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COMPUTATION OF SYNCHROTRON RADIATION FROM BENDING MAGNET AND WIGGLER

October 1989

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(Received September 25, 1989)

The programs for the VAX/MicroVAX computer were written in order to calculate various differential and total fluxes of synchrotron radiation from bending magnet and wiggler.

These computer programs are here listed.

1) Vertical angular dependences of "brightness" (angular flux density) and degree of circular polarization for a bending magnet case. [photons/s/mrad^2/0.1%b.w./mA]
2) Flux spectrum for a bending magnet or a wiggler case. [photons/s/mrad/0.1%b.w./mA]
3) Spectral brightness for a bending magnet or a wiggler case. [photons/s/mrad^2/0.1%b.w./mA]
4) Spectral brilliance for a bending magnet or a wiggler case. [photons/s/mrad^2/mm^2/0.1%b.w.]
5) Angular dependences of flux and percentage of circular polarization for a bending magnet case. (Flux of elliptically polarized photon.) [photons/s/mrad/0.1%b.w.]
6) Flux through a slit. [photons/s/0.1%b.w.]
7) Flux spectrum through a slit. [photons/s/0.1%b.w.]
8) Integrated flux through a slit. [photons/s]

The calculated parameters will be useful for practical synchrotron radiation users.

Keywords: Synchrotron Radiation, Bending Magnet, Wiggler, Emittance, Flux, Brightness, Brilliance, Angular Flux Density, Integrated Flux, Beamline, Slit

偏向電磁石及びウイグラーからの放射光計算プログラム

日本原子力研究所東海研究所物理部
佐々木　茂美

（1989年9月25日受理）

大型放射光施設では，挿入装置（ウイグラー，アンジュレーター）及び偏向電磁石から発生する光を多くの実験者が利用することが計画されている。放射光利用実験者にとって，光源からビームラインに入って来る光の実際的強度を把握することは重要である。

本報告は，放射光利用実験者が必要とする偏向電磁石，あるいはウイグラーからの光に関する基本的パラメータ（放射光強度の角度依存性，偏光度，フラックス，輝度スペクトル）及びスリットを通過する放射光フラックス，積分強度等を計算するプログラムとその計算例である。放射光利用者は，これらのプログラムを用いて簡便に必要な具体的パラメータを計算出来ると期待される。

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1. Introduction

Since the synchrotron radiation had begun to be used in various scientific fields such as physics, chemistry, biology and materials science, the horizons of these fields were expanded dramatically because there had been no competitive radiation sources in VUV and x-ray regions.

In the past decade, the population of the synchrotron radiation users has been increased. This is one of the most important reasons why the Science and Technology Agency (STA) of Japanese Government has decided to promote a project for constructing a high energy (8 GeV) third generation storage ring (SPring-8), as well as in Europe (ESRF) and in the U.S.A. (APS). The increase of the synchrotron radiation users leads to energetic activities of the synchrotron radiation society. But, unfortunately, some of the general users do not pay much attention to the characteristics of the synchrotron radiation source.

The purpose of this paper is to give some basic ideas related to the synchrotron radiation source and some simple ways to calculate the useful parameters for synchrotron radiation users.

2. Basic Equations

2.1 The synchrotron radiation source

Every user should aware that there are three important parameters ε, β and η to determine the electron beam size, where ε is the emittance, β is the betatron function and η is the dispersion function. The emittance ε is a unique constant value in a given lattice. The horizontal(σ_x) and vertical(σ_y) beam sizes are given by

$$\sigma_x = \sqrt{\beta_x \varepsilon_x + (\sigma_\varepsilon \eta_x / E)^2} \tag{1}$$

and

$$\sigma_y = \sqrt{\beta_y \varepsilon_y}\,, \tag{2}$$

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and

$$\sigma_y = \sqrt{\beta_y \varepsilon_y}\,, \qquad (2)$$

respectively, where σ_ε is the energy spread. The divergence in the vertical direction $\sigma_{y'}$ is calculated by the following equation :

$$\sigma_{y'}=\sqrt{\gamma_y \varepsilon_y}, \tag{3}$$

where $\gamma_y=\frac{1+\alpha_y^2}{\beta_y}$, $\alpha_y=-\frac{1}{2}\frac{d\beta_y}{ds}$.

2.2 The synchrotron radiation intensities[1]

The basic equations describing synchrotron radiation was given by Schwinger[2], Sokolov and Ternov[3] and Tomboulian and Hartman[4]. In this paper, it is not the case for going into the detailed derivation of the equations. Practically, the number of photons emitted from point source in a continuously curving "bending magnet" trajectory (this is so called "brightness".) is given by :

$$\text{Brightness}\,(d^3n/dtd\lambda d\Omega)\ [\text{photons/s/mrad}^2/0.1\%\text{b.w./mA}] = 3.46\times10^3\gamma^2\{F^\sigma(u,v)+F^\pi(u,v)\} \tag{4}$$

where $\gamma=E/mc^2=1957E(\text{GeV})$, $F^\sigma(u,v)$ and $F^\pi(u,v)$ are vertical and horizontal polarization component distribution functions respectively. Here $u=\lambda_c/\lambda$, $v=\gamma\psi$, λ_c is the critical wavelength and ψ is the vertical angle measured from the orbit plane of electrons. The distribution functions are defined by using modified Bessel functions $K_{2/3}$ and $K_{1/3}$ as follows:

$$F^\sigma(u,v)=u^2(1+v^2)^2K_{2/3}^2\{u(1+v^2)^{3/2}/2\} \tag{5}$$

$$F^\pi(u,v)=u^2v^2(1+v^2)K_{1/3}^2\{u(1+v^2)^{3/2}/2\}. \tag{6}$$

The degree of circular polarization is defined as:

$$P_{cir}=\frac{2(F^\sigma F^\pi)^{1/2}}{F^\sigma+F^\pi}. \tag{7}$$

Total flux per unit horizontal angle can be obtained by integrating the brightness in vertical direction. One can also calculate the flux and the integrated flux over the range of wavelength between λ_L and λ_H by using the following equation:

$$\text{Flux}(d^3n/dtd\lambda d\theta)\ [\text{photons/s/mrad/0.1\%b.w./mA}] = 1.256\times10^7\gamma G(\lambda_c/\lambda), \tag{8}$$

and

$$\text{Integrated Flux}(d^2n/dtd\theta)\ [\text{photons/s/mrad/mA}] = 1.256\times10^{10}\gamma \int_{\lambda_L}^{\lambda_H}\{G(\lambda_c/\lambda')/\lambda'\}d\lambda' , \tag{9}$$

respectively, where G is defined by using a modified Bessel function again as:

$$G(u)=u\int_u^\infty K_{5/3}(u')du' . \tag{10}$$

By using equation (4) at ψ=0, the actual brilliance is defined as follows:

$$\text{Brilliance}\ [\text{photons/s/mm}^2\text{/mrad}^2\text{/0.1\%b.w.}] = \frac{3.46\times10^3\gamma^2 INF^{\sigma}(u,0)}{\sigma_x\sigma_y\sqrt{1+(\sigma_{y'}/\sigma_{SR})^2}}, \tag{11}$$

where I is the beam current, N is the number of poles (e.g. 1 for bending magnet), and σ_{SR} is the standard deviation of vertical angular distribution for synchrotron radiation. If $\lambda\leq\lambda_c$, this standard deviation is approximately described as $\sigma_{SR}=0.565(\lambda/\lambda_c)^{0.425}\gamma^{-1}$ [5]. From this equation we find that shorter photon wavelength and larger electron beam divergence lead to reduced intensity.

For the actual usage of the equations described above, one has to spatially integrate these differential and integrated fluxes according to the actual situation such as a beamline length and a slit width.

3. Description of Programs

All programs included here are written in FORTRAN for the VAX/MicroVAX computer. These programs calculate various differential and integrated fluxes of synchrotron radiation from bending magnets and wigglers as follows:

1) Vertical angular dependences of "brightness" (angular flux density) for a bending magnet case and degree of circular polarization. (See Fig. 1.) [photons/s/mrad^2/0.1%b.w./mA]
2) Flux spectrum for a bending magnet or a wiggler.case. (See Fig. 2.) [photons/s/mrad/0.1%b.w./mA]
3) Spectral brightness for a bending magnet or a wiggler case. (See Fig. 3.) [photons/s/mrad^2/0.1%b.w./mA]
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5) Vertical.angular dependences of flux and percentage of circular polarization for a bending magnet case. (Flux of elliptically polarized photon.) [photons/s/mrad/0.1%b.w.]
6) Flux through a slit for a given photon energy. [photons/s/0.1%b.w.]
7) Flux spectrum through a slit. (See Fig. 5.) [photons/s/0.1%b.w.]
8) Integrated flux through a slit. (See Fig. 6.) [photons/s]

Programs 6), 7) and 8) calculate the fluxes passing through the first slit of a beamline. In order to use these programs, the beamline length (source to slit) and the slit size (vertical and horizontal width) are required for the input parameters. Programs 6), 7) and 8) do not include the calculation for a wiggler case. But, one can easily estimate the flux for a multipole wiggler by simply

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multiplying the number of poles of the wiggler to the output data for a bending magnet case.

Program 8) calculates the integrated fluxes above 4 keV. This value, the minimum photon energy, was chosen so as to simulate an upstream beryllium window which absorb photons below 4 keV.

For the small computer users convenience, a subroutine program for the calculation of modified Bessel function is included in each program. In this subroutine, we use the approximations as follows[6]:

$$K_\nu(x) = h\left\{\frac{e^{-x}}{2} + \sum_{r=1}^{n} e^{-x\cosh(rh)}\cosh(\nu rh)\right\} \tag{12}$$

and

$$\int_x^\infty K_\nu(\eta)\,d\eta = h\left\{\frac{e^{-x}}{2} + \sum_{r=1}^{n} e^{-x\cosh(rh)}\,\frac{\cosh(\nu rh)}{\cosh(rh)}\right\} \tag{13}$$

for any fractional order ν and x. Here n is a large integer and h is a small interval.

4. Program Listings and Examples

All programs with some examples of output data and figures(Figs. 1-6) are shown in this section.

The input parameters for each example are listed here. A bending magnet radiation has been assumed for the examples of programs 1), 2), 5), 6), 7) and 8). A wiggler radiation has bee assumed only for the programs 3) and 4).

1) E(electron energy)=8.0 GeV,
   B(strength of magnetic field)=0.61 T,
   EP(photon energy)=26.0 keV.
2) E=8.0 GeV, B=0.61 T.
3) E=8.0 GeV, B=1.0 T, J(number of poles)=22.
4) E=8.0 GeV, B=1.0 T, J=22,
   SIGX(σ_x)=0.0737 mm, SIGY(σ_y)=0.0487 mm,
   SIGDY($\sigma_{y'}$)=9.8x10^{-6} rad, CURRENT(beam current)=100. mA.
5) E=8.0 GeV, B=0.61 T, EP=26.0 keV,
   BC(beam current)=100.0 mA,
   PER(percentage of circular polarization)=80.0 %.
6) E=8.0 GeV, B=0.61 T, EP=26.0 keV, BC=100.0 mA,
   BL(length of beamline from source to slit)=50.0 m,
   VW(vertical width of slit)=3.0 mm,
   HW(horizontal width of slit)=50.0 mm.
7) E=8.0 GeV, B=0.61 T, BC=100.0 mA,
   BL=50.0 m, VW=3.0 mm, HW=50.0 mm.
8) E=8.0 GeV, B=0.61 T, BC=100.0 mA,
   EMAX(required maximum photon energy)=100.0 keV,
   BL=50.0 m, VW=3.0 mm, HW=50.0 mm.

Program 1

```
C     Calculation of Vertical Angular Dependence of Brightness
C     Bending Magnet Case
C     Includes Angular Dependence of Circular Polarization

      WRITE(6,100)
  100 FORMAT(' INPUT ENECTRON ENERGY (GeV)')
      READ(5,200) E
  200 FORMAT(F8.2)

      WRITE(6,300)
  300 FORMAT(' INPUT MAGNETIC-FIELD (T)')
      READ(5,400) B
  400 FORMAT(F8.2)

      WRITE(6,500)
  500 FORMAT(' INPUT PHOTON ENERGY (keV)')
      READ(5,600) EP
  600 FORMAT(F8.2)

      GLC=18.6/(B*E**2)
      GL=12398./(1000.*EP)
      GAMMA=1957.*E
      EC=12.398/GLC

      U=GLC/GL

C     (Z : Vertical Angle in rad)
      DO Z=0.,0.0002,0.000002
         V=GAMMA*Z
         X=U*(1.+V**2)**(3./2.)/2.
         IF(X.GT.30.) GO TO 20
         GNU=2./3.
         CALL BESSEL(GNU,X,S)
         FHOR=U**2*(1.+V**2)**2*S**2

         GNU=1./3.
         CALL BESSEL(GNU,X,S)
         FVER=U**2*V**2*(1.+V**2)*S**2

         IF(Z.EQ.0.0) FO=FHOR

         PHOTON=3460.*GAMMA**2*(FHOR+FVER)
         BRITE=3460.*GAMMA**2*FO
         PCIR=2.*(FHOR*FVER)**0.5/(FHOR+FVER)
         CIR=BRITE*PCIR
         FRAC=PHOTON*PCIR

         WRITE(6,'(5E)') Z, PHOTON, PCIR, FRAC, CIR
         WRITE(7,'(2E)') Z, FRAC
         WRITE(8,'(2E)') Z, PHOTON
         WRITE(9,'(4E)') Z, PHOTON, PCIR, FRAC
      END DO

   20 STOP
      END

      SUBROUTINE BESSEL(GNU,X,S)
```

```
C     Calculation of Bessel Function

      H=X/100.
      N=1000
      IF(X.GT.5.0) H=0.05
      IF(X.LT.0.5) N=INT(1000./X)
      S=EXP(-X)/2.
      DO I=1,N
      S=S+COSH(GNU*FLOAT(I)*H)*EXP(-X*COSH(FLOAT(I)*H))
   END DO
   S=S*H
   RETURN
   END
```

