INTEGRATION OF A STRIPLINE KICKER PROTOTYPE FOR CLIC PROJECT INTO ALBA STORAGE RING

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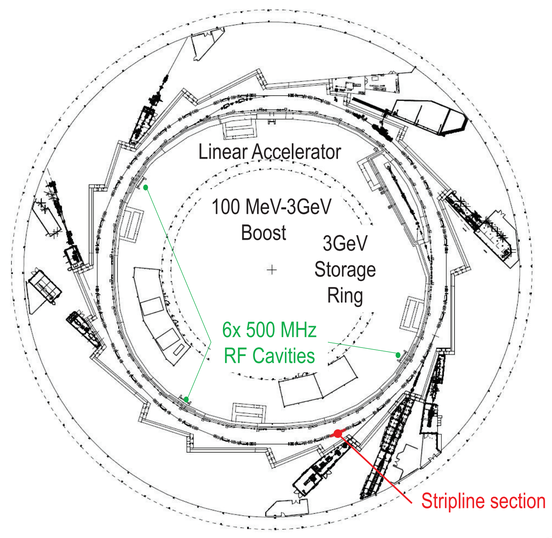
Abstract

The Compact Linear Collider (CLIC) project is an international collaboration working on the development of a high-energy and high-luminosity machine which will accelerate and collide electrons and positrons at energies between 0.5 and 5 TeV. The extraction system for the Damping Rings of CLIC shall follow very tight requirements in order to maintain the ultra-low emittance of the extracted bunches. A first prototype of the extraction kicker based on stripline technologies has been built and characterized at CERN without beam. The stripline will be shortly installed in the ALBA Synchrotron to be tested under beam. In situ measurements of the impedance, transversal field homogeneity and flat-top ripple aims to complete its characterization. This contribution presents the design of the set up for the integration of the stripline in one of the medium straight sections of ALBA storage ring.

