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APS Undulator and Wiggler Sources: Monte-Carlo Simulation

by S. L. Xu, B. Lai, and P. J. Viccaro

Advanced Photon Source

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by S. L. Xu, B. Lai, and P. J. Viccaro
Experimental Facilities Division
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February 1992

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INTRODUCTION

Standard insertion devices will be provided to each sector by the Advanced Photon Source. It is important to define the radiation characteristics of these general purpose devices. In this document, results of Monte-Carlo simulation are presented. These results, based on the SHADOW program,¹ include the APS Undulator A (UA), Wiggler A (WA), and Wiggler B (WB).

In an undulator, the energy tuning is accomplished by changing the magnetic gap opening. Fig. 1 shows the first harmonic energy and the deflection parameter K, as a function of the magnetic gap size for Undulator A. Note that by varying the magnetic gap, the first harmonic energy may be tuned from 4.5 keV to 13.5 keV, which corresponds to a change in K from 2.1 to 0.3. The brilliance of the first and the third harmonic were calculated for this range of K values, and the spectra are displayed in Fig. 2. Very high brilliance on the order of 10^{18} is generally obtained from the first harmonic, while the third harmonic extends the spectral range up to 40 keV. The parameters of Undulator A used for this calculation are listed in Table 1, and the energies of the first 3 harmonics computed using:

$$E = \frac{n h c \gamma^2}{\lambda_u (1 + K^2/2)} \quad n = 1, 2, 3$$

are listed in Table 2.

To adequately handle and make efficient use of this unprecedented brilliance in the hard x-rays, detailed information about its spatial distribution is needed. For this purpose, the angular

¹ B. Lai and F. Cerrina, *Nucl. Instr. and Meth.* **A246**, 337 (1986); B. Lai, K. Chapman and F. Cerrina, *Nucl. Instr. and Meth.* **A266**, 544 (1988).

distribution of x-rays produced by Undulator A has been simulated here (see Figs. UA1 - UA57) for K ranging from 2.1 to 0.3 in steps of 0.1. For each K , the radiation pattern in angular space (x',y') was modeled at the first 3 harmonic energies using an undulator modeling method described previously.² In each figure, the APS beam emittance case is shown together with the limiting case of zero emittance, so that contribution from higher harmonics and effects of emittance broadening may be easily identified. Note that in most cases, the central cone is dominated by the beam divergence. These angular plots, when multiplied by the distance from the source, represent the spatial flux pattern obtained in the far-field regime. For the near-field region, the spatial distribution is further broadened by the finite source size in x and y (besides the zero-emittance pattern is more complex).³ A program to take into account the near-field effects is being developed at APS. Each diagram is generated with 1000 rays and is displayed over an angular limit of 1 mrad by 1 mrad in x' and y' . Because a fixed number of rays (1000) is always used in creating the angular plots, they do not show the relative intensity variation between the harmonics. That information is contained in Fig. 2.

In the second part, similar angular plots for the two wigglers are presented (Figs. WA1 - WA8 and WB1 - WB8). Wiggler A (WA), with critical energy of 32.6 keV, is optimized for the high-energy region and will extend the spectral range to 200 keV and above (Fig. 3). Wiggler B (WB), on the other hand, is designed for the low-energy region with $E_c = 9.8$ keV (Fig. 4). Because the radiation from a wiggler is more spread out in the horizontal direction x' , all the

² K. Chapman, B. Lai, F. Cerrina and P. J. Viccaro, *Nucl. Instr. and Meth.* **A283**, 88 (1989).

³ See for instance R. P. Walker, *Nucl. Instr. and Meth.* **A267**, 537 (1988).

angular diagrams are plotted over a wider limit of 2.5 mrad by 2.5 mrad. The actual extent of the ray distribution is determined by K/γ . Thus, since WA has larger K than WB, the photons are distributed over 2 mrad for WA versus 1 mrad for WB. As for the spread in the vertical direction y' , note that the photons are confined within smaller and smaller angles as the photon energy increases, which is similar to bending magnet radiation. The parameters used in the wiggler calculation are listed in Table 3.

Fig. 1 First harmonic energy and deflection parameter K as a function of the magnetic gap for Undulator A.

Fig. 2 On-axis brilliance of Undulator A. The spectral distribution of the first 3 harmonics are shown for the case of $K = 0.3$ (solid line) and $K = 2.1$ (dotted line). The overall envelope of the first and the third harmonic for the K -values in between are showed in dashed lines.

Fig. 3 Angle integrated flux for Wiggler A.

Fig. 4 Angle integrated flux for Wiggler B.

Table 1. Parameters of Undulator A used in calculation

λ_0	3.3 cm
K	0.3 - 2.1
N	70 periods
E_b	7.0 GeV
I_b	100 mA
σ_x	0.308 mm
σ_y	0.085 mm
$\sigma_{x'}$	24 μ rad
$\sigma_{y'}$	9 μ rad
$\Delta E/E$	0.1% Bandwidth
Maximum angle	0.3 mrad

Beam Emittance	UAS-0	zero
	UAS-1	$\epsilon_x = 7.3, \epsilon_y = 0.73$ nm-rad

Table 2. Energy of the first 3 harmonics for Undulator A

K =	1 st harmonic	2 nd harmonic	3 rd harmonic
2.1	4.40	8.80	13.20
2.0	4.70	9.40	14.10
1.9	5.03	10.06	15.08
1.8	5.38	10.77	16.15
1.7	5.77	11.54	17.30
1.6	6.19	12.37	18.56
1.5	6.64	13.27	19.91
1.4	7.12	14.24	21.37
1.3	7.64	15.29	22.93
1.2	8.20	16.40	24.60
1.1	8.79	17.57	26.36
1.0	9.40	18.80	28.20
0.9	10.04	20.07	30.11
0.8	10.68	21.37	32.05
0.7	11.33	22.65	33.98
0.6	11.95	23.90	35.85
0.5	12.54	25.07	37.61
0.4	13.06	26.12	39.17
0.3	13.50	26.99	40.49

Table 3. Parameters of Wiggler A and Wiggler B used in calculation

	WA	WB
λ_0	15 cm	25 cm
K	14	7
N (periods)	10	20
E_c	32.57 keV	9.77 keV
2θ	2 mrad	1 mrad
E_b	7 GeV	
I_b	100 mA	
$\Delta E/E$	0.1% Bandwidth	
σ_x	0.308 mm	
σ_y	0.085 mm	
$\sigma_{x'}$	24 μ rad	
$\sigma_{y'}$	9 μ rad	
ϵ_x	7.3 nm-rad	
ϵ_y	0.73 nm-rad

APS UNDULATOR A

RAY-TRACING RESULTS

USER\$DISK:[XUS.SHADOW]BEGIN.DAT;7

10-APR-1991 08:51

UAS 0 K=2.1F E=4.4ke

V

10-APR-91 08:53:04
H Length 0.10000E-02
H center 0.00000E+00
V Length 0.10000E-02
V center 0.00000E+00
AUTOSCALING
--GOOD ONLY
TOT = 1000
LOST = 0
Horizontal: 4
Vertical: 6

USER\$DISK:[XUS.SHADOW]BEGIN.DAT;8

10-APR-1991 08:55

UAS-1 K=2.1F E=4.4ke

V

10-APR-91 08:56:37
H Length 0.10000E-02
H center 0.00000E+00
V Length 0.10000E-02
V center 0.00000E+00
AUTOSCALING
--GOOD ONLY
TOT = 1000
LOST = 0
Horizontal: 4
Vertical: 6

Fig. UA-1. The angular pattern at the first harmonic ($h\nu = 4.40$ keV) for $K = 2.1$. The zero-emittance case is shown on the top (UAS-0), while the bottom part shows the case for APS emittance (UAS-1). The limits for each plot are 1 mrad x 1 mrad.