Vertical Angle Ψ [rad]	Flux Density [phs/s/mrad²/0.1%b.w./mA]	P_{air}	Flux Density × P_{air}
0.0000000E+00	0.1233503E+13	0.0000000E+00	0.0000000E+00
0.2000000E-05	0.1232826E+13	0.5130560E-01	0.6325086E+11
0.4000000E-05	0.1230790E+13	0.1023194E+00	0.1259337E+12
0.6000000E-05	0.1227358E+13	0.1527563E+00	0.1874866E+12
0.8000000E-05	0.1222463E+13	0.2023450E+00	0.2473592E+12
0.1000000E-04	0.1216027E+13	0.2508327E+00	0.3050193E+12
0.1200000E-04	0.1207947E+13	0.2979920E+00	0.3599585E+12
0.1400000E-04	0.1198111E+13	0.3436223E+00	0.4116976E+12
0.1600000E-04	0.1186398E+13	0.3875542E+00	0.4597934E+12
0.1800000E-04	0.1172679E+13	0.4296509E+00	0.5038427E+12
0.2000000E-04	0.1156838E+13	0.4698068E+00	0.5434903E+12
0.2200000E-04	0.1138754E+13	0.5079492E+00	0.5784290E+12
0.2400000E-04	0.1118338E+13	0.5440331E+00	0.6084128E+12
0.2600000E-04	0.1095505E+13	0.5780433E+00	0.6332493E+12
0.2800000E-04	0.1070206E+13	0.6099879E+00	0.6528129E+12
0.3000000E-04	0.1042424E+13	0.6398968E+00	0.6670437E+12
0.3200000E-04	0.1012173E+13	0.6678179E+00	0.6759475E+12
0.3400000E-04	0.9795109E+12	0.6938129E+00	0.6795973E+12
0.3600000E-04	0.9445312E+12	0.7179574E+00	0.6781331E+12
0.3800001E-04	0.9073780E+12	0.7403337E+00	0.6717625E+12
0.4000001E-04	0.8682255E+12	0.7610320E+00	0.6607474E+12
0.4200001E-04	0.8273010E+12	0.7801430E+00	0.6454131E+12
0.4400001E-04	0.7848601E+12	0.7977635E+00	0.6261328E+12
0.4600001E-04	0.7411941E+12	0.8139875E+00	0.6033228E+12
0.4800001E-04	0.6966204E+12	0.8289096E+00	0.5774353E+12
0.5000001E-04	0.6514810E+12	0.8426196E+00	0.5489506E+12
0.5200001E-04	0.6061278E+12	0.8552076E+00	0.5183651E+12
0.5400001E-04	0.5609200E+12	0.8667562E+00	0.4861809E+12
0.5600001E-04	0.5162141E+12	0.8773467E+00	0.4528988E+12
0.5800001E-04	0.4723581E+12	0.8870538E+00	0.4190071E+12
0.6000001E-04	0.4296789E+12	0.8959497E+00	0.3849707E+12
0.6200001E-04	0.3884807E+12	0.9041001E+00	0.3512254E+12
0.6400001E-04	0.3490345E+12	0.9115672E+00	0.3181684E+12
0.6600002E-04	0.3115757E+12	0.9184084E+00	0.2861537E+12
0.6800002E-04	0.2762971E+12	0.9246765E+00	0.2554854E+12
0.7000002E-04	0.2433497E+12	0.9304208E+00	0.2264177E+12
0.7200002E-04	0.2128383E+12	0.9356858E+00	0.1991498E+12
0.7400002E-04	0.1848235E+12	0.9405128E+00	0.1738289E+12
0.7600002E-04	0.1593226E+12	0.9449401E+00	0.1505503E+12
0.7800002E-04	0.1363119E+12	0.9490027E+00	0.1293604E+12
0.8000002E-04	0.1157314E+12	0.9527317E+00	0.1102610E+12
0.8200002E-04	0.9748856E+11	0.9561564E+00	0.9321431E+11
0.8400002E-04	0.8146424E+11	0.9593031E+00	0.7814890E+11
0.8600002E-04	0.6751721E+11	0.9621960E+00	0.6496479E+11
0.8800002E-04	0.5549098E+11	0.9648571E+00	0.5354087E+11
0.9000002E-04	0.4521827E+11	0.9673062E+00	0.4373991E+11
0.9200002E-04	0.3652713E+11	0.9695616E+00	0.3541531E+11
0.9400002E-04	0.2924493E+11	0.9716402E+00	0.2841555E+11
0.9600003E-04	0.2320304E+11	0.9735570E+00	0.2258948E+11
0.9800003E-04	0.1823991E+11	0.9753256E+00	0.1778985E+11
0.1000000E-03	0.1420391E+11	0.9769588E+00	0.1387663E+11
0.1020000E-03	0.1095536E+11	0.9784677E+00	0.1071946E+11
0.1040000E-03	0.8367628E+10	0.9798630E+00	0.8199129E+10
0.1060000E-03	0.6327897E+10	0.9811537E+00	0.6208639E+10
0.1080000E-03	0.4737210E+10	0.9823488E+00	0.4653593E+10
0.1100000E-03	0.3510072E+10	0.9834563E+00	0.3452002E+10
0.1120000E-03	0.2573737E+10	0.9844829E+00	0.2533801E+10

Vertical Angle ψ [rad]	Flux Density [phs/s/mrad²/0.1%b.w./mA]	P_{air}	Flux Density x P_{air}
0.1140000E-03	0.1867196E+10	0.9854357E+00	0.1840001E+10
0.1160000E-03	0.1340039E+10	0.9863202E+00	0.1321708E+10
0.1180000E-03	0.9511996E+09	0.9871420E+00	0.9389690E+09
0.1200000E-03	0.6676918E+09	0.9879062E+00	0.6596169E+09
0.1220000E-03	0.4633974E+09	0.9886171E+00	0.4581227E+09
0.1240000E-03	0.3179283E+09	0.9892791E+00	0.3145198E+09
0.1260000E-03	0.2155872E+09	0.9898959E+00	0.2134089E+09
0.1280000E-03	0.1444646E+09	0.9904709E+00	0.1430880E+09
0.1300000E-03	0.9564602E+08	0.9910074E+00	0.9478592E+08
0.1320000E-03	0.6255502E+08	0.9915083E+00	0.6202382E+08
0.1340000E-03	0.4040827E+08	0.9919763E+00	0.4008405E+08
0.1360000E-03	0.2577596E+08	0.9924136E+00	0.2558041E+08
0.1380000E-03	0.1623375E+08	0.9928229E+00	0.1611724E+08
0.1400000E-03	0.1009260E+08	0.9932060E+00	0.1002403E+08
0.1420000E-03	0.6192853E+07	0.9935648E+00	0.6153001E+07
0.1440000E-03	0.3749791E+07	0.9939011E+00	0.3726921E+07
0.1460000E-03	0.2240124E+07	0.9942165E+00	0.2227168E+07
0.1480000E-03	0.1320106E+07	0.9945126E+00	0.1312862E+07
0.1500000E-03	0.7672570E+06	0.9947904E+00	0.7632599E+06
0.1520000E-03	0.4397333E+06	0.9950516E+00	0.4375573E+06
0.1540000E-03	0.2484715E+06	0.9952971E+00	0.2473029E+06
0.1560000E-03	0.1383963E+06	0.9955281E+00	0.1377774E+06
0.1580000E-03	0.7597218E+05	0.9957455E+00	0.7564896E+05
0.1600000E-03	0.4109511E+05	0.9959503E+00	0.4092868E+05
0.1620000E-03	0.2190054E+05	0.9961432E+00	0.2181608E+05
0.1640000E-03	0.1149646E+05	0.9963251E+00	0.1145421E+05
0.1660000E-03	0.5943560E+04	0.9964968E+00	0.5922738E+04
0.1680000E-03	0.3025677E+04	0.9966587E+00	0.3015567E+04
0.1700000E-03	0.1516394E+04	0.9968117E+00	0.1511560E+04
0.1720000E-03	0.7480623E+03	0.9969563E+00	0.7457854E+03
0.1740000E-03	0.3631801E+03	0.9970930E+00	0.3621243E+03
0.1760000E-03	0.1734943E+03	0.9972223E+00	0.1730124E+03
0.1780000E-03	0.8153585E+02	0.9973447E+00	0.8131935E+02
0.1800000E-03	0.3769080E+02	0.9974605E+00	0.3759509E+02
0.1820000E-03	0.1713426E+02	0.9975703E+00	0.1709263E+02
0.1840000E-03	0.7658828E+01	0.9976743E+00	0.7641016E+01
0.1860000E-03	0.3365432E+01	0.9977729E+00	0.3357937E+01
0.1880000E-03	0.1453551E+01	0.9978666E+00	0.1450450E+01
0.1900000E-03	0.6169518E+00	0.9979554E+00	0.6156904E+00
0.1920001E-03	0.2572886E+00	0.9980397E+00	0.2567843E+00
0.1940001E-03	0.1054055E+00	0.9981199E+00	0.1052074E+00
0.1960001E-03	0.4241296E-01	0.9981961E+00	0.4233645E-01
0.1980001E-03	0.1675904E-01	0.9982685E+00	0.1673002E-01
0.2000001E-03	0.6501752E-02	0.9983374E+00	0.6490943E-02

Program 2

```
C     CALCULATION OF TOTAL FLUX OF PHOTON FROM BM AND WIGGLER
C     [photons/s/mrad/0.1%b.w./mA]

      WRITE(6,100)
  100 FORMAT(' INPUT ELECTRON ENERGY (GeV)')
      READ(5,200) E
  200 FORMAT(F8.2)

      WRITE(6,300)
  300 FORMAT(' INPUT MAGNETIC FIELD (T)')
      READ(5,400) B
  400 FORMAT(F8.2)

      WRITE(6,500)
  500 FORMAT(' INPUT NUMBER OF POLES (BM=01)')
      READ(5,600) J
  600 FORMAT(I2)

      GAMMA=1957.*E
      GLC=18.6/(B*E**2)
      GNU=5./3.

      DO Z=2.,6.,0.1
         EP=10.**Z
         GL=12398./EP
         X=GLC/GL
         H=X/100.
         N=1000
         IF(X.GT.5.0) H=0.05
         IF(X.LT.0.5) N=INT(1000./X)
         S=EXP(-X)/2.
         DO 10 I=1,N
          S=S+COSH(GNU*FLOAT(I)*H)*EXP(-X*COSH(FLOAT(I)*H))/
     1       COSH(FLOAT(I)*H)
   10    CONTINUE
         S=S*H
         G=X*S
         FLUX=1.256E7*GAMMA*G*J
         DAT=ALOG10(FLUX)
         WRITE(6,'(4E)') Z, X, EP, FLUX
         WRITE(7,'(2E)') EP, FLUX
         WRITE(8,'(2E)') Z, DAT
      END DO
      STOP
      END
```

Photon Energy [eV]	Flux [phs/s/mrad/0.1%b.w./mA]
0.1000000E+03	0.6483008E+11
0.1258925E+03	0.6975908E+11
0.1584892E+03	0.7501421E+11
0.1995261E+03	0.8061171E+11
0.2511884E+03	0.8655501E+11
0.3162274E+03	0.9284326E+11
0.3981067E+03	0.9947655E+11
0.5011865E+03	0.1064369E+12
0.6309562E+03	0.1137030E+12
0.7943267E+03	0.1212328E+12
0.9999978E+03	0.1289689E+12
0.1258922E+04	0.1368270E+12
0.1584889E+04	0.1446934E+12
0.1995257E+04	0.1524169E+12
0.2511879E+04	0.1597989E+12
0.3162267E+04	0.1665878E+12
0.3981058E+04	0.1724656E+12
0.5011854E+04	0.1770453E+12
0.6309548E+04	0.1798669E+12
0.7943249E+04	0.1804052E+12
0.9999956E+04	0.1780928E+12
0.1258920E+05	0.1723664E+12
0.1584886E+05	0.1627508E+12
0.1995252E+05	0.1489805E+12
0.2511873E+05	0.1311577E+12
0.3162260E+05	0.1099245E+12
0.3981049E+05	0.8657730E+11
0.5011843E+05	0.6303422E+11
0.6309535E+05	0.4154785E+11
0.7943232E+05	0.2414610E+11
0.9999934E+05	0.1196663E+11
0.1258917E+06	0.4848670E+10
0.1584882E+06	0.1523107E+10
0.1995248E+06	0.3469277E+09
0.2511868E+06	0.5267072E+08
0.3162253E+06	0.4793875E+07
0.3981040E+06	0.2289096E+06
0.5011832E+06	0.4848512E+04
0.6309521E+06	0.3688009E+02
0.7943214E+06	0.7722831E-01
0.9999912E+06	0.3186182E-04

Program 3

```
c      Calculation of Brightness of BM & Wiggler
c      [photons/s/mrad**2/0.1%b.w./mA]

       WRITE(6,100)
  100  FORMAT(' INPUT ELECTRON ENERGY (GeV)')
       READ(5,200) E
  200  FORMAT(F8.2)

       WRITE(6,300)
  300  FORMAT(' INPUT MAGNETIC FIELD (T)')
       READ(5,400) B
  400  FORMAT(F8.2)

       WRITE(6,500)
  500  FORMAT(' INPUT NUMBER OF POLES (01 for BM)')
       READ(5,600) J
  600  FORMAT(I2)

       GAMMA=1957.*E
       GLC=18.6/(B*E**2)
       GNU=2./3.

       DO Z=2.,6.,0.1
          EP=10.**Z
          GL=12398./EP
          U=GLC/GL
          X=U/2.
          H=X/100.
          N=1000
          IF(X.LT.0.001) GO TO 20
          IF(X.GT.5.0) H=0.05
          IF(X.LT.0.5) N=INT(1000./X)
          S=EXP(-X)/2.
          DO 10 I=1,N
           S=S+COSH(GNU*FLOAT(I)*H)*EXP(-X*COSH(FLOAT(I)*H))
   10     CONTINUE
          S=S*H
          F=U**2*S**2
          PHOTON=3.46E3*GAMMA**2*F*J
          DAT=ALOG10(PHOTON)
          WRITE(6,'(4E)') Z,X,EP,PHOTON
          WRITE(7,'(2E)') EP, PHOTON
          WRITE(8,'(2E)') Z, DAT
   20  END DO

       STOP
       END
```

Photon Energy [eV]	Brightness [phs/s/mrad²/0.1%b.w./mA]
0.1000000E+03	0.9579876E+12
0.1258925E+03	0.1116371E+13
0.1584892E+03	0.1301305E+13
0.1995261E+03	0.1517109E+13
0.2511884E+03	0.1768766E+13
0.3162274E+03	0.2061574E+13
0.3981067E+03	0.2402412E+13
0.5011865E+03	0.2799417E+13
0.6309562E+03	0.3261213E+13
0.7943267E+03	0.3797848E+13
0.9999978E+03	0.4421037E+13
0.1258922E+04	0.5143564E+13
0.1584889E+04	0.5979685E+13
0.1995257E+04	0.6944885E+13
0.2511879E+04	0.8054883E+13
0.3162267E+04	0.9325671E+13
0.3981058E+04	0.1077103E+14
0.5011854E+04	0.1240112E+14
0.6309548E+04	0.1421768E+14
0.7943249E+04	0.1620966E+14
0.9999956E+04	0.1834526E+14
0.1258920E+05	0.2056266E+14
0.1584886E+05	0.2275839E+14
0.1995252E+05	0.2477642E+14
0.2511873E+05	0.2640142E+14
0.3162260E+05	0.2736325E+14
0.3981049E+05	0.2736342E+14
0.5011843E+05	0.2613403E+14
0.6309535E+05	0.2353249E+14
0.7943232E+05	0.1965508E+14
0.9999934E+05	0.1491759E+14
0.1258917E+06	0.1002533E+14
0.1584882E+06	0.5774666E+13
0.1995248E+06	0.2736483E+13
0.2511868E+06	0.1013264E+13
0.3162253E+06	0.2747787E+12
0.3981040E+06	0.5030292E+11
0.5011832E+06	0.5611120E+10
0.6309521E+06	0.3352459E+09
0.7943214E+06	0.9122009E+07
0.9999912E+06	0.9216751E+05

