LCLS Physics Requirements Document # 1.3-017	Linac	Revision 0

ADJUSTABLE COLLIMATOR REQUIREMENTS

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Brief Summary:
This document describes adjustable collimator requirements for the LCLS accelerator. The collimators are used for energy collimation and charge halo reduction, mostly to protect the permanent magnet undulator from radiation damage. The 'primary' (*i.e.*, first-pass) betatron collimators are presently installed in sectors 29-30 of the SLAC linac, whereas the energy and secondary betatron collimators are new devices to be installed in the LCLS Linac-To-Undulator (LTU) beamline.

Change History Log:

Rev Number	Revision Date	Sections Affected	Description of Change
000	Sep. 5, 2005	All	Initial Version

Overview

Each collimator station is a pair of movable, opposing jaws that can be independently positioned transverse to the local beam direction. Each pair collimates the beam in either the *x* (horizontal) or *y* (vertical) direction. There are 18 pairs of movable collimator jaws in the LCLS accelerator, 8 of which already exist in the SLAC linac in sectors 29-30 [1].

Table 1. Summary of collimators in the LCLS.

Area	BC1	BC2	*LI29*	*LI30*	LTU	**Total**
Movable Collimator Jaw Pairs	1	1	*4**	*4**	8	**18**

* these are existing, installed collimators [1]

Requirements

1. Each collimator jaw is approximately 2 radiation lengths long, which for a Titanium jaw amounts to about an 8-cm length (in the beam direction), as designed and applied in sectors 29-30 of the SLAC linac [1].
2. Each jaw surface (facing the electron beam) should be coated with a thin (1-2 microns) layer of Titanium-Nitride (TiN, or equivalent) for durability and high electrical conductivity [1].
3. Each jaw is remotely adjustable in transverse position, independent of its opposing jaw:
    a. Each collimator has an adjustable gap-width between the jaws; specifically, both jaws are moveable in unison to adjust the gap, but keep the center position constant.
    b. Each collimator has an adjustable gap center; specifically, both jaws are moveable in unison while providing a constant gap width.
    c. A jaw 'over-travel' will allow the gap center to be displaced several millimeters from the nominal collimator center, while still limiting the minimum gap (see Table 2 and Figure 1 below).
4. Collimator jaws shall not touch one another during or after motion; specifically, the gap between the jaws shall never be less than a pre-determined minimum distance (see Table 2 below).
5. Collimator jaws shall not take more than about 10 seconds to travel their maximum distance.
6. Collimator jaws may need to be water cooled:
    a. The collimators must be able to absorb the full beam power, but at an MPS-reduced repetition rate of 10 Hz, amounting to up to 200 Watts of average power.
    b. Water temperature and flow measurements should be provided and integrated with the Machine Protection System (MPS). The beam will be rate limited if the temperature exceeds a threshold specified in the database and shutoff completely if the temperature continues to rise above a second threshold.
    c. Local beam loss should be measured and integrated with the MPS. The rate limiting and automated shutoff of the beam are described separately in the MPS requirements document.

7. For the new LCLS collimators (the sector 29-30 collimators are already complete and installed), the following parameters and jaw adjustability apply (see Table 2).

Table 2. Collimator parameters and jaw adjustability requirements.

Coll. Name	Area	Coll. function	Nom. beam energy [GeV]	Jaw motion axis	rms beam size* [mm]	Min. full gap [mm]	Nom. full gap [mm]	Max. full gap [mm]	Min. jaw step size [mm]	Jaw over-travel [mm]
CE11	BC1	energy	0.25	*x*	3.6	1	90	100	0.2	10
CE21	BC2	energy	4.3	*x*	2.5	1	72	80	0.2	10
C29096	Sec-29	*y*	10.6	*y*	0.055	**	3.2	**	**	**
C29146	Sec-29	*x*	10.8	*x*	0.055	**	3.2	**	**	**
C29446	Sec-29	*y*	11.3	*y*	0.055	**	3.2	**	**	**
C29546	Sec-29	*x*	11.5	*x*	0.055	**	3.2	**	**	**
C30096	Sec-30	*y*	12.1	*y*	0.055	**	3.6	**	**	**
C30146	Sec-30	*x*	12.3	*x*	0.055	**	3.6	**	**	**
C30446	Sec-30	*y*	12.9	*y*	0.055	**	3.6	**	**	**
C30546	Sec-30	*x*	13.1	*x*	0.055	**	3.6	**	**	**
CEDL1	LTU	energy	13.6	*x*	0.060	0.4	5.0	20	0.02	2
CEDL3	LTU	energy	13.6	*x*	0.060	0.4	5.0	20	0.02	2
CX31	LTU	*x*	13.6	*x*	0.055	0.4	4.4	20	0.02	2
CY32	LTU	*y*	13.6	*y*	0.055	0.4	4.4	20	0.02	2
CX35	LTU	*x*	13.6	*x*	0.055	0.4	4.4	20	0.02	2
CY36	LTU	*y*	13.6	*y*	0.055	0.4	4.4	20	0.02	2
CX37	LTU	*x*	13.6	*x*	0.050	0.4	4.6	20	0.02	2
CY38	LTU	*y*	13.6	*y*	0.070	0.4	6.4	20	0.02	2

* RMS beam sizes are measured in the direction of jaw motion (*i.e.*, jaw translation direction)
** Collimator is an existing design with adequate jaw adjustability.

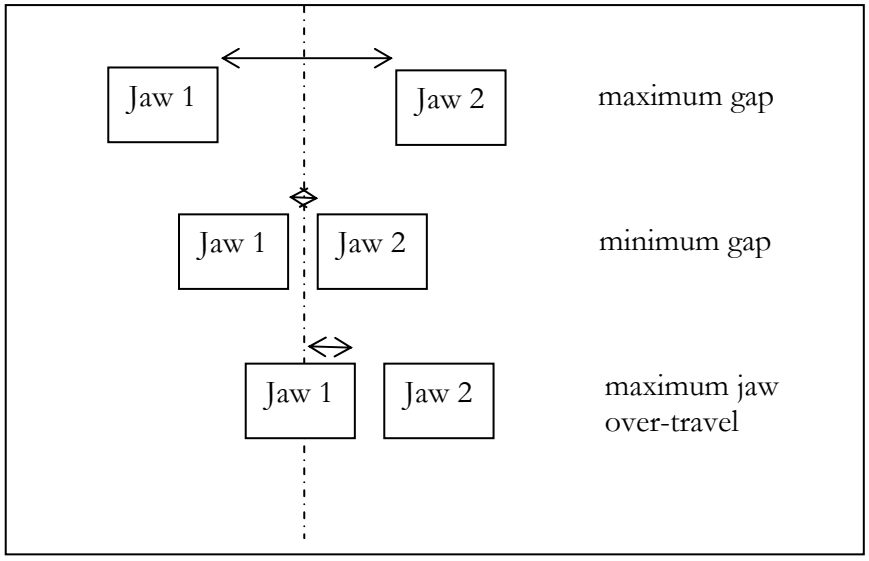

Figure 1: Illustration of collimator jaw position limits from Table 2, with reference to the beam center line.

[1] F.-J. Decker *et al.*, *Design and Wakefield Performance of the New SLC Collimators*, Proceedings of the XVIII International Linac Accelerator Conference, Geneva, Switzerland, August 26-30, 1996. http://accelconf.web.cern.ch/accelconf/l96/PAPERS/MOP35.PDF