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Note: **M-2**

CORRECTOR MAGNETS FOR SESAME

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I Introduction

In this note the design of the corrector magnets for the main storage ring is presented.
In SESAME [1÷3] due to space shortage the Horizontal (Vertical) corrector are embedded in all the Sextupoles SF (SD).
In order to have reasonable field uniformity, 6 coils are used for the Horizontal corrector and 4 coils for the Vertical one.
Moreover we show in section IV that is possible, by rearranging the electrical connection, to transform a Horizontal corrector in a Skew Quadrupole.
The transverse field profile of the correctors has been optimized by using 2D POISSON code [4], while the effective magnetic length has been evaluated in 3D geometry.

II Specifications

The maximum kick assumed for each single corrector magnet in the ring is 0.5 mrad @ 2.5 GeV. The transverse field profile has been optimized with 2D Poisson code. In order to evaluate the effective magnetic length 3D calculation has also been performed.
The transverse field profile and the Poisson output are shown in the Fig.1 for the Vertical corrector,

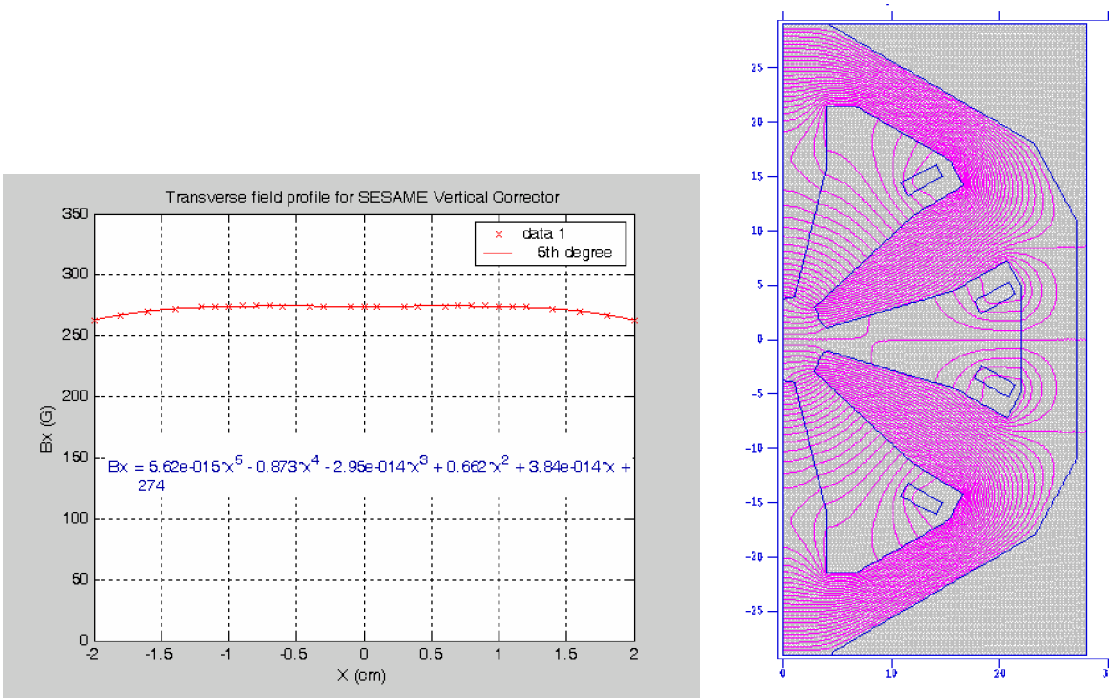

Figure1. Transverse field profile and Poisson output for the vertical corrector.

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and in Fig. 2 for the Horizontal one.

