Electron Beam Diagnostics for the ALBA Synchrotron Light Source

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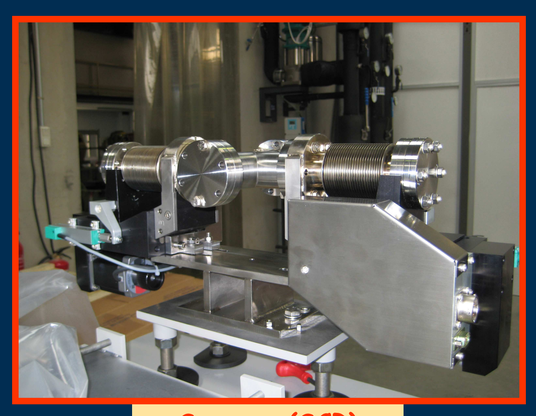
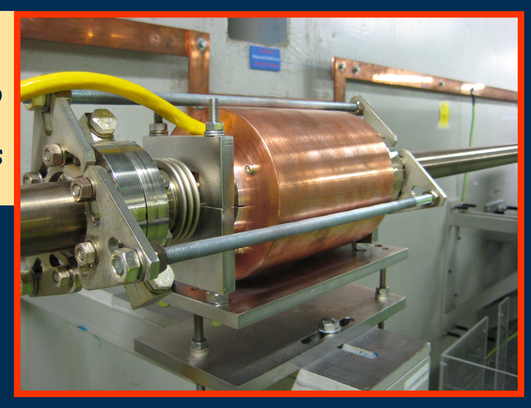
ALBA is a 3 GeV third generation Synchrotron Radiation Facility currently under construction in Cerdanyola del Vallès, Barcelona, Spain. The injector for ALBA consists of a 100 MeV Linac, a 3 GeV Booster and the corresponding transfer lines Linac To Booster (LTB) and Booster To Storage Ring (BTS). Routine user operation is expected to start Beginning 2011.

	Linac	Booster	Storage Ring
Energy [GeV]	0.1	3	3
Circumference [m]		249.6	268.8
Max. current [mA]	5	5	400
Bunch spacing [ns]	2 - 218	2	2
rms bunch length [ps]	~200	60	15
Hor. Emittance [nm rad]	150	9	4.3
Coupling	100%	10%	1%
Dipole field [T]	0.189	0.873	1.42
Horizontal tune Q_x		11.42	18.18
Vertical tune Q_y		7.38	8.37

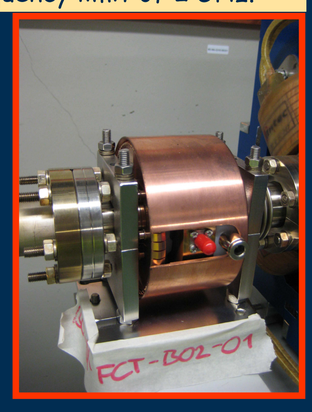


Scraper (SCR)
Mechanical system that collimates the beam in order to get rid of undesired halo particles.

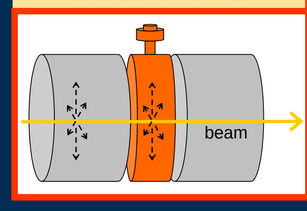
DC Current Transformer (DCCT)
Measures the electron beam intensity using a principle similar to the one of FCT. Additionally, a second magnetic modulator detects the beam DC component.

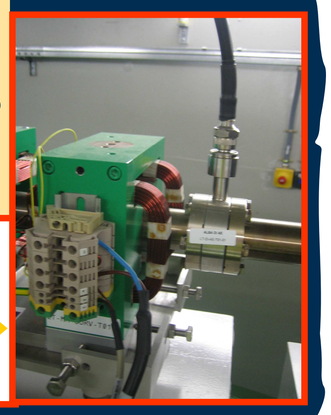


Fast Current Transformers (FCT)
Measures the current induced in a coil when the electron beam passes through it. Provides information about electron beam charge and profile. Upper frequency limit of 2 GHz.