Program 4

```
C     Calculation of Brilliance of BM & Wiggler
C     [photons/s/mrad**2/mm**2/0.1%b.w.]

      WRITE(6,100)
  100 FORMAT(' INPUT ELECTRON ENERGY (GeV)')
      READ(5,150) E
  150 FORMAT(F8.2)

      WRITE(6,200)
  200 FORMAT(' INPUT MAGNETIC FIELD (T)')
      READ(5,250) B
  250 FORMAT(F8.2)

      WRITE(6,300)
  300 FORMAT(' INPUT NUMBER OF POLES,(01 FOR BM)')
      READ(5,350) J
  350 FORMAT(I2)

      WRITE(6,400)
  400 FORMAT(' INPUT SIGMA X (mm)')
      READ(5,450) SIGX
  450 FORMAT(F9.3)

      WRITE(6,500)
  500 FORMAT(' INPUT SIGMA Y (mm)')
      READ(5,550) SIGY
  550 FORMAT(F9.3)

      WRITE(6,600)
  600 FORMAT(' INPUT SIGMA DY')
      READ(5,650) SIGDY
  650 FORMAT(E9.3)
      WRITE(6,'(1E)') SIGDY

      WRITE(6,700)
  700 FORMAT(' INPUT BEAM CURRENT (mA)')
      READ(5,750) CURRENT
  750 FORMAT(F8.2)

      GAMMA=1957.*E
      GLC=18.6/(B*E**2)
      GNU=2./3.

      DO Z=2.,6.,0.1
         EP=10.**Z
         GL=12398./EP
         SIGSR=0.565*(GL/GLC)**0.425/GAMMA
         U=GLC/GL
         X=U/2.
         H=X/100.
         N=1000
         IF(X.LT.0.001) GO TO 20
         IF(X.GT.5.0)   H=0.05
         IF(X.LT.0.5)   N=INT(1000./X)
         S=EXP(-X)/2.
         DO 10 I=1,N
          S=S+COSH(GNU*FLOAT(I)*H)*EXP(-X*COSH(FLOAT(I)*H))
```

```
10     CONTINUE
       S=S*H
       F=U**2*S**2
       PHOTON=3.46E3*GAMMA**2*F*J/(1.+(SIGDY/SIGSR)**2)**0.5
  1           /SIGX/SIGY*CURRENT
       DAT=ALOG10(PHOTON)
       WRITE(6,'(4E)') Z, X, EP, PHOTON
       WRITE(7,'(2E)') EP, PHOTON
       WRITE(8,'(2E)') Z, DAT
 20 END DO
    STOP
    END
```

Photon Energy [eV]	Brilliance [phs/s/mrad²/mm²/0.1%b.w.]
0.1000000E+03	0.2668519E+17
0.1258925E+03	0.3109559E+17
0.1584892E+03	0.3624473E+17
0.1995261E+03	0.4225254E+17
0.2511884E+03	0.4925727E+17
0.3162274E+03	0.5740567E+17
0.3981067E+03	0.6688826E+17
0.5011865E+03	0.7793005E+17
0.6309562E+03	0.9076901E+17
0.7943267E+03	0.1056817E+18
0.9999978E+03	0.1229899E+18
0.1258922E+04	0.1430433E+18
0.1584889E+04	0.1662299E+18
0.1995257E+04	0.1929684E+18
0.2511879E+04	0.2236792E+18
0.3162267E+04	0.2587838E+18
0.3981058E+04	0.2986334E+18
0.5011854E+04	0.3434677E+18
0.6309548E+04	0.3932786E+18
0.7943249E+04	0.4476866E+18
0.9999956E+04	0.5057208E+18
0.1258920E+05	0.5655627E+18
0.1584886E+05	0.6242388E+18
0.1995252E+05	0.6773398E+18
0.2511873E+05	0.7188780E+18
0.3162260E+05	0.7414774E+18
0.3981049E+05	0.7371851E+18
0.5011843E+05	0.6991684E+18
0.6309535E+05	0.6243288E+18
0.7943232E+05	0.5162809E+18
0.9999934E+05	0.3872153E+18
0.1258917E+06	0.2565907E+18
0.1584882E+06	0.1453653E+18
0.1995248E+06	0.6755708E+17
0.2511868E+06	0.2445354E+17
0.3162253E+06	0.6459299E+16
0.3981040E+06	0.1147292E+16
0.5011832E+06	0.1236436E+15
0.6309521E+06	0.7105277E+13
0.7943214E+06	0.1850881E+12
0.9999912E+06	0.1781836E+10

Program 5

```
C     Calculation of Vertical Angular Dependence of Flux
C     Bending Magnet Case
C     Angular Dependence of Circular Polarized Flux

      WRITE(6,100)
  100 FORMAT(' INPUT ENECTRON ENERGY (GeV)')
      READ(5,200) E
  200 FORMAT(F8.2)

      WRITE(6,250)
  250 FORMAT(' INPUT BEAM CURRENT (mA)')
      READ(5,260) BC
  260 FORMAT(F8.2)

      WRITE(6,300)
  300 FORMAT(' INPUT MAGNETIC FIELD (T)')
      READ(5,400) B
  400 FORMAT(F8.2)

      WRITE(6,500)
  500 FORMAT(' INPUT PHOTON ENERGY (keV)')
      READ(5,600) EP
  600 FORMAT(F8.2)

      WRITE(6,650)
  650 FORMAT(' INPUT REQUIRED PERCENTAGE OF CIRCULAR POLARIZATION')
      READ(5,660) PER
  660 FORMAT(F8.2)
      PER=PER/100.

      GLC=18.6/(B*E**2)
      GL=12398./(1000.*EP)
      GAMMA=1957.*E
      EC=12.398/GLC

      U=GLC/GL

      ZLIM=0.0002
      DZ=0.000001
      FLUX=0.
      DFLUX=0.
```

```
C     (Z : Vertical Angle in rad)
      DO Z=0.,ZLIM,DZ
         V=GAMMA*Z
         X=U*(1.+V**2)**(3./2.)/2.
         IF(X.GT.30.) GO TO 20
         GNU=2./3.
         CALL BESSEL(GNU,X,S)
         FHOR=U**2*(1.+V**2)**2*S**2

         GNU=1./3.
         CALL BESSEL(GNU,X,S)
         FVER=U**2*V**2*(1.+V**2)*S**2

         IF(Z.EQ.0.0) FO=FHOR

         PHOTON=3460.*GAMMA**2*(FHOR+FVER)*BC
         BRITE=3460.*GAMMA**2*FO*BC
         PCIR=2.*(FHOR*FVER)**0.5/(FHOR+FVER)
         CIR=BRITE*PCIR

         IF(PCIR.GE.PER) DFLUX=PHOTON*DZ*1000.
         FLUX=FLUX+DFLUX

         WRITE(6,'(5E)') Z, PHOTON, PCIR, CIR, FLUX
         WRITE(7,'(4E)') Z, PHOTON, PCIR, FLUX
         WRITE(8,'(2E)') Z, PHOTON
         WRITE(9,'(2E)') Z, CIR
      END DO

   20 STOP
      END

      SUBROUTINE BESSEL(GNU,X,S)

C     Calculation of Bessel Function

      H=X/100.
      N=1000
      IF(X.GT.5.0) H=0.05
      IF(X.LT.0.5) N=INT(1000./X)
      S=EXP(-X)/2.
      DO I=1,N
         S=S+COSH(GNU*FLOAT(I)*H)*EXP(-X*COSH(FLOAT(I)*H))
      END DO
      S=S*H
      RETURN
      END
```

Vertical Angle Ψ [rad]	Flux Density [phs/s/mrad²/0.1%b.w.]	P_{cir}	Flux [phs/s/mrad/0.1%b.w.]
0.0000000E+00	0.1233503E+15	0.0000000E+00	0.0000000E+00
0.1000000E-05	0.1233333E+15	0.2567111E-01	0.0000000E+00
0.2000000E-05	0.1232826E+15	0.5130560E-01	0.0000000E+00
0.3000000E-05	0.1231980E+15	0.7686699E-01	0.0000000E+00
0.4000000E-05	0.1230790E+15	0.1023194E+00	0.0000000E+00
0.5000000E-05	0.1229251E+15	0.1276273E+00	0.0000000E+00
0.6000000E-05	0.1227358E+15	0.1527563E+00	0.0000000E+00
0.7000000E-05	0.1225098E+15	0.1776728E+00	0.0000000E+00
0.8000000E-05	0.1222463E+15	0.2023450E+00	0.0000000E+00
0.9000000E-05	0.1219444E+15	0.2267414E+00	0.0000000E+00
0.1000000E-04	0.1216027E+15	0.2508327E+00	0.0000000E+00
0.1100000E-04	0.1212201E+15	0.2745918E+00	0.0000000E+00
0.1200000E-04	0.1207947E+15	0.2979921E+00	0.0000000E+00
0.1300000E-04	0.1203258E+15	0.3210092E+00	0.0000000E+00
0.1400000E-04	0.1198111E+15	0.3436223E+00	0.0000000E+00
0.1500000E-04	0.1192498E+15	0.3658100E+00	0.0000000E+00
0.1600000E-04	0.1186397E+15	0.3875543E+00	0.0000000E+00
0.1700000E-04	0.1179796E+15	0.4088394E+00	0.0000000E+00
0.1800000E-04	0.1172679E+15	0.4296509E+00	0.0000000E+00
0.1900000E-04	0.1165033E+15	0.4499765E+00	0.0000000E+00
0.2000000E-04	0.1156838E+15	0.4698069E+00	0.0000000E+00
0.2100000E-04	0.1148083E+15	0.4891328E+00	0.0000000E+00
0.2200000E-04	0.1138754E+15	0.5079492E+00	0.0000000E+00
0.2300000E-04	0.1128843E+15	0.5262502E+00	0.0000000E+00
0.2400000E-04	0.1118338E+15	0.5440332E+00	0.0000000E+00
0.2500000E-04	0.1107229E+15	0.5612974E+00	0.0000000E+00
0.2600001E-04	0.1095504E+15	0.5780435E+00	0.0000000E+00
0.2700001E-04	0.1083166E+15	0.5942730E+00	0.0000000E+00
0.2800001E-04	0.1070206E+15	0.6099879E+00	0.0000000E+00
0.2900001E-04	0.1056625E+15	0.6251947E+00	0.0000000E+00
0.3000001E-04	0.1042424E+15	0.6398968E+00	0.0000000E+00
0.3100001E-04	0.1027604E+15	0.6541023E+00	0.0000000E+00
0.3200001E-04	0.1012173E+15	0.6678179E+00	0.0000000E+00
0.3300001E-04	0.9961381E+14	0.6810516E+00	0.0000000E+00
0.3400001E-04	0.9795107E+14	0.6938129E+00	0.0000000E+00
0.3500001E-04	0.9623031E+14	0.7061118E+00	0.0000000E+00
0.3600001E-04	0.9445310E+14	0.7179575E+00	0.0000000E+00
0.3700001E-04	0.9262172E+14	0.7293609E+00	0.0000000E+00
0.3800001E-04	0.9073779E+14	0.7403336E+00	0.0000000E+00
0.3900001E-04	0.8880379E+14	0.7508864E+00	0.0000000E+00
0.4000001E-04	0.8682253E+14	0.7610320E+00	0.0000000E+00
0.4100001E-04	0.8479696E+14	0.7707800E+00	0.0000000E+00
0.4200001E-04	0.8273011E+14	0.7801430E+00	0.0000000E+00
0.4300001E-04	0.8062523E+14	0.7891339E+00	0.0000000E+00
0.4400001E-04	0.7848599E+14	0.7977635E+00	0.0000000E+00
0.4500001E-04	0.7631595E+14	0.8060446E+00	0.7631595E+11
0.4600001E-04	0.7411938E+14	0.8139876E+00	0.1504353E+12
0.4700001E-04	0.7189995E+14	0.8216052E+00	0.2223353E+12
0.4800001E-04	0.6966203E+14	0.8289096E+00	0.2919973E+12
0.4900001E-04	0.6740995E+14	0.8359100E+00	0.3594073E+12
0.5000001E-04	0.6514809E+14	0.8426196E+00	0.4245553E+12
0.5100001E-04	0.6288085E+14	0.8490482E+00	0.4874362E+12
0.5200001E-04	0.6061278E+14	0.8552076E+00	0.5480490E+12
0.5300001E-04	0.5834834E+14	0.8611062E+00	0.6063973E+12
0.5400001E-04	0.5609196E+14	0.8667562E+00	0.6624893E+12
0.5500001E-04	0.5384829E+14	0.8721660E+00	0.7163376E+12
0.5600002E-04	0.5162142E+14	0.8773466E+00	0.7679590E+12
0.5700002E-04	0.4941593E+14	0.8823060E+00	0.8173749E+12

Vertical Angle Ψ [rad]	Flux Density [phs/s/mrad²/0.1%b.w.]	P_{air}	Flux [phs/s/mrad/0.1%b.w.]
0.5800002E-04	0.4723581E+14	0.8870538E+00	0.8646107E+12
0.5900002E-04	0.4508515E+14	0.8915989E+00	0.9096958E+12
0.6000002E-04	0.4296790E+14	0.8959497E+00	0.9526637E+12
0.6100002E-04	0.4088772E+14	0.9001139E+00	0.9935515E+12
0.6200001E-04	0.3884807E+14	0.9041001E+00	0.1032400E+13
0.6300001E-04	0.3685231E+14	0.9079152E+00	0.1069252E+13
0.6400001E-04	0.3490345E+14	0.9115672E+00	0.1104155E+13
0.6500001E-04	0.3300435E+14	0.9150627E+00	0.1137160E+13
0.6600002E-04	0.3115757E+14	0.9184084E+00	0.1168317E+13
0.6700002E-04	0.2936534E+14	0.9216111E+00	0.1197683E+13
0.6800002E-04	0.2762971E+14	0.9246765E+00	0.1225312E+13
0.6900002E-04	0.2595248E+14	0.9276111E+00	0.1251265E+13
0.7000002E-04	0.2433497E+14	0.9304208E+00	0.1275600E+13
0.7100002E-04	0.2277848E+14	0.9331103E+00	0.1298378E+13
0.7200002E-04	0.2128383E+14	0.9356858E+00	0.1319662E+13
0.7300002E-04	0.1985167E+14	0.9381515E+00	0.1339514E+13
0.7400002E-04	0.1848235E+14	0.9405128E+00	0.1357996E+13
0.7500002E-04	0.1717595E+14	0.9427743E+00	0.1375172E+13
0.7600002E-04	0.1593226E+14	0.9449401E+00	0.1391104E+13
0.7700002E-04	0.1475089E+14	0.9470152E+00	0.1405855E+13
0.7800002E-04	0.1363119E+14	0.9490027E+00	0.1419486E+13
0.7900002E-04	0.1257230E+14	0.9509071E+00	0.1432059E+13
0.8000002E-04	0.1157314E+14	0.9527317E+00	0.1443632E+13
0.8100002E-04	0.1063247E+14	0.9544805E+00	0.1454264E+13
0.8200002E-04	0.9748856E+13	0.9561564E+00	0.1464013E+13
0.8300002E-04	0.8920749E+13	0.9577630E+00	0.1472934E+13
0.8400002E-04	0.8146424E+13	0.9593031E+00	0.1481080E+13
0.8500002E-04	0.7424055E+13	0.9607799E+00	0.1488504E+13
0.8600002E-04	0.6751721E+13	0.9621960E+00	0.1495256E+13
0.8700002E-04	0.6127426E+13	0.9635541E+00	0.1501383E+13
0.8800002E-04	0.5549098E+13	0.9648571E+00	0.1506933E+13
0.8900002E-04	0.5014614E+13	0.9661067E+00	0.1511947E+13
0.9000002E-04	0.4521827E+13	0.9673062E+00	0.1516469E+13
0.9100002E-04	0.4068585E+13	0.9684571E+00	0.1520538E+13
0.9200002E-04	0.3652713E+13	0.9695616E+00	0.1524190E+13
0.9300002E-04	0.3272056E+13	0.9706222E+00	0.1527462E+13
0.9400002E-04	0.2924493E+13	0.9716402E+00	0.1530387E+13
0.9500002E-04	0.2607925E+13	0.9726180E+00	0.1532995E+13
0.9600003E-04	0.2320304E+13	0.9735570E+00	0.1535315E+13
0.9700003E-04	0.2059636E+13	0.9744591E+00	0.1537375E+13
0.9800003E-04	0.1823991E+13	0.9753256E+00	0.1539199E+13
0.9900003E-04	0.1611504E+13	0.9761585E+00	0.1540810E+13
0.1000000E-03	0.1420391E+13	0.9769588E+00	0.1542231E+13
0.1010000E-03	0.1248943E+13	0.9777281E+00	0.1543480E+13
0.1020000E-03	0.1095535E+13	0.9784677E+00	0.1544575E+13
0.1030000E-03	0.9586263E+12	0.9791789E+00	0.1545534E+13
0.1040000E-03	0.8367628E+12	0.9798630E+00	0.1546371E+13
0.1050000E-03	0.7285771E+12	0.9805208E+00	0.1547099E+13
0.1060000E-03	0.6327897E+12	0.9811537E+00	0.1547732E+13
0.1070000E-03	0.5482072E+12	0.9817626E+00	0.1548280E+13
0.1080000E-03	0.4737210E+12	0.9823488E+00	0.1548754E+13
0.1090000E-03	0.4083033E+12	0.9829131E+00	0.1549162E+13
0.1100000E-03	0.3510072E+12	0.9834563E+00	0.1549513E+13
0.1110000E-03	0.3009624E+12	0.9839793E+00	0.1549814E+13
0.1120000E-03	0.2573737E+12	0.9844829E+00	0.1550072E+13
0.1130000E-03	0.2195123E+12	0.9849683E+00	0.1550291E+13
0.1140000E-03	0.1867196E+12	0.9854357E+00	0.1550478E+13
0.1150000E-03	0.1583964E+12	0.9858861E+00	0.1550636E+13