USER#DISK:(XUS.SHADOW)BEGIN.DAT;1

10-APR-1991 13:38

UAS-0 K=2.1s E=8.8ke
V

10-APR-91 13:39:35	
H Length	0.10000E-02
H center	0.00000E+00
V Length	0.10000E-02
V center	0.00000E+00
AUTOSCALING	
--GOOD ONLY	
TOT	1000
LOST	0
Horizontal:	4
Vertical:	6

USER#DISK:(XUS.SHADOW)BEGIN.DAT;2

10-APR-1991 13:41

UAS-1 K=2.1s E=8.8ke
V

10-APR-91 13:43:03	
H Length	0.10000E-02
H center	0.00000E+00
V Length	0.10000E-02
V center	0.00000E+00
AUTOSCALING	
--GOOD ONLY	
TOT	1000
LOST	0
Horizontal:	4
Vertical:	6

Fig. UA-2. K = 2.1, second harmonic.

USER#DISK:[XUS.SHADOW]BEGIN.DAT;3

10-APR-1991 14:05

UAS-0 K=2.1T E=13.2k
eV

10-APR-91 14:06:35	
H Length	0.10000E-02
H center	0.00000E+00
V Length	0.10000E-02
V center	0.00000E+00
AUTOSCALING	
--GOOD ONLY	
TOT -	1000
LOST -	0
Horizontal:	4
Vertical:	6

USER#DISK:[XUS.SHADOW]BEGIN.DAT;4

10-APR-1991 14:13

UAS-1 K=2.1T E=13.2K
EV

10-APR-91 14:17:15	
H Length	0.10000E-02
H center	0.00000E+00
V Length	0.10000E-02
V center	0.00000E+00
AUTOSCALING	
--GOOD ONLY	
TOT -	1000
LOST -	0
Horizontal:	4
Vertical:	6

Fig. UA-3. K = 2.1, third harmonic.

USER#DISK:[XUS.SHADOW]BEGIN.DAT;7

22-MAR-1991 15:01

UAS-0 K=2.0 E=4.7keV

USER#DISK:[XUS.SHADOW]BEGIN.DAT;8

22-MAR-1991 15:07

UAS-1 K=2.0 E=4.7keV

Fig. UA-4. K = 2.0, first harmonic.

USER:DISK:(XUS.SHADOW)BEGIN.DAT;9

22-MAR-1991 15:22

UAS-0 K=2.0 E=9.4keV

22-MAR-91 15:24:45	
H Length	0.10000E-02
H center	0.00000E+00
V Length	0.10000E-02
V center	0.00000E+00
AUTOSCALING	
--GOOD ONLY	
TOT	1000
LOST	0
Horizontal:	4
Vertical:	6

USER:DISK:(XUS.SHADOW)BEGIN.DAT;11

22-MAR-1991 15:41

UAS-1 K=2.0 E=9.4keV

22-MAR-91 15:42:35	
H Length	0.10000E-02
H center	0.00000E+00
V Length	0.10000E-02
V center	0.00000E+00
AUTOSCALING	
--GOOD ONLY	
TOT	1000
LOST	0
Horizontal:	4
Vertical:	6

Fig. UA-5. K = 2.0, second harmonic.

USER#DISK:[XUS.SHADOW]BEGIN.DAT;14

22-MAR-1991 16:16

UAS-0 K=2.0 E=14.1ke
V

USER#DISK:[XUS.SHADOW]BEGIN.DAT;13

22-MAR-1991 16:02

UAS-1 K=2.0 E=14.1ke
V

Fig. UA-6. K = 2.0, third harmonic.

USER#DISK:(XUS)BEGIN.DAT;1

12-APR-1991 08:40

UAS-0 K=1.9F E=5.03k

eV

12-APR-91 08:41:57	
H Length	0.10000E-02
H center	0.00000E+00
V Length	0.10000E-02
V center	0.00000E+00
AUTOSCALING	
--GOOD ONLY	
TOT -	1000
LOST -	0
Horizontal:	4
Vertical:	6

USER#DISK:(XUS)BEGIN.DAT;3

12-APR-1991 08:45

UAS-1 K=1.9F E=5.03k

eV

12-APR-91 08:47:17	
H Length	0.10000E-02
H center	0.00000E+00
V Length	0.10000E-02
V center	0.00000E+00
AUTOSCALING	
--GOOD ONLY	
TOT -	1000
LOST -	0
Horizontal:	4
Vertical:	6

Fig. UA-7. K = 1.9, first harmonic.

USER#DISK:(XUS)BEGIN.DAT;4

12-APR-1991 08:56

UAS 0 K=1.9s E=10.00
keV

12-APR-91 08:58:53	
H Length	0.10000E-02
H center	0.00000E+00
V Length	0.10000E-02
V center	0.00000E+00
AUTOSCALING	
--GOOD ONLY	
TOT -	1000
LOST -	0
Horizontal:	4
Vertical:	6

USER#DISK:(XUS)BEGIN.DAT;5

12-APR-1991 09:01

UAS-1 K=1.9s E=10.00
keV

12-APR-91 09:02:38	
H Length	0.10000E-02
H center	0.00000E+00
V Length	0.10000E-02
V center	0.00000E+00
AUTOSCALING	
--GOOD ONLY	
TOT -	1000
LOST -	0
Horizontal:	4
Vertical:	6

Fig. UA-8. K = 1.9, second harmonic.

USER#DISK:(XUS)BEGIN.DAT;6

12-APR-1991 09:12

UAS-0 K=1.9t E=15.08
keV

USER#DISK:(XUS)BEGIN.DAT;7

12-APR-1991 09:16

UAS-0 K=1.9t E=15.08
keV

Fig. UA-9. K = 1.9, third harmonic.

USER*DISK:[XUS.SHADOW]BEGIN.DAT;3

8-APR-1991 14:48

UAS-0 K=1.8F E=5.38k
eV

8-APR-91 14:49:48	
H Length	0.10000E-02
H center	0.00000E+00
V Length	0.10000E-02
V center	0.00000E+00
AUTOSCALING	
--GOOD ONLY	
TOT -	1000
LOST -	0
Horizontal:	4
Vertical:	6

USER*DISK:[XUS.SHADOW]BEGIN.DAT;4

8-APR-1991 14:53

UAS-1 K=1.8F E=5.38k
eV

8-APR-91 14:54:51	
H Length	0.10000E-02
H center	0.00000E+00
V Length	0.10000E-02
V center	0.00000E+00
AUTOSCALING	
--GOOD ONLY	
TOT -	1000
LOST -	0
Horizontal:	4
Vertical:	6

Fig. UA-10. K = 1.8, first harmonic.

USER#DISK:[XUS.SHADOW]BEGIN.DAT;5

8-APR-1991 15:19

UAS-0 K=1.8s E=10.76
keV

8-APR-91 15:20:47	
H Length	0.10000E-02
H center	0.00000E+00
V Length	0.10000E-02
V center	0.00000E+00
AUTOSCALING	
--GOOD ONLY	
TOT -	1000
LOST -	0
Horizontal:	4
Vertical:	6

USER#DISK:[XUS.SHADOW]BEGIN.DAT;6

8-APR-1991 15:23

UAS-1 K=1.8s E=10.76
keV

8-APR-91 15:24:39	
H Length	0.10000E-02
H center	0.00000E+00
V Length	0.10000E-02
V center	0.00000E+00
AUTOSCALING	
--GOOD ONLY	
TOT -	1000
LOST -	0
Horizontal:	4
Vertical:	6

Fig. UA-11. $\bar{K} = 1.8$, second harmonic.

