

LS-18
S.H. Kim
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**HYBRID UNDULATORS AND WIGGLERS
FOR THE ALADDIN SYNCHROTRON LIGHT SOURCE**

In this note, design parameters of two hybrid undulators and one hybrid wiggler are considered with a minimum gap of 1.25 cm. The length of the insertion devices considered here is 3.5 m. The magnetic field along the axis of the hybrid devices of samarium-cobalt permanent magnets and vanadium permendur poletips is expressed as:

$$B = 3.3 \times 0.90 e^{-\frac{g}{\lambda_u}} (5.47 - 1.80 g/\lambda_u) ,$$

where λ_u and g are the undulator period and gap, and a filling or assembly factor of 90% is assumed.

Figure 1 shows the deflection parameter K vs gap for three insertion devices (see the names). The parameters used in this note are marked as 'circles in Fig. 1.

In Figs. 2 and 3, the first few harmonics of the spectral brilliance of Undulator A and Undulator B are shown. For both undulators with deflection parameters larger than 1.5, it is seen that the decreasing rates of the peak brilliance with increasing harmonic numbers are rather slow.

Because of considerable computing time for the spectral brilliance of higher harmonics, even with a low emittance in this case, only peak values of the brilliance for the two undulators each with different K values are shown in Fig. 4.

When the electron beam parameters of the ALS design are used for the two undulators considered here, the brilliance was considerably higher compared to Fig. 4 by one or two orders of the magnitude depending on the order of the harmonics. This is due to the different values of the electron energy (1.3 times), beam current (4 times), number of periods (1.4 times), β , and ϵ_{x0} .

Figure 5 shows the brilliance of the hybrid wiggler for different values of ϵ_{x0} . Since flux (number of photons per sec., per 0.1% bandwidth, per mrad

of the horizontal angle θ) is sometimes a more useful unit for experiments, the flux vs photon energy is shown in Fig. 6, The flux is obtained by integrating the number of photons for all the vertical angle ψ . The spread of the photon beam in the vertical angle in this case is about 0.5 mrad.

