A MODEL OF A SUPERCONDUCTING
WIGGLER FOR THE PHOTON FACTORY

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The requirements for the wiggler which is expected to use in the Photon Factory Project are
- to produce synchrotron lights with the wave length down to 10^{-1}Å
- to wiggle electron beams in the vertical direction so as to get polarized synchrotron lights parallel to the plane of the electron orbit.

The wiggler which consists of superconducting coils and an iron magnetic shield has three poles with the magnetic field of 6 tesla. Its schematic drawing is shown in Fig. 1. The spectral curves of synchrotron lights from this wiggler, together with the spectra from the bending magnet of the 2.5 GeV electron storage ring are shown in Fig. 2.

The superconducting magnet has a rectangular shape, so as to give no tune shift in the horizontal betatron oscillation. In the vertical betatron oscillation, the tune shift, $\Delta\nu_z$, is given approximately by

$$\Delta\nu_z \approx - \frac{\beta_z}{\pi\rho_w} \theta \quad ,$$

where β_z : beta-function at the wiggler
θ : deflection angle in one pole of the wiggler
ρ_w : radius of curvature of the wiggled beam.

The radiation loss of an electron during the passage of the wiggler is given by

$$V_w = \frac{2\theta}{\pi} \frac{B_w}{B_o} V_o \quad ,$$

where B_w and B_o are the magnetic field strength in the wiggler and the normal bending magnet respectively, and V_o is the radiation loss per turn without wiggler and is 415 KeV. In the normal operation, B_o is one tesla so that V_w is calculated to be 55 KeV.

A Prototype model of a superconducting wiggler magnet has been fabricated and tested. The experimental result of the critical currents as the function of magnetic fields are shown in Fig. 3. The Figure 4 shows the result of the measurement together with the calculated excitation curves using "GFUN" and "TRIM" programs.
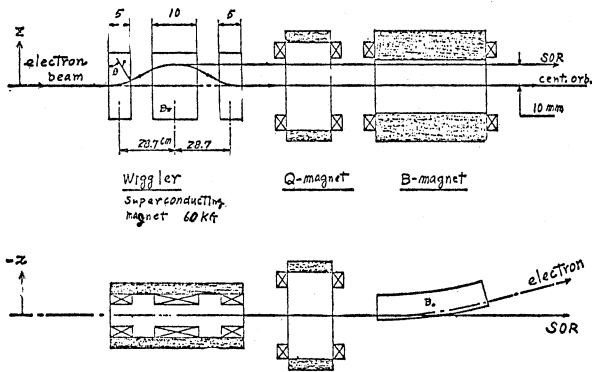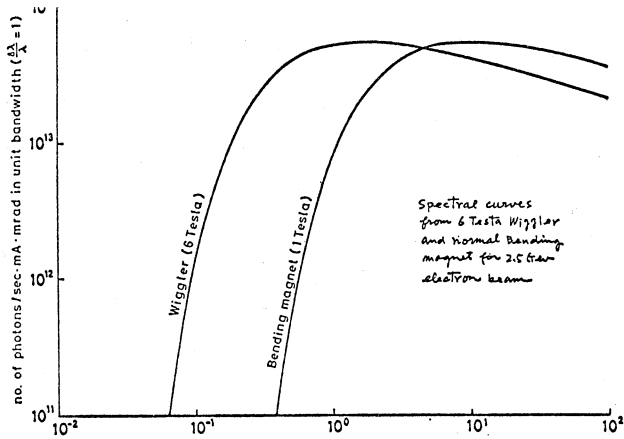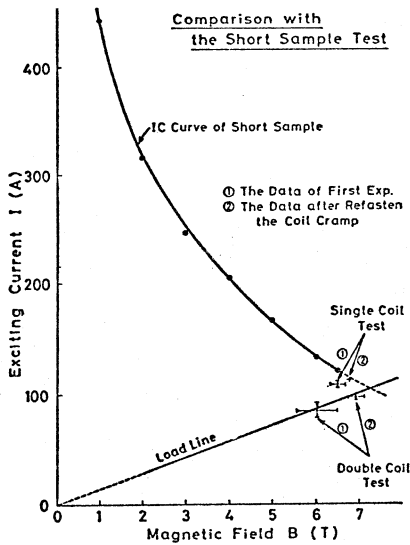
Figure 1.

Figure 2.

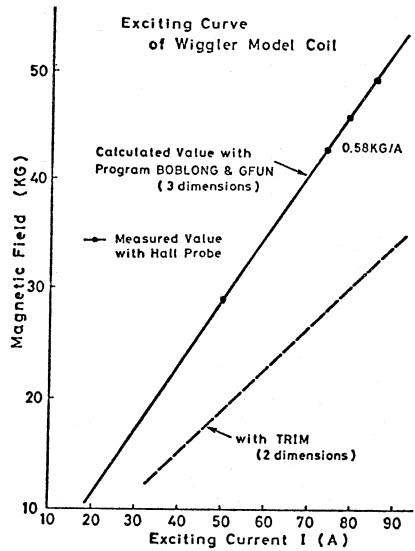Spectral curves from 6 Tesla Wiggler and normal Bending magnet for 2.5 Gev electron beam

Figure 3.

Figure 4.