P61 BEAMLINE

31-01-2018

Calculations of beamline characteristics

Version 2.3
P61 Beamline

CALCULATIONS OF BEAMLINE CHARACTERISTICS

PHOTON FLUX FROM 10 WIGGLERS FOR P61

Flux from each wiggler starting from 133m away

1 mm x 1 mm aperture
FILTERED FLUX FOR P61A

Flux (ph/s/0.1%bw.) vs. Energy (keV) for different filter configurations on P61A. The plot shows the filtered flux for P61A with varying numbers of FE filters and an additional 4 mm C filter. The total flux at HZG and at 100m at the end of the optics hutch is also shown.
P61 Beamline

CALCULATIONS OF BEAMLINE CHARACTERISTICS

FILTERED FLUX FOR P61B

![Graph showing filtered flux for P61B](image-url)
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CALCULATIONS OF BEAMLINE CHARACTERISTICS

BEAM SIZE ESTIMATION BY FLUX COMPARISON

![Graph showing beam size estimation by flux comparison](image-url)
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CALCULATIONS OF BEAMLINE CHARACTERISTICS

COMPARISON OF FLUX WITH OTHER WIGGLER AND BENDING MAGNET HIGH-PRESSURE BEAMLINES

![Graph showing flux comparison with other beamlines](image-url)

- 28-ID-2 (developing) - NSLS2
- P61B - FS-PEX (10 wigglers)
- X17B2 - NSLS (decommissioned)
- BL04B1 - SPring-8
- 6-BM - APS
- XAS, D-DIA - Australia (developing)
**P61 Beamline**

**CALCULATIONS OF BEAMLINE CHARACTERISTICS**

**COMPARISON OF FLUX WITH EXISTING HIGH-PRESSURE BEAMLINES, INCLUDING ID06 AT ESRF**

NATURALLY, UNDULATOR FLUX AT ESRF IS VERY HIGH, EVEN AFTER A MONOCHROMATOR (FACTOR X10 LESS). HOWEVER, ONLY AD-XRD IS POSSIBLE AT FIXED ENERGY, SO SOME STUDIES ON AMORPHOUS, LIQUID AND LOW-Z MATERIALS WOULD BE CHALLENGING.
FLUX DENSITY PROFILES FOR PEAK FLUX AT 50 KEV

Beam size at P61B
P61 Beamline

CALCULATIONS OF BEAMLINE CHARACTERISTICS

COMPARISON OF FLUX DENSITY WITH OTHER WIGGLER AND BENDING MAGNET BEAMLINES
COMPARISON OF GAUSSIAN APPROXIMATED (G.A.) BRILLIANCE WITH OTHER WIGGLER AND BENDING MAGNET BEAMLINES
CUMULATIVE POWER DENSITY FROM ALL WIGGLERS

Power per unit solid angle (kW/mrad^2)

Horizontal distance (mm)

Power density at PS in P61B OH (133 m from last wiggler)

Power density (W/mm^2)
CUMULATIVE POWER FROM ALL WIGGLERS AFTER 1 X 1 mm² APERTURE IN FRONT END (85.5 M) AND AT P61B OH (133 M)

Total power assuming:
1 x 1 mm² aperture in Front End
TOTAL UNFILTERED POWER FROM ALL WIGGLERS FOR RANGE OF APERTURES IN PS AT P61B OH (133 M)

Max. power at 85.5 m thru 1 x 1 mm²

Max. approx. beam size (1.15x1.15)

Max. approx. beam size (1.5x1.5)
TOTAL FILTERED POWER (INCL. 0.5 MM AL EXIT WINDOW),
IN P61A OH (100 M)

Total power at P61A OH (100 m from last wiggler)
P61 Beamline

**CALCULATIONS OF BEAMLINE CHARACTERISTICS**

**TOTAL FILTERED POWER (INCL. 0.5 MM AL EXIT WINDOW), IN P61B EH (139 M) TO CMOS CAMERA/BEAMSTOP**

Total power to beam stop / CMOS camera at P61B EH (139 m from last wiggler)

![Graph showing total power to beam stop vs. aperture with various filter configurations.]
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CALCULATIONS OF BEAMLINE CHARACTERISTICS

FILTERED POWER COMPARISON P61B WITH BL04B1 BEAMLINE AT SPRING-8

![Diagram showing power comparison between P61B and BL04B1 with various filter configurations.](image-url)

- **P61B**: 139 m from source
- **BL04B1**: 30 m from source

**Known 'safe' operation of sCMOS camera**

- FE filters (3x) + 0.5 mm Al
- FE filters (3x) + 0.5 mm Al + 4 mm C
- FE filters (3x) + 0.5 mm Al + 4 mm SiC
- FE filters (3x) + 0.5 mm Al + 8 mm SiC

Typical max. beam size at BL04B1 ->

- 2.7 mm Al
- 30 mm Al
- 50 mm Al

**BL04B1 SPRing-8 Japan**
DENSAMET ($W_{95}Ni_{3}Fe_{2}$) BLADE THICKNESS FOR POWER SLITS IN P61B EH AT ~133M TO NEARLY ABSORB ALL X-RAYS

Flux vs slit blade thickness (mm) for 1.5 x 1.5 mm² beam size at 133m in P61B OH

This result should be equivalent at P61A at 100m for beam size of 1.15 mm x 1.15 mm!
## Summary

<table>
<thead>
<tr>
<th>Source</th>
<th>ID</th>
<th>Total power (kW)</th>
<th>Power density (W mm$^{-1}$)</th>
<th>Notes</th>
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<tr>
<td>PETRA III</td>
<td>DW</td>
<td>210</td>
<td>&gt; 34</td>
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<td>FE + 4 mm C</td>
<td>−0.034</td>
<td>15</td>
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<td>+ 50 mm Al</td>
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<td>0.5 (filtered)</td>
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<td>NSLS2</td>
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<td>0.6 (filtered)</td>
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<td>BM</td>
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<td>DW</td>
<td>8.5</td>
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BEAM SIZE

P61 Wiggler beamline
SHADOW3 X-ray tracing
29/01/2018
R. Farla
Beam size in red
Beam divergence in blue

Source (last wiggler) magnified x100

Machine Parameters
- Electron Energy [GeV]: 6.0
- Electron Current [mA]: 100.0
- Use Emittance?: Yes
- Sigma X [cm]: 0.01275
- Sigma Z [cm]: 0.001275
- Emittance X [rad.cm]: 1e-07
- Emittance Z [rad.cm]: 1e-09
- Distance from Waist X [cm]: 0.0
- Distance from Waist Z [cm]: 0.0

Electron Beam Parameters
- Shift Transversal Velocity: No shift
- Shift Transversal Coordinate: Half excursion

Wiggler Parameters
- Type: conventional sinusoidal
- Number of Periods: 19
- K value: 28.4
- ID period [m]: 0.2

529.92 mm x 14.82 mm
No slits

HZG - P61A
100 m - OH
1.1 mm x 1.1 mm

0.335 mm x 0.028 mm
3.99 mrad x 0.11 mrad

85.5 m

1 mm x 1 mm
High-powered slits

0.023 mrad x 0.023 mrad

47.5 m

1.5 mm x 1.5 mm

LVP - P61B
HP slits in OH
0.05 - 1.5 mm
x 0.05 - 1.5 mm

133 m