

MAGNET DIVISION NOTES

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Task Force: Coil Geometry Analysis
Title: Field Calculation for the Coil C358A and
Iron Design IBL13

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(This paper consists of 9 pages excluding cover sheet)

Field Calculation for the Coil C358A and Iron Design LBL13

Ramesh C. Gupta

July 10, 1987

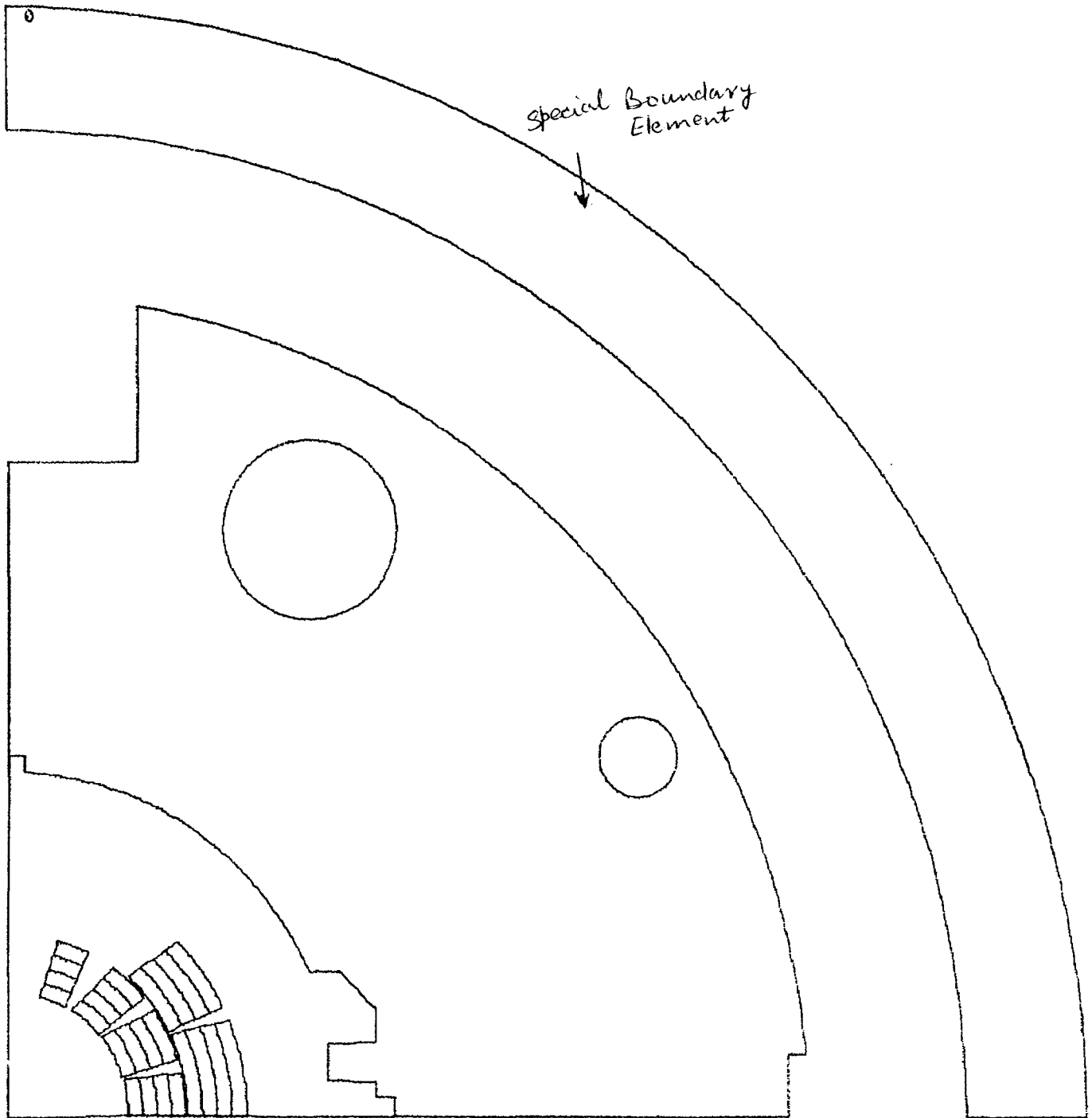
In this note we present the magnetic field calculations using the code POISSON for the coil geometry designated as C358A and the iron design designated as LBL3. The coil and iron design are described by Morgan in more detail in Ref 1. This reference also gives the results of the similar calculations with the code MDP. We would compare the results obtained by these two codes. The POISSON calculations have been done in two ways. In first way, we place the boundary of the geometry at 30 cm (boundary means the place where either the Dirichlet or Neumann boundary condition is to be applied). In the second way, we use the method developed by Caspi, Helms, et al., where a special boundary element is used which produces the results as if the boundary was placed at infinite distance (See Ref 2).

