 40 mm** diameter
   - Aiming for **100 µm image resolution** at the above parameters

BGC v4.1 Integration

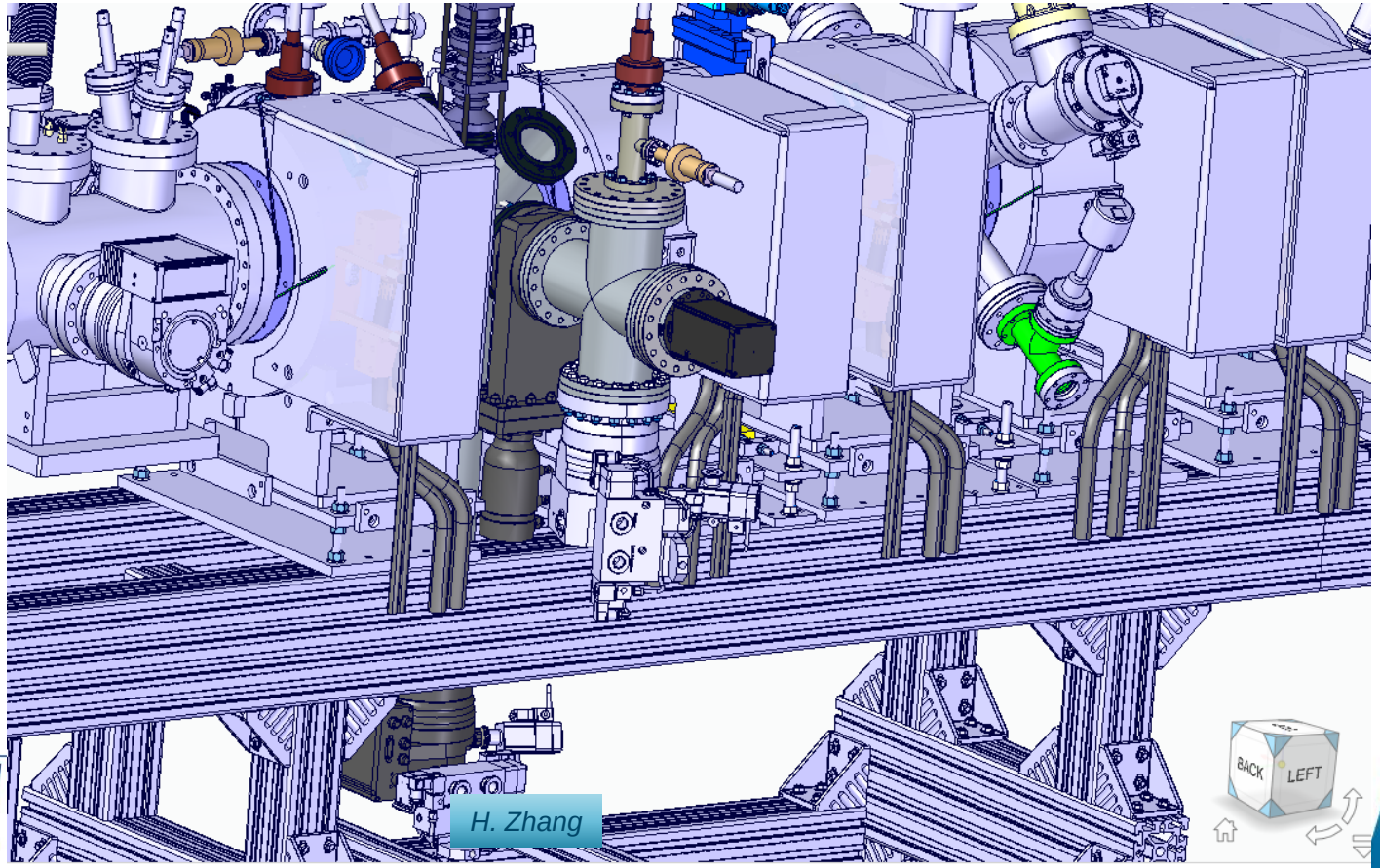
Top View



H. Zhang

BGC v4.1 Integration

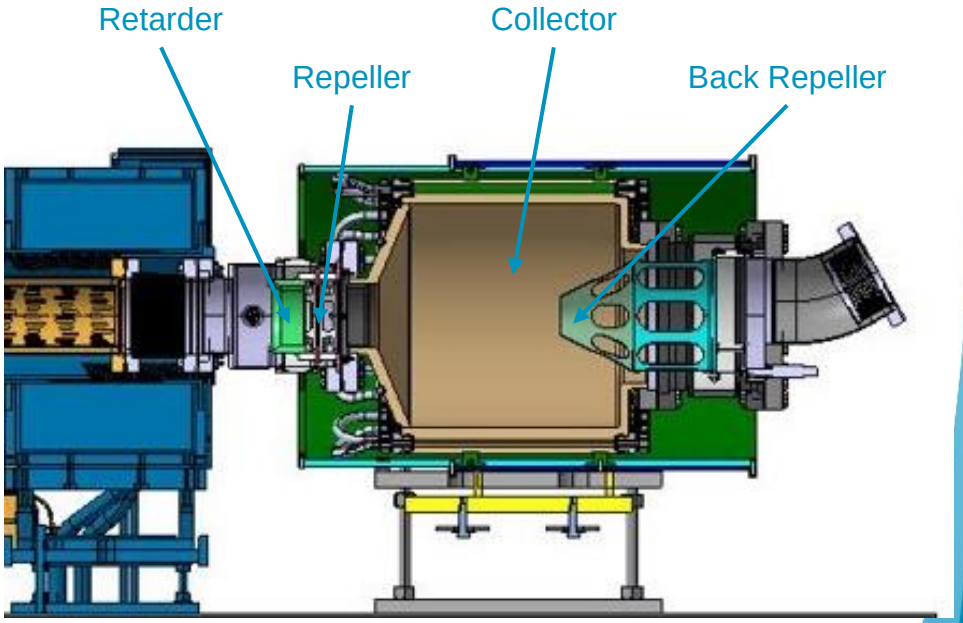
Side View



H. Zhang

HEL Collector

- HEL Collector Details
  - Entrance aperture: 80 mm
  - Gun-Collector Potential: up to +5 kV
  - Beam Current: up to 5 A
- Benefits
  - Works with both DC and pulsed electron beams
- Challenges
  - Vacuum/pumping requirements are high
  - Reflected / secondary electrons needs to be suppressed → **BGC**
  - Requires high voltage platform

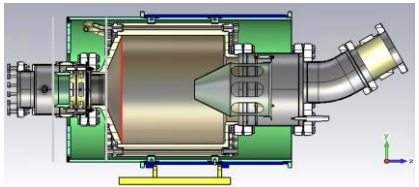


A. Kolehmainen, M. Sameed

Status of HEL Collector

Design

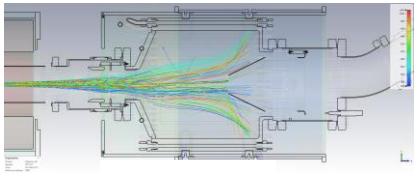