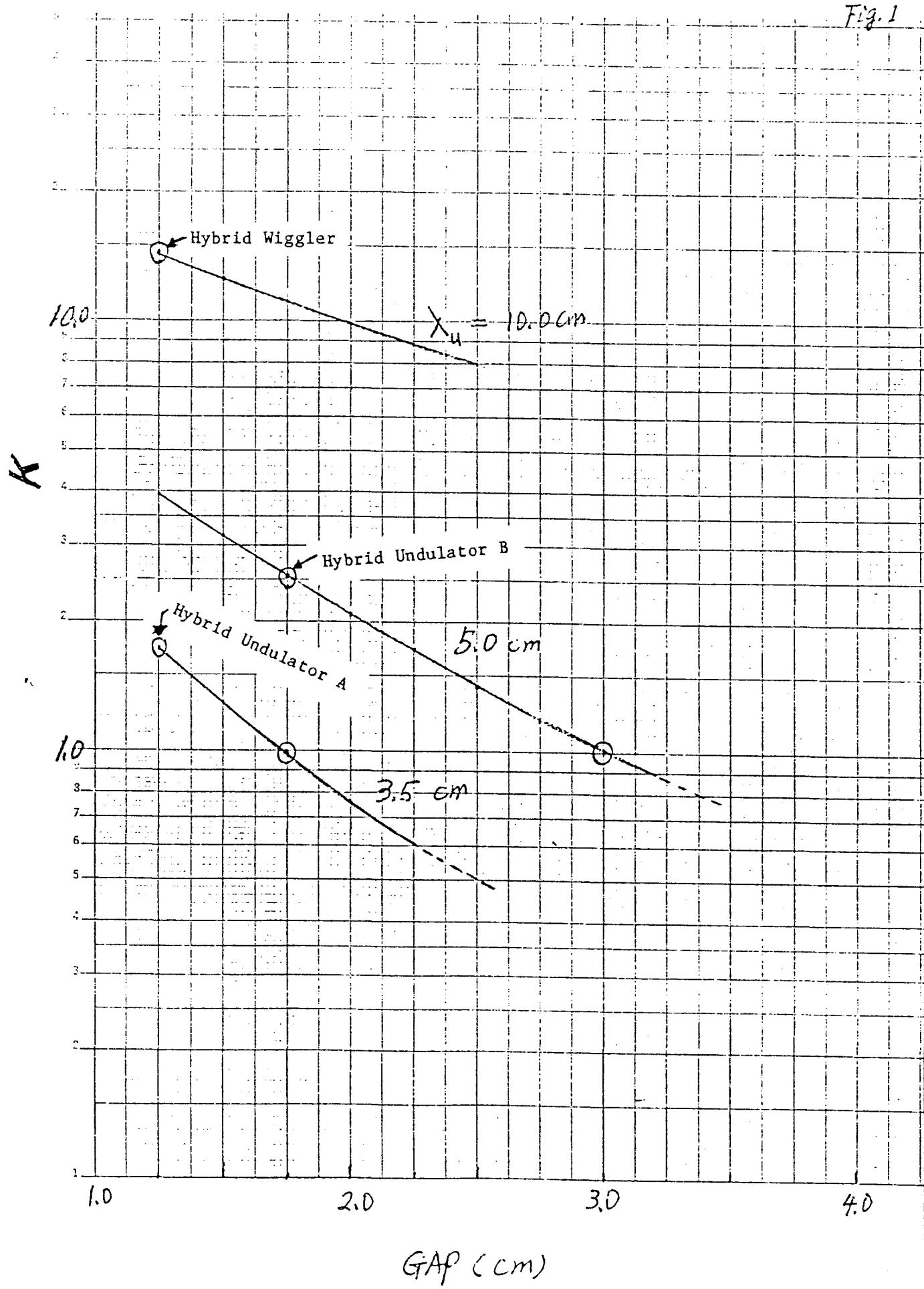
The steeper slope in the region of the low photon energy in Fig. 5, compared to that of the flux in Fig. 6, is due to the fact that for E_p less than 0.1 keV the diffraction size and diffraction divergence are comparable to the beam size and beam divergence, respectively.

In order to estimate the heat deposition on experimental samples, power spectrum (mW/mrad, 0.1% BW) is shown in Fig. 7. Total power radiation by the insertion devices and other parameters are listed in Table 1.