USER#DISK:[XUS.SHADOW]BEGIN.DAT;7

8-APR-1991 15:33

UAS-0 K=1.8T E=16.15
keV

8-APR-91 15:37:20	
H Length	0.10000E+02
H center	0.00000E+00
V Length	0.10000E+02
V center	0.00000E+00
AUTOSCALING	
--GOOD ONLY	
TOT -	1000
LOST -	0
Horizontal:	4
Vertical:	6

USER#DISK:[XUS.SHADOW]BEGIN.DAT;8

8-APR-1991 15:41

UAS-1 K=1.8T E=16.15
keV

8-APR-91 15:43:04	
H Length	0.10000E+02
H center	0.00000E+00
V Length	0.10000E+02
V center	0.00000E+00
AUTOSCALING	
--GOOD ONLY	
TOT -	1000
LOST -	0
Horizontal:	4
Vertical:	6

Fig. UA-12. K = 1.8, third harmonic.

USER\$DISK:(XUS.SHADOW)BEGIN.DAT;1

12-APR-1991 14:15

UAS-0 K=1.7F E=5.77k

eV

USER\$DISK:(XUS.SHADOW)BEGIN.DAT;2

12-APR-1991 14:20

UAS-1 K=1.7F E=5.77k

eV

Fig. UA-13. K = 1.7, first harmonic.

USER#DISK:[XUS.SHADOW]BEGIN.DAT;3

12-APR-1991 14:28

UAS-0 K=1.7s E=11.54
keV

USER#DISK:[XUS.SHADOW]BEGIN.DAT;4

12-APR-1991 14:31

UAS-1 K=1.7s E=11.54
keV

Fig. UA-14. K = 1.7, second harmonic.

USER#DISK:IXUSIBEGIN.DAT;9

12-APR-1991 12:00

UAS-0 K=1.7t E=17.3k
eV

12-APR-91 13:35:52	
H Length	0.10000E-02
H center	0.00000E+00
V Length	0.10000E-02
V center	0.00000E+00
AUTOSCALING	
--GOOD ONLY	
TOT -	1000
LOST -	0
Horizontal:	4
Vertical:	6

USER#DISK:IXUS.SHADOWIBEGIN.DAT;5

12-APR-1991 14:39

UAS-1 K=1.7T E=17.3k
eV

12-APR-91 14:41:51	
H Length	0.10000E-02
H center	0.00000E+00
V Length	0.10000E-02
V center	0.00000E+00
AUTOSCALING	
--GOOD ONLY	
TOT -	1000
LOST -	0
Horizontal:	4
Vertical:	6

Fig. UA-15. K = 1.7, third harmonic.

USER#DISK:(XUS.SHADOW)BEGIN.DAT;9

8-APR-91 15:50

UAS-0 K=1.6F E=6.10k

eV

8-APR-91 15:53:42	
H Length	0.10000E-02
H center	0.00000E+00
V Length	0.10000E-02
V center	0.00000E+00
AUTOSCALING	
--GOOD ONLY	
TOT -	1000
LOST -	0
Horizontal:	4
Vertical:	6

USER#DISK:(XUS.SHADOW)BEGIN.DAT;10

8-APR-91 15:55

UAS-1 K=1.6F E=6.10k

eV

8-APR-91 15:57:06	
H Length	0.10000E-02
H center	0.00000E+00
V Length	0.10000E-02
V center	0.00000E+00
AUTOSCALING	
--GOOD ONLY	
TOT -	1000
LOST -	0
Horizontal:	4
Vertical:	6

Fig. UA-16. K = 1.6, first harmonic.

USER#DISK:[XUS.SHADOW]BEGIN.DAT;11

8-APR-1991 16:08

UAS-0 K=1.6s E=12.37
keV

8-APR-91 16:10:15	
H Length	0.10000E-02
H center	0.00000E+00
V Length	0.10000E-02
V center	0.00000E+00
AUTOSCALING	
--GOOD ONLY	
TOT -	1000
LOST -	0
Horizontal:	4
Vertical:	6

USER#DISK:[XUS.SHADOW]BEGIN.DAT;12

8-APR-1991 16:13

UAS-1 K=1.6s E=12.37
keV

8-APR-91 16:15:37	
H Length	0.10000E-02
H center	0.00000E+00
V Length	0.10000E-02
V center	0.00000E+00
AUTOSCALING	
--GOOD ONLY	
TOT -	1000
LOST -	0
Horizontal:	4
Vertical:	6

Fig. UA-17. K = 1.6, second harmonic.

USER#DISK:(XUS.SHADOW)BEGIN.DAT;1

8 APR 1991 16:27

UAS 0 K=1.61 E=18.56
keV

8-APR-91 16:30:07	
H Length	0.10000E-02
H center	0.00000E+00
V Length	0.10000E-02
V center	0.00000E+00
AUTOSCALING	
--GOOD ONLY	
TOT -	1000
LOST -	0
Horizontal:	4
Vertical:	6

USER#DISK:(XUS.SHADOW)BEGIN.DAT;2

8-APR-1991 16:33

UAS-1 K=1.61 E=18.56
keV

8-APR-91 16:35:23	
H Length	0.10000E-02
H center	0.00000E+00
V Length	0.10000E-02
V center	0.00000E+00
AUTOSCALING	
--GOOD ONLY	
TOT -	1000
LOST -	0
Horizontal:	4
Vertical:	6

Fig. UA-18. K = 1.6, third harmonic.

USER#DISK:(XUS.SHADOW)BEGIN.DAT;2

25-MAR-1991 08:53

UAS-0 K=1.5 E=6.6keV

USER#DISK:(XUS.SHADOW)BEGIN.DAT;1

25-MAR-1991 08:47

UAS-1 K=1.5 E=6.6keV

Fig. UA-19. K = 1.5, first harmonic.

USER#DISK:IXUS.SHADOWIBEGIN.DAT;3

25-MAR-1991 09:16

UAS-0 K=1.5 E=13.27k
eV

USER#DISK:IXUS.SHADOWIBEGIN.DAT;4

25-MAR-1991 09:21

UAS-1 K=1.5 E=13.27k
eV

Fig. UA-20. $K = 1.5$, second harmonic.

USERIDISK:(XUS.SHADOW)BEGIN.DAT;7

25-MAR-1991 09:53

UAS-0 K=1.5 E=19.909
keV

25-MAR-91 09:55:31	
H Length	0.10000E-02
H center	0.00000E+00
V Length	0.10000E-02
V center	0.00000E+00
AUTOSCALING	
--GOOD ONLY	
TOT	1000
LOST	0
Horizontal:	4
Vertical:	6

USERIDISK:(XUS.SHADOW)BEGIN.DAT;8

25-MAR-1991 09:58

UAS-1 K=1.5 E=19.909
keV

25-MAR-91 10:00:32	
H Length	0.10000E-02
H center	0.00000E+00
V Length	0.10000E-02
V center	0.00000E+00
AUTOSCALING	
--GOOD ONLY	
TOT	1000
LOST	0
Horizontal:	4
Vertical:	6

Fig. UA-21. K = 1.5, third harmonic.