Vertical Angle ψ [rad]	Flux Density [phs/s/mrad²/0.1%b.w.]	P_{cir}	Flux [phs/s/mrad/0.1%b.w.]
0.1160000E-03	0.1340039E+12	0.9863202E+00	0.1550770E+13
0.1170000E-03	0.1130566E+12	0.9867387E+00	0.1550883E+13
0.1180000E-03	0.9511996E+11	0.9871420E+00	0.1550979E+13
0.1190000E-03	0.7980579E+11	0.9875310E+00	0.1551058E+13
0.1200000E-03	0.6676918E+11	0.9879062E+00	0.1551125E+13
0.1210000E-03	0.5570379E+11	0.9882681E+00	0.1551181E+13
0.1220000E-03	0.4633974E+11	0.9886171E+00	0.1551227E+13
0.1230000E-03	0.3843893E+11	0.9889541E+00	0.1551266E+13
0.1240000E-03	0.3179283E+11	0.9892791E+00	0.1551297E+13
0.1250000E-03	0.2621897E+11	0.9895930E+00	0.1551324E+13
0.1260000E-03	0.2155878E+11	0.9898958E+00	0.1551345E+13
0.1270000E-03	0.1767433E+11	0.9901885E+00	0.1551363E+13
0.1280000E-03	0.1444656E+11	0.9904710E+00	0.1551377E+13
0.1290000E-03	0.1177269E+11	0.9907438E+00	0.1551389E+13
0.1300000E-03	0.9564700E+10	0.9910074E+00	0.1551399E+13
0.1310000E-03	0.7747069E+10	0.9912621E+00	0.1551406E+13
0.1320000E-03	0.6255581E+10	0.9915084E+00	0.1551413E+13
0.1330000E-03	0.5035583E+10	0.9917462E+00	0.1551418E+13
0.1340000E-03	0.4040899E+10	0.9919762E+00	0.1551422E+13
0.1350000E-03	0.3232502E+10	0.9921986E+00	0.1551425E+13
0.1359999E-03	0.2577643E+10	0.9924138E+00	0.1551428E+13
0.1369999E-03	0.2048913E+10	0.9926217E+00	0.1551430E+13
0.1379999E-03	0.1623409E+10	0.9928229E+00	0.1551431E+13
0.1389999E-03	0.1282122E+10	0.9930176E+00	0.1551433E+13
0.1399999E-03	0.1009285E+10	0.9932060E+00	0.1551434E+13
0.1409999E-03	0.7919125E+09	0.9933883E+00	0.1551434E+13
0.1419999E-03	0.6193060E+09	0.9935648E+00	0.1551435E+13
0.1429999E-03	0.4827164E+09	0.9937357E+00	0.1551436E+13
0.1439999E-03	0.3749933E+09	0.9939011E+00	0.1551436E+13
0.1449999E-03	0.2903307E+09	0.9940613E+00	0.1551436E+13
0.1459999E-03	0.2240221E+09	0.9942165E+00	0.1551436E+13
0.1469999E-03	0.1722687E+09	0.9943669E+00	0.1551437E+13
0.1479999E-03	0.1320174E+09	0.9945125E+00	0.1551437E+13
0.1489999E-03	0.1008212E+09	0.9946537E+00	0.1551437E+13
0.1499998E-03	0.7672994E+08	0.9947904E+00	0.1551437E+13
0.1509998E-03	0.5819082E+08	0.9949229E+00	0.1551437E+13
0.1519998E-03	0.4397581E+08	0.9950516E+00	0.1551437E+13
0.1529998E-03	0.3311568E+08	0.9951763E+00	0.1551437E+13
0.1539998E-03	0.2484862E+08	0.9952972E+00	0.1551437E+13
0.1549998E-03	0.1857867E+08	0.9954143E+00	0.1551437E+13
0.1559998E-03	0.1384053E+08	0.9955280E+00	0.1551437E+13
0.1569998E-03	0.1027345E+08	0.9956385E+00	0.1551437E+13
0.1579998E-03	0.7597769E+07	0.9957455E+00	0.1551437E+13
0.1589998E-03	0.5598355E+07	0.9958494E+00	0.1551437E+13
0.1599998E-03	0.4109849E+07	0.9959503E+00	0.1551437E+13
0.1609998E-03	0.3005881E+07	0.9960481E+00	0.1551437E+13
0.1619998E-03	0.2190242E+07	0.9961432E+00	0.1551437E+13
0.1629998E-03	0.1589912E+07	0.9962354E+00	0.1551437E+13
0.1639997E-03	0.1149760E+07	0.9963251E+00	0.1551437E+13
0.1649997E-03	0.8282915E+06	0.9964122E+00	0.1551437E+13
0.1659997E-03	0.5944173E+06	0.9964967E+00	0.1551437E+13
0.1669997E-03	0.4249374E+06	0.9965789E+00	0.1551437E+13
0.1679997E-03	0.3026005E+06	0.9966587E+00	0.1551437E+13
0.1689997E-03	0.2146452E+06	0.9967363E+00	0.1551437E+13
0.1699997E-03	0.1516570E+06	0.9968117E+00	0.1551437E+13
0.1709997E-03	0.1067313E+06	0.9968851E+00	0.1551437E+13
0.1719997E-03	0.7481562E+05	0.9969563E+00	0.1551437E+13
0.1729997E-03	0.5223458E+05	0.9970256E+00	0.1551437E+13

Vertical Angle Ψ [rad]	Flux Density [phs/s/mrad²/0.1%b.w.]	P_{cir}	Flux [phs/s/mrad/0.1%b.w.]
0.1739997E-03	0.3632278E+05	0.9970930E+00	0.1551437E+13
0.1749997E-03	0.2515619E+05	0.9971585E+00	0.1551437E+13
0.1759997E-03	0.1735187E+05	0.9972223E+00	0.1551437E+13
0.1769997E-03	0.1191991E+05	0.9972843E+00	0.1551437E+13
0.1779997E-03	0.8154810E+04	0.9973446E+00	0.1551437E+13
0.1789996E-03	0.5555964E+04	0.9974033E+00	0.1551437E+13
0.1799996E-03	0.3769669E+04	0.9974605E+00	0.1551437E+13
0.1809996E-03	0.2547017E+04	0.9975162E+00	0.1551437E+13
0.1819996E-03	0.1713710E+04	0.9975702E+00	0.1551437E+13
0.1829996E-03	0.1148180E+04	0.9976230E+00	0.1551437E+13
0.1839996E-03	0.7660123E+03	0.9976743E+00	0.1551437E+13
0.1849996E-03	0.5088780E+03	0.9977242E+00	0.1551437E+13
0.1859996E-03	0.3366078E+03	0.9977729E+00	0.1551437E+13
0.1869996E-03	0.2216984E+03	0.9978204E+00	0.1551437E+13
0.1879996E-03	0.1453844E+03	0.9978666E+00	0.1551437E+13
0.1889996E-03	0.9492496E+02	0.9979116E+00	0.1551437E+13
0.1899996E-03	0.6170795E+02	0.9979554E+00	0.1551437E+13
0.1909996E-03	0.3993832E+02	0.9979982E+00	0.1551437E+13
0.1919996E-03	0.2573454E+02	0.9980398E+00	0.1551437E+13
0.1929995E-03	0.1650856E+02	0.9980804E+00	0.1551437E+13
0.1939995E-03	0.1054302E+02	0.9981198E+00	0.1551437E+13
0.1949995E-03	0.6702904E+01	0.9981585E+00	0.1551437E+13
0.1959995E-03	0.4242304E+01	0.9981961E+00	0.1551437E+13
0.1969995E-03	0.2672829E+01	0.9982326E+00	0.1551437E+13
0.1979995E-03	0.1676323E+01	0.9982685E+00	0.1551437E+13
0.1989995E-03	0.1046529E+01	0.9983033E+00	0.1551437E+13

Program 6

```
C     Calculation of Flux through a Slit
C     Bending Magnet Case
C     [photons/s/0.1%b.w.]

      WRITE(6,100)
  100 FORMAT(' INPUT ENECTRON ENERGY (GeV)')
      READ(5,200) E
  200 FORMAT(F8.2)

      WRITE(6,250)
  250 FORMAT(' INPUT BEAM CURRENT (mA)')
      READ(5,260) BC
  260 FORMAT(F8.2)

      WRITE(6,300)
  300 FORMAT(' INPUT MAGNETIC FIELD (T)')
      READ(5,400) B
  400 FORMAT(F8.2)

      WRITE(6,500)
  500 FORMAT(' INPUT PHOTON ENERGY (keV)')
      READ(5,600) EP
  600 FORMAT(F8.2)

      WRITE(6,610)
  610 FORMAT(' INPUT LENGTH OF BEAMLINE FROM SOURCE TO SLIT (m)')
      READ(5,620) BL
  620 FORMAT(F8.2)

      WRITE(6,630)
  630 FORMAT(' INPUT VERTICAL WIDTH OF SLIT (mm)')
      READ(5,640) VW
  640 FORMAT(F9.4)
      VW=VW/1000./2.
      RAD=VW/BL

      WRITE(6,650)
  650 FORMAT(' INPUT HORIZONTAL WIDTH OF SLIT (mm)')
      READ(5,660) HW
  660 FORMAT(F9.4)
      HMRAD=HW/BL

      GLC=18.6/(B*E**2)
      GL=12398./(1000.*EP)
      GAMMA=1957.*E
      EC=12.398/GLC

      U=GLC/GL

      ZLIM=0.00015
      DZ=0.00000025
      FLUX=0.
      DFLUX=0.
```

```
C      (Z : Vertical Angle in rad)
       DO Z=0.,ZLIM,DZ
          V=GAMMA*Z
          X=U*(1.+V**2)**(3./2.)/2.
          IF(X.GT.30.) GO TO 20
          GNU=2./3.
          CALL BESSEL(GNU,X,S)
          FHOR=U**2*(1.+V**2)**2*S**2

          GNU=1./3.
          CALL BESSEL(GNU,X,S)
          FVER=U**2*V**2*(1.+V**2)*S**2
          IF(Z.EQ.0.0) FO=FHOR

          PHOTON=3460.*GAMMA**2*(FHOR+FVER)*BC*HMRAD
          BRITE=3460.*GAMMA**2*FO*BC
          PCIR=2.*(FHOR*FVER)**0.5/(FHOR+FVER)
          CIR=BRITE*PCIR

          DFLUX=PHOTON*DZ*1000.*2.
          FLUX=FLUX+DFLUX
          IF(RAD.LT.Z) GO TO 20

          WRITE(6,'(5E)') Z, PHOTON, PCIR, CIR, FLUX
          WRITE(7,'(4E)') Z, PHOTON, PCIR, FLUX
       END DO

   20 WRITE(6,950) FLUX
  950 FORMAT(' FLUX=',E10.3)
       STOP
       END


       SUBROUTINE BESSEL(GNU,X,S)

C      Calculation of Bessel Function

       H=X/100.
       N=1000
       IF(X.GT.5.0) H=0.05
       IF(X.LT.0.5) N=INT(1000./X)
       S=EXP(-X)/2.
       DO I=1,N
          S=S+COSH(GNU*FLOAT(I)*H)*EXP(-X*COSH(FLOAT(I)*H))
       END DO
       S=S*H
       RETURN
       END
```

```
C      (Z : Vertical Angle in rad)
       DO Z=0.,ZLIM,DZ
          V=GAMMA*Z
          X=U*(1.+V**2)**(3./2.)/2.
          IF(X.GT.30.) GO TO 20
          GNU=2./3.
          CALL BESSEL(GNU,X,S)
          FHOR=U**2*(1.+V**2)**2*S**2

          GNU=1./3.
          CALL BESSEL(GNU,X,S)
          FVER=U**2*V**2*(1.+V**2)*S**2
          IF(Z.EQ.0.0) FO=FHOR

          PHOTON=3460.*GAMMA**2*(FHOR+FVER)*BC*HMRAD
          BRITE=3460.*GAMMA**2*FO*BC
          PCIR=2.*(FHOR*FVER)**0.5/(FHOR+FVER)
          CIR=BRITE*PCIR

          DFLUX=PHOTON*DZ*1000.*2.
          FLUX=FLUX+DFLUX
          IF(RAD.LT.Z) GO TO 20

          WRITE(6,'(5E)') Z, PHOTON, PCIR, CIR, FLUX
          WRITE(7,'(4E)') Z, PHOTON, PCIR, FLUX
       END DO

   20 WRITE(6,950) FLUX
  950 FORMAT(' FLUX=',E10.3)
       STOP
       END


       SUBROUTINE BESSEL(GNU,X,S)

C      Calculation of Bessel Function

       H=X/100.
       N=1000
       IF(X.GT.5.0) H=0.05
       IF(X.LT.0.5) N=INT(1000./X)
       S=EXP(-X)/2.
       DO I=1,N
          S=S+COSH(GNU*FLOAT(I)*H)*EXP(-X*COSH(FLOAT(I)*H))
       END DO
       S=S*H
       RETURN
       END
```