Table 1

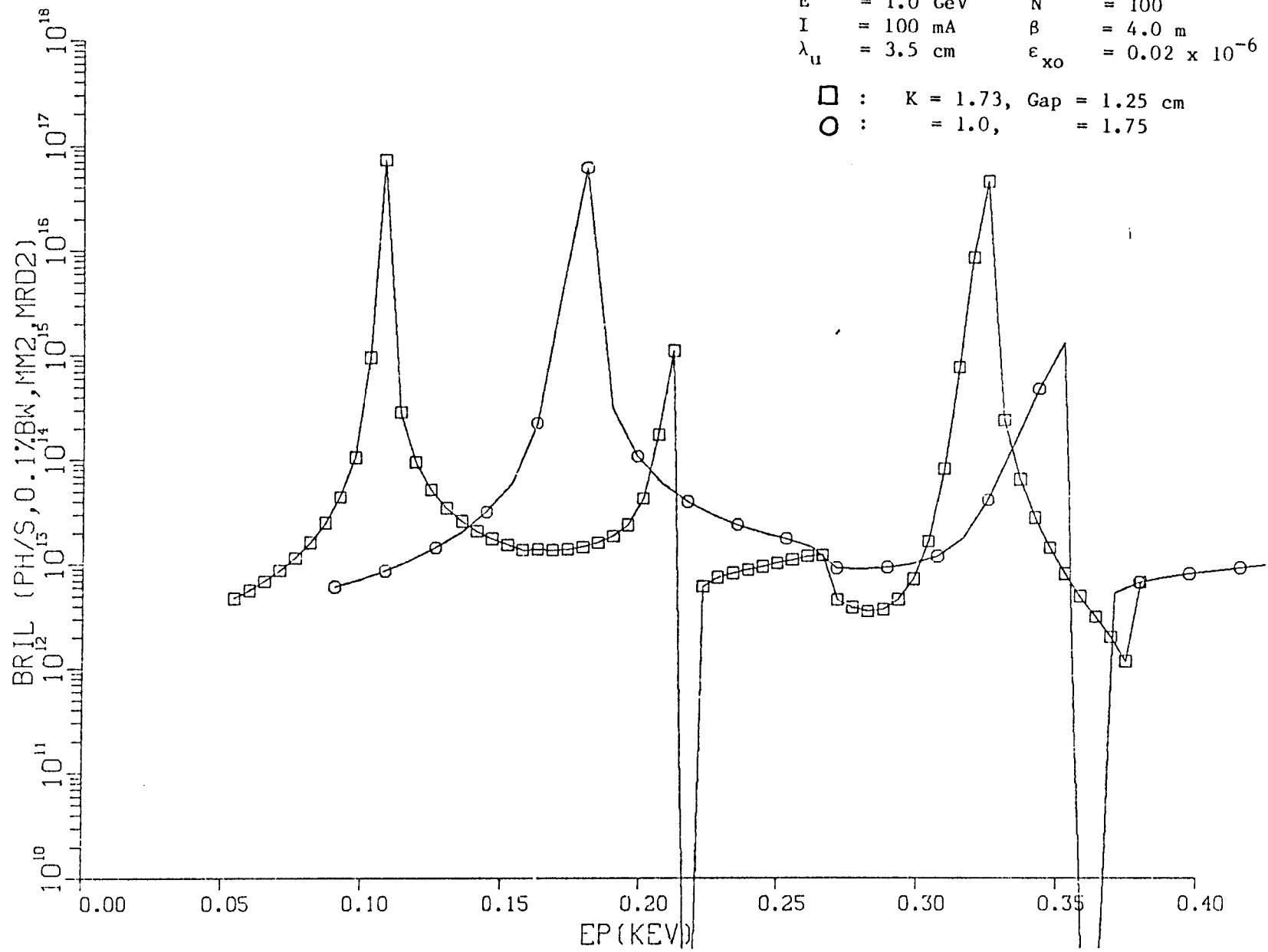
	<u>Hybrid Undulator A</u>	<u>Hybrid Undulator B</u>	<u>Hybrid Wiggler</u>
Critical Energy (keV)	0.35	0.36	1.02
Critical Wavelength (A)	35	34	121
Total Power Radiated by the Device (kW)	0.062	0.066	0.53
Power Radiated for all Vertical Angle and Wavelength (kW/mrad)	0.045	0.032	0.046
Number of Photons at the Critical Energy (/sec, 0.1%, mrad)	3.2×10^{14}	2.24×10^{14}	1.12×10^{14}
Power Radiated for all Wavelength at Zero Angle (kW/mrad, mrad)	0.057	0.041	0.058