USER#DISK:(XUS.SHADOW)BEGIN.DAT;8

8-APR-1991 12:06

UAS-0 K=1.4F E=7.12k
eV

USER#DISK:(XUS.SHADOW)BEGIN.DAT;9

8-APR-1991 13:48

UAS-1 K=1.4F E=7.12k
eV

Fig. UA-22. K = 1.4, first harmonic.

USER#DISK:(XUS.SHADOW)BEGIN.DAT;10

8-APR-1991 13:58

UAS-0 K=1.4s E=14.24
keV

USER#DISK:(XUS.SHADOW)BEGIN.DAT;11

8-APR-1991 14:03

UAS-1 K=1.4s E=14.24
keV

Fig. UA-23. K = 1.4, second harmonic.

USER#DISK:EXUS.SHADOWIBEGIN.DAT;1

8-APR-1991 14:19

UAS-0 K=1.4T E=21.37
keV

USER#DISK:EXUS.SHADOWIBEGIN.DAT;2

8-APR-1991 14:22

UAS-1 K=1.4T E=21.37
keV

Fig. UA-24. K = 1.4, third harmonic.

USER#DISK:EXUS.SHADOWIBEGIN.DAT;1

1-APR-1991 15:38

UAS-0 K=1.3 E=7.64KE
V

USER#DISK:EXUS.SHADOWIBEGIN.DAT;2

1-APR-1991 15:44

UAS-1 K=1.3F E=7.64K
EV

Fig. UA-25. K = 1.3, first harmonic.

USER\$DISK:(XUS.SHADOW)BEGIN.DAT;2

8-APR-1991 09:09

UAS-0 K=1.3s E=15.29
keV

8-APR-91 09:12:31	
H Length	0.10000E-02
H center	0.00000E+00
V Length	0.10000E-02
V center	0.00000E+00
AUTOSCALING	
--GOOD ONLY	
TOT -	1000
LOST -	0
Horizontal:	4
Vertical:	6

USER\$DISK:(XUS.SHADOW)BEGIN.DAT;3

8-APR-1991 09:16

UAS-1 K=1.3s E=15.29
keV

8-APR-91 09:17:56	
H Length	0.10000E-02
H center	0.00000E+00
V Length	0.10000E-02
V center	0.00000E+00
AUTOSCALING	
--GOOD ONLY	
TOT -	1000
LOST -	0
Horizontal:	4
Vertical:	6

Fig. UA-26. K = 1.3, second harmonic.

USER\$DISK:(XUS.SHADOW)BEGIN.DAT;7

26-APR-1991 09:56

UAS-0 K=1.3, E=22.9ke
V 0.12mrad

26-APR-91 09:58:20	
H Length	0.10000E-02
H center	0.00000E+00
V Length	0.10000E-02
V center	0.00000E+00
EXTERNAL	
--GOOD ONLY	
TOT -	1000
LOST -	0
Horizontal:	4
Vertical:	6

USER\$DISK:(XUS.SHADOW)BEGIN.DAT;8

26-APR-1991 10:00

UAS-1 K=1.3, E=22.9ke
V 0.12mrad

26-APR-91 10:03:10	
H Length	0.10000E-02
H center	0.00000E+00
V Length	0.10000E-02
V center	0.00000E+00
EXTERNAL	
--GOOD ONLY	
TOT -	1000
LOST -	0
Horizontal:	4
Vertical:	6

Fig. UA-27. K = 1.3, third harmonic.

USER#DISK:(XUS.SHADOW)BEGIN.DAT;13

28-MAR-91 15:17

UAS-0 K=1.2F E=8.199

keV

28-MAR-91 15:19:09	
H Length	0.10000E+02
H center	0.00000E+00
V Length	0.10000E+02
V center	0.00000E+00
AUTOSCALING	
--GOOD ONLY	
TOT	1000
LOST	0
Horizontal:	4
Vertical:	6

USER#DISK:(XUS.SHADOW)BEGIN.DAT;14

28-MAR-91 15:21

UAS-1 E=1.2F E=8.199

keV

28-MAR-91 15:22:58	
H Length	0.10000E+02
H center	0.00000E+00
V Length	0.10000E+02
V center	0.00000E+00
AUTOSCALING	
--GOOD ONLY	
TOT	1000
LOST	0
Horizontal:	4
Vertical:	6

Fig. UA-28. K = 1.2, first harmonic.

USER#DISK:[XUS.SHADOW]BEGIN.DAT;1

28-MAR-1991 15:31

UAS-0 K=1.2s E=16.39

8keV

28-MAR-91 15:33:25	
H Length	0.10000E-02
H center	0.00000E+00
V Length	0.10000E-02
V center	0.00000E+00
AUTOSCALING	
--GOOD ONLY	
TOT -	1000
LOST -	0
Horizontal:	4
Vertical:	6

USER#DISK:[XUS.SHADOW]BEGIN.DAT;2

28-MAR-1991 15:35

UAS-1 K=1.2s E=16.39

8keV

28-MAR-91 15:36:53	
H Length	0.10000E-02
H center	0.00000E+00
V Length	0.10000E-02
V center	0.00000E+00
AUTOSCALING	
--GOOD ONLY	
TOT -	1000
LOST -	0
Horizontal:	4
Vertical:	6

Fig. UA-29. K = 1.2, second harmonic.

USER#DISK:(XUS.SHADOW)BEGIN.DAT;5

26-APR-1991 09:34

UAS-0 K=1.2, E=24.6ke
V 0.012mrad

USER#DISK:(XUS.SHADOW)BEGIN.DAT;6

26-APR-1991 09:40

UAS-1 K=1.2, E=24.6ke
V 0.12mrad

Fig. UA-30. K = 1.2, third harmonic.

USER\DISK:\XUS.SHADOW\BEGIN.DAT;7

28-MAR-1991 14:03

UAS-0 K=1.1f E=8.79k
eV

28-MAR-91 14:05:35	
H Length	0.10000E-02
H center	0.00000E+00
V Length	0.10000E-02
V center	0.00000E+00
AUTOSCALING	
--GOOD ONLY	
TOT -	1000
LOST -	0
Horizontal:	4
Vertical:	6

USER\DISK:\XUS.SHADOW\BEGIN.DAT;8

28-MAR-1991 14:07

UAS-1 K=1.1f E=8.79k
eV

28-MAR-91 14:09:20	
H Length	0.10000E-02
H center	0.00000E+00
V Length	0.10000E-02
V center	0.00000E+00
AUTOSCALING	
--GOOD ONLY	
TOT -	1000
LOST -	0
Horizontal:	4
Vertical:	6

Fig. UA-31. K = 1.1, first harmonic.

USER#DISK:[XUS.SHADOW]BEGIN.DAT;9

28-MAR-1991 14:18

UAS-0 K=1.1s E=17.57
keV

28-MAR-91 14:20:17
H Length 0.10000E-02
H center 0.00000E+00
V Length 0.10000E-02
V center 0.00000E+00

AUTOSCALING

--GOOD ONLY

TOT = 1000

LOST = 0

Horizontal: 4

Vertical: 6

USER#DISK:[XUS.SHADOW]BEGIN.DAT;10

28-MAR-1991 14:24

UAS-1 K=1.1s E=17.57
keV

28-MAR-91 14:25:38
H Length 0.10000E-02
H center 0.00000E+00
V Length 0.10000E-02
V center 0.00000E+00

AUTOSCALING

--GOOD ONLY

TOT = 1000

LOST = 0

Horizontal: 4

Vertical: 6

Fig. UA-32. K = 1.1, second harmonic.

