HIGS Flux Performance Table, DFELL, Feb 04, 2009, Version (1.0)

HIGS Flux Performance Projection (2009 – 2011)	Total Flux [g/s] CW Operation Two-Bunch (*)	Collimated Flux ($\Delta E_\gamma / E_\gamma$ = 3% FWHM) (%, @)	FEL λ [nm]	Comment
No Loss Mode < 20 MeV				Both Linear and Circular Polarization
E_γ = 1 – 2 MeV (E_e = 0.237 – 0.335 GeV)	1 x 10^8 – 4 x 10^8	4 x 10^6 – 1.6 x 10^7	1064	Comments (a), (b)
E_γ = 2 – 2.9 MeV (E_e = 0.335 – 0.404 GeV)	4 x 10^8 – 1 x 10^9	1.6 x 10^7 – 4 x 10^7	1064	Comments (a), (b)
E_γ = 2 – 3 MeV (E_e = 0.288 – 0.353 GeV)	2 x 10^8 – 6 x 10^8	8 x 10^6 – 2.4 x 10^7	780	Comments (a), (b)
E_γ = 3 – 5.4 MeV (E_e = 0.353 – 0.474 GeV)	6 x 10^8 – 2 x 10^9	2.4 x 10^7 – 8 x 10^7	780	Comments (a), (b)
E_γ = 5 – 8 MeV (E_e = 0.380 – 0.481GeV)	4 x 10^8 – 1 x 10^9	1.6 x 10^7 – 4 x 10^7	540	Comments (a), (b)
E_γ = 8 – 11.1 MeV (E_e = 0.481 – 0.567 GeV)	1 x 10^9 – 2 x 10^9	4 x 10^7 – 8 x 10^7	540	Comments (a), (b)
E_γ = 8 – 11.0 MeV (E_e = 0.439 – 0.516 GeV)	5 x 10^8 – 1 x 10^9	2 x 10^7 – 4 x 10^7	450	Comments (a), (b)
E_γ = 11 – 16.0 MeV (E_e = 0.516 – 0.624 GeV)	1 x 10^9 – 2 x 10^9	4 x 10^7 – 8 x 10^7	450	Comments (a), (b)
Loss Mode > 20 MeV				Circular Polarization
E_γ = 21 – 45 MeV (E_e = 0.547 – 0.808 GeV)	~ 2 x 10^8	~ 8 x 10^6	260	Comments (c)
E_γ = 21 – 60 MeV (E_e = 0.526 – 0.901 GeV)	~ 2 x 10^8	~ 8 x 10^6	240	Comments (c), (d)
E_γ = 50 – 95 MeV (E_e = 0.738 – 1.03 GeV)	~ 1 x 10^8	~ 4 x 10^6	193	Comments (c), (e)

(a) As mirrors degrade significantly due to wiggler radiation, the gamma flux can decrease below the listed numbers. Operating in circular polarization slows mirror degradation.

(b) With new FEL mirrors, the flux of circularly polarized gamma beam can be few times higher than the listed numbers.

(c) The flux is currently limited by the capability of sustaining a high intra-cavity power by the FEL mirrors and electron injection rate.

(d) This requires the purchase of new FEL mirrors. User operation in this energy range is expected as early as Q2, 2010.

(e) This requires the purchase of new FEL mirrors. User operation in this energy range is expected as early as Q2, 2011.

(*) The flux numbers are projected for a continuous wave (CW) FEL operation with two symmetric electron bunches in the high-flux mode. The gamma flux will be different in other operation modes, including the high-resolution mode, and giant-pulse mode.

(%) The energy resolution for the collimated gamma beam depends on parameters of electron and FEL beams, as well as the size of the collimator opening aperture. The 3% FWHM flux in the table is used here for the purpose of illustration only. Using a given FEL mirror set, the portion of the gamma flux selected by the collimator is inversely proportional to the gamma beam energy.

(@) It is critical to match the experimental sample and collimated gamma beam. A useful formula to estimate the portion of the gamma-ray beam after collimation is:

$$\frac{\text{Collimated Flux}}{\text{Total Flux}} = a * \left[\frac{\text{Ee [MeV]}}{0.511} * \frac{\text{r [mm]}}{6*10^4}\right]^2, \qquad a \sim 1.2 \text{ to } 1.4,$$

where Ee is the electron energy in MeV and r is the radius of the collimating aperture in mm. The distance between the collision point and the collimator is about 60 meters for the existing collimator hut (2009).