Fig. 1



ALADDIN HYBRID UNDULATOR A

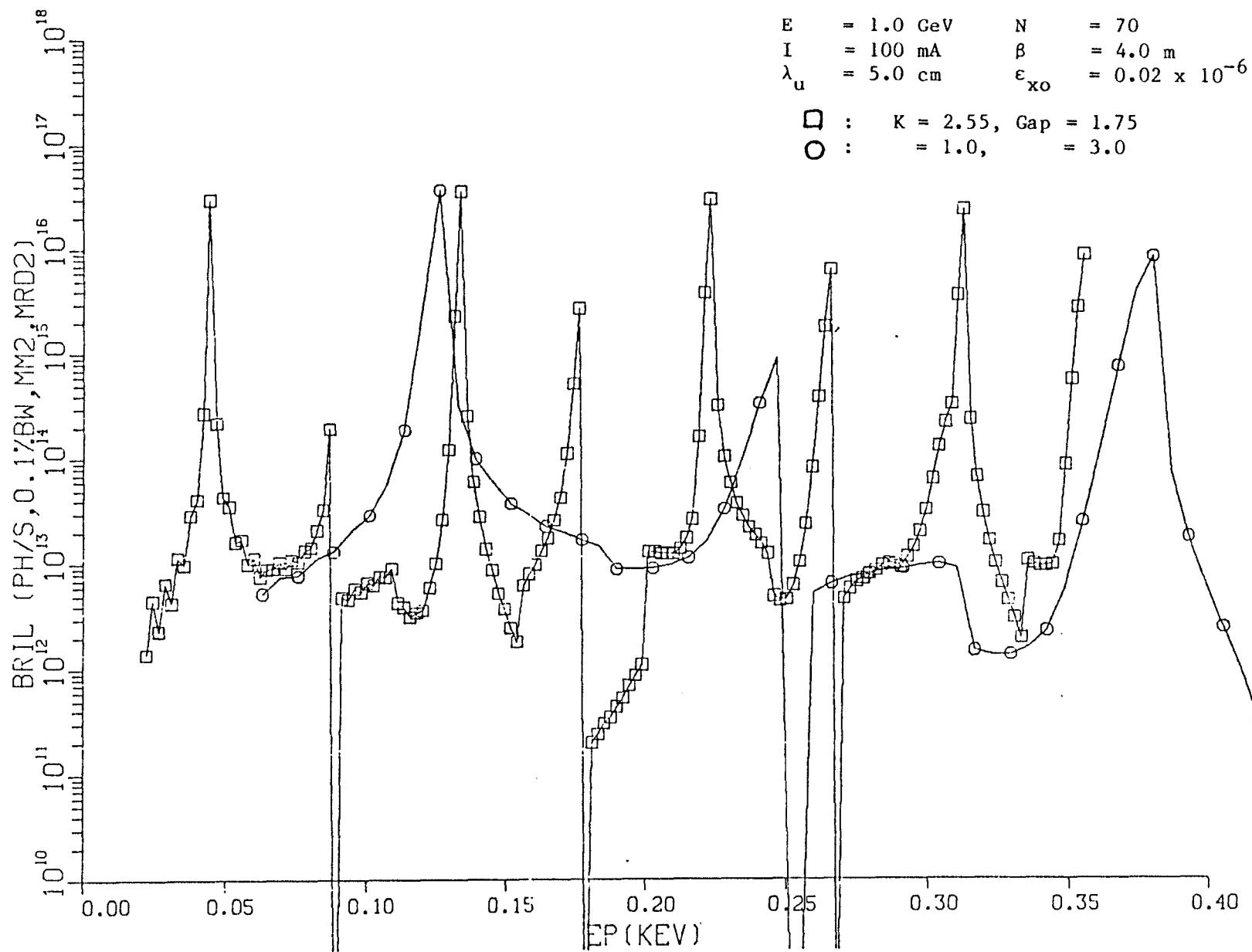
$E = 1.0 \text{ GeV}$ $N = 100$
 $I = 100 \text{ mA}$ $\beta = 4.0 \text{ m}$
 $\lambda_u = 3.5 \text{ cm}$ $\epsilon_{x_0} = 0.02 \times 10^{-6}$
 □ : $K = 1.73$, Gap = 1.25 cm
 ○ : $K = 1.0$, Gap = 1.75