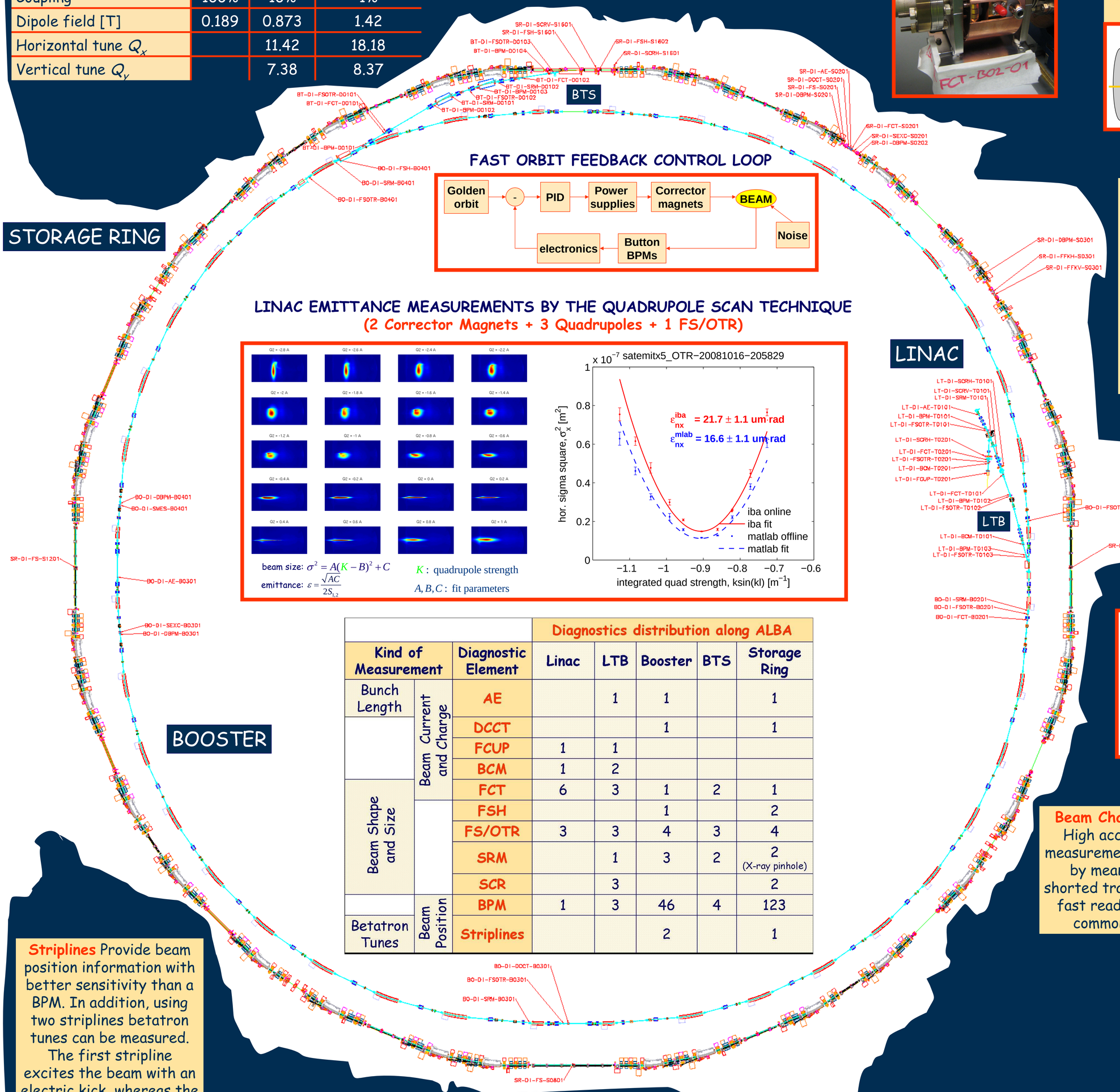


Anular Electrode (AE)
Measures the electron beam charge by means of a cylindrical electrode placed inside the vacuum chamber. System up to 8 GHz bandwidth, allowing bunch length measurements.