- Complete

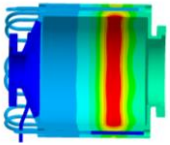


A. Kolehmainen

Simulations

- Complete





I. Tabian

Fabrication

- All parts ordered
- Fabrication ongoing
- Delivery in March 2024

T. Coiffet, A. Gerardin, L. Deparis

Installation

- Planned for Q1 2024 (tentatively during week of 11 March)

Summary

- Design, simulations, and integration model for BGC v4.1 on EBTS almost complete…design should be approved during BGC collaboration meeting and drawings should be finalized and approved to start procurement…delivery June 2024?

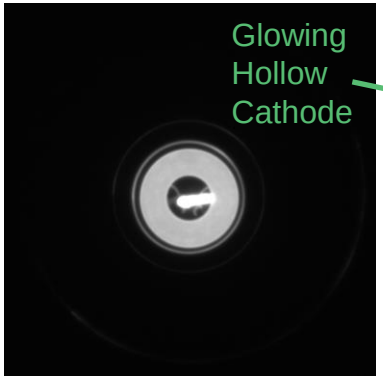
- HEL collector fabrication and assembly underway, delivery scheduled for Q1 2024

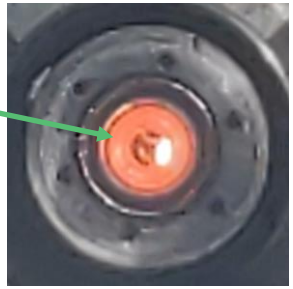
Thank You !