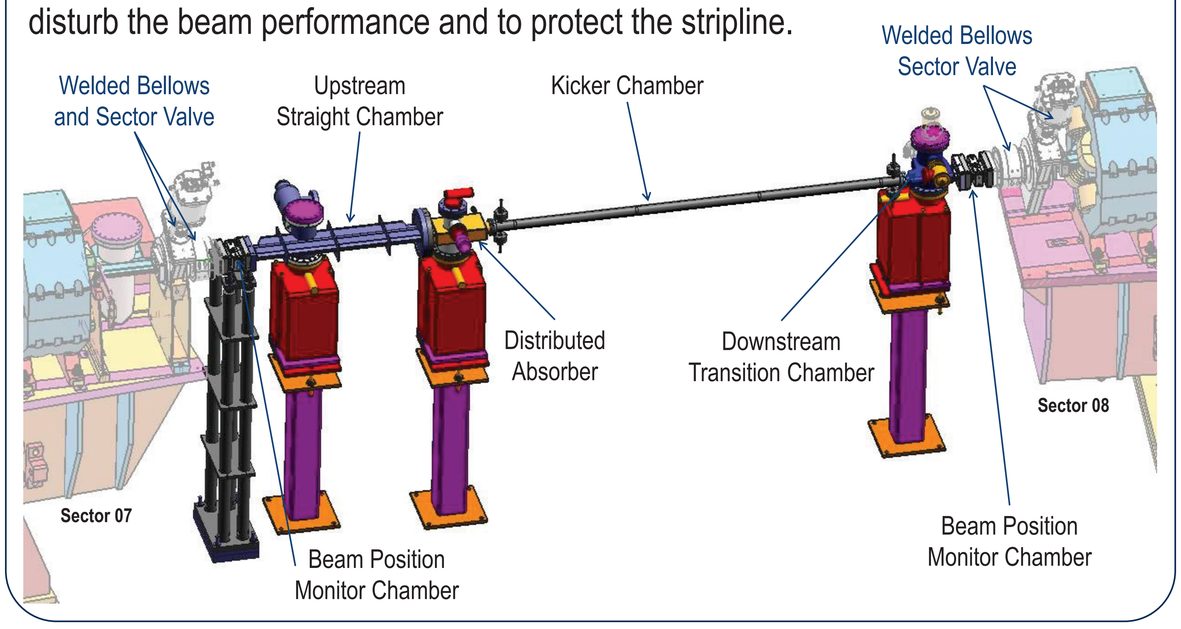
ALBA Machine Characteristics

MAIN PARAMETERS OF ALBA STORAGE RING	
Energy	3 GeV
Design Current	400 mA
Circumference	268.8 m
Lattice	Expanded DBA
Number of dipoles	32
Dipole Magnetic Field	1.42 T
Horizontal Emmitance	4.58 nm.rad
Horizontal Beta Function	0.4 / 18 m
Vertical Beta Function	1.3 / 25 m
Total photon flux at the design current	$9.7 \cdot 10^{20}$ Ph·s^{-1}
Total power at the design current	407 KW



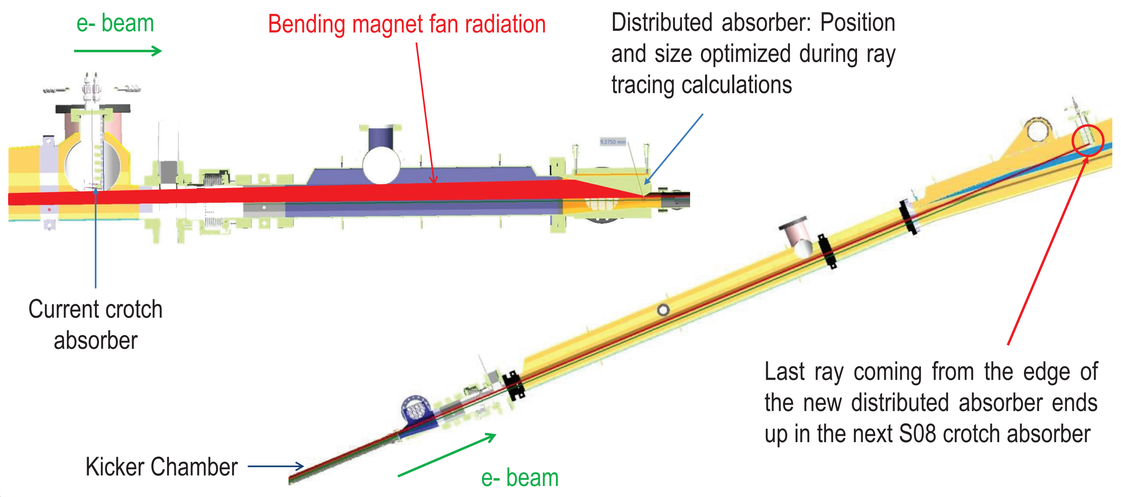
Layout Integration

The stripline kicker chamber will be installed in a medium straight section of 3200mm length, between Sectors 07 and 08 of the ALBA Storage Ring. The adjacent vacuum chambers and absorbers have been designed in order to not disturb the beam performance and to protect the stripline.

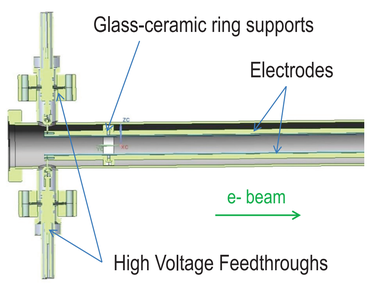


Ray Tracing Study

In order to avoid the incidence of synchrotron radiation over the new elements, ray tracing calculations have been performed. A safety margin of 1 mm has been considered between the inner part of the kicker chamber's ring supports and the x-ray fan.

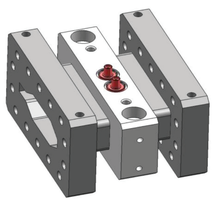


Chambers Design



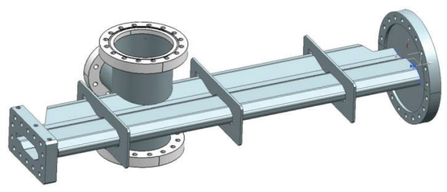
KICKER CHAMBER

- Stripline kicker system is used to extract the beam from the CLIC Damping Ring.
- Design optimized to achieve an excellent field homogeneity, good power transmission and broadband low beam coupling impedance [1].
- The kicker chamber will be installed at ALBA 90º rotated to avoid synchrotron radiation incidence over the electrodes.



