Laboratori Nazionali di Frascati

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The design of a 6 Tesla, one pole wiggler with NbTi superconducting windings, to be installed in a straight section of the 1.5 GeV storage ring Adone is in progres.

With reference to the fundamental laws of synchrotron light emission:

a) $dP/dl = 3.312 \times 10^{-6} \gamma^2 \int B^2 ds$ W/A   B(T) and s(cm);

b) the "Universal" spectral curve (Fig. 2);

c) $\lambda_c = 18.6/(BE^2)$ Å.   E(GeV);

d) $\varepsilon = 12.35/\lambda(Å)$ KeV;

and to the machine requirements:

- no beam deflection $\int Bds=0$;   - compensated field at any operation mode
- tolerances on the higher order field terms (quadrupole, sextupole, etc) introduced by the wiggler;

we choose a transverse wiggler magnet creating a particular field pattern along the beam trajectory; the electrons perform a single orbit bump in the horizontal plane, which is also the orbit plane of the unperturbed storage ring.

Fig. 1 shows the electron trajectory and the field in the straight section where the wiggler is installed.

Fig. 2 shows the shift of the "Universal" spectral curve towards the higher energy photons in the case of the existing 2T conventional wiggler and the superconducting 6T one.

The synchrotron light source distribution in the horizontal phase space is shown in Fig. 3. The radiation is concentrated near x=35 mm (the peak of the orbit) with x' ranging from $\approx$-35 to $\approx$+35 mrad (zone intensely hatched in the picture).
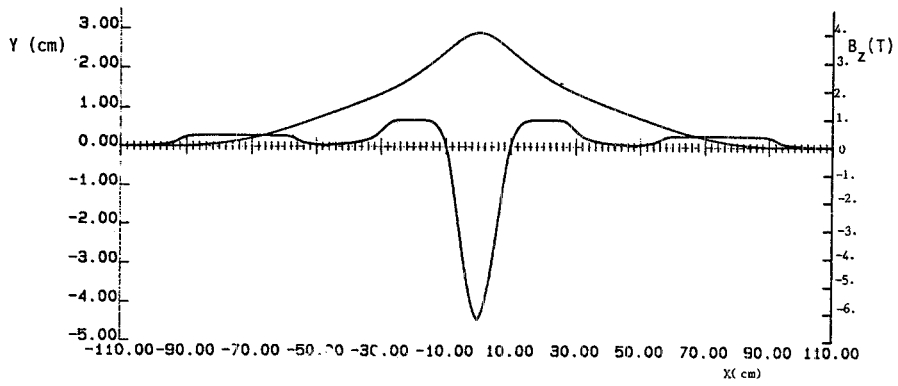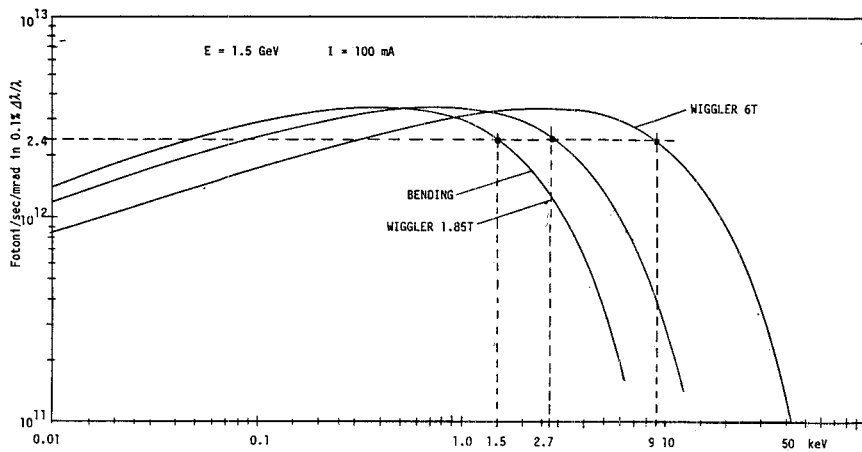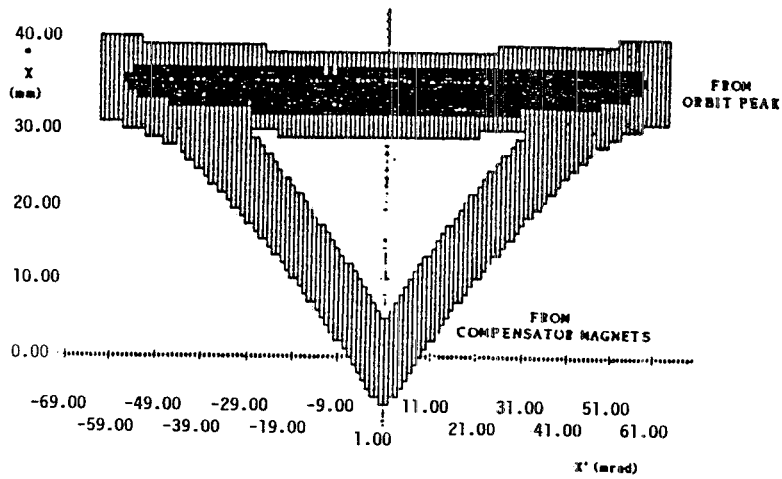
Fig. 1