Questions?

Backup Slides

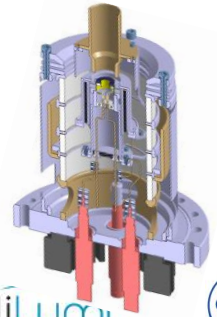
Electron Gun



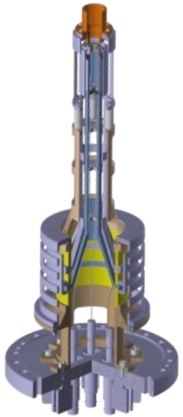


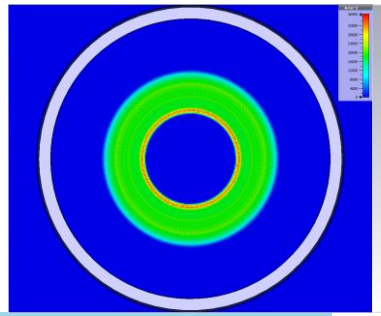
- Cathode Parameters
  - OD: 16.10mm, ID: 8.05mm
  - Current Density: 3.3 A/cm^2
- Electron Beam Parameters
  - Beam Current: 0-5 A
  - Beam Energy: 0-15 keV
- Pulse Modulator (Marx Generator)
  - Pulse Duration: 1us - 100us
  - Rise/Fall Time: 200 ns
  - Repetition Frequency: 1Hz - 50 Hz

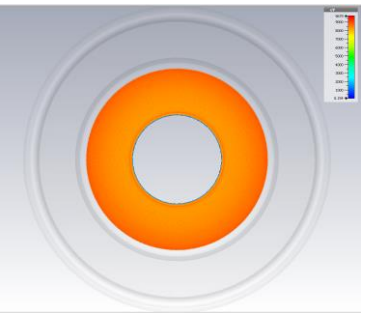
HEL Gun v1 (FNAL)



HEL Gun v3 (CERN)

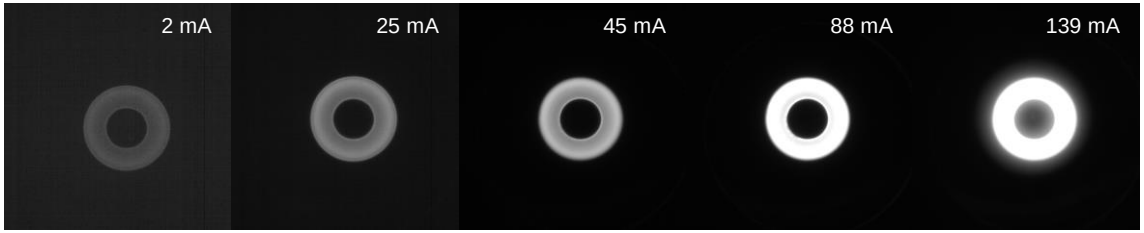




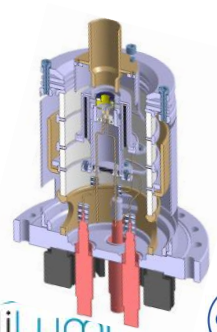


Electron Gun

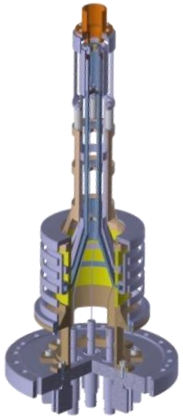
- Gun Characterization
  - Measurements at both FNAL and CERN
  - Comparison of experimental results with simulations (SAM / WARP / CST / TRAK)

