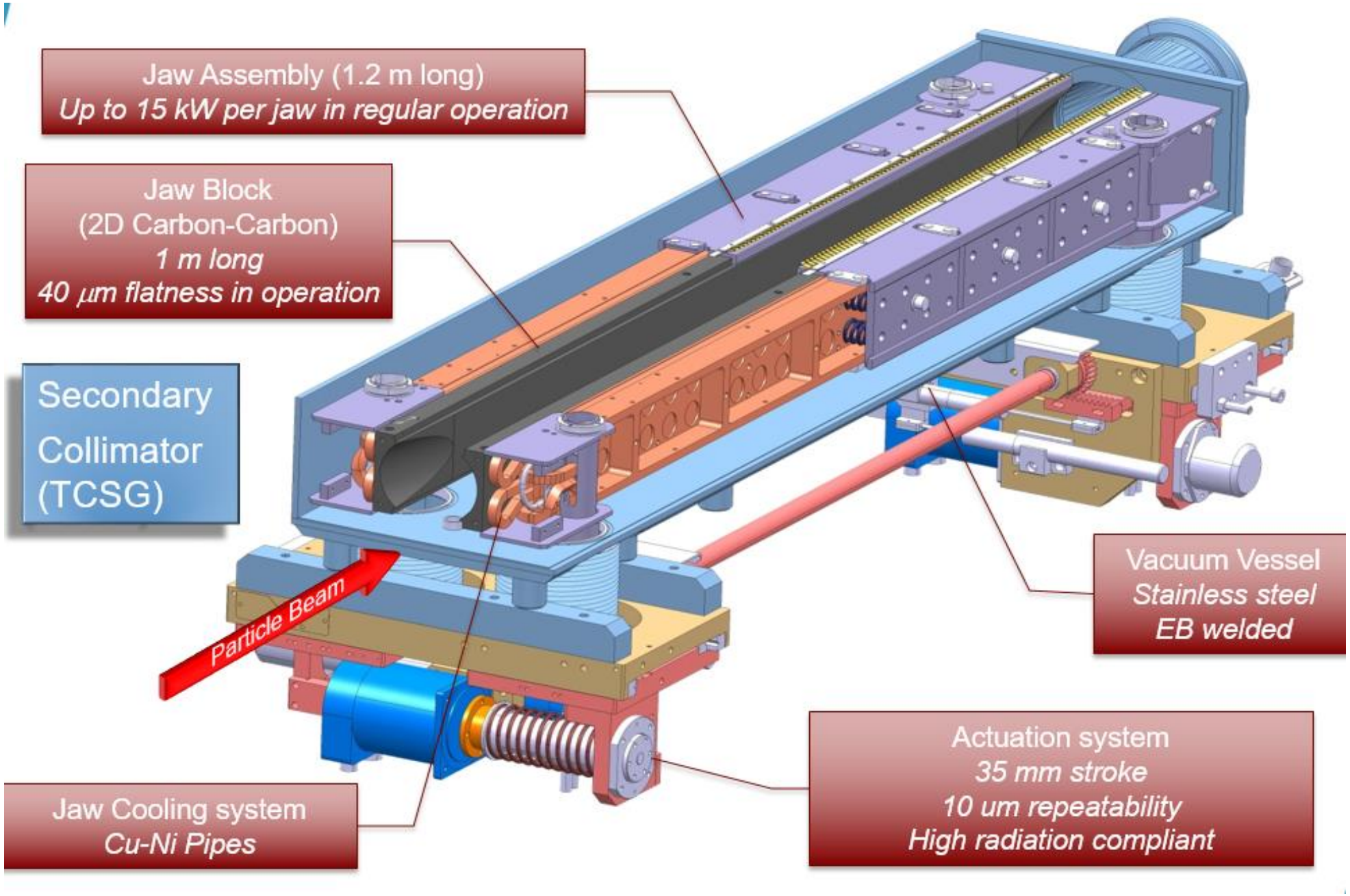