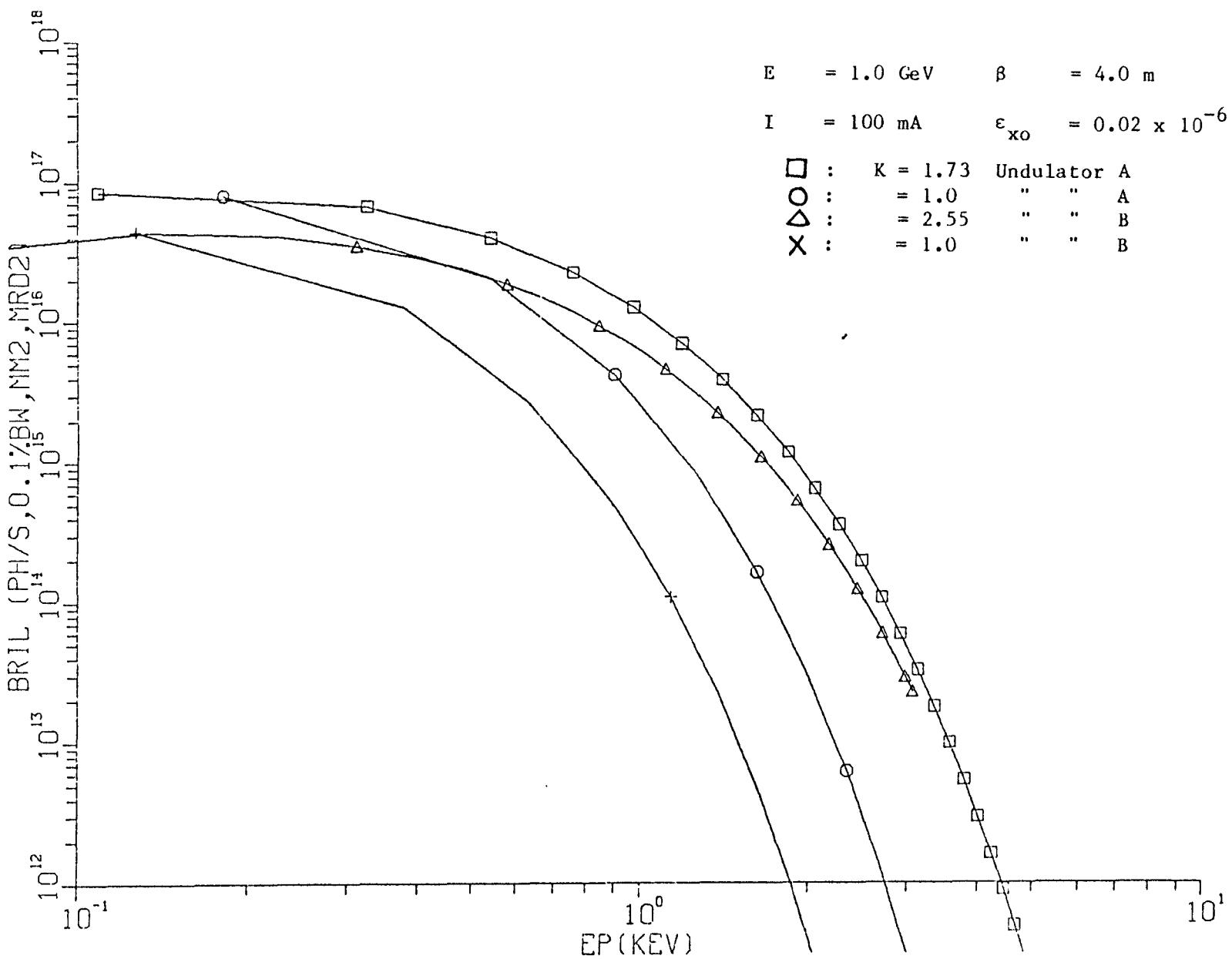
ALADDIN HYBRID UNDULATOR B

$E = 1.0 \text{ GeV}$ $N = 70$
 $I = 100 \text{ mA}$ $\beta = 4.0 \text{ m}$
 $\lambda_u = 5.0 \text{ cm}$ $\epsilon_{xo} = 0.02 \times 10^{-6}$