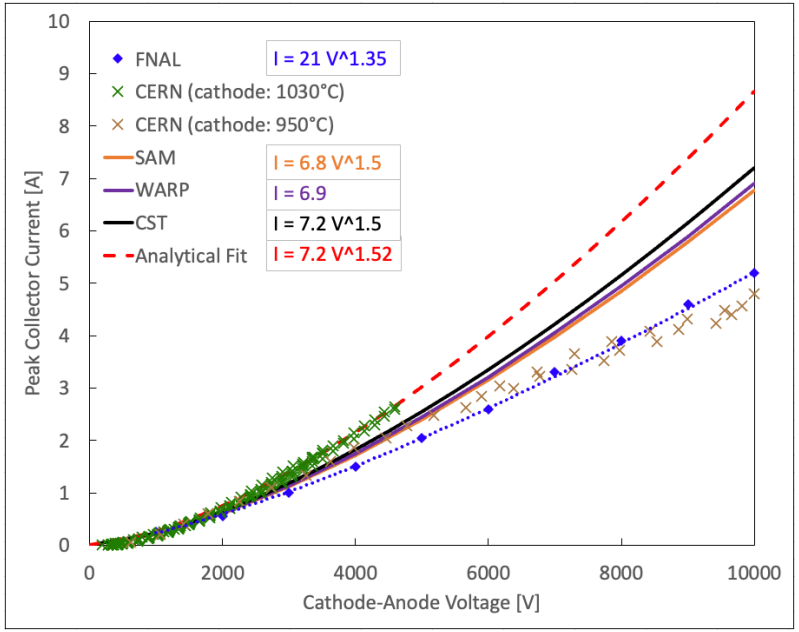


HEL Gun v1 (FNAL)

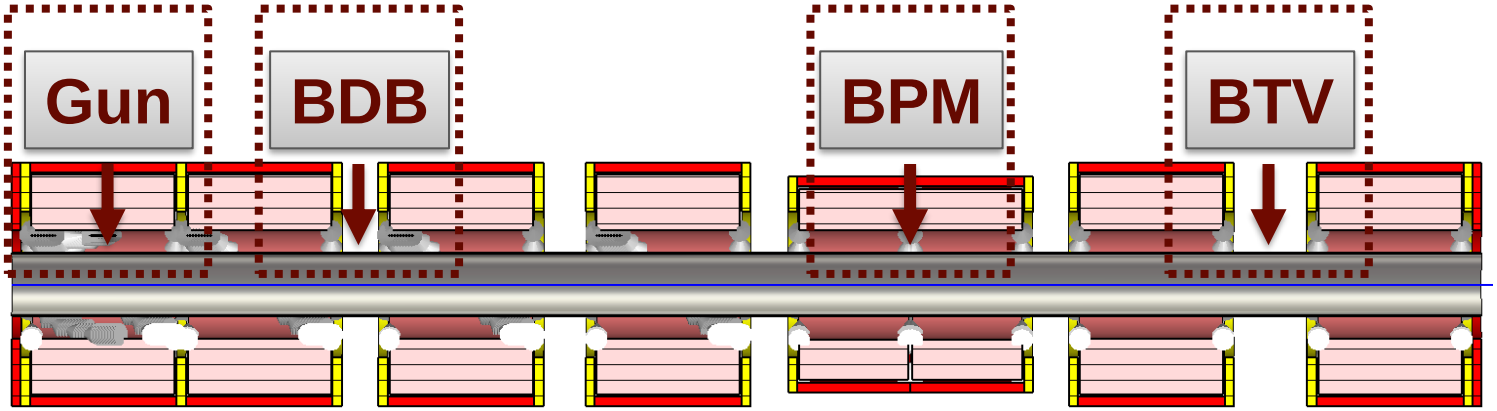


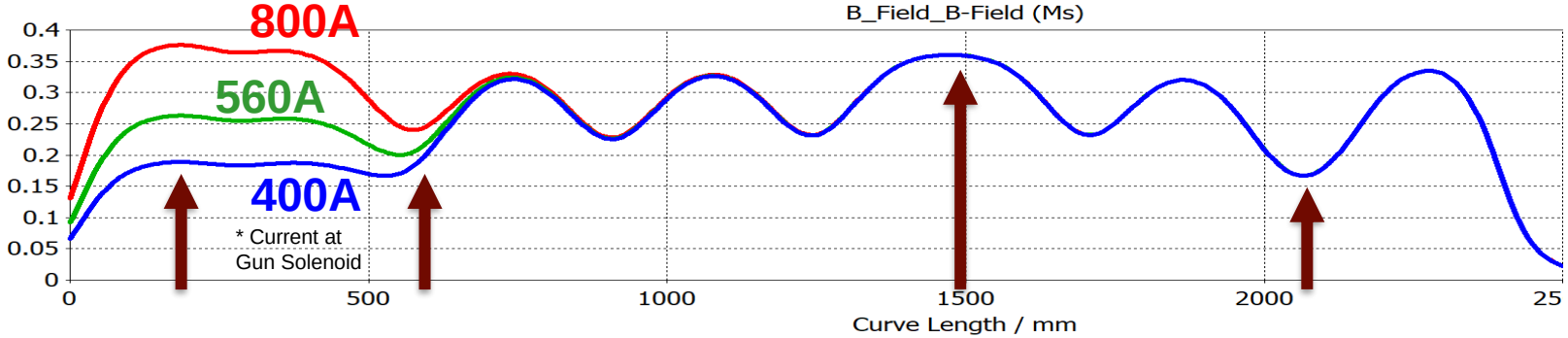
HEL Gun v3 (CERN)