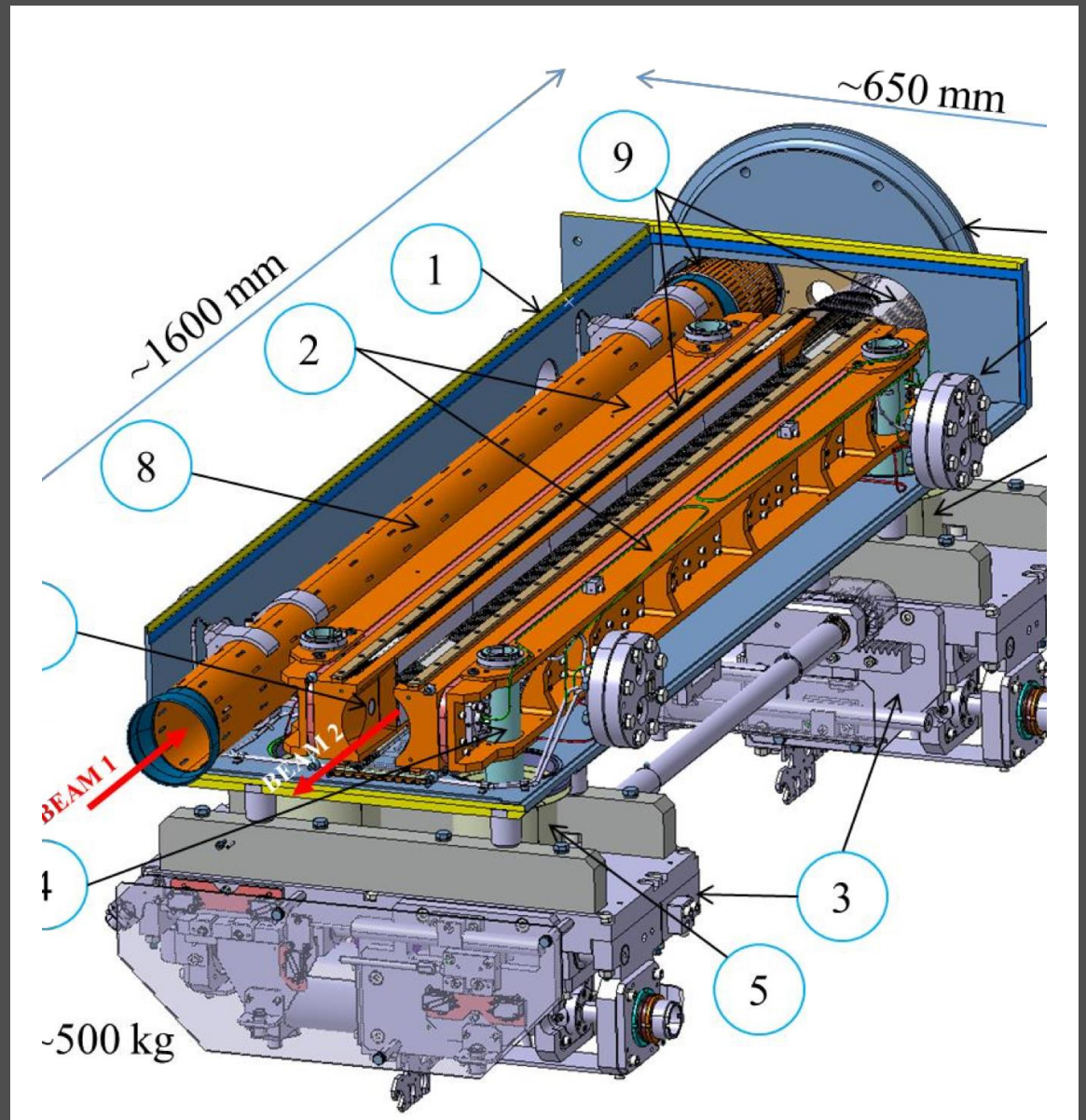