USERIDISK:(XUS.SHADOW)BEGIN.DAT;3

26-APR-1991 09:05

UAS-0 K=1.1 E=26.36k
eV 0.12mrad

26-APR-91 09:13:10	
H Length	0.10000E-02
H center	0.00000E+00
V Length	0.10000E-02
V center	0.00000E+00
AUTOSCALING	
--GOOD ONLY	
TOT -	1000
LOST -	0
Horizontal:	4
Vertical:	6

USERIDISK:(XUS.SHADOW)BEGIN.DAT;4

26-APR-1991 09:15

UAS-1 K=1.1 E=26.36k
eV 0.12mrad

26-APR-91 09:17:07	
H Length	0.10000E-02
H center	0.00000E+00
V Length	0.10000E-02
V center	0.00000E+00
AUTOSCALING	
--GOOD ONLY	
TOT -	1000
LOST -	0
Horizontal:	4
Vertical:	6

Fig. UA-33. K = 1.1, third harmonic.

USERIDISK:EXUS.SHADOWIBEGIN.DAT;10

25 MAR-91 12:59

UAS-0 K=1.0 E=9.4keV

USERIDISK:EXUS.SHADOWIBEGIN.DAT;9

25-MAR-1991 11:55

UAS-1 K=1.0 E=9.4keV

Fig. UA-34. K = 1.0, first harmonic.

USER#DISK:(XUS.SHADOW)BEGIN.DAT;1

25-MAR-1991 13:57

UAS-0 K=1.0 E 18.8ke
V

USER#DISK:(XUS.SHADOW)BEGIN.DAT;2

25-MAR-1991 14:02

UAS-1 K=1.0 E=18.8ke
V

Fig. UA-35. K = 1.0, second harmonic.

USER#DISK:(XUS.SHADOW)BEGIN.DAT;2

25-APR-1991 17:33

UAS-0 K=1 E=28.2keV
0.12mrad

26-APR-01 08:32:34	
H Length	0.10000E-02
H center	0.00000E+00
V Length	0.10000E-02
V center	0.00000E+00
EXTERNAL	
--GOOD ONLY	
TOT -	1000
LOST -	0
Horizontal:	4
Vertical:	6

USER#DISK:(XUS.SHADOW)BEGIN.DAT;1

25-APR-1991 17:27

UAS-1 K=1 E=28.2keV
0.12mrad

25-APR-91 17:31:24	
H Length	0.10000E-02
H center	0.00000E+00
V Length	0.10000E-02
V center	0.00000E+00
AUTOSCALING	
--GOOD ONLY	
TOT -	1000
LOST -	0
Horizontal:	4
Vertical:	6

Fig. UA-36. K = 1.0, third harmonic.

USER#DISK:(XUS.SHADOW)BEGIN.DAT;1

28-MAR-1991 08:59

UAS-0 K=0.9F E=10.04
keV

USER#DISK:(XUS.SHADOW)BEGIN.DAT;2

28-MAR-1991 09:03

UAS-1 K=0.9F E=10.04
keV

Fig. UA-37. K = 0.9, first harmonic.

USER#DISK:[XUS.SHADOW]BEGIN.DAT;3

28-MAR-1991 09:19

UA-10 K=0.9s E=20.07

keV

USER#DISK:[XUS.SHADOW]BEGIN.DAT;4

28-MAR-1991 09:24

UA-11 K=0.9s E=20.07

keV

Fig. UA-38. K = 0.9, second harmonic.

USER#DISK:[XUS.SHADOW]BEGIN.DAT;12

25-APR-1991 16:20

UAS-0 K=0.9, E=30.11k
eV 0.12mrad

USER#DISK:[XUS.SHADOW]BEGIN.DAT;13

25-APR-1991 16:30

UAS-1 K=0.9, E=30.11k
eV 0.12mrad

Fig. UA-39. K = 0.9, third harmonic.

USER\$DISK:(XUS.SHADOW)BEGIN.DAT;1

27-MAR-1991 11:18

UAS-0 K=0.8F E=10.68
keV

USER\$DISK:(XUS.SHADOW)BEGIN.DAT;2

27-MAR-1991 11:22

UAS-1 K=0.8F E=10.68
keV

Fig. UA-40. K = 0.8, first harmonic.

USER\$DISK:(XUS.SHADOW)BEGIN.DAT;3

27-MAR-1991 11:34

UAS-0 K=0.8s E=21.37

keV

27-MAR-91 11:36:30	
H Length	0.10000E-02
H center	0.00000E+00
V Length	0.10000E-02
V center	0.00000E+00
AUTOSCALING	
--GOOD ONLY	
TOT -	1000
LOST -	0
Horizontal:	4
Vertical:	6

USER\$DISK:(XUS.SHADOW)BEGIN.DAT;4

27-MAR-1991 11:38

UAS-1 K=0.8s E=21.37

keV

27-MAR-91 11:39:58	
H Length	0.10000E-02
H center	0.00000E+00
V Length	0.10000E-02
V center	0.00000E+00
AUTOSCALING	
--GOOD ONLY	
TOT -	1000
LOST -	0
Horizontal:	4
Vertical:	6

Fig. UA-41. K = 0.8, second harmonic.

USER#DISK:(XUS.SHADOW)BEGIN.DAT;15

9-OCT-1991 09:14

UAS-0 K=0.8 E=32.05
keV 0.08mrad

9-OCT-91 09:24:04	
H Length	0.10000E-02
H center	0.00000E+00
V Length	0.10000E-02
V center	0.00000E+00
EXTERNAL	
--GOOD ONLY	
TOT -	1000
LOST -	0
Horizontal:	4
Vertical:	6

USER#DISK:(XUS.SHADOW)BEGIN.DAT;16

9-OCT-1991 09:26

UAS-1 K=0.8 E=32.05
keV 0.08mrad

9-OCT-91 09:29:04	
H Length	0.10000E-02
H center	0.00000E+00
V Length	0.10000E-02
V center	0.00000E+00
EXTERNAL	
--GOOD ONLY	
TOT -	1000
LOST -	0
Horizontal:	4
Vertical:	6

Fig. UA-42. K = 0.8, third harmonic.

USER#DISK:[XUS.SHADOW]BEGIN.DAT;1

25-MAR-1991 15:13

UAS-0 F=0.7 E=11.327

keV

25-MAR-91 15:15:27	
H Length	0.10000E-02
H center	0.00000E+00
V Length	0.10000E-02
V center	0.00000E+00
AUTOSCALING	
--GOOD ONLY	
TOT -	1000
LOST -	0
Horizontal:	4
Vertical:	6

USER#DISK:[XUS.SHADOW]BEGIN.DAT;2

25-MAR-1991 15:17

UAS-1 K=0.7 E=11.327

keV

25-MAR-91 15:19:11	
H Length	0.10000E-02
H center	0.00000E+00
V Length	0.10000E-02
V center	0.00000E+00
AUTOSCALING	
--GOOD ONLY	
TOT -	1000
LOST -	0
Horizontal:	4
Vertical:	6

Fig. UA-43. K = 0.7, first harmonic.

USER#DISK:IXUS.SHADOW\BEGIN.DAT;3

25-MAR-1991 15:33

UAS=0 K=0.7 E=22.65k
eV

USER#DISK:IXUS.SHADOW\BEGIN.DAT;4

25-MAR-1991 15:39

UAS=1 K=0.7 E=22.65k
eV

Fig. UA-44. K = 0.7, second harmonic.