Vertical Angle [rad]	Flux Density [phs/s/mrad²/0.1%b.w.]	P_{cir}	Flux [phs/s/0.1%b.w.]
0.0000000E+00	0.1233503E+15	0.0000000E+00	0.6167513E+11
0.2500000E-06	0.1233492E+15	0.6419207E-02	0.1233497E+12
0.5000000E-06	0.1233458E+15	0.1283784E-01	0.1850226E+12
0.7500000E-06	0.1233404E+15	0.1925537E-01	0.2466928E+12
0.1000000E-05	0.1233333E+15	0.2567111E-01	0.3083595E+12
0.1250000E-05	0.1233237E+15	0.3208460E-01	0.3700214E+12
0.1500000E-05	0.1233124E+15	0.3849521E-01	0.4316775E+12
0.1750000E-05	0.1232984E+15	0.4490240E-01	0.4933268E+12
0.2000000E-05	0.1232826E+15	0.5130560E-01	0.5549680E+12
0.2250000E-05	0.1232647E+15	0.5770423E-01	0.6166004E+12
0.2500000E-05	0.1232446E+15	0.6409779E-01	0.6782227E+12
0.2750000E-05	0.1232225E+15	0.7048547E-01	0.7398339E+12
0.3000000E-05	0.1231980E+15	0.7686699E-01	0.8014329E+12
0.3250000E-05	0.1231716E+15	0.8324170E-01	0.8630187E+12
0.3500001E-05	0.1231431E+15	0.8960897E-01	0.9245903E+12
0.3750001E-05	0.1231122E+15	0.9596843E-01	0.9861465E+12
0.4000000E-05	0.1230790E+15	0.1023194E+00	0.1047686E+13
0.4250001E-05	0.1230439E+15	0.1086613E+00	0.1109208E+13
0.4500001E-05	0.1230067E+15	0.1149936E+00	0.1170711E+13
0.4750001E-05	0.1229671E+15	0.1213158E+00	0.1232195E+13
0.5000001E-05	0.1229251E+15	0.1276274E+00	0.1293657E+13
0.5250001E-05	0.1228813E+15	0.1339277E+00	0.1355098E+13
0.5500001E-05	0.1228350E+15	0.1402164E+00	0.1416515E+13
0.5750001E-05	0.1227865E+15	0.1464927E+00	0.1477909E+13
0.6000001E-05	0.1227358E+15	0.1527563E+00	0.1539277E+13
0.6250001E-05	0.1226828E+15	0.1590067E+00	0.1600618E+13
0.6500001E-05	0.1226274E+15	0.1652433E+00	0.1661932E+13
0.6750001E-05	0.1225699E+15	0.1714654E+00	0.1723217E+13
0.7000001E-05	0.1225098E+15	0.1776728E+00	0.1784471E+13
0.7250002E-05	0.1224475E+15	0.1838651E+00	0.1845695E+13
0.7500002E-05	0.1223826E+15	0.1900418E+00	0.1906886E+13
0.7750002E-05	0.1223158E+15	0.1962017E+00	0.1968044E+13
0.8000002E-05	0.1222463E+15	0.2023450E+00	0.2029168E+13
0.8250002E-05	0.1221745E+15	0.2084711E+00	0.2090255E+13
0.8500002E-05	0.1221002E+15	0.2145796E+00	0.2151305E+13
0.8750002E-05	0.1220235E+15	0.2206698E+00	0.2212317E+13
0.9000002E-05	0.1219444E+15	0.2267415E+00	0.2273289E+13
0.9250002E-05	0.1218625E+15	0.2327942E+00	0.2334220E+13
0.9500002E-05	0.1217785E+15	0.2388270E+00	0.2395109E+13
0.9750002E-05	0.1216918E+15	0.2448403E+00	0.2455955E+13
0.1000000E-04	0.1216027E+15	0.2508327E+00	0.2516757E+13
0.1025000E-04	0.1215109E+15	0.2568049E+00	0.2577512E+13
0.1050000E-04	0.1214165E+15	0.2627557E+00	0.2638221E+13
0.1075000E-04	0.1213196E+15	0.2686844E+00	0.2698880E+13
0.1100000E-04	0.1212201E+15	0.2745919E+00	0.2759491E+13
0.1125000E-04	0.1211177E+15	0.2804765E+00	0.2820049E+13
0.1150000E-04	0.1210130E+15	0.2863380E+00	0.2880556E+13
0.1175000E-04	0.1209051E+15	0.2921770E+00	0.2941008E+13
0.1200000E-04	0.1207948E+15	0.2979920E+00	0.3001406E+13
0.1225000E-04	0.1206816E+15	0.3037834E+00	0.3061747E+13
0.1250000E-04	0.1205656E+15	0.3095505E+00	0.3122030E+13
0.1275000E-04	0.1204469E+15	0.3152926E+00	0.3182253E+13
0.1300000E-04	0.1203258E+15	0.3210093E+00	0.3242416E+13
0.1325000E-04	0.1202014E+15	0.3267016E+00	0.3302517E+13
0.1350000E-04	0.1200741E+15	0.3323675E+00	0.3362554E+13
0.1375000E-04	0.1199442E+15	0.3380083E+00	0.3422526E+13
0.1400000E-04	0.1198111E+15	0.3436223E+00	0.3482431E+13
0.1425000E-04	0.1196752E+15	0.3492096E+00	0.3542269E+13
0.1450000E-04	0.1195363E+15	0.3547708E+00	0.3602037E+13
0.1475000E-04	0.1193946E+15	0.3603044E+00	0.3661734E+13

Vertical Angle [rad]	Flux Density [phs/s/mrad²/0.1%b.w.]	P_{cir}	Flux [phs/s/0.1%b.w.]
0.1500000E-04	0.1192497E+15	0.3658101E+00	0.3721359E+13
0.1525000E-04	0.1191019E+15	0.3712882E+00	0.3780910E+13
0.1550000E-04	0.1189508E+15	0.3767386E+00	0.3840385E+13
0.1575000E-04	0.1187969E+15	0.3821605E+00	0.3899784E+13
0.1600000E-04	0.1186397E+15	0.3875543E+00	0.3959104E+13
0.1625000E-04	0.1184794E+15	0.3929192E+00	0.4018343E+13
0.1650000E-04	0.1183160E+15	0.3982552E+00	0.4077501E+13
0.1675000E-04	0.1181496E+15	0.4035622E+00	0.4136576E+13
0.1700000E-04	0.1179796E+15	0.4088395E+00	0.4195566E+13
0.1725000E-04	0.1178067E+15	0.4140875E+00	0.4254469E+13
0.1750000E-04	0.1176304E+15	0.4193054E+00	0.4313284E+13
0.1775000E-04	0.1174509E+15	0.4244930E+00	0.4372010E+13
0.1800000E-04	0.1172679E+15	0.4296509E+00	0.4430644E+13
0.1825000E-04	0.1170821E+15	0.4347782E+00	0.4489185E+13
0.1850000E-04	0.1168923E+15	0.4398758E+00	0.4547631E+13
0.1875000E-04	0.1166995E+15	0.4449414E+00	0.4605980E+13
0.1900000E-04	0.1165033E+15	0.4499766E+00	0.4664232E+13
0.1925000E-04	0.1163034E+15	0.4549814E+00	0.4722384E+13
0.1950000E-04	0.1161005E+15	0.4599538E+00	0.4780434E+13
0.1975000E-04	0.1158939E+15	0.4648958E+00	0.4838381E+13
0.2000000E-04	0.1156838E+15	0.4698069E+00	0.4896223E+13
0.2025001E-04	0.1154700E+15	0.4746866E+00	0.4953958E+13
0.2050001E-04	0.1152529E+15	0.4795338E+00	0.5011585E+13
0.2075001E-04	0.1150325E+15	0.4843487E+00	0.5069101E+13
0.2100001E-04	0.1148083E+15	0.4891328E+00	0.5126505E+13
0.2125001E-04	0.1145807E+15	0.4938847E+00	0.5183796E+13
0.2150001E-04	0.1143493E+15	0.4986045E+00	0.5240971E+13
0.2175001E-04	0.1141143E+15	0.5032926E+00	0.5298028E+13
0.2200001E-04	0.1138754E+15	0.5079492E+00	0.5354965E+13
0.2225001E-04	0.1136332E+15	0.5125723E+00	0.5411782E+13
0.2250001E-04	0.1133875E+15	0.5171635E+00	0.5468476E+13
0.2275001E-04	0.1131378E+15	0.5217230E+00	0.5525045E+13
0.2300001E-04	0.1128843E+15	0.5262502E+00	0.5581487E+13
0.2325001E-04	0.1126274E+15	0.5307444E+00	0.5637801E+13
0.2350001E-04	0.1123665E+15	0.5352063E+00	0.5693984E+13
0.2375001E-04	0.1121020E+15	0.5396361E+00	0.5750035E+13
0.2400001E-04	0.1118338E+15	0.5440332E+00	0.5805952E+13
0.2425001E-04	0.1115619E+15	0.5483974E+00	0.5861733E+13
0.2450001E-04	0.1112858E+15	0.5527298E+00	0.5917376E+13
0.2475001E-04	0.1110061E+15	0.5570301E+00	0.5972879E+13
0.2500001E-04	0.1107229E+15	0.5612974E+00	0.6028241E+13
0.2525001E-04	0.1104356E+15	0.5655321E+00	0.6083459E+13
0.2550001E-04	0.1101445E+15	0.5697351E+00	0.6138531E+13
0.2575001E-04	0.1098493E+15	0.5739053E+00	0.6193456E+13
0.2600001E-04	0.1095504E+15	0.5780435E+00	0.6248231E+13
0.2625001E-04	0.1092479E+15	0.5821490E+00	0.6302855E+13
0.2650001E-04	0.1089412E+15	0.5862224E+00	0.6357325E+13
0.2675001E-04	0.1086308E+15	0.5902636E+00	0.6411640E+13
0.2700001E-04	0.1083166E+15	0.5942730E+00	0.6465799E+13
0.2725001E-04	0.1079986E+15	0.5982492E+00	0.6519798E+13
0.2750001E-04	0.1076763E+15	0.6021945E+00	0.6573636E+13
0.2775001E-04	0.1073504E+15	0.6061071E+00	0.6627311E+13
0.2800001E-04	0.1070206E+15	0.6099879E+00	0.6680822E+13
0.2825001E-04	0.1066869E+15	0.6138374E+00	0.6734165E+13
0.2850001E-04	0.1063495E+15	0.6176543E+00	0.6787340E+13
0.2875001E-04	0.1060079E+15	0.6214405E+00	0.6840344E+13
0.2900001E-04	0.1056625E+15	0.6251947E+00	0.6893176E+13
0.2925001E-04	0.1053133E+15	0.6289173E+00	0.6945832E+13
0.2950001E-04	0.1049603E+15	0.6326082E+00	0.6998313E+13
0.2975001E-04	0.1046033E+15	0.6362681E+00	0.7050614E+13

Program 7

```
C     Calculation of Flux Spectrum through a Slit
C     Bending Magnet Case
C     [photons/s/0.1%b.w.]

      WRITE(6,100)
  100 FORMAT(' INPUT ENECTRON ENERGY (GeV)')
      READ(5,200) E
  200 FORMAT(F8.2)

      WRITE(6,250)
  250 FORMAT(' INPUT BEAM CURRENT (mA)')
      READ(5,260) BC
  260 FORMAT(F8.2)

      WRITE(6,300)
  300 FORMAT(' INPUT MAGNETIC FIELD (T)')
      READ(5,400) B
  400 FORMAT(F8.2)

      WRITE(6,610)
  610 FORMAT(' INPUT LENGTH OF BEAMLINE FROM SOURCE TO SLIT (m)')
      READ(5,620) BL
  620 FORMAT(F8.2)

      WRITE(6,630)
  630 FORMAT(' INPUT VERTICAL WIDTH OF SLIT (mm)')
      READ(5,640) VW
  640 FORMAT(F9.4)
      VW=VW/1000./2.
      RAD=VW/BL

      WRITE(6,650)
  650 FORMAT(' INPUT HORIZONTAL WIDTH OF SLIT (mm)')
      READ(5,660) HW
  660 FORMAT(F9.4)
      HMRAD=HW/BL

      DO EP=4.,100.,1.

      GLC=18.6/(B*E**2)
      GL=12398./(1000.*EP)
      GAMMA=1957.*E
      EC=12.398/GLC

      U=GLC/GL

      ZLIM=0.00015
      DZ=0.0000005
      FLUX=0.
      DFLUX=0.
```

```
C      (Z : Vertical Angle in rad)
       DO Z=0.,ZLIM,DZ
          V=GAMMA*Z
          X=U*(1.+V**2)**(3./2.)/2.
          IF(X.GT.30.) GO TO 20
          GNU=2./3.
          CALL BESSEL(GNU,X,S)
          FHOR=U**2*(1.+V**2)**2*S**2

          GNU=1./3.
          CALL BESSEL(GNU,X,S)
          FVER=U**2*V**2*(1.+V**2)*S**2

          IF(Z.EQ.0.0) FO=FHOR
          PHOTON=3460.*GAMMA**2*(FHOR+FVER)*BC*HMRAD
          BRITE=3460.*GAMMA**2*FO*BC
          PCIR=2.*(FHOR*FVER)**0.5/(FHOR+FVER)

          DFLUX=PHOTON*DZ*1000.*2.
          FLUX=FLUX+DFLUX
          IF(RAD.LT.Z) GO TO 20
       END DO

   20  WRITE(6,'(3E)') EP, BRITE, FLUX
       WRITE(7,'(5E)') EP, Z, BRITE, PCIR, FLUX
       WRITE(8,'(2E)') EP, FLUX
       END DO
       STOP
       END


       SUBROUTINE BESSEL(GNU,X,S)

C      Calculation of Bessel Function

       H=X/100.
       N=1000
       IF(X.GT.5.0) H=0.05
       IF(X.LT.0.5) N=INT(1000./X)
       S=EXP(-X)/2.
       DO I=1,N
          S=S+COSH(GNU*FLOAT(I)*H)*EXP(-X*COSH(FLOAT(I)*H))
       END DO
       S=S*H
       RETURN
       END
```