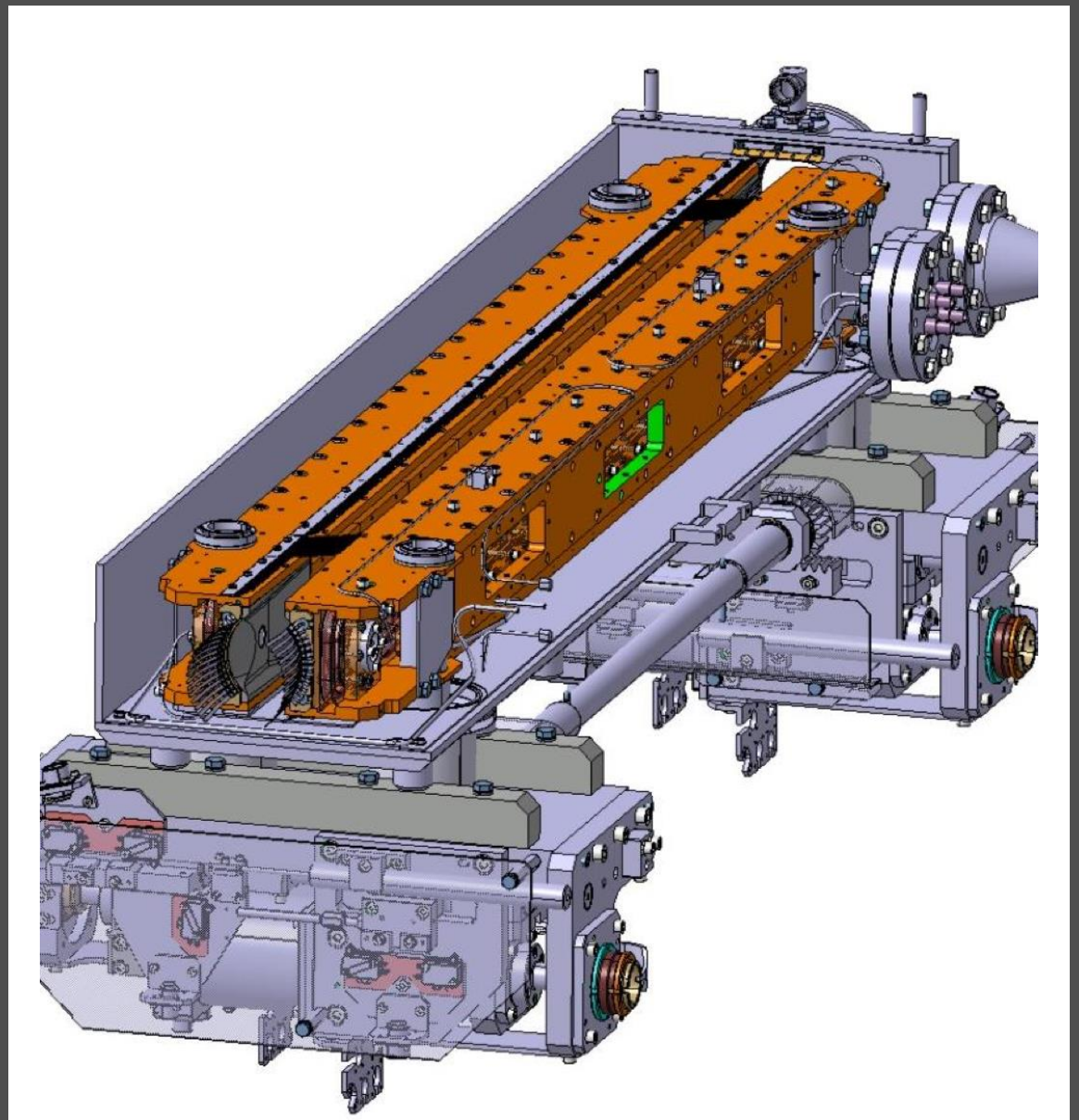
LHC collimators challenges