In Fig 1, we show the model of this magnet on the code POISSON. The coil is shown in more detail in Fig 2. The input to AUTOMESH, which also gives various dimensions, is given in Figure 3. The results of the field computations are given in Table 1. In Table 2, we compare these results with those obtained by the code MDP for the transfer function and for the sextupole harmonic.

In Fig 4 and Fig 5 we plot transfer function and the sextupole harmonic with the current in the coil. As mentioned before, the POISSON calculations have been done in two ways, namely, namely with the special boundary element and with the boundary at 30 cm. All our previous calculations for other models have been done with the boundary being at 30 cm. We start observing the difference in the two after 4000 Amps current and this difference is found only in the transfer function and in the sextupole harmonics (all other harmonics remain practically unchanged). Though, obviously, the special boundary element results are more reliable, but the difference is not large enough (upto the maximum operating field of 6.3 T) that our previous conclusions about other models and other calculations need to be altered significantly. It has been found that the special boundary element method, on the average, takes 50% more CPU time for such calculations.

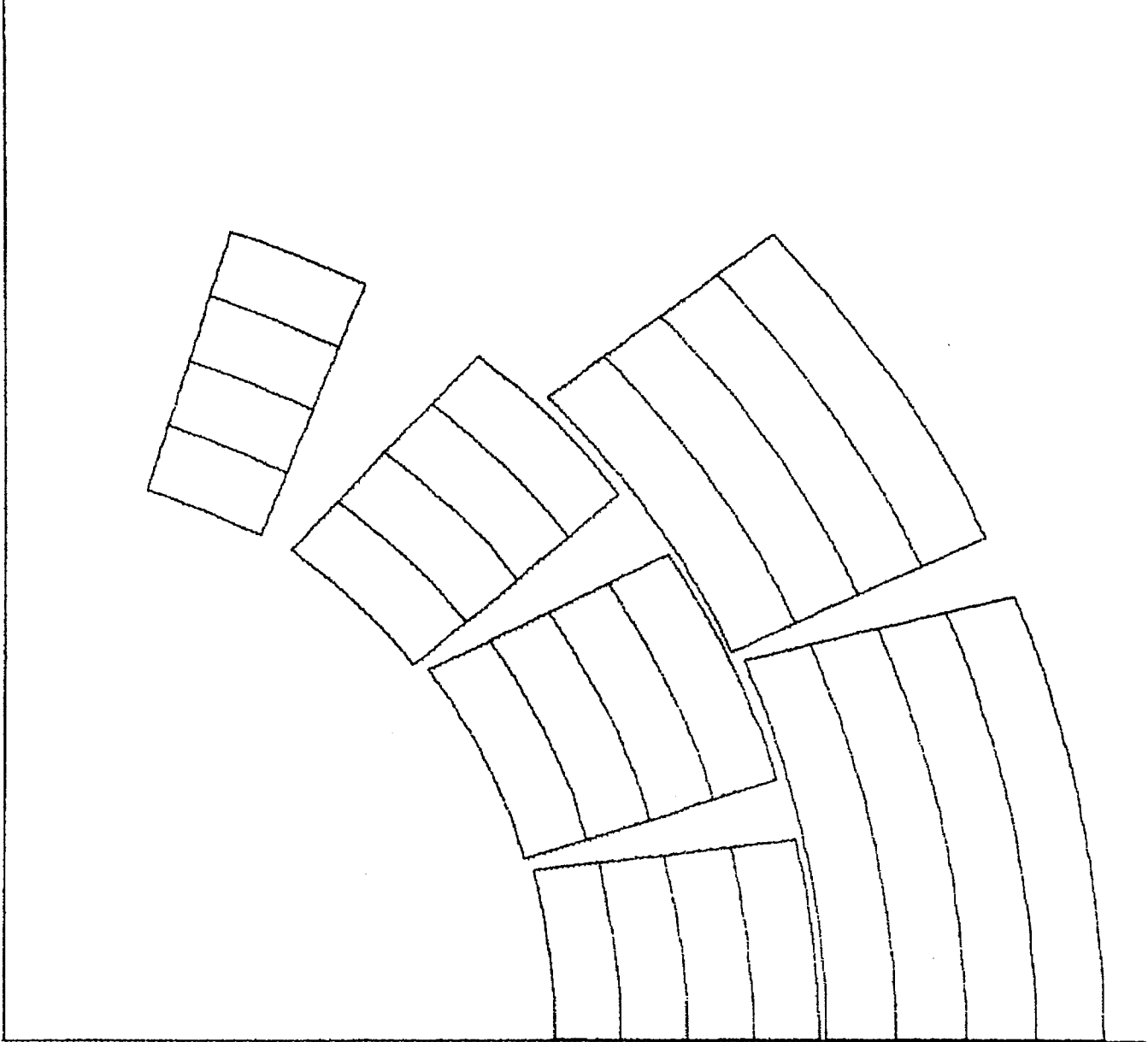
References:

1. G. Morgan, "LBL - A Collar and Iron Design With Tapered Keys", Magnet Division Note 214-1 (SSC-MD-159), April 8, 1987.
2. S. Caspi, M. Helm, L.J. Laslett, "Incorporation of A Circular Boundary Condition into the Program POISSON", LBL-17064, 2/84.



PROP. NAME = SSC MAGNET : COIL C358A & Iron LBL/CYCLE

Fig 1. Coil & Iron



PROB. NAME = SSC MAGNET : COIL C358A

CYCLE =

Fig 2. Coil

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SSC MAGNET : COIL C358A I=5000A
SREG NREG=30, IREG=1, MAT=1, KMAX=89, IMAX=107
NEXT=7, XMIN=0, YMIN=0.
XSTR=0, YSTR=0, XEND=30, YEND=30.
KSTR=1, LSTR=1, KEND=89, LEND=107
XMAX=30, YMAX=30, CUR=0, NPOINT=4, ICONT=0$
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SPO X=0, Y=30, NT=2$
SPO X=0, Y=0.0$
SPO X=30, Y=0.0$
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XSTR=12.9913, XEND=13.296, YSTR=0, YEND=13.3363
KSTR=74, KEND=75, LSTR=1, LEND=92$
SPO X=12.9913, Y=0.0$
SPO X=12.9913, Y=1.031$
SPO X=13.296, Y=1.031$
SREG ICONT=1, NPOINT=2
XSTR=0, XEND=12.9913, KSTR=1, KEND=73$
SPO X=13.296, Y=1.031$
SPO X=2.159, Y=13.1604, NT=2$
SREG ICONT=1, NPOINT=2
YSTR=10.6172, YEND=13.1604, LSTR=85, LEND=91$
SPO X=2.159, Y=13.1604$
SPO X=2.159, Y=10.6172$
SREG ICONT=1, NPOINT=2
LSTR=73, LEND=85, YSTR=6.0833, YEND=10.6172$
SPO X=2.159, Y=10.6172, NT=1$
SPO X=0, Y=10.6172$
SREG ICONT=0, NPOINT=3
YSTR=0, YEND=10.6172, LSTR=1, LEND=73
XSTR=0, XEND=12.9913, KSTR=1, KEND=74$
SPO X=0, Y=10.6172$
SPO X=0, Y=0.0$
SPO X=12.9913, Y=0.0$
SREG MAT=1, IREG=3, NPOINT=5
XSTR=3.5195, XEND=6.5405, KSTR=24, KEND=40
YSTR=8.0645, YEND=10.9855, LSTR=67, LEND=80$
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SPO R=1.4605, THETA=90, NT=2, XO=5.08, YO=9.525$
SPO R=1.4605, THETA=180, NT=2, XO=5.08, YO=9.525$
SPO R=1.4605, THETA=270, NT=2, XO=5.08, YO=9.525$
SPO R=1.4605, THETA=0, NT=2, XO=5.08, YO=9.525$
SREG MAT=1, IREG=4, NPOINT=5
XSTR=9.5, XEND=11.0, KSTR=57, KEND=64
YSTR=6.0, YEND=8.0, LSTR=43, LEND=56$
SPO R=0.6528, THETA=0, XO=10.541, YO=5.842$
SPO R=0.6528, THETA=90, NT=2, XO=10.541, YO=5.842$
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SPO R=0.6528, THETA=270, NT=2, XO=10.541, YO=5.842$
SPO R=0.6528, THETA=0, NT=2, XO=10.541, YO=5.842$
SREG IREG=5, KSTR=0, XEND=5.5563, KSTR=1, KEND=56
YSTR=0, YEND=5.5563, LSTR=1, LEND=72
NPOINT=15$
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SPO X=2.558, Y=5.842$
SPO X=5.0578, Y=5.566$
SPO X=5.0578, Y=2.3368, NT=2$
SPO X=5.5677, Y=2.3368$
SPO X=6.1265, Y=