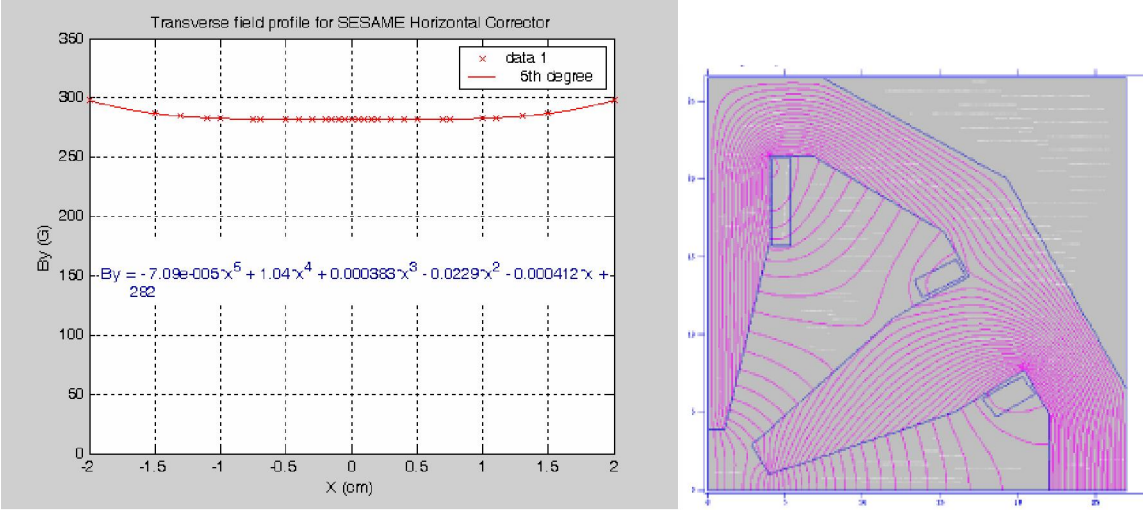

Figure 2. Transverse field profile and Poisson output for the Horizontal corrector.

Let us point out that for the Horizontal corrector one could have used only the top and bottom coils. In this case the transverse field quality was not very good and we used 4 additional coils to improve the field quality.

III Coils Parameters

In Tab.1 the magnetic and electric parameters of SESAME Corrector magnets are listed.

Table.1 Parameters of SESAME Corrector magnets.

	Horizontal Corrector	Vertical Corrector
θ @ 2.5 GeV (mrad)	0.500	0.500
Magnetic field (T)	0.0274	0.0274
Effective magnetic length (m)	0.15	0.15
Yoke Length (m)	0.1	0.1
Ampere-Turns per pole	1080 (2)+540(4)	905 (4)
Turns per Coil	100+50	100
Conductor size (mm)	Φ 2.65	Φ 2.65
Current Density (A/mm2)	2	1.64
Conductor Length (m)	210	213
Magnet Resistance (Ω)	0.639	0.648
Current (A)	11	9.1
Total Voltage (V)	7.03	5.9
Total Power (W)	77.4	54
PS Current (A)	12	12
PS Voltage (V)	8	8

The coil design is based on copper conductors of circular cross section with a diameter of 2.65mm. This is the same of the conductor used for DAFNE correctors [5].
The overall conductor length for the vertical corrector is 213m, with the total resistance of 0.648Ω and total inductance of 22.5mH calculated from the stored energy in the magnet. The required current to produce a kick of 0.5 mrad is 9.1A; which results in 5.9 V voltage drop and 54 W thermal power dissipation in the conductors.
Likewise the overall conductor length for the horizontal corrector is 210m, with the total resistance of 0.639Ω and total inductance of 15.9mH. The nominal current for 0.5 mrad kick is 11A; which results in 7.03 V voltage drop and 77.4 W thermal power dissipation in the conductor.
The coils are cooled with normal air and there is no need to use water cooling system.

IV Skew Quadrupole.

By properly rearranging in the SF sextupole the electrical connections of the additional coils it is possible to transform the Horizontal corrector in a *Skew Quadrupole*. The Poisson output for the Skew Quadrupole configuration is shown in Fig. 3, while the field profile for the B_x and B_y components are shown in Fig.4.