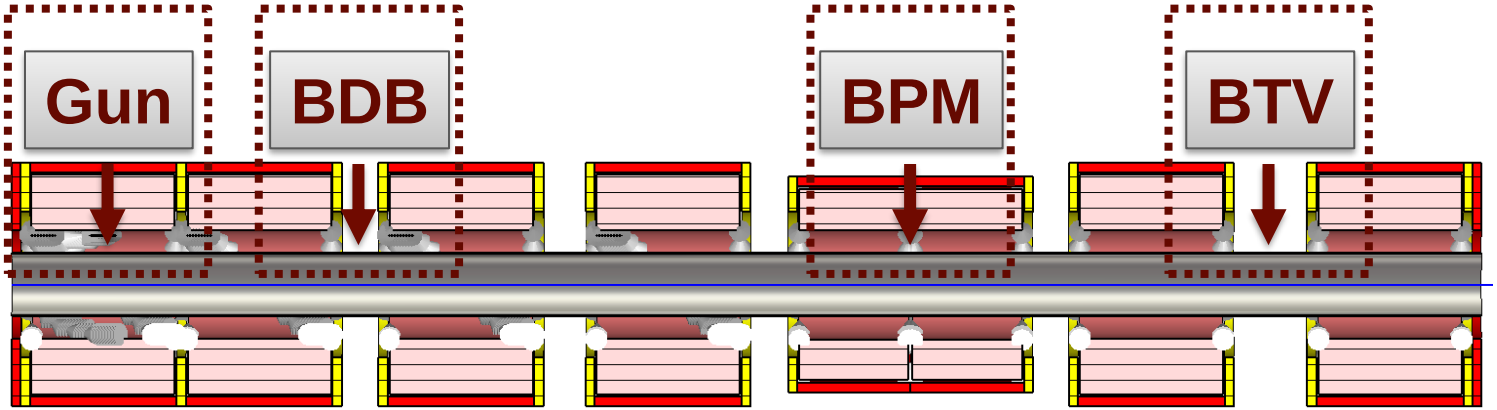
EBTS Solenoids and Correctors

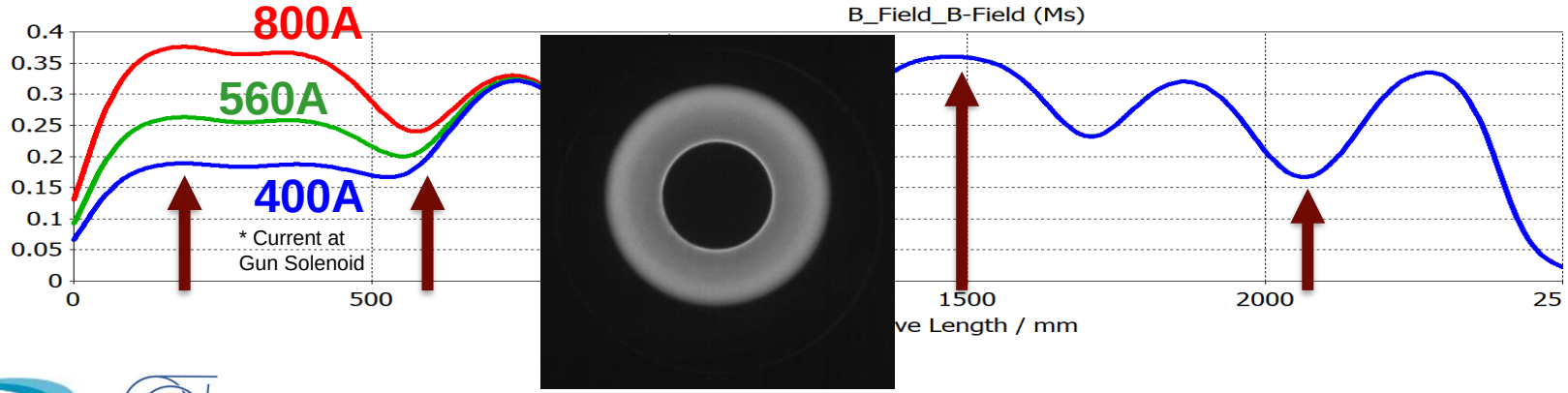




A. Rossi

EBTS Solenoids and Correctors

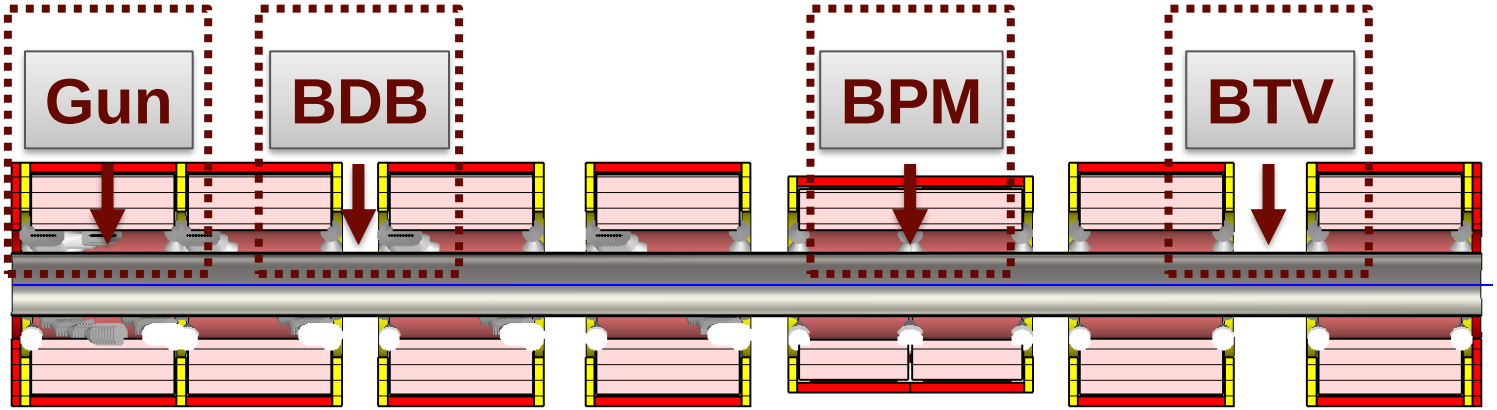