Photon Energy [keV]	Vertical Angle ψ [rad]	Brightness [phs/s/mrad²/0.1%b.w./mA]	P_{cir}	Flux [phs/s/0.1%b.w.]
0.4000000E+01	0.3000001E-04	0.6608788E+14	0.4895437E+00	0.4082994E+13
0.5000000E+01	0.3000001E-04	0.7497078E+14	0.5110680E+00	0.4627751E+13
0.6000000E+01	0.3000001E-04	0.8267416E+14	0.5281934E+00	0.5096320E+13
0.7000000E+01	0.3000001E-04	0.8939244E+14	0.5422662E+00	0.5500872E+13
0.8000000E+01	0.3000001E-04	0.9526318E+14	0.5541049E+00	0.5850238E+13
0.9000000E+01	0.3000001E-04	0.1003929E+15	0.5642463E+00	0.6151229E+13
0.1000000E+02	0.3000001E-04	0.1048638E+15	0.5730595E+00	0.6409334E+13
0.1100000E+02	0.3000001E-04	0.1087457E+15	0.5808091E+00	0.6629112E+13
0.1200000E+02	0.3000001E-04	0.1120960E+15	0.5876902E+00	0.6814458E+13
0.1300000E+02	0.3000001E-04	0.1149659E+15	0.5938522E+00	0.6968727E+13
0.1400000E+02	0.3000001E-04	0.1173981E+15	0.5994071E+00	0.7094880E+13
0.1500000E+02	0.3000001E-04	0.1194305E+15	0.6044470E+00	0.7195541E+13
0.1600000E+02	0.3000001E-04	0.1210987E+15	0.6090457E+00	0.7273060E+13
0.1700000E+02	0.3000001E-04	0.1224328E+15	0.6132601E+00	0.7329560E+13
0.1800000E+02	0.3000001E-04	0.1234618E+15	0.6171416E+00	0.7366956E+13
0.1900000E+02	0.3000001E-04	0.1242105E+15	0.6207268E+00	0.7386986E+13
0.2000000E+02	0.3000001E-04	0.1247025E+15	0.6240535E+00	0.7391253E+13
0.2100000E+02	0.3000001E-04	0.1249590E+15	0.6271472E+00	0.7381207E+13
0.2200000E+02	0.3000001E-04	0.1249999E+15	0.6300356E+00	0.7358194E+13
0.2300000E+02	0.3000001E-04	0.1248435E+15	0.6327367E+00	0.7323438E+13
0.2400000E+02	0.3000001E-04	0.1245060E+15	0.6352709E+00	0.7278071E+13
0.2500000E+02	0.3000001E-04	0.1240035E+15	0.6376530E+00	0.7223133E+13
0.2600000E+02	0.3000001E-04	0.1233503E+15	0.6398968E+00	0.7159587E+13
0.2700000E+02	0.3000001E-04	0.1225592E+15	0.6420151E+00	0.7088315E+13
0.2800000E+02	0.3000001E-04	0.1216433E+15	0.6440178E+00	0.7010143E+13
0.2900000E+02	0.3000001E-04	0.1206137E+15	0.6459154E+00	0.6925824E+13
0.3000000E+02	0.3000001E-04	0.1194814E+15	0.6477153E+00	0.6836055E+13
0.3100000E+02	0.3000001E-04	0.1182561E+15	0.6494250E+00	0.6741479E+13
0.3200000E+02	0.3000001E-04	0.1169475E+15	0.6510529E+00	0.6642691E+13
0.3300000E+02	0.3000001E-04	0.1155635E+15	0.6526041E+00	0.6540241E+13
0.3400000E+02	0.3000001E-04	0.1141129E+15	0.6540828E+00	0.6434639E+13
0.3500000E+02	0.3000001E-04	0.1126029E+15	0.6554957E+00	0.6326348E+13
0.3600000E+02	0.3000001E-04	0.1110405E+15	0.6568468E+00	0.6215801E+13
0.3700000E+02	0.3000001E-04	0.1094318E+15	0.6581405E+00	0.6103397E+13
0.3800000E+02	0.3000001E-04	0.1077834E+15	0.6593793E+00	0.5989499E+13
0.3900000E+02	0.3000001E-04	0.1061006E+15	0.6605681E+00	0.5874444E+13
0.4000000E+02	0.3000001E-04	0.1043886E+15	0.6617096E+00	0.5758539E+13
0.4100000E+02	0.3000001E-04	0.1026522E+15	0.6628059E+00	0.5642074E+13
0.4200000E+02	0.3000001E-04	0.1008960E+15	0.6638613E+00	0.5525300E+13
0.4300000E+02	0.3000001E-04	0.9912432E+14	0.6648762E+00	0.5408464E+13
0.4400000E+02	0.3000001E-04	0.9734074E+14	0.6658546E+00	0.5291776E+13
0.4500000E+02	0.3000001E-04	0.9554890E+14	0.6667972E+00	0.5175439E+13
0.4600000E+02	0.3000001E-04	0.9375198E+14	0.6677068E+00	0.5059630E+13
0.4700000E+02	0.3000001E-04	0.9195342E+14	0.6685847E+00	0.4944517E+13
0.4800000E+02	0.3000001E-04	0.9015583E+14	0.6694328E+00	0.4830246E+13
0.4900000E+02	0.3000001E-04	0.8836170E+14	0.6702518E+00	0.4716952E+13
0.5000000E+02	0.3000001E-04	0.8657347E+14	0.6710454E+00	0.4604755E+13
0.5100000E+02	0.3000001E-04	0.8479336E+14	0.6718127E+00	0.4493766E+13
0.5200000E+02	0.3000001E-04	0.8302352E+14	0.6725550E+00	0.4384084E+13
0.5300000E+02	0.3000001E-04	0.8126551E+14	0.6732749E+00	0.4275790E+13
0.5400000E+02	0.3000001E-04	0.7952134E+14	0.6739722E+00	0.4168966E+13
0.5500000E+02	0.3000001E-04	0.7779239E+14	0.6746495E+00	0.4063676E+13
0.5600000E+02	0.3000001E-04	0.7607989E+14	0.6753059E+00	0.3959982E+13
0.5700000E+02	0.3000001E-04	0.7438525E+14	0.6759429E+00	0.3857933E+13
0.5800000E+02	0.3000001E-04	0.7270963E+14	0.6765620E+00	0.3757572E+13
0.5900000E+02	0.3000001E-04	0.7105419E+14	0.6771632E+00	0.3658939E+13
0.6000000E+02	0.3000001E-04	0.6941956E+14	0.6777477E+00	0.3562064E+13
0.6100000E+02	0.3000001E-04	0.6780658E+14	0.6783166E+00	0.3466971E+13

Photon Energy [keV]	Vertical Angle Ψ [rad]	Brightness [phs/s/mrad²/0.1%b.w./mA]	P_{cir}	Flux [phs/s/0.1%b.w.]
0.6200000E+02	0.3000001E-04	0.6621627E+14	0.6788697E+00	0.3373681E+13
0.6300000E+02	0.3000001E-04	0.6464888E+14	0.6794081E+00	0.3282206E+13
0.6400000E+02	0.3000001E-04	0.6310527E+14	0.6799320E+00	0.3192561E+13
0.6500000E+02	0.3000001E-04	0.6158580E+14	0.6804425E+00	0.3104750E+13
0.6600000E+02	0.3000001E-04	0.6009082E+14	0.6809397E+00	0.3018775E+13
0.6700000E+02	0.3000001E-04	0.5862067E+14	0.6814248E+00	0.2934635E+13
0.6800000E+02	0.3000001E-04	0.5717572E+14	0.6818975E+00	0.2852325E+13
0.6900000E+02	0.3000001E-04	0.5575607E+14	0.6823587E+00	0.2771840E+13
0.7000000E+02	0.3000001E-04	0.5436196E+14	0.6828087E+00	0.2693169E+13
0.7100000E+02	0.3000001E-04	0.5299341E+14	0.6832471E+00	0.2616300E+13
0.7200000E+02	0.3000001E-04	0.5165057E+14	0.6836758E+00	0.2541217E+13
0.7300000E+02	0.3000001E-04	0.5033347E+14	0.6840943E+00	0.2467905E+13
0.7400000E+02	0.3000001E-04	0.4904209E+14	0.6845031E+00	0.2396347E+13
0.7500000E+02	0.3000001E-04	0.4777638E+14	0.6849027E+00	0.2326522E+13
0.7600000E+02	0.3000001E-04	0.4653615E+14	0.6852931E+00	0.2258408E+13
0.7700000E+02	0.3000001E-04	0.4532146E+14	0.6856745E+00	0.2191984E+13
0.7800000E+02	0.3000001E-04	0.4413195E+14	0.6860479E+00	0.2127225E+13
0.7900000E+02	0.3000001E-04	0.4296763E+14	0.6864130E+00	0.2064108E+13
0.8000000E+02	0.3000001E-04	0.4182825E+14	0.6867706E+00	0.2002607E+13
0.8100000E+02	0.3000001E-04	0.4071356E+14	0.6871200E+00	0.1942696E+13
0.8200000E+02	0.3000001E-04	0.3962336E+14	0.6874623E+00	0.1884348E+13
0.8300000E+02	0.3000001E-04	0.3855740E+14	0.6877974E+00	0.1827535E+13
0.8400000E+02	0.3000001E-04	0.3751539E+14	0.6881256E+00	0.1772230E+13
0.8500000E+02	0.3000001E-04	0.3649706E+14	0.6884467E+00	0.1718406E+13
0.8600000E+02	0.3000001E-04	0.3550208E+14	0.6887620E+00	0.1666032E+13
0.8700000E+02	0.3000001E-04	0.3453019E+14	0.6890704E+00	0.1615083E+13
0.8800000E+02	0.3000001E-04	0.3358102E+14	0.6893734E+00	0.1565526E+13
0.8900000E+02	0.3000001E-04	0.3265430E+14	0.6896698E+00	0.1517336E+13
0.9000000E+02	0.3000001E-04	0.3174960E+14	0.6899605E+00	0.1470482E+13
0.9100000E+02	0.3000001E-04	0.3086668E+14	0.6902459E+00	0.1424937E+13
0.9200000E+02	0.3000001E-04	0.3000515E+14	0.6905255E+00	0.1380670E+13
0.9300000E+02	0.3000001E-04	0.2916461E+14	0.6908001E+00	0.1337655E+13
0.9400000E+02	0.3000001E-04	0.2834480E+14	0.6910694E+00	0.1295861E+13
0.9500000E+02	0.3000001E-04	0.2754526E+14	0.6913339E+00	0.1255263E+13
0.9600000E+02	0.3000001E-04	0.2676573E+14	0.6915936E+00	0.1215831E+13
0.9700000E+02	0.3000001E-04	0.2600574E+14	0.6918485E+00	0.1177537E+13
0.9800000E+02	0.3000001E-04	0.2526499E+14	0.6920987E+00	0.1140355E+13
0.9900000E+02	0.3000001E-04	0.2454307E+14	0.6923448E+00	0.1104258E+13
0.1000000E+03	0.3000001E-04	0.2383962E+14	0.6925859E+00	0.1069218E+13

Program 8

```
C      Calculation of Integrated Flux above 4 keV through a Slit
C      Bending Magnet Case
C      [photons/s]

       WRITE(6,100)
  100  FORMAT(' INPUT ELECTRON ENERGY (GeV)')
       READ(5,200) E
  200  FORMAT(F8.2)

       WRITE(6,250)
  250  FORMAT(' INPUT BEAM CURRENT (mA)')
       READ(5,260) BC
  260  FORMAT(F8.2)

       WRITE(6,300)
  300  FORMAT(' INPUT MAGNETIC FIELD-(T)')
       READ(5,400) B
  400  FORMAT(F8.2)

       WRITE(6,500)
  500  FORMAT(' INPUT REQUIRED MAXIMUM PHOTON ENERGY (keV)')
       READ(5,600) EMAX
  600  FORMAT(F8.2)

       WRITE(6,610)
  610  FORMAT(' INPUT LENGTH OF BEAMLINE FROM SOURCE TO SLIT (m)')
       READ(5,620) BL
  620  FORMAT(F8.2)

       WRITE(6,630)
  630  FORMAT(' INPUT VERTICAL WIDTH OF SLIT (mm)')
       READ(5,640) VW
  640  FORMAT(F9.4)
       VW=VW/1000./2.
       RAD=VW/BL

       WRITE(6,650)
  650  FORMAT(' INPUT HORIZONTAL WIDTH OF SLIT (mm)')
       READ(5,660) HW
  660  FORMAT(F9.4)
       HMRAD=HW/BL

       TFLUX=0.
       DE=1.

       DO EP=4.,EMAX,DE

       GLC=18.6/(B*E**2)
       GL=12398./(1000.*EP)
       GAMMA=1957.*E
       EC=12.398/GLC

       U=GLC/GL

       ZLIM=0.00015
       DZ=0.0000005
       FLUX=0.
       DFLUX=0.
```

```
C      (Z : Vertical Angle in rad)
       DO Z=0.,ZLIM,DZ
          V=GAMMA*Z
          X=U*(1.+V**2)**(3./2.)/2.
          IF(X.GT.30.) GO TO 20
          GNU=2./3.
          CALL BESSEL(GNU,X,S)
          FHOR=U**2*(1.+V**2)**2*S**2

          GNU=1./3.
          CALL BESSEL(GNU,X,S)
          FVER=U**2*V**2*(1.+V**2)*S**2

          IF(Z.EQ.0.0) FO=FHOR

          PHOTON=3460.*GAMMA**2*(FHOR+FVER)*BC*HMRAD
          BRITE=3460.*GAMMA**2*FO*BC
          PCIR=2.*(FHOR*FVER)**0.5/(FHOR+FVER)

          DFLUX=PHOTON*DZ*1000.*2.
          FLUX=FLUX+DFLUX
          IF(RAD.LT.Z) GO TO 20
       END DO

   20  TFLUX=TFLUX+FLUX*DE/0.001/EP
       WRITE(6,'(4E)') EP, BRITE, FLUX, TFLUX
       WRITE(7,'(5E)') EP, BRITE, PCIR, FLUX, TFLUX
       WRITE(8,'(2E)') EP, FLUX
       WRITE(9,'(2E)') EP, TFLUX
       END DO
       STOP
       END


       SUBROUTINE BESSEL(GNU,X,S)

C      Calculation of Bessel Function

       H=X/100.
       N=1000
       IF(X.GT.5.0) H=0.05
       IF(X.LT.0.5) N=INT(1000./X)
       S=EXP(-X)/2.
       DO I=1,N
          S=S+COSH(GNU*FLOAT(I)*H)*EXP(-X*COSH(FLOAT(I)*H))
       END DO
       S=S*H
       RETURN
       END
```