M. Calviani (SY-STI)

MS-4810/SY/HL-LHC


Jaw Assembly (1.2 m long)
Up to 15 kW per jaw in regular operation
Jaw Block
(2D Carbon-Carbon)
1 m long
40 μm flatness in operation
Secondary
Collimator
(TCSG)
Particle Beam
Vacuum Vessel
Stainless steel
EB welded
Actuation system
35 mm stroke
10 um repeatability
High radiation compliant
Jaw Cooling system
Cu-Ni Pipes

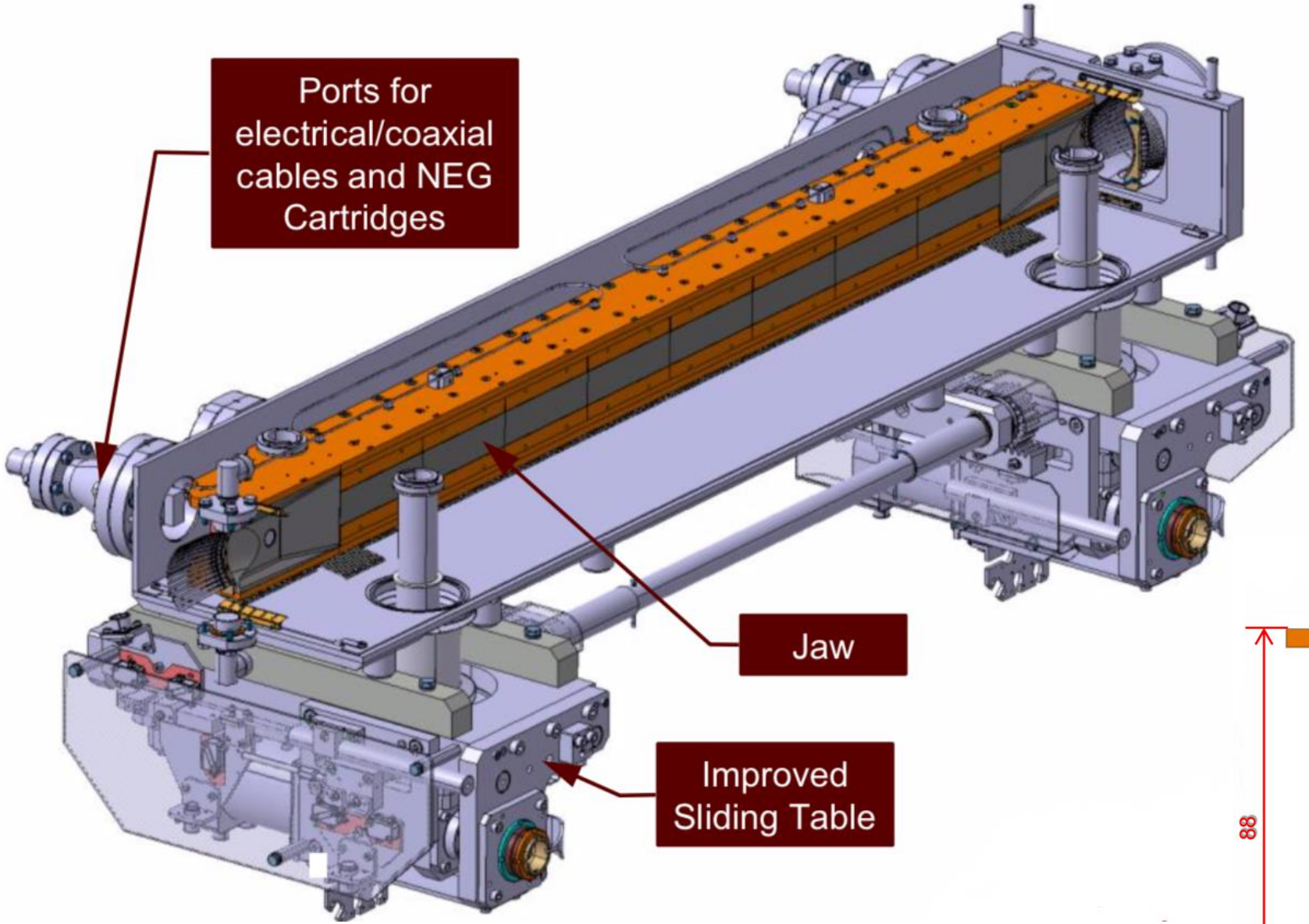

~650 mm
~1600 mm
9
1
2
8
BEAM 1
BEAM 2
3
5
~500 kg

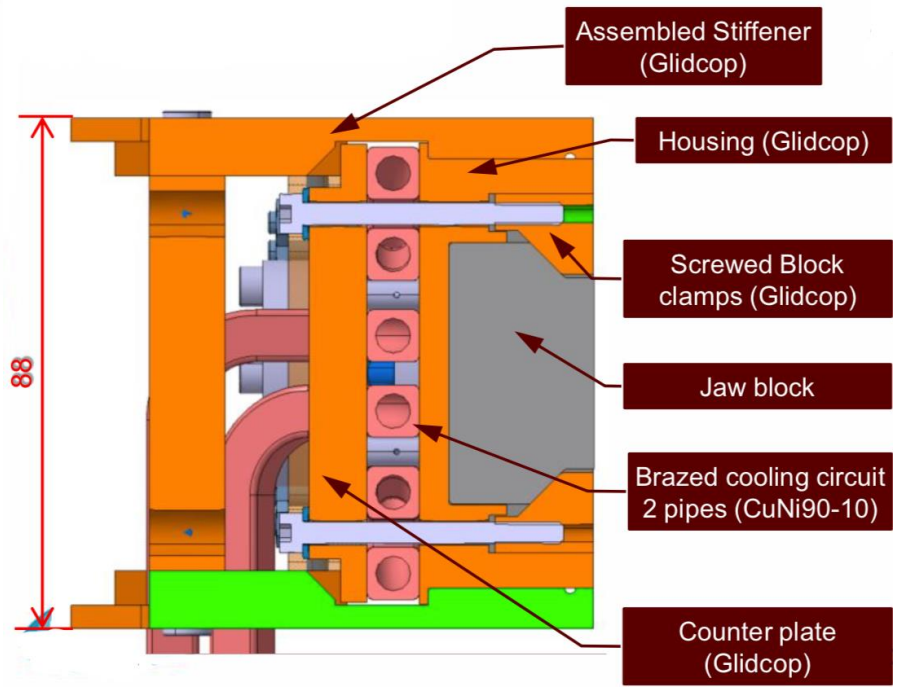


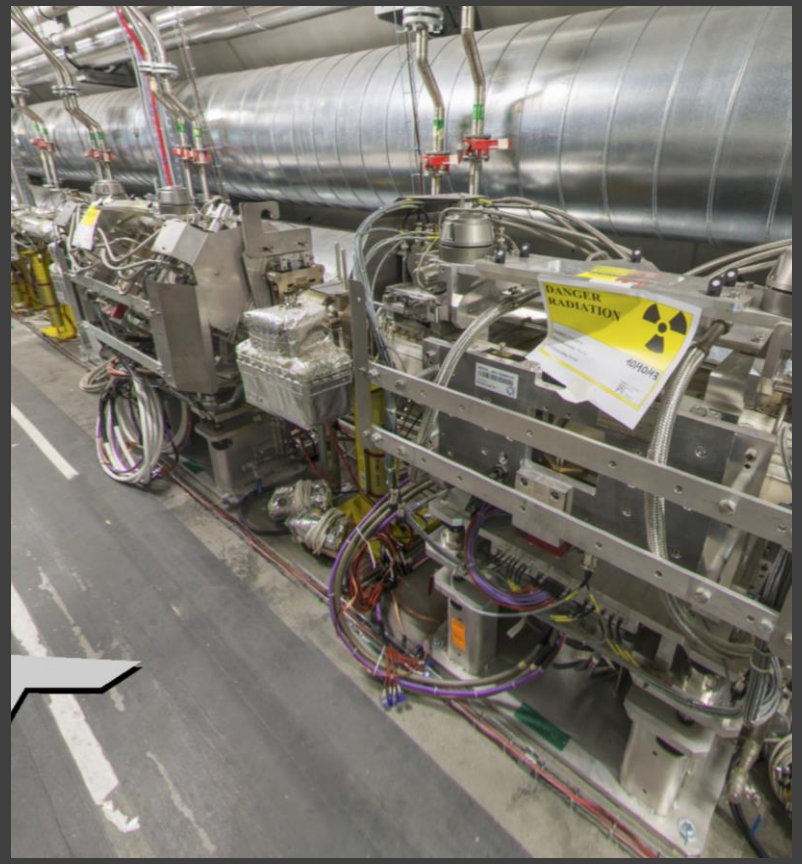
Qualification and requirements

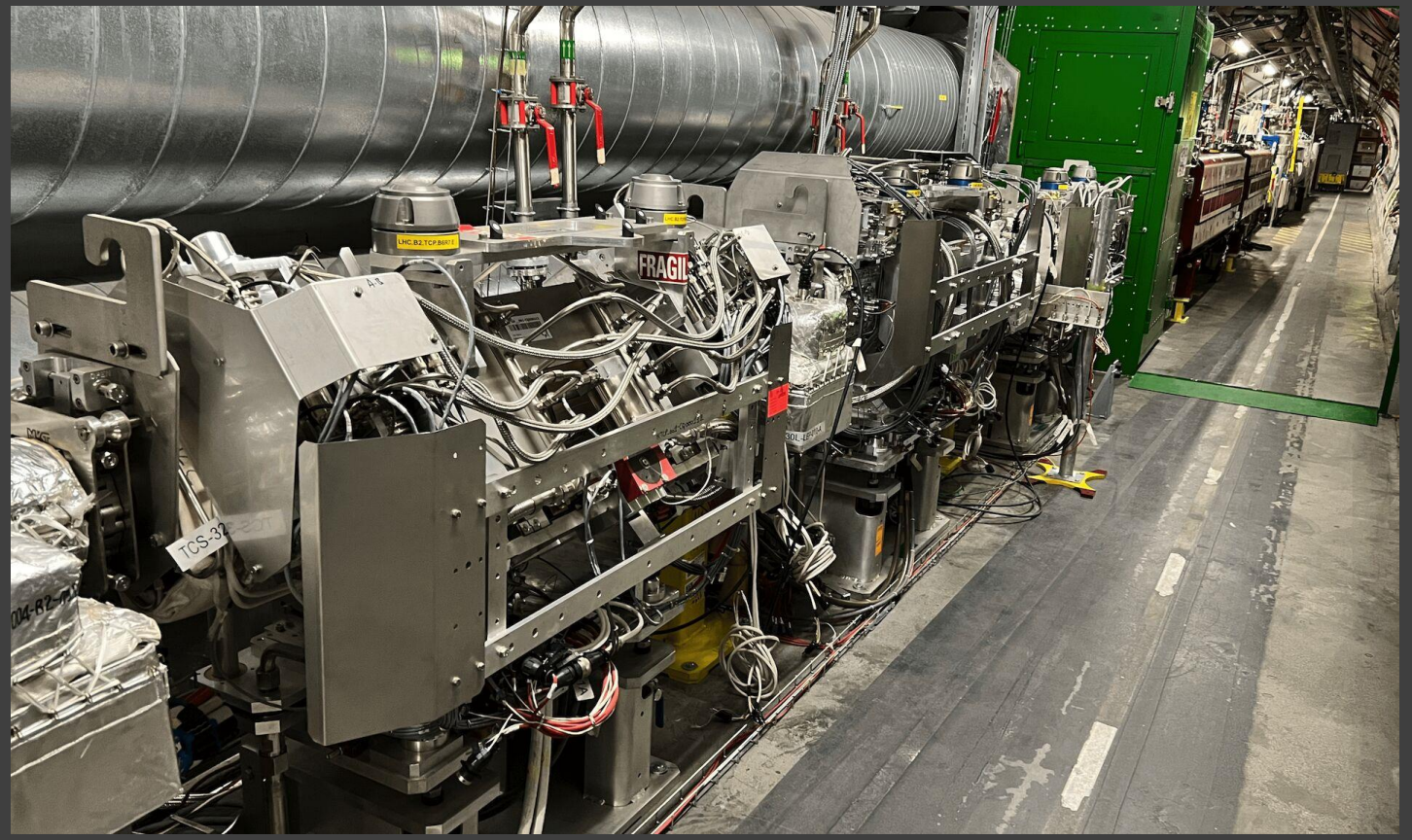
- Machining, Sheet Metal Forming and Cutting Requirements
  - Accurate machining of various metallic materials (stainless steels, aluminium alloys, brass, coppery alloys)
  - Stress relief heat treatments to achieve needed flatness after heating cycles up to 250 C