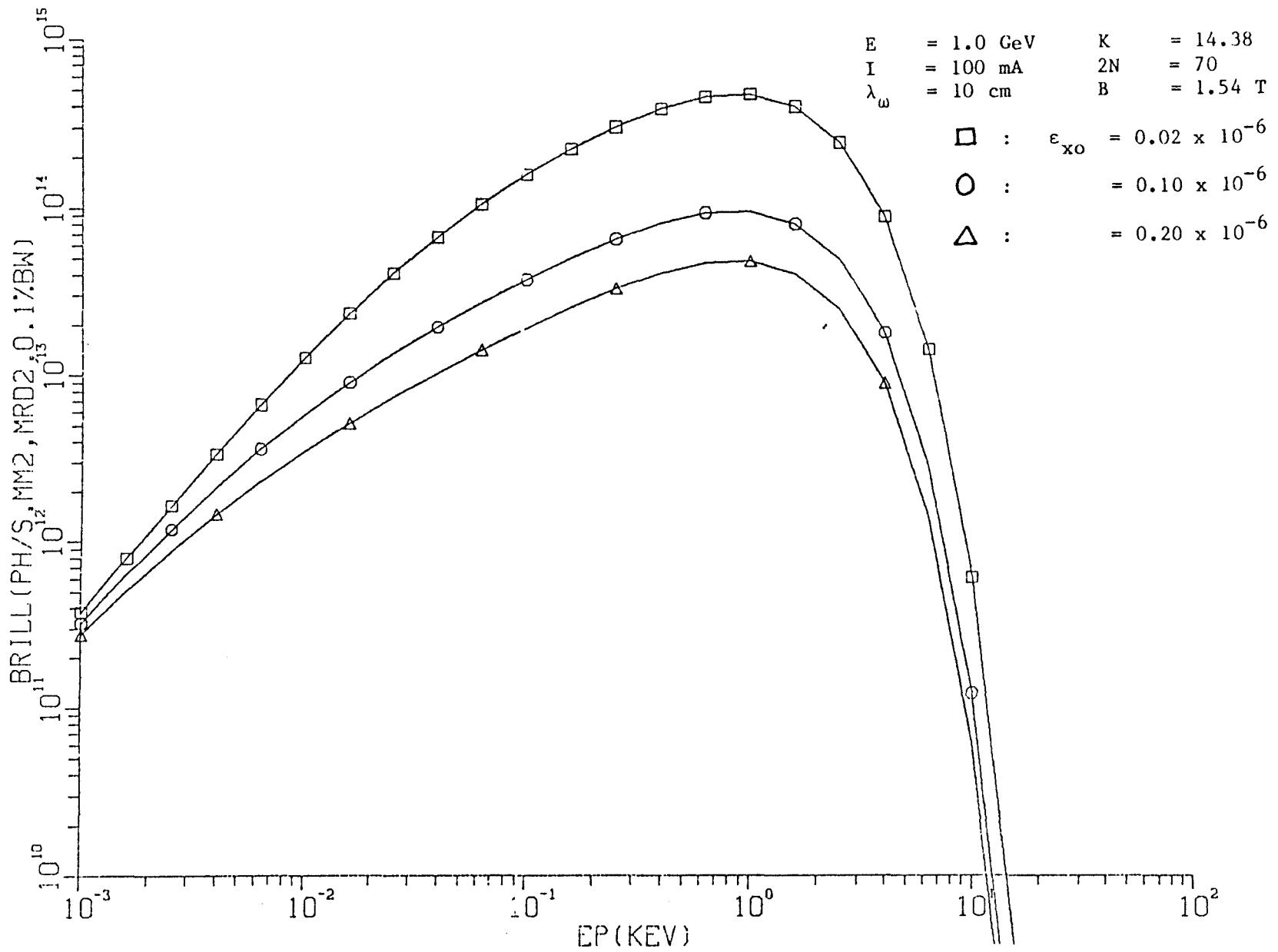
$\square : K = 2.55, \text{ Gap} = 1.75$
 $\circ : = 1.0, \quad = 3.0$