STORAGE RING



STORAGE RING

BOOSTER

LINAC

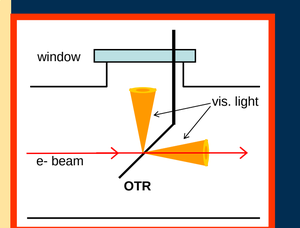
LTB

BTS

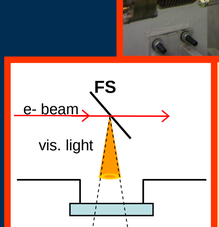
FAST ORBIT FEEDBACK CONTROL LOOP

LINAC EMITTANCE MEASUREMENTS BY THE QUADRUPOLE SCAN TECHNIQUE
(2 Corrector Magnets + 3 Quadrupoles + 1 FS/OTR)

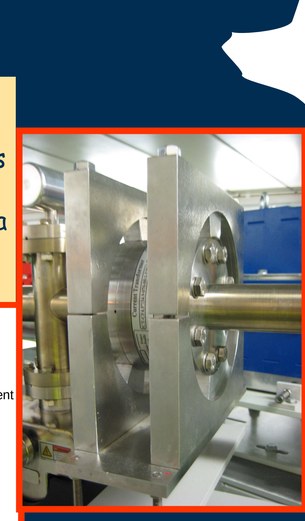
Optical Transition Radiation (OTR)
Light is emitted when a charged particle crosses the interface of two media with different dielectric constant. Transverse beam spatial distribution is measured. Good for high beam current.

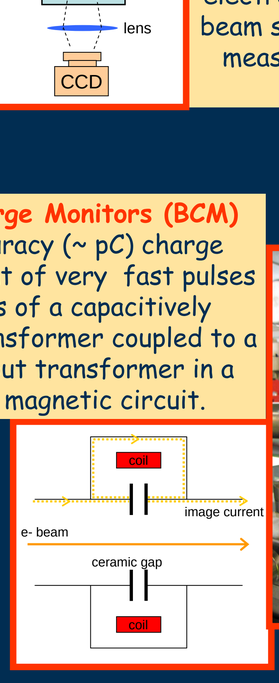


Fluorescence Screens (FS)
A fluorescencent material (typically YAG:Ce) produces light upon collision with the electron beam. Transverse beam spatial distribution is measured. Good for low beam current.



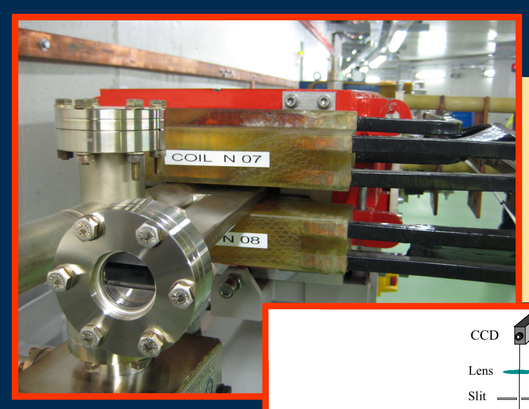
Beam Charge Monitors (BCM)
High accuracy (~ pC) charge measurement of very fast pulses by means of a capacitively shorted transformer coupled to a fast readout transformer in a common magnetic circuit.



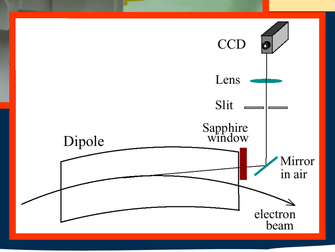


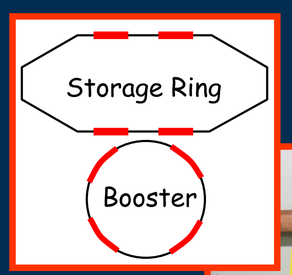
		Diagnostic Element	Linac	LTB	Booster	BTS	Storage Ring
			Diagnostics distribution along ALBA				
Kind of Measurement							
Bunch Length	Beam Current and Charge	AE		1	1		1
		DCCT			1		1
		FCUP	1	1			
		BCM	1	2			
Beam Shape and Size		FCT	6	3	1	2	1
		FSH			1		2
		FS/OTR	3	3	4	3	4
		SRM		1	3	2	2 (X-ray pinhole)
		SCR		3			2
Betatron Tunes	Beam Position	BPM	1	3	46	4	123
		Striplines			2		1

Striplines Provide beam position information with better sensitivity than a BPM. In addition, using two striplines betatron tunes can be measured. The first stripline excites the beam with an electric kick, whereas the second one detects the transverse oscillations and infer the tune frequency.



Synchrotron Radiation Monitor (SRM)
Infers the electron beam size by analyzing the synchrotron radiation produced when the beam passes through a bending magnet. A pinhole system is used additionally at the Storage Ring to improve in image resolution.





Beam Position Monitor (BPM)
Strategically placed electrodes inside the vacuum chamber provide spatial information of the electron beam.