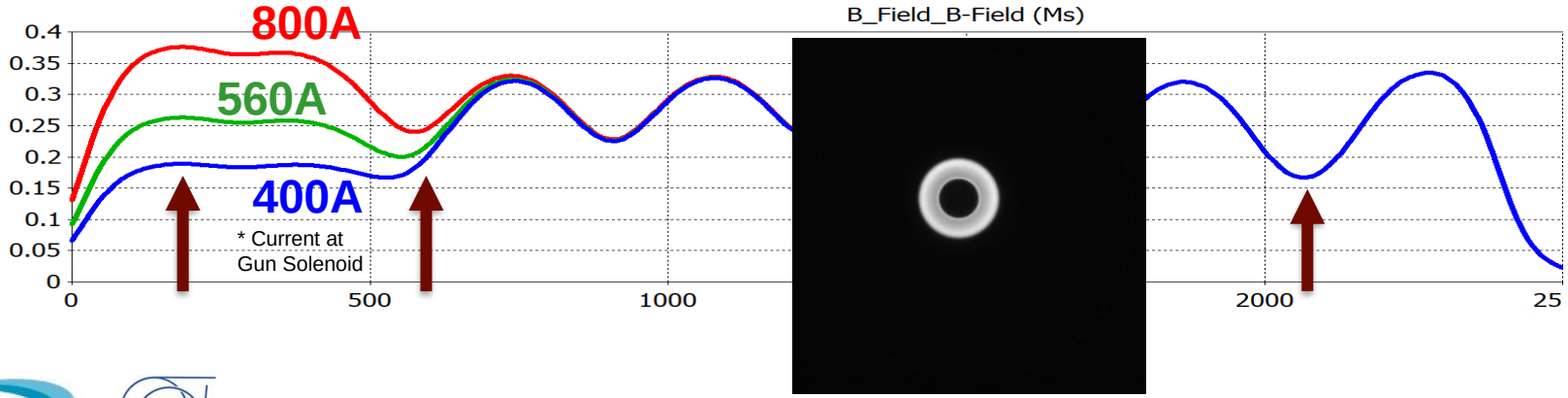


Beam Compression

A. Rossi

EBTS Solenoids and Correctors



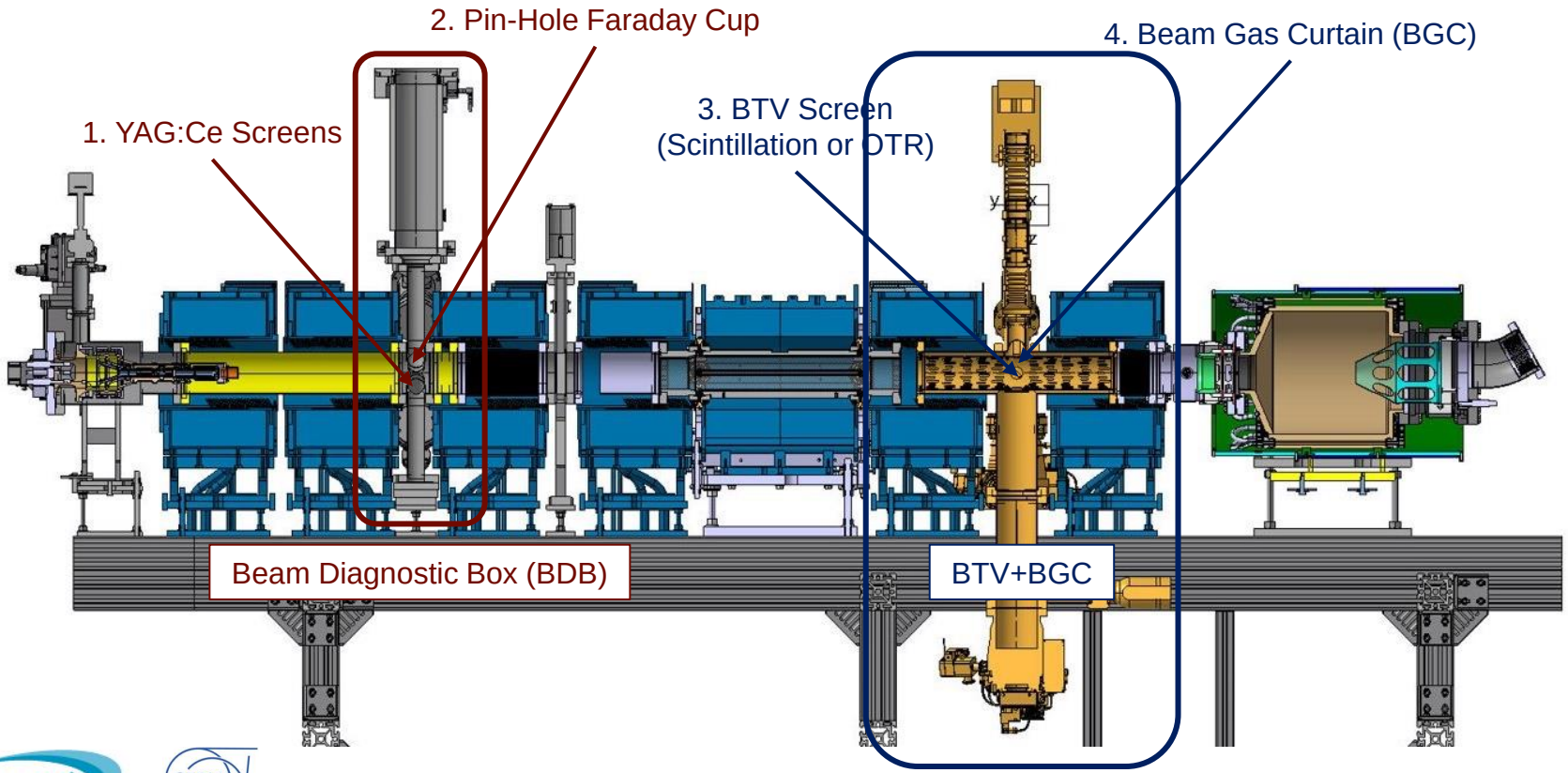


H/V Correction

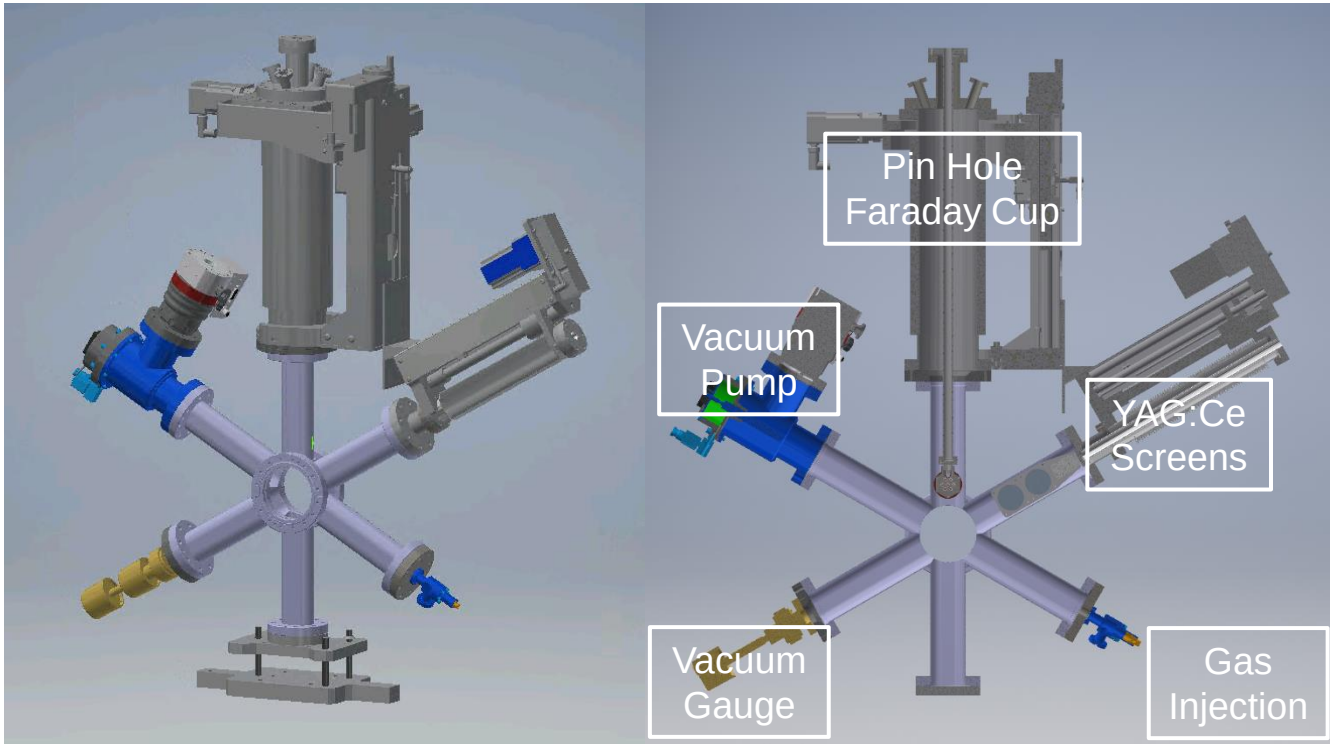
A. Rossi

Beam Instrumentation at EBTS

Beam Profile Monitors



Beam Diagnostic Box



F. Guillot-Vignot

YAG:Ce Screens

YAG:Ce Screens

- Screen Details
  - Two screens (Al-coated and ITO-coated) on a linear translator
  - 50 mm diameter
- Benefits
  - High photon yield (2 x 10^4 photons/MeV)
  - Short decay time (~100 ns)
  - Very high image resolution
- Challenges
  - Image saturation and/or screen damage at high beam current or long pulse duration

F. Guillot-Vignot