  - Some critical steps require oil free machining techniques to respect UHV requirements
- Ultra High Vacuum requirements
  - Materials used for the UHV parts of the collimators shall be cleaned and treated according to specific procedures to be agreed upon with CERN
  - They shall be leak tested, with a helium leak detector. The maximum acceptable leak rate shall be set to 1.0×10^{-11} Pa.m^3/s (1.0×10^{-10} mbar.L/s)
  - Heating cycles, followed by measurement of outgassing rate and RGA performed

- Vacuum brazing requirements
  - Materials for vacuum brazing such as stainless steel, copper-based materials (OFE copper and dispersion strengthened copper up to 1.3 m in length) and cupronickel components
  - A furnace with a size of at least $1600 \times 600 \times 600\ mm^3$ will be needed
- Welding requirements
  - The major parts of the vacuum tanks shall be assembled by Electron Beam Welding (EBW) although some parts shall be assembled using Tungsten Inert Gas (TIG) welding
  - Welding Procedure Specifications (WPS) as well as Welding Procedures Qualification Records (WPQR) will be requested
- Assembly and Cleaning Requirements
  - Several high precision subassemblies are needed in a collimator
  - Tight tolerances of position, co-axiality and surface flatness (20 µm or less)
  - The different assembly steps shall be followed by dimensional controls
  - All parts shall be cleaned for UHV conditions before assembly
- Several coatings will be required on different components of the collimators


Ports for electrical/coaxial cables and NEG Cartridges
Jaw
Improved Sliding Table


Assembled Stiffener (Glidcop)
Housing (Glidcop)
Screwed Block clamps (Glidcop)
Jaw block
Brazed cooling circuit 2 pipes (CuNi90-10)
Counter plate (Glidcop)
88





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