

# SLAC MEMORANDUM

RP-RPG-080606-MEM-01

---

**DATE:** June 6, 2008

**TO:** Hal Tompkins, Javier Sevilla (LCLS)

**FROM:** Joachim ~~Vollaire~~ and Alyssa Prinz (RPG)

**Via:** Sayed Rokni, (RSO) *SR*

---

**SUBJECT: Shielding recommendations for the walls of the FEH hutches**

---

The minimum wall thickness necessary to reduce the dose rate to 0.05 mrem/h when an experiment is being carried out in one of the hutches of the Far Experimental Hall has been calculated with the codes FLUKA and STAC8 for different materials.

No bremsstrahlung photons is assumed to enter the FEH hutches and only synchrotron radiation (spontaneous + FEL) was considered as the radiation source. The spontaneous photon spectra used in the calculation were taken from Ref. [1] for electron beam energies of 13.64 and 17 GeV. A Linac charge of 1 nC/bunch and a repetition rate of 120 Hz were considered. The spectra in Ref. [1] take into account the aperture of the C1 collimator (5 mm) which significantly reduces the spontaneous photon power. In addition, the attenuation of the two SiC mirrors (M1H and M2H) of the OMS of the hard X-ray line is also taken into account. The effect of other collimator apertures downstream of C1 (C2H, C4H, C5H, C6H with a 3 mm aperture), the M1H and M2H mirrors acceptance, as well as the attenuation of mirrors or crystal in the X-Ray Tunnel, were not considered.

FEL photons pass unobstructed through the different apertures of the OMS while attenuation of the mirrors becomes significant starting at the second odd harmonic and is taken into account in the source term described in Ref. [1]. While an important fraction of the synchrotron radiation power is carried out by FEL photons from the first harmonic (8.27 keV for the 13.6 GeV electron beam) after the OMS, the shielding requirement is dominated by more penetrating spontaneous photons in the 20 to 40 keV range [2].

In the shielding calculations, a tilted 1-cm-thick silicon slab was used as a scattering target for synchrotron radiation. The thickness of concrete, iron or lead necessary to reduce the dose rate to 0.05 mrem/h was calculated assuming a standard 1-meter distance between the target and the lateral and downstream walls. Table 1 summarizes the recommended lateral (side and roof) and downstream wall thicknesses for the three materials considered based on the synchrotron radiation spectra produced by 13.6 GeV and 17 GeV electron beams. For walls located closer to the beam pipe than 1-meter, values in Table 1 can not be used and the recommended thickness has to be evaluated by the Radiation Physics group.

**Table 1 Recommended minimum wall thickness for wall located at 100 cm from the synchrotron radiation scattering target based on the spontaneous and FEL spectra described in Ref. [1]**

	Electron Energy (GeV)	Lead [mm]	Iron [mm]	Concrete [mm]
Lateral wall (100 cm)	13.6	0.18	0.94	19
	17	0.19	1.03	21
Downstream wall (100 cm)	13.6	0.68	4.6	73
	17	0.90	6.2	88

**References**

1. P, Stefan, "*Estimation of the XTOD Beam Line Photon Spectra*", LCLS ESD 1.5-127, April 1, 2008.
2. J. Vollaire and A. Prinz, "*Comparison of FLUKA and STAC8 for shielding calculations of the hard X-ray line of the LCLS*", RP Note 08-Draft, June ,2008.

**c.c.: John Arthur, Richard M. Boyce, Stan Mao, James Liu, Mario Santana, Johannes Bauer, RP file**

**Attachment(s):**

none