Photon Energy [keV]	Brightness [phs/s/mrad²/0.1%b.w./mA]	P_{cir}	Flux [phs/s/0.1%b.w.]	Integrated Flux [phs/s]
0.4000000E+01	0.6608788E+14	0.4895437E+00	0.4082994E+13	0.1020748E+16
0.5000000E+01	0.7497078E+14	0.5110680E+00	0.4627751E+13	0.1946299E+16
0.6000000E+01	0.8267416E+14	0.5281934E+00	0.5096320E+13	0.2795685E+16
0.7000000E+01	0.8939244E+14	0.5422662E+00	0.5500872E+13	0.3581524E+16
0.8000000E+01	0.9526318E+14	0.5541049E+00	0.5850238E+13	0.4312804E+16
0.9000000E+01	0.1003929E+15	0.5642463E+00	0.6151229E+13	0.4996274E+16
0.1000000E+02	0.1048638E+15	0.5730595E+00	0.6409334E+13	0.5637207E+16
0.1100000E+02	0.1087457E+15	0.5808091E+00	0.6629112E+13	0.6239854E+16
0.1200000E+02	0.1120960E+15	0.5876902E+00	0.6814458E+13	0.6807725E+16
0.1300000E+02	0.1149659E+15	0.5938522E+00	0.6968727E+13	0.7343781E+16
0.1400000E+02	0.1173981E+15	0.5994071E+00	0.7094880E+13	0.7850558E+16
0.1500000E+02	0.1194305E+15	0.6044470E+00	0.7195541E+13	0.8330261E+16
0.1600000E+02	0.1210987E+15	0.6090457E+00	0.7273060E+13	0.8784827E+16
0.1700000E+02	0.1224328E+15	0.6132601E+00	0.7329560E+13	0.9215978E+16
0.1800000E+02	0.1234618E+15	0.6171416E+00	0.7366956E+13	0.9625253E+16
0.1900000E+02	0.1242105E+15	0.6207268E+00	0.7386986E+13	0.1001404E+17
0.2000000E+02	0.1247025E+15	0.6240535E+00	0.7391253E+13	0.1038360E+17
0.2100000E+02	0.1249590E+15	0.6271472E+00	0.7381207E+13	0.1073509E+17
0.2200000E+02	0.1249999E+15	0.6300356E+00	0.7358194E+13	0.1106955E+17
0.2300000E+02	0.1248435E+15	0.6327367E+00	0.7323438E+13	0.1138796E+17
0.2400000E+02	0.1245060E+15	0.6352709E+00	0.7278071E+13	0.1169122E+17
0.2500000E+02	0.1240035E+15	0.6376530E+00	0.7223133E+13	0.1198014E+17
0.2600000E+02	0.1233503E+15	0.6398968E+00	0.7159587E+13	0.1225551E+17
0.2700000E+02	0.1225592E+15	0.6420151E+00	0.7088315E+13	0.1251804E+17
0.2800000E+02	0.1216433E+15	0.6440178E+00	0.7010143E+13	0.1276840E+17
0.2900000E+02	0.1206137E+15	0.6459154E+00	0.6925824E+13	0.1300722E+17
0.3000000E+02	0.1194814E+15	0.6477153E+00	0.6836055E+13	0.1323509E+17
0.3100000E+02	0.1182561E+15	0.6494250E+00	0.6741479E+13	0.1345256E+17
0.3200000E+02	0.1169475E+15	0.6510529E+00	0.6642691E+13	0.1366014E+17
0.3300000E+02	0.1155635E+15	0.6526041E+00	0.6540241E+13	0.1385833E+17
0.3400000E+02	0.1141129E+15	0.6540828E+00	0.6434639E+13	0.1404759E+17
0.3500000E+02	0.1126029E+15	0.6554957E+00	0.6326348E+13	0.1422834E+17
0.3600000E+02	0.1110405E+15	0.6568468E+00	0.6215801E+13	0.1440100E+17
0.3700000E+02	0.1094318E+15	0.6581405E+00	0.6103397E+13	0.1456596E+17
0.3800000E+02	0.1077834E+15	0.6593793E+00	0.5989499E+13	0.1472358E+17
0.3900000E+02	0.1061006E+15	0.6605681E+00	0.5874444E+13	0.1487420E+17
0.4000000E+02	0.1043886E+15	0.6617096E+00	0.5758539E+13	0.1501817E+17
0.4100000E+02	0.1026522E+15	0.6628059E+00	0.5642074E+13	0.1515578E+17
0.4200000E+02	0.1008960E+15	0.6638613E+00	0.5525300E+13	0.1528733E+17
0.4300000E+02	0.9912432E+14	0.6648762E+00	0.5408464E+13	0.1541311E+17
0.4400000E+02	0.9734074E+14	0.6658546E+00	0.5291776E+13	0.1553338E+17
0.4500000E+02	0.9554890E+14	0.6667972E+00	0.5175439E+13	0.1564839E+17
0.4600000E+02	0.9375198E+14	0.6677068E+00	0.5059630E+13	0.1575838E+17
0.4700000E+02	0.9195342E+14	0.6685847E+00	0.4944517E+13	0.1586358E+17
0.4800000E+02	0.9015583E+14	0.6694328E+00	0.4830246E+13	0.1596421E+17
0.4900000E+02	0.8836170E+14	0.6702518E+00	0.4716952E+13	0.1606048E+17
0.5000000E+02	0.8657347E+14	0.6710454E+00	0.4604755E+13	0.1615257E+17
0.5100000E+02	0.8479336E+14	0.6718127E+00	0.4493766E+13	0.1624069E+17
0.5200000E+02	0.8302352E+14	0.6725550E+00	0.4384084E+13	0.1632499E+17
0.5300000E+02	0.8126551E+14	0.6732749E+00	0.4275790E+13	0.1640567E+17
0.5400000E+02	0.7952134E+14	0.6739722E+00	0.4168966E+13	0.1648287E+17
0.5500000E+02	0.7779239E+14	0.6746495E+00	0.4063676E+13	0.1655676E+17
0.5600000E+02	0.7607989E+14	0.6753059E+00	0.3959982E+13	0.1662747E+17
0.5700000E+02	0.7438525E+14	0.6759429E+00	0.3857933E+13	0.1669516E+17
0.5800000E+02	0.7270963E+14	0.6765620E+00	0.3757572E+13	0.1675994E+17
0.5900000E+02	0.7105419E+14	0.6771632E+00	0.3658939E+13	0.1682196E+17
0.6000000E+02	0.6941956E+14	0.6777477E+00	0.3562064E+13	0.1688133E+17
0.6100000E+02	0.6780658E+14	0.6783166E+00	0.3466971E+13	0.1693816E+17

Photon Energy [keV]	Brightness [phs/s/mrad²/0.1%b.w./mA]	P_{cir}	Flux [phs/s/0.1%b.w.]	Integrated Flux [phs/s]
0.6200000E+02	0.6621627E+14	0.6788697E+00	0.3373681E+13	0.1699258E+17
0.6300000E+02	0.6464888E+14	0.6794081E+00	0.3282206E+13	0.1704467E+17
0.6400000E+02	0.6310527E+14	0.6799320E+00	0.3192561E+13	0.1709456E+17
0.6500000E+02	0.6158580E+14	0.6804425E+00	0.3104750E+13	0.1714232E+17
0.6600000E+02	0.6009082E+14	0.6809397E+00	0.3018775E+13	0.1718806E+17
0.6700000E+02	0.5862067E+14	0.6814248E+00	0.2934635E+13	0.1723186E+17
0.6800000E+02	0.5717572E+14	0.6818975E+00	0.2852325E+13	0.1727381E+17
0.6900000E+02	0.5575607E+14	0.6823587E+00	0.2771840E+13	0.1731398E+17
0.7000000E+02	0.5436196E+14	0.6828087E+00	0.2693169E+13	0.1735245E+17
0.7100000E+02	0.5299341E+14	0.6832471E+00	0.2616300E+13	0.1738930E+17
0.7200000E+02	0.5165057E+14	0.6836758E+00	0.2541217E+13	0.1742460E+17
0.7300000E+02	0.5033347E+14	0.6840943E+00	0.2467905E+13	0.1745841E+17
0.7400000E+02	0.4904209E+14	0.6845031E+00	0.2396347E+13	0.1749079E+17
0.7500000E+02	0.4777638E+14	0.6849027E+00	0.2326522E+13	0.1752181E+17
0.7600000E+02	0.4653615E+14	0.6852931E+00	0.2258408E+13	0.1755153E+17
0.7700000E+02	0.4532146E+14	0.6856745E+00	0.2191984E+13	0.1757999E+17
0.7800000E+02	0.4413195E+14	0.6860479E+00	0.2127225E+13	0.1760726E+17
0.7900000E+02	0.4296763E+14	0.6864130E+00	0.2064108E+13	0.1763339E+17
0.8000000E+02	0.4182825E+14	0.6867706E+00	0.2002607E+13	0.1765843E+17
0.8100000E+02	0.4071356E+14	0.6871200E+00	0.1942696E+13	0.1768241E+17
0.8200000E+02	0.3962336E+14	0.6874623E+00	0.1884348E+13	0.1770539E+17
0.8300000E+02	0.3855740E+14	0.6877974E+00	0.1827535E+13	0.1772741E+17
0.8400000E+02	0.3751539E+14	0.6881256E+00	0.1772230E+13	0.1774851E+17
0.8500000E+02	0.3649706E+14	0.6884467E+00	0.1718406E+13	0.1776872E+17
0.8600000E+02	0.3550208E+14	0.6887620E+00	0.1666032E+13	0.1778809E+17
0.8700000E+02	0.3453019E+14	0.6890704E+00	0.1615083E+13	0.1780666E+17
0.8800000E+02	0.3358102E+14	0.6893734E+00	0.1565526E+13	0.1782445E+17
0.8900000E+02	0.3265430E+14	0.6896698E+00	0.1517336E+13	0.1784150E+17
0.9000000E+02	0.3174960E+14	0.6899605E+00	0.1470482E+13	0.1785784E+17
0.9100000E+02	0.3086668E+14	0.6902459E+00	0.1424937E+13	0.1787349E+17
0.9200000E+02	0.3000515E+14	0.6905255E+00	0.1380670E+13	0.1788850E+17
0.9300000E+02	0.2916461E+14	0.6908001E+00	0.1337655E+13	0.1790289E+17
0.9400000E+02	0.2834480E+14	0.6910694E+00	0.1295861E+13	0.1791667E+17
0.9500000E+02	0.2754526E+14	0.6913339E+00	0.1255263E+13	0.1792989E+17
0.9600000E+02	0.2676573E+14	0.6915936E+00	0.1215831E+13	0.1794255E+17
0.9700000E+02	0.2600574E+14	0.6918485E+00	0.1177537E+13	0.1795469E+17
0.9800000E+02	0.2526499E+14	0.6920987E+00	0.1140355E+13	0.1796633E+17
0.9900000E+02	0.2454307E+14	0.6923448E+00	0.1104258E+13	0.1797748E+17
0.1000000E+03	0.2383962E+14	0.6925859E+00	0.1069218E+13	0.1798817E+17

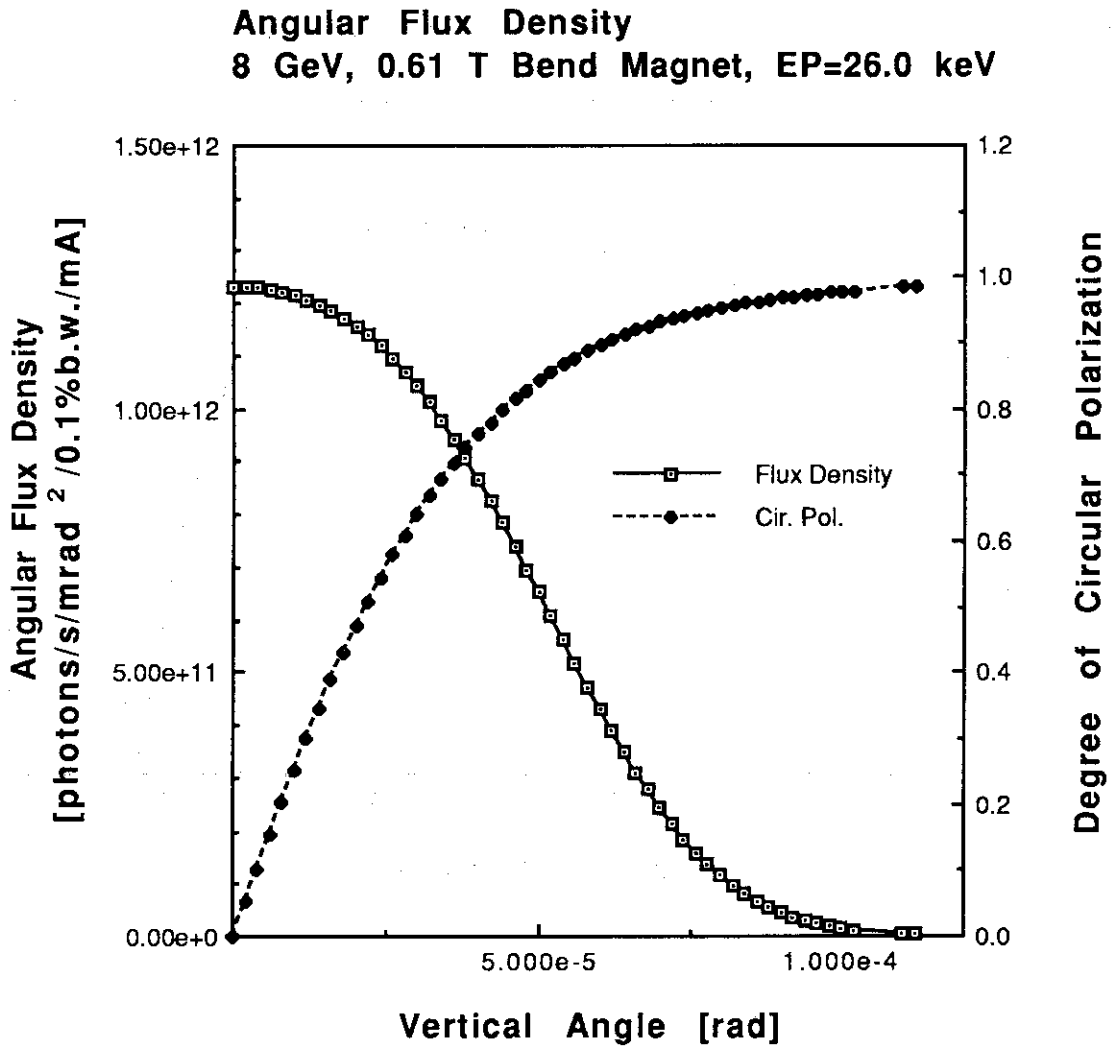

Fig. 1 Example for Program 1. Vertical angular dependence of the flux density per unit beam current and the degree of circular polarization.

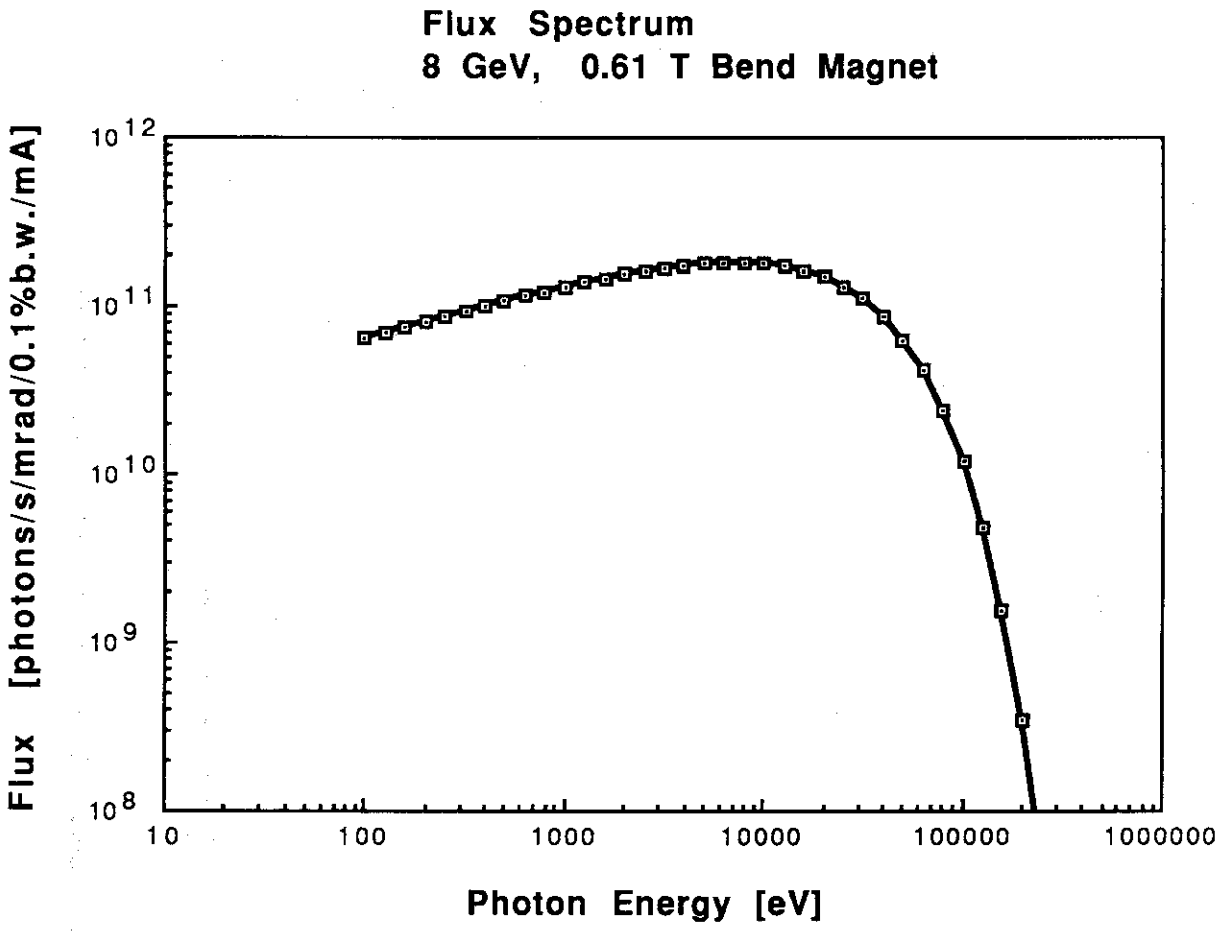

Fig. 2 Example for Program 2. The total flux spectrum per unit beam current from a bending magnet. The calculation was performed for an acceptance of 1 horizontal milliradian.