USER#DISK:(XUS.SHADOW)BEGIN.DAT;17

9-OCT-1991 09:42

UAS-0 K=0.7t E= 33.98
keV 0.07mrad

9-OCT-91 09:46:04	
H Length	0.10000E-02
H center	0.00000E+00
V Length	0.10000E-02
V center	0.00000E+00
EXTERNAL	
--GOOD ONLY	
TOT -	1000
LOST -	0
Horizontal:	4
Vertical:	6

USER#DISK:(XUS.SHADOW)BEGIN.DAT;18

9-OCT-1991 09:49

UAS-1 K=0.7t E= 33.98
keV 0.07mrad

9-OCT-91 09:51:04	
H Length	0.10000E-02
H center	0.00000E+00
V Length	0.10000E-02
V center	0.00000E+00
EXTERNAL	
--GOOD ONLY	
TOT -	1000
LOST -	0
Horizontal:	4
Vertical:	6

Fig. UA-45. K = 0.7, third harmonic.

USER\$DISK:IBLAL.TRACY.TESTIBEGIN.DAT;43

19-JAN-92 22:45

UAS-0 K=0.6 E=11.95k

eV

19-JAN-92 22:51:25	
H Length	0.10000E-02
H center	0.00000E+00
V Length	0.10000E-02
V center	0.00000E+00
EXTERNAL	
--GOOD ONLY	
TOT -	1000
LOST -	0
Horizontal:	4
Vertical:	6

USER\$DISK:IBLAL.TRACY.TESTIBEGIN.DAT;44

19-JAN-1992 22:52

UAS-1 K=0.6 E=11.95k

eV

19-JAN-92 22:54:45	
H Length	0.10000E-02
H center	0.00000E+00
V Length	0.10000E-02
V center	0.00000E+00
EXTERNAL	
- GOOD ONLY	
TOT -	1000
LOST -	0
Horizontal:	4
Vertical:	6

Fig. UA-46. K = 0.6, first harmonic.

USER:DISK:(XUS.SHADOW)BEGIN.DAT;19

9-OCT-1991 10:11

UAS-0 K=0.6s E=23.90

keV 0.1mrad

9-OCT-91 10:13:47	
H Length	0.10000E-02
H center	0.00000E+00
V Length	0.10000E-02
V center	0.00000E+00
EXTERNAL	
--GOOD ONLY	
TOT -	1000
LOST -	0
Horizontal:	4
Vertical:	6

USER:DISK:(XUS.SHADOW)BEGIN.DAT;20

9-OCT-1991 10:16

UAS-1 K=0.6s E=23.90

keV 0.1mrad

9-OCT-91 10:28:28	
H Length	0.10000E-02
H center	0.00000E+00
V Length	0.10000E-02
V center	0.00000E+00
EXTERNAL	
--GOOD ONLY	
TOT -	1000
LOST -	0
Horizontal:	4
Vertical:	6

Fig. UA-47. K = 0.6, second harmonic.

USERIDISK:(XUS,SHADOW)BEGIN.DAT;21

9 OCT-1991 10:47

UAS 0 K=0.6 E=35.85k

α V 0.06mrad

USERIDISK:(XUS,SHADOW)BEGIN.DAT;22

9 OCT-1991 10:52

UAS 1 K=0.6t E=35.85

keV 0.06mrad

Fig. UA-48. K = 0.6, third harmonic.

USER:DISK:(BLA1,TRACY,TEST)BEGIN.DAT;36

19-JAN-1992 17:34

UAS-0 K=0.5 E=12.54k
eV

19-JAN-92 17:36:26	
H Length	0.10000E-02
H center	0.00000E+00
V Length	0.10000E-02
V center	0.00000E+00

EXTERNAL

--GOOD ONLY

TOT	=	1000
LOST	=	0

Horizontal:	4
Vertical:	6

USER:DISK:(BLA1,TRACY,TEST)BEGIN.DAT;37

19-JAN-1992 17:37

UAS-1 K=0.5 E=12.54k
eV

19-JAN-92 17:37:37	
H Length	0.10000E-02
H center	0.00000E+00
V Length	0.10000E-02
V center	0.00000E+00

EXTERNAL

--GOOD ONLY

TOT	=	1000
LOST	=	0

Horizontal:	4
Vertical:	6

Fig. UA-49. K = 0.5, first harmonic.

USER:DISK:(BLAI,TRACY,TEST)BEGIN,DATE;38

19 JAN-1992 17:41

UAS-0 K=0.5 E=25.074

eV

19-JAN-92 17:43:58
H Length 0.10000E-02
H center 0.00000E+00
V Length 0.10000E-02
V center 0.00000E+00
EXTERNAL
--GOOD ONLY
TOT = 1000
LOST = 0
Horizontal: 4
Vertical: 5

USER:DISK:(BLAI,TRACY,TEST)BEGIN,DATE;39

19 JAN-1992 17:44

UAS-1 K=0.5 E=25.074

eV

19-JAN-92 17:45:23
H Length 0.10000E-02
H center 0.00000E+00
V Length 0.10000E-02
V center 0.00000E+00
EXTERNAL
--GOOD ONLY
TOT = 1000
LOST = 0
Horizontal: 4
Vertical: 5

Fig. UA-50. K = 0.5, second harmonic.

USER#DISK:XAUS,SHADOWIBEGIN.DAT;23

9-OCT-91 11:11

UAS 0 K=0.5 E=37.61k

eV 0.06mrad

9-OCT-91 11:25:11
H Length 0.10000E-02
H center 0.00000E+00
V Length 0.10000E-02
V center 0.00000E+00
EXTERNAL
GOOD ONLY
TOT = 1000
LOST = 0
Horizontal: 4
Vertical: 6

USER#DISK:IXUS,SHADOWIBEGIN.DAT;25

9-OCT-1991 11:28

UAS-1 K=0.5 E=37.61k

eV 0.06mrad

9-OCT-91 11:29:46
H Length 0.10000E-02
H center 0.00000E+00
V Length 0.10000E-02
V center 0.00000E+00
EXTERNAL
GOOD ONLY
TOT = 1000
LOST = 0
Horizontal: 4
Vertical: 6

Fig. UA-51. K = 0.5, third harmonic.

USER#0034-16LALTRACY.TESTIBEGIN.DAT;29

19-JAN-1992 17:08

UAS-0 K=0.4 E=13.06k
ev 0.1mrad

19-JAN-92 17:09:08
H Length 0.10000E-02
H center 0.00000E+00
V Length 0.10000E-02
V center 0.00000E+00
EXTERNAL
--GOOD ONLY
TOT = 1000
LOST = 0
Horizontal: 4
Vertical: 6

USER#0034-16LALTRACY.TESTIBEGIN.DAT;30

19-JAN-1992 17:09

UAS-1 K=0.4 E=13.06k
ev 0.1mrad

19-JAN-92 17:10:35
H Length 0.10000E-02
H center 0.00000E+00
V Length 0.10000E-02
V center 0.00000E+00
EXTERNAL
--GOOD ONLY
TOT = 1000
LOST = 0
Horizontal: 4
Vertical: 6

Fig. UA-52. K = 0.4, first harmonic.

USER\$DISK:BLA1.TRACY.TESTIBEGIN.DAT:31

19-JAN-92 17:17:15

UAS-0 K=0.4 E=20.12k
ev 0.1mrad

19-JAN-92 17:17:18
H Length 0.10000E-02
H center 0.00000E+00
V Length 0.10000E-02
V center 0.00000E+00
EXTERNAL
--GOOD ONLY
TOT = 1000
LOST = 0
Horizontal: 4
Vertical: 6

USER\$DISK:BLA1.TRACY.TESTIBEGIN.DAT:32

19-JAN-1992 17:17

UAS-1 K=0.4 E=20.12k
ev 0.1mrad

19-JAN-92 17:18:31
H Length 0.10000E-02
H center 0.00000E+00
V Length 0.10000E-02
V center 0.00000E+00
EXTERNAL
--GOOD ONLY
TOT = 1000
LOST = 0
Horizontal: 4
Vertical: 6

Fig. UA-53. K = 0.4, second harmonic.