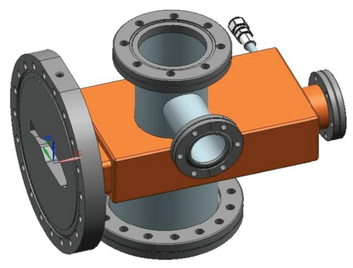
BEAM POSITION MONITOR

- Downstream BPM installed in a bracket and referenced to the girder as the rest of BPM net.
- Upstream BPM in fixed position acting as global reference respect to the floor, mounted in a FeNi36 high stability support.
- Designed for keeping a beam orbit stability of 10% of beam size and keeping the vertical deformation at a submicron level.



STRAIGHT CHAMBER

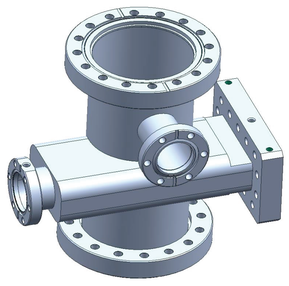
- Stainless steel chamber with "key-hole" cross section according to ALBA standard profile.
- Electron beam channel as main chamber and photon beam channel as antechamber allowing synchrotron radiation to be delivered to the front ends or being stopped in the absorbers.



DISTRIBUTED ABSORBER

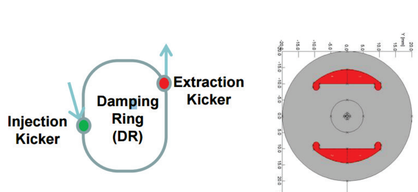
- OFHC copper main block brazed to stainless steel flanges and auxiliary ports.
- Tapered from standard profile to a circular opening and water cooled.

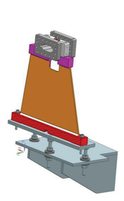
POWER DENSITY DISTRIBUTION (Beam Current = 400 mA)	Pa_{MAX} = 4.3 W/mm^2 Total Power = 782.7 W
TEMPERATURE DISTRIBUTION	T_{MAX} = 58.5°C
STRAIN DISTRIBUTION	S_{MAX} = 0.027%
STRESS DISTRIBUTION	S_{MAX} = 31.2 MPa

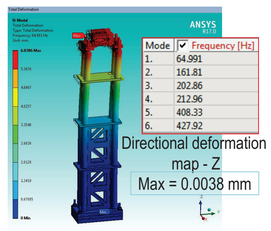


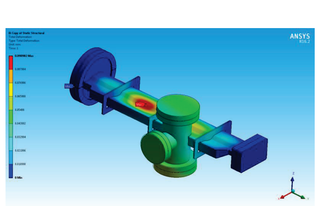
TRANSITION CHAMBER

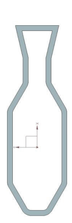
- Stainless steel chamber connecting the kicker and the downstream BPM block.
- Transitional cross section with a smooth tapering from the standard ALBA profile to a circular opening of 40 mm internal diameter.
- Change of section and pattern of holes over the pumping ports to prevent disturbance of the electron beam.

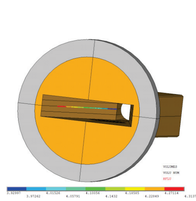


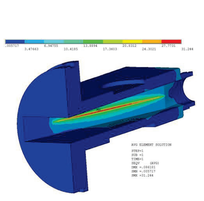


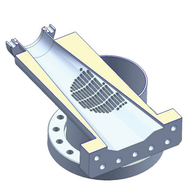


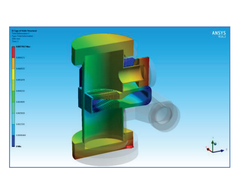












Installation and Commissioning

- Prior bakeout and in-situ vacuum conditioning of the chambers.
- Fiducialization and alignment of the assembly.
- Cabling, electronics and instrumentation installation.
- EPS commisioning for vacuum and temperature signals.
- Functional tests.
- BPM tests with beam.

Testing with beam

Measurements of:

- Beam coupling impedance
- Transversal field homogeneity
- Flat-top ripple

References

[1] C. Belver-Aguilar et al, Design and Manufacturing Description of the Prototype Striplines for the Extraction Kicker of the CLIC Damping Rings, Proc. IPAC2013