Fig. 2

Fig. 3

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The installation of the wiggler in Adone modifies some optical parameters of the machine, in particular the emittance, energy spread and damping times. The required RF voltage requirement for a 100 h quantum lifetime is also given:

	Adone	Wiggler 6T		Adone	Wiggler 6T
$U(KeV)$	89.5	8.93	τ_x (ms)	11.51	12.48
ε_x(mrad)	2.43×10^{-7}	4.13×10^{-7}	τ_z (ms)	11.7	10.66
σ_p(at 1.5 GeV)	5.78×10^{-4}	6.39×10^{-4}	τ_ε (ms)	6.0	4.97
$V_{RF}(KV)$	155.1	175.2			

The Wiggler parameters, expected performance and superconducting coil characteristics are also listed for E=1.5 GeV and I_{beam}=100 mA in Tables I and II.

TABLE I

No. of poles	1 s.c. + 2 compensators
Magnetic full gap	6 cm
Compensator full gap	5 cm
Vertical beam stay-clear	3.2 cm
f.m.m./s.c. pole	777600 (at 6.1 T) Asp
f.m.m./compensator pole	11500 Asp
$\lambda_W/2$ (negative peak)	20 cm
Maximum field on orbit plane	6.1 T
Critical wavelength	1.38 Å
Photon flux at $\lambda=\lambda_c$ phot/sec/mrad in $\Delta\lambda/\lambda$=0.1%	2.4×10^{12}
Stored energy (s.c.)	184 KJ
Radiation emission angle	51 mrad
Total radiated power	$\approx$1000 W
Iron weight	356 Kg

TABLE II

No. of turns	2160
Bare wire section	2×1 mm^2
Ins. wire section	2.15×1.15 mm^2
Cu/SC ratio	≥ 2
Filament dia.	45 μm
No. of filaments	300
Twist pitch	25 mm
Current	360 A
Critical current (at 7T, 4.6°K)	430 A
Current density	180 A/mm^2
Critical current density	215 A/mm^2
Field	6.9 T
Conductor weight	90 Kg