USER\$DISK\$RELALTRACY.TESTIBEGIN.DAT:34

19 JAN-1992 17:26

UAS-0 K=0.4 E=39.17k
eV 0.07mrad

19-JAN-92 17:27:55	
H Length	0.10000E-02
H center	0.00000E+00
V Length	0.10000E-02
V center	0.00000E+00
EXTERNAL	
--GOOD ONLY	
TOT -	1000
LOST -	0
Horizontal:	4
Vertical:	6

USER\$DISK\$RELALTRACY.TESTIBEGIN.DAT:35

19 JAN-1992 17:29

UAS-1 K=0.4 E=39.17k
eV 0.07mrad

19-JAN-92 17:29:53	
H Length	0.10000E-02
H center	0.00000E+00
V Length	0.10000E-02
V center	0.00000E+00
EXTERNAL	
--GOOD ONLY	
TOT -	1000
LOST -	0
Horizontal:	4
Vertical:	6

Fig. UA-54. K = 0.4, third harmonic.

USER:DISK:BLA1.TRACY.TEST\BEGIN.DAT:26

19-JAN-1992 16:54

UAS-0 K=0.3 E=13.50k
eV 0.08mrad

19-JAN-92 16:55:03	
H Length	0.10000E-02
H center	0.00000E+00
V Length	0.10000E-02
V center	0.00000E+00
EXTERNAL	
--GOOD ONLY	
TOT -	1000
LOST -	0
Horizontal:	4
Vertical:	6

USER:DISK:BLA1.TRACY.TEST\BEGIN.DAT:27

19-JAN-1992 16:55

UAS-1 K=0.3 E=13.50k
eV 0.08mrad

19-JAN-92 16:56:18	
H Length	0.10000E-02
H center	0.00000E+00
V Length	0.10000E-02
V center	0.00000E+00
EXTERNAL	
--GOOD ONLY	
TOT -	1000
LOST -	0
Horizontal:	4
Vertical:	6

Fig. UA-55. K = 0.3, first harmonic.

USER:DISK:IBLAL.TRACY.TESTIBEGIN.DAT;24

19-JAN-1992 16:48

UAS-0 K=0.3 E=26.99k
eV 0.1mrad

19-JAN-92 16:49:13	
H Length	0.10000E+02
H center	0.00000E+00
V Length	0.10000E+02
V center	0.00000E+00
EXTERNAL	
--GOOD ONLY	
TOT -	1000
LOST -	0
Horizontal:	4
Vertical:	6

USER:DISK:IBLAL.TRACY.TESTIBEGIN.DAT;25

19-JAN-1992 16:49

UAS-1 K=0.3 E=26.99k
eV 0.1mrad

19 JAN 92 16:50:40	
H Length	0.10000E+02
H center	0.00000E+00
V Length	0.10000E+02
V center	0.00000E+00
EXTERNAL	
--GOOD ONLY	
TOT -	1000
LOST -	0
Horizontal:	4
Vertical:	6

Fig. UA-56. K = 0.3, second harmonic.

USER\$DISK:(BLAI.TRACY.TEST)BEGIN.DAT;22

19-JAN-1992 16:37

UAS-0 K=0.3 E=40.49k

eV 0.07mrad

USER\$DISK:(BLAI.TRACY.TEST)BEGIN.DAT;23

19-JAN-1992 16:41

UAS-1 K=0.3 E=40.49k

eV 0.07mrad

Fig. UA-57. K = 0.3, third harmonic.

APS WIGGLER A

RAY-TRACING RESULTS

USER801(SHADOWS.SHADOWWIBEGIN.DAT;2

17-APR-1991 11:44

WAS K=14 E=8keV

17-APR-91 11:46:25	
H Length	0.25000E+02
H center	0.00000E+00
V Length	0.25000E+02
V center	0.00000E+00
EXTERNAL	
--GOOD ONLY	
TOT -	1000
LOST -	0
Horizontal:	4
Vertical:	6

USER801(SHADOWS.SHADOWWIBEGIN.DAT;3

17-APR-1991 11:51

WAS K=14 E=12keV

17-APR-91 11:52:26	
H Length	0.25000E+02
H center	0.00000E+00
V Length	0.25000E+02
V center	0.00000E+00
EXTERNAL	
--GOOD ONLY	
TOT -	1000
LOST -	0
Horizontal:	4
Vertical:	6

Fig. WA-1. Wiggler A. Top: $h\nu = 8$ keV, bottom: $h\nu = 12$ keV. The limits for each plot are 2.5 mrad x 2.5 mrad.

USER:KUS:KUS.SNAD\WIBEGIN.DAT:3

16-APR-91 15:39

WAS K=14 E=16keV

USER:KUS:KUS.SNAD\WIBEGIN.DAT:1

17-APR-1991 09:37

WAS K=14 E=20keV

Fig. WA-2. Wiggler A. Top: $h\nu = 16$ keV, bottom: $h\nu = 20$ keV.

USER:DISK1\XUS\SHADOW\BEGIN.DAT12

17-APR-1991 09:50

WAS K=14 E=24keV

17-APR-91 09:52:15	
H Length	0.25000E-02
H center	0.00000E+00
V Length	0.25000E-02
V center	0.00000E+00
EXTERNAL	
--GOOD ONLY	
TOT =	1000
LOST =	0
Horizontal:	4
Vertical:	6

USER:DISK1\XUS\SHADOW\BEGIN.DAT13

17-APR-1991 09:59

WAS K=14 E=28keV

17-APR-91 10:01:43	
H Length	0.25000E-02
H center	0.00000E+00
V Length	0.25000E-02
V center	0.00000E+00
EXTERNAL	
--GOOD ONLY	
TOT =	1000
LOST =	0
Horizontal:	4
Vertical:	6

Fig. WA-3. Wiggler A. Top: $h\nu = 24$ keV, bottom: $h\nu = 28$ keV.

USER8DISK1\KUS.SHAADOWIBEGIN.DAT;6

16 APR 91 16:34

WAS K=14 E=32.5keV

16 APR 91 16:34:51
H Length 0.25000E+02
H center 0.00000E+00
V Length 0.25000E+02
V center 0.00000E+00
EXTERNAL
--GOOD ONLY
TOT = 1000
LOST = 0
Horizontal: 4
Vertical: 6

USER8DISK1\KUS.SHAADOWIBEGIN.DAT;6

17 APR 1991 10:18

WAS K=14 E=48keV

17-APR-91 10:20:05
H Length 0.25000E+02
H center 0.00000E+00
V Length 0.25000E+02
V center 0.00000E+00
EXTERNAL
--GOOD ONLY
TOT = 1000
LOST = 0
Horizontal: 4
Vertical: 6

Fig. WA-4. Wiggler A. Top: $h\nu = 32.5 \text{ keV}$ ($=E_c$), bottom: $h\nu = 48 \text{ keV}$.

