



<b>LCLS Physics</b>		
<b>Requirements Document #</b>	<b>1.3-009</b>	<b>Linac</b>
		<b>Revision 0</b>
<b><u>X-BAND RF REQUIREMENTS</u></b>		
Peter McIntosh (Author)	_____	_____
	Signature	Date
Eric Bong (System Manager)	_____	_____
	Signature	Date
Paul Emma (System Physicist)	_____	_____
	Signature	Date
John Galayda (Project Director)	_____	_____
	Signature	Date

**Brief Summary:** This specification summarizes RF requirements for the X-band RF system used to linearize the energy gradient across each bunch prior to the BC1 bunch compressor.

**Keywords:** Linac, X-band RF

**Key WBS#'s:** 1.3.6

## X-Band RF System Requirements

The X-Band RF system (LINAC -X) is located between the LINAC-1 section and the first bunch compressor chicane BC-1 (see Figure 1).

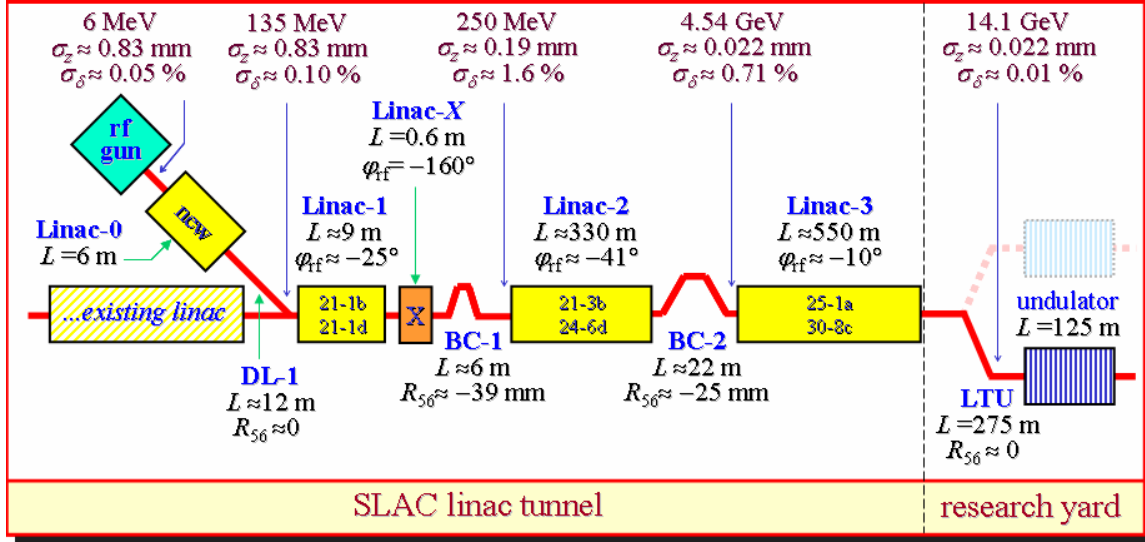


Figure 1 LCLS LINAC RF System Layout

A 60cm long X-band structure is used to linearize the energy-time correlation (or gradient) across each bunch from L0 and L1. The system operates on the negative RF crest to decelerate the beam, reducing the non-linear components of the correlation which allows for more efficient compression in both bunch compressor chicanes BC-1 and BC-2. These non-linear correlation components, if left to propagate, will initiate coherent synchrotron radiation (CSR) instabilities in the chicanes, resulting in large current spikes at the head and tail of each bunch. The decelerating field in the X-band structure will be achieved by operating at  $-160^\circ$  off the RF crest. To provide the decelerating field, the structure needs to operate at a 32 MeV/m gradient, which equates to a decelerating voltage of 19 MV. The beam energy exiting the X-band structure will be 250 MeV, from a nominal input energy of 268 MeV. Table 1 shows the RF system requirements for both the accelerating structure and the klystron.

Table 1 RF System Parameters and Stability

Parameter	Target (Nom)	NLCTA (Nom)	Units
Structure Length	60	60	cm
Structure Voltage	19	<b>30</b>	MV
Phase	-160	-	deg
Klystron Power	21	50	MW
Repetition Rate	120	60	Hz
Duty Cycle	0.1	1.6	ms

The X-band RF station will comprise an XL-4 klystron and modulator system, feeding power through a WR293 mode converter into the accelerator tunnel, where it is converted back into WR90 waveguide and fed into the X-band structure (see Figure 2). RF power for the accelerating structure will be provided using a XL-4 (50 MW) X-Band klystron of the same variety currently used for NLCTA. Successful operation of this klystron has been shown up to 60 Hz at full power; however its operation for LCLS at 120 Hz at < 50% full power is not thought to be a problem for this device.

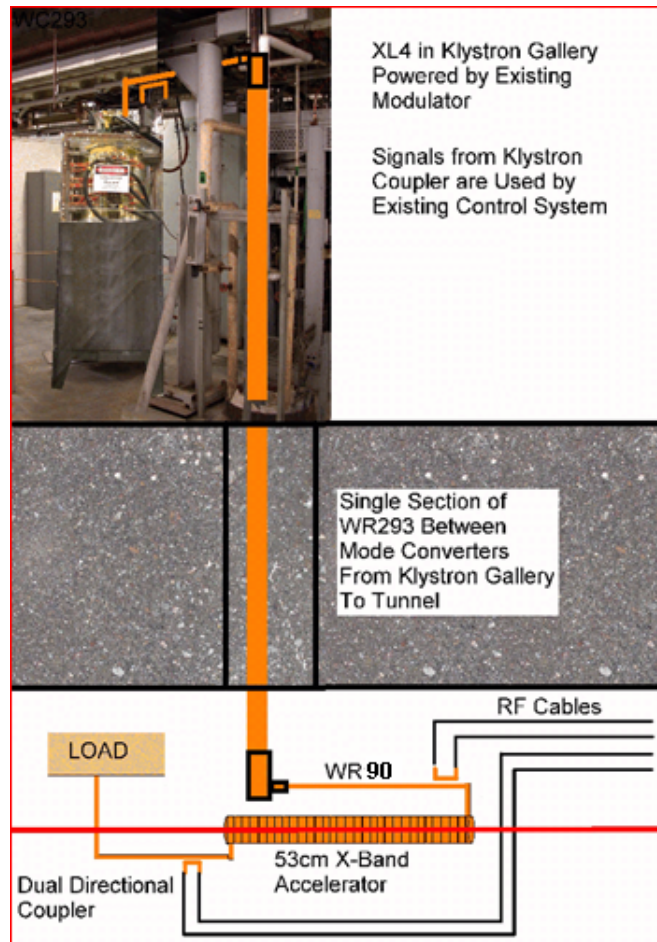


Figure 2 X-Band RF Station Layout

The stability requirements for the X-Band RF system, in order to achieve efficient bunch compression in BC-1 and BC-2, are  $0.5_{X\text{-band}}^{\circ}$  in phase and 0.25% in amplitude.