Fig. 4 shows the mechanical layout of the compensator magnet. Figg. 5 and 6 show respectively the installation in Adone and a cross section of the SC pole in its cryostat.
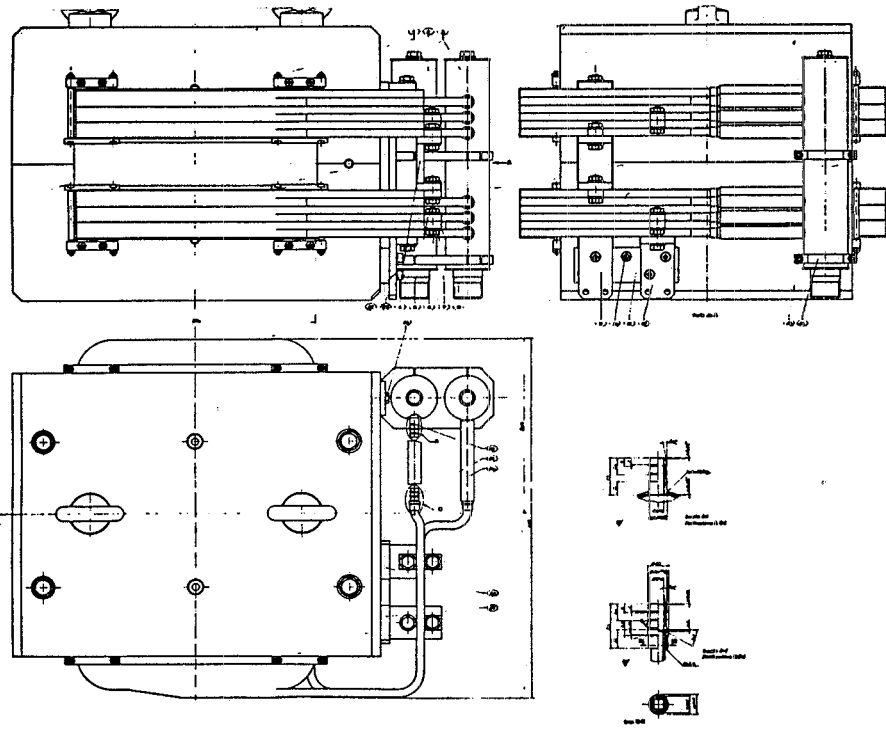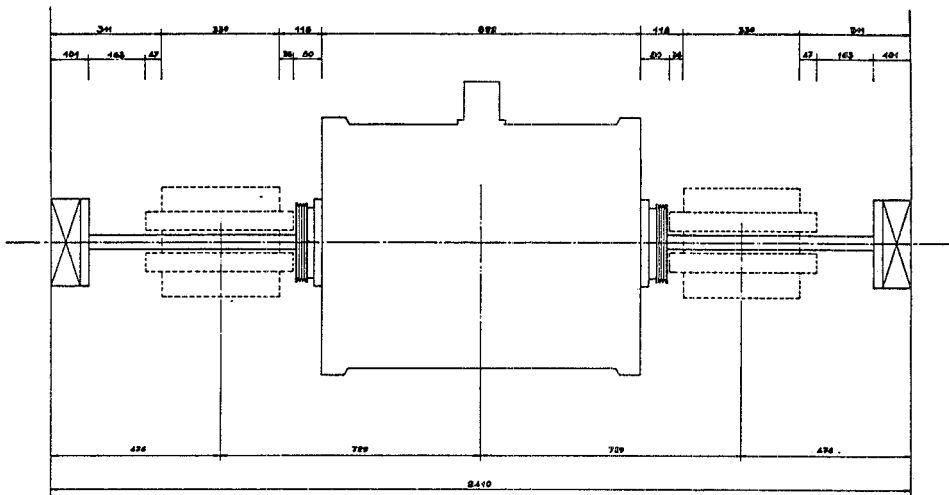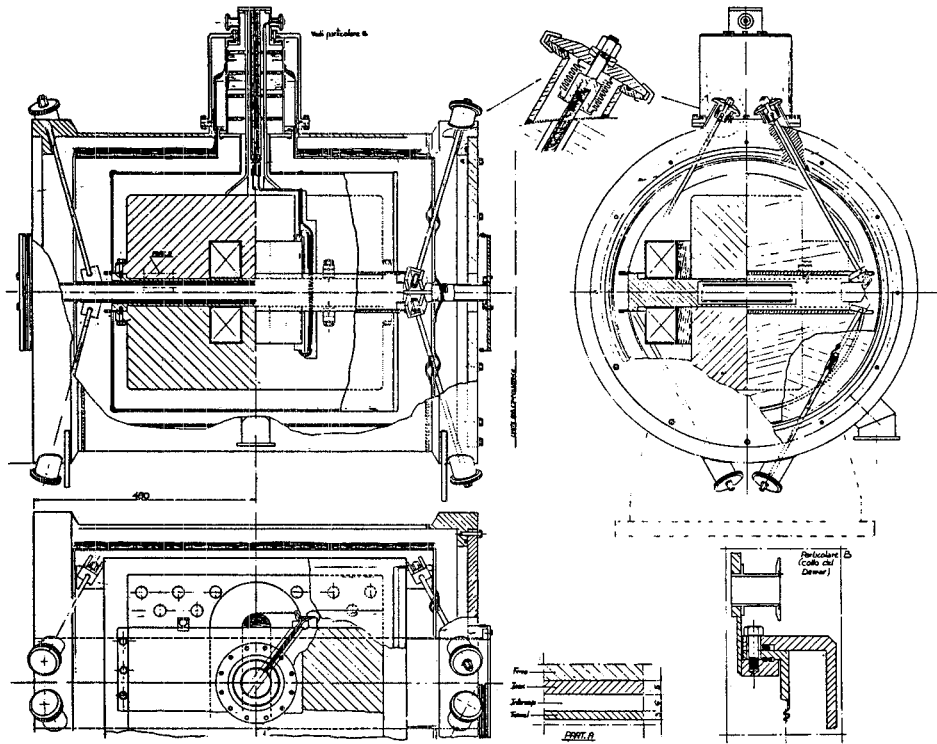
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Fig. 4

Fig. 5

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Fig. 6

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