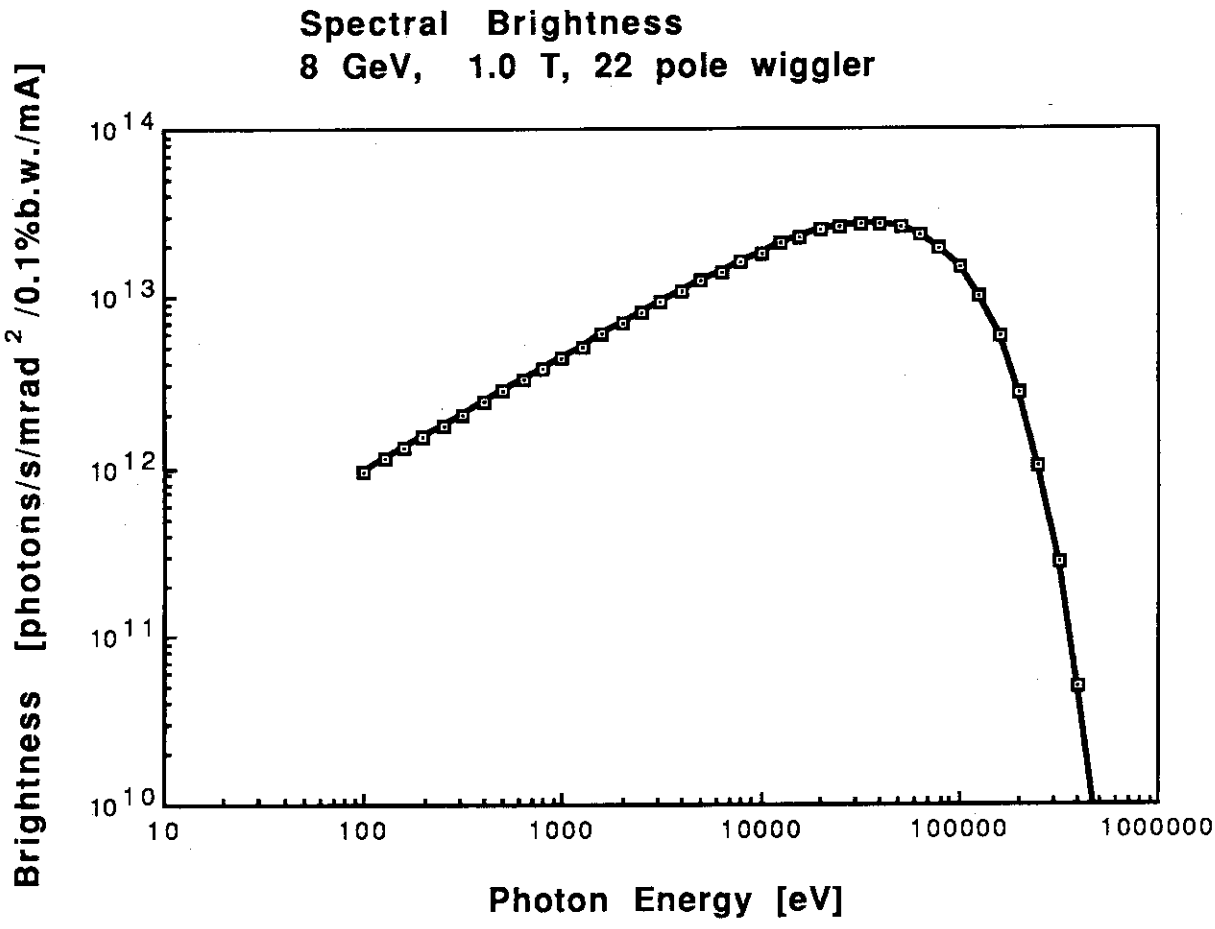

Fig. 3 Example for Program 3. Spectral brightness per unit beam current from a 22 pole wiggler.

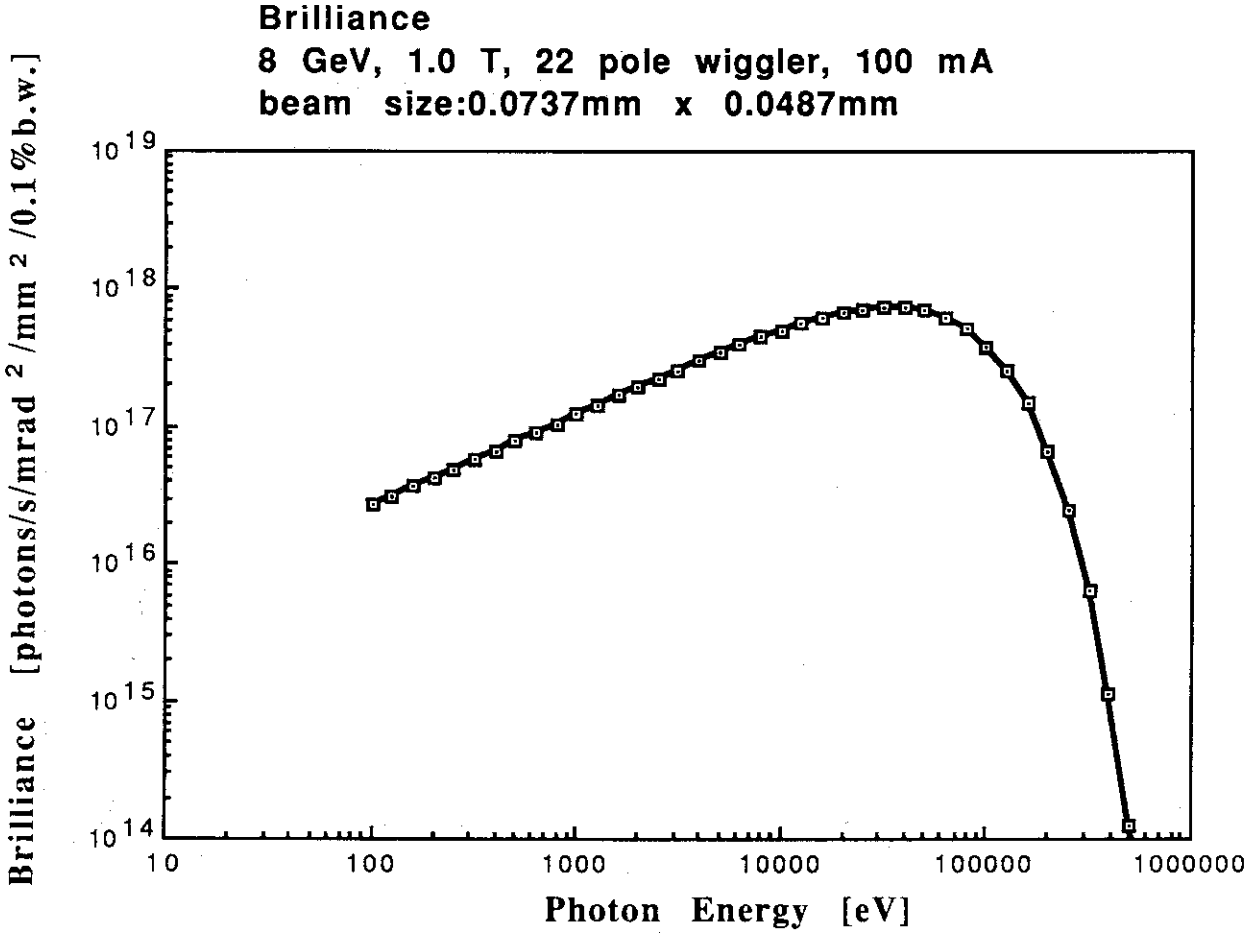

Fig. 4 Example for Program 4. Spectral brilliance of a 22 pole wiggler. Electron energy and beam current are assumed to be 8 GeV and 100 mA, respectively.

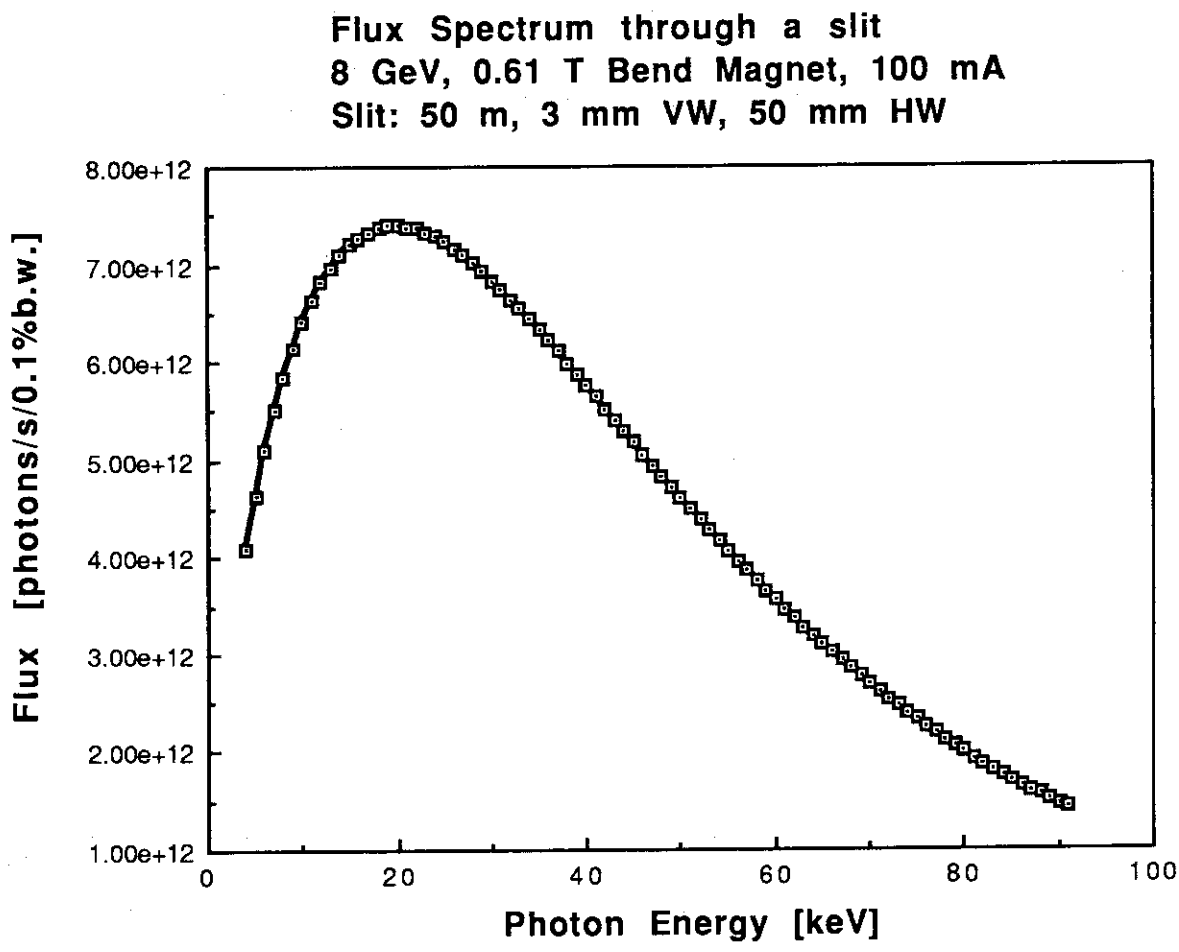

Fig. 5 Example for Program 7. The flux through a slit versus photon energy. A 3 mm (vertical width) x 50 mm (horizontal width) slit is located 50 m away from the source point.

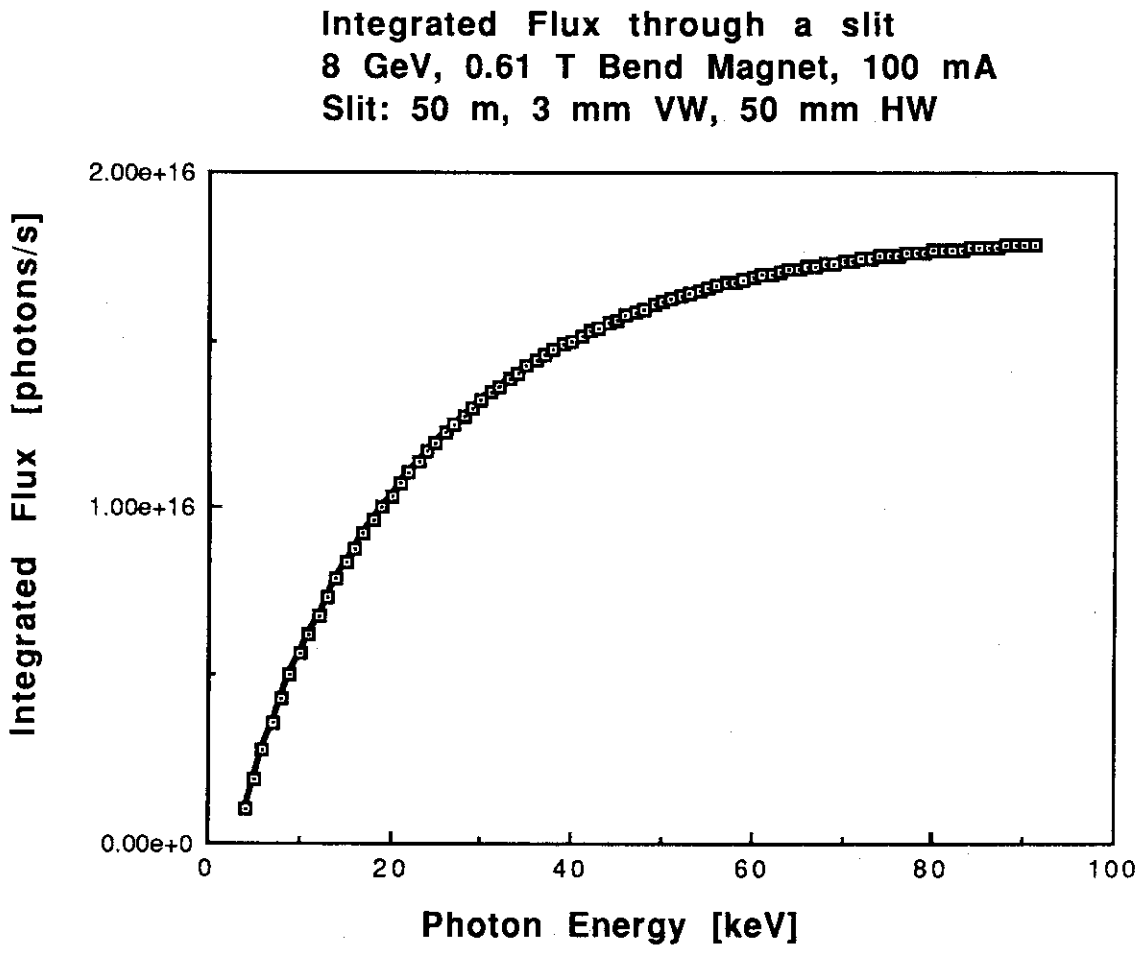

Fig. 6 Example for Program 8. The integrated flux above 4 keV versus photon energy. A 3 mm (vertical width) x 50 mm (horizontal width) slit is located 50 m away from the source point.

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