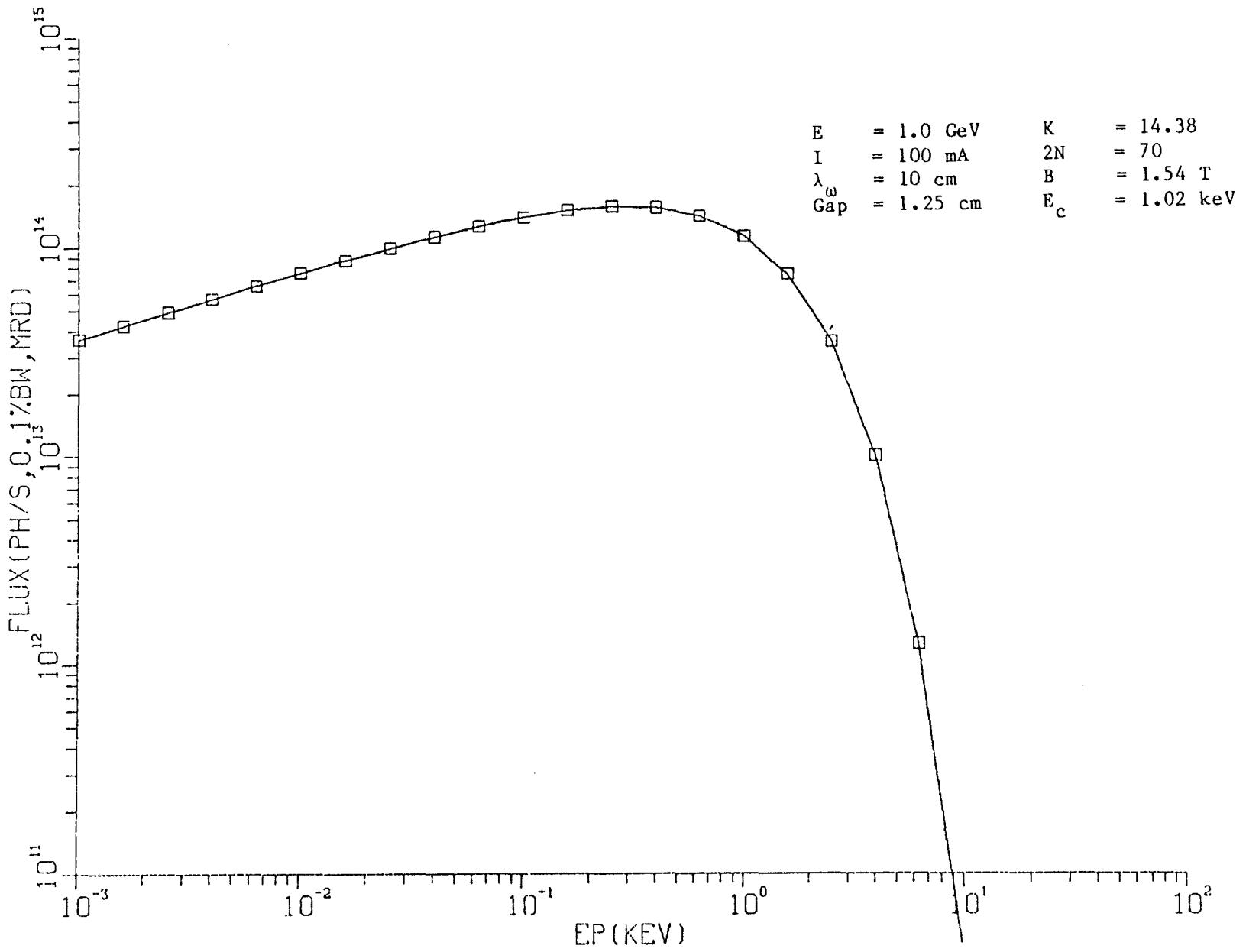
ALADDIN HYBRID UNDULATOR



ALADDIN HYBRID WIGGLER

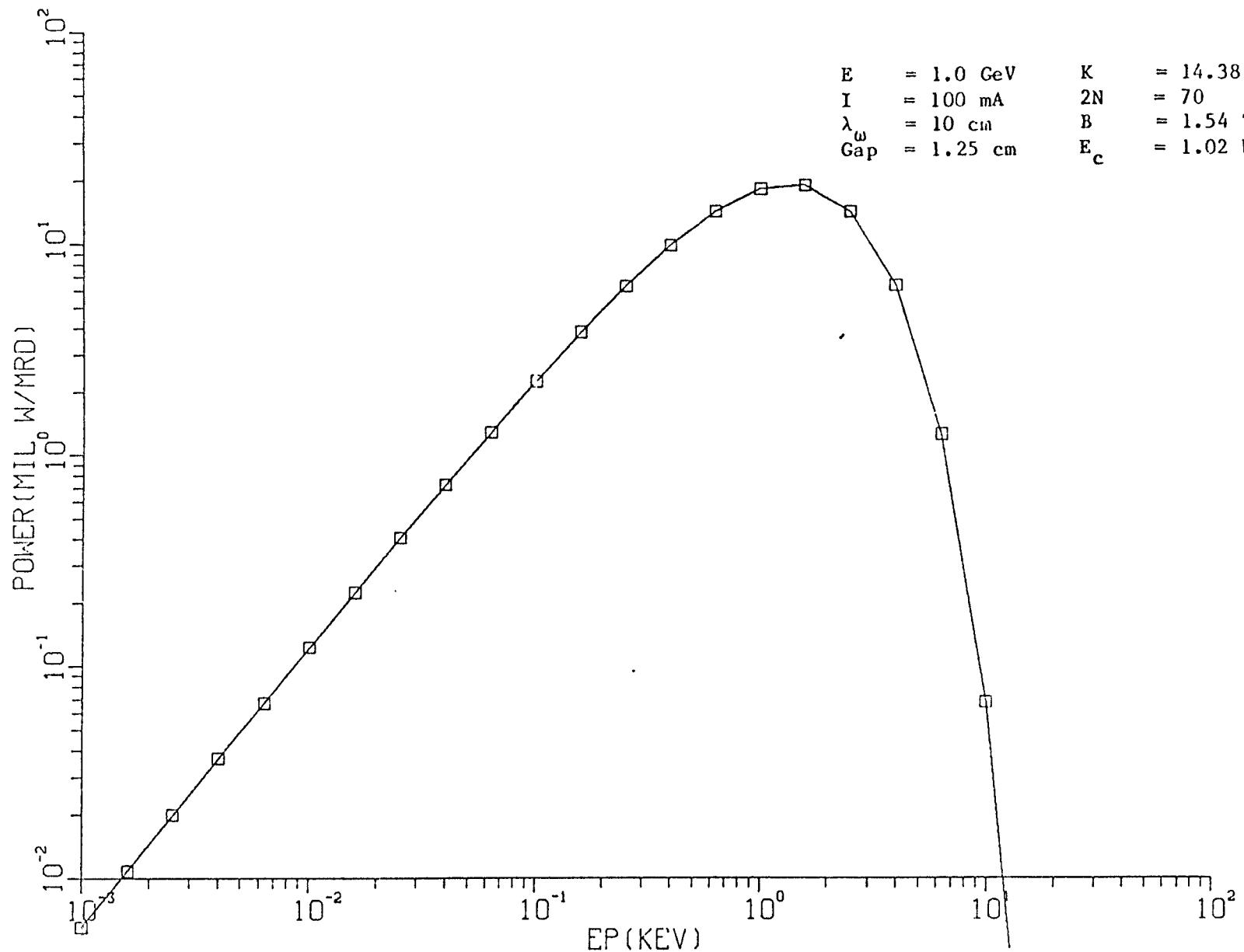


ALADDIN HYBRID WIGGLER



ALADDIN HYBRID WIGGLER

FIG. 1 14.24.03 THUR 21 MAR, 1995 JOSEPH E. REEDNEE DISSENR 9.0



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