USER8DISK10US.HWIBEGIN.DAT17

17-APR-91 10:35

WAS K=14 E=64keV

17-APR-91 10:35:28
H Length 0.25000E-02
H center 0.00000E+00
V Length 0.25000E-02
V center 0.00000E+00
EXTERNAL
--GOOD ONLY
TOT = 1000
LOST = 0
Horizontal: 4
Vertical: 6
b.wd 25

USER8DISK10US.SHADOWIBEGIN.DAT18

17-APR-1991 10:58

WAS K=14 E=80KeV

17-APR-91 10:59:47
H Length 0.25000E-02
H center 0.00000E+00
V Length 0.25000E-02
V center 0.00000E+00
EXTERNAL
--GOOD ONLY
TOT = 1000
LOST = 0
Horizontal: 4
Vertical: 6

Fig. WA-5. Wiggler A. Top: $h\nu = 64$ keV, bottom: $h\nu = 80$ keV.

USER81015A.DOS.SPACLOWIBEGIN.DAT:4

16 APR 1991 15:50

WAS K=14 E=96keV

16-APR-91 15:52:10	
H Length	0.25000E-02
H center	0.00000E+00
V Length	0.25000E-02
V center	0.00000E+00
EXTERNAL	
--GOOD ONLY	
TOT -	1000
LOST -	0
Horizontal:	4
Vertical:	6

USER81015A.DOS.SPACLOWIBEGIN.DAT:9

17-APR-1991 11:04

WAS K=14 E=112keV

17-APR-91 11:06:41	
H Length	0.25000E-02
H center	0.00000E+00
V Length	0.25000E-02
V center	0.00000E+00
EXTERNAL	
--GOOD ONLY	
TOT -	1000
LOST -	0
Horizontal:	4
Vertical:	6

Fig. WA-6. Wiggler A. Top: $h\nu = 96$ keV, bottom: $h\nu = 112$ keV.

USER\$DIS-1XUS.SHADOWIBEGIN.DAT;10

17-APR-1991 11:13

WAS K=14 E=128keV

17-APR-91 11:15:58
H Length 0.25000E-02
H center 0.00000E+00
V Length 0.25000E-02
V center 0.00000E+00
EXTERNAL
--GOOD ONLY
TOT - 1000
LOST - 0
Horizontal: 4
Vertical: 6

USER\$DIS-1XUS.SHADOWIBEGIN.DAT;11

17-APR-1991 11:20

WAS K=14 E=150keV

17-APR-91 11:24:20
H Length 0.25000E-02
H center 0.00000E+00
V Length 0.25000E-02
V center 0.00000E+00
EXTERNAL
--GOOD ONLY
TOT - 1000
LOST - 0
Horizontal: 4
Vertical: 6

Fig. WA-7. Wiggler A. Top: $h\nu = 128$ keV, bottom: $h\nu = 150$ keV.

USER\$DIR:KUS.SHA-175BEGIN.DAT:1

17-APR-91 11:34

Was K=14 E=175keV

17-APR-91 11:37:51	
H Length	0.25000E+02
H center	0.00000E+00
V Length	0.15000E+02
V center	0.00000E+00
EXTERNAL	
--GOOD ONLY	
TOT =	1000
LOST =	0
Horizontal:	4
Vertical:	6

USER\$DIR:KUS.SHADOW-BEGIN.DAT:5

16-APR-1991 16:06

WAS K=14 E=200keV

16-APR-91 16:09:40	
H Length	0.25000E+02
H center	0.00000E+00
V Length	0.25000E+02
V center	0.00000E+00
EXTERNAL	
--GOOD ONLY	
TOT =	1000
LOST =	0
Horizontal:	4
Vertical:	6

Fig. WA-8. Wiggler A. Top: $h\nu = 175$ keV, bottom: $h\nu = 200$ keV.

APS WIGGLER B

RAY-TRACING RESULTS

USER\$D15-HUS-SHADOWIBEGIN.DAT:4

17-APR-91 13:39

WBS K=7 E=2keV

USER\$D15-HUS-SHADOWIBEGIN.DAT:7

17-APR-91 14:50

WBA K=7 E=3keV

Fig. WB-1. Wiggler B. Top: $h\nu = 2$ keV, bottom: $h\nu = 3$ keV. The limits for each plot are 2.5 mrad x 2.5 mrad.

USER:IC13A:RMS.WB3.WB3IN.DAT:1

17-APR-91 15:04

WB3 K=7 E=4keV

17-APR-91 15:06:17	
H Length	0.25000E-02
H center	0.00000E+00
V Length	0.25000E-02
V center	0.00000E+00
EXTERNAL	
--GOOD ONLY	
TOT -	1000
LOST -	0
Horizontal:	4
Vertical:	5

USER:IC13A:RMS.SHADOWWB3IN.DAT:3

17-APR-1991 15:31

WB3 K=7 E=5keV

17-APR-91 15:32:46	
H Length	0.25000E-02
H center	0.00000E+00
V Length	0.25000E-02
V center	0.00000E+00
EXTERNAL	
--GOOD ONLY	
TOT -	1000
LOST -	0
Horizontal:	4
Vertical:	5

Fig. WB-2. Wiggler B. Top: $h\nu = 4$ keV, bottom: $h\nu = 5$ keV.

USER:GISA:KUSHA BEGIN.DAT:4

17-APR-91 15:43

WBS K=7 E=6keV

USER:GISA:KUSHA SHADOW BEGIN.DAT:5

17-APR-91 15:48

WBS K=7 E=7keV

Fig. WB-3. Wiggler B. Top: $h\nu = 6$ keV, bottom: $h\nu = 7$ keV.

USER3013-EXUS-SHADOWIBEGIN.DAT17

17-APR-91 15:08

WBS K=7 E=8keV

17-APR-91 15:08:48	
H Length	0.25000E+02
H center	0.00000E+00
V Length	0.25000E+02
V center	0.00000E+00
EXTERNAL	
--GOOD ONLY	
TOT -	1000
LOST -	0
Horizontal:	4
Vertical:	6

USER3013-EXUS-SHADOWIBEGIN.DAT17

17-APR-1991 16:04

WBS K=7 E=9keV

17-APR-91 16:06:39	
H Length	0.25000E+02
H center	0.00000E+00
V Length	0.25000E+02
V center	0.00000E+00
EXTERNAL	
--GOOD ONLY	
TOT -	1000
LOST -	0
Horizontal:	4
Vertical:	6

Fig. WB-4. Wiggler B. Top: $h\nu = 8$ keV, bottom: $h\nu = 9$ keV.

Fig. WB-5. Wiggler B. Top: $h\nu = 9.8 \text{ keV}$ ($=E_c$), bottom: $h\nu = 15 \text{ keV}$.

Fig. WB-6. Wiggler B. Top: $h\nu = 20$ keV, bottom: $h\nu = 25$ keV.

USER3013- H.C.S.-ACOWIBEGIN.DAT:3

17-APR-1991 17:04

WBS k=7 E=30keV

17-APR-91 17:04:47
H Length 0.25000E+02
H center 0.00000E+00
V Length 0.25000E+02
V center 0.00000E+00
EXTERNAL
--GOOD ONLY
TOT = 1000
LOST = 0
Horizontal: 4
Vertical: 6

USER3013- H.C.S.-ACOWIBEGIN.DAT:4

17-APR-1991 17:07

WBS k=7 E=40keV

17-APR-91 17:10:40
H Length 0.25000E+02
H center 0.00000E+00
V Length 0.25000E+02
V center 0.00000E+00
EXTERNAL
--GOOD ONLY
TOT = 1000
LOST = 0
Horizontal: 4
Vertical: 6

Fig. WB-7. Wiggler B. Top: $h\nu = 30$ keV, bottom: $h\nu = 40$ keV.

END

**DATE
FILMED**

5 / 11 / 92