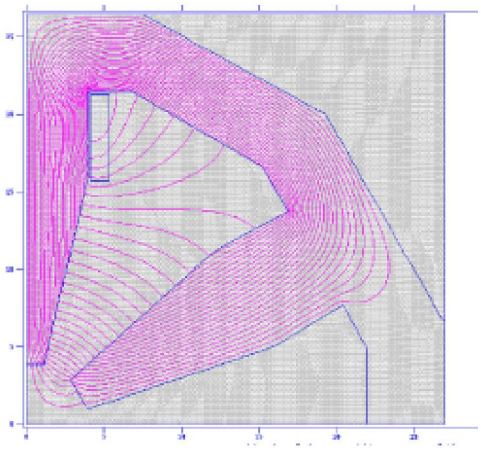

Figure 3. Poisson output for the Skew Quadrupole configuration

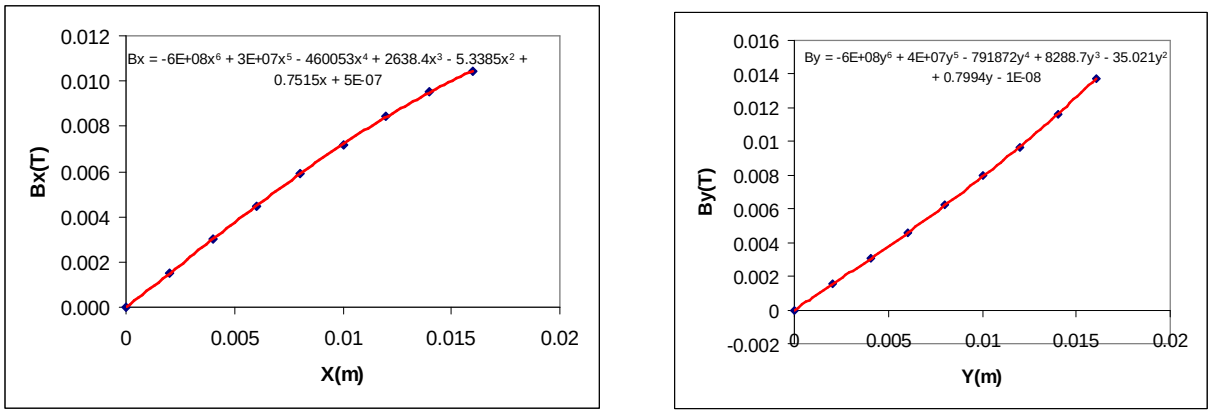

Figure 4. B_x and B_y components for the *Skew Quadrupole* configuration.

Fig. 4 shows that the field behavior in the region close to the magnetic center is much more linear and the gradient (T/m) for the x and y plane are 0.76(T/m) and 0.78(T/m) in a region of ±6mm around the center.

V References

[1] Yellow Book - http://www.sesame.org.jo/publication/SesamePublications.aspx
[2] G.Vignola et al. “SESAME in Jordan”, PAC 2005, May 2005, USA
[3] G.Vignola, “SESAME Lattice” SESAME Tech. Note O-1, Dec. 2004
[4] “Poisson Superfish Manual” LANL document server
[5] B. Bolli, et al. "Measurements on SIGMA-PHI Rectangular Corrector Prototype for the DAFNE Main Rings", DAFNE Tech. Note, MM-15, 1996

Appendix

For completeness we show in the Figure A.1 the schematic of the electric current direction in the coils for the 3 different configurations.

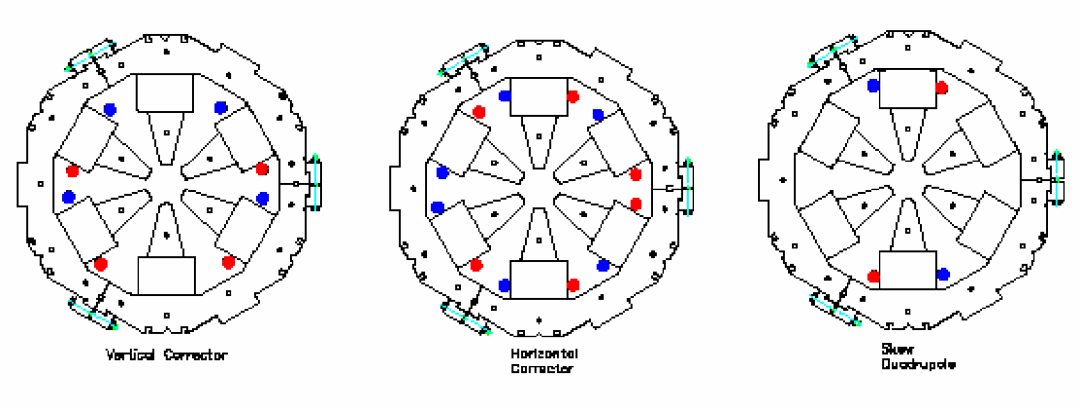

Figure A.1: Current direction for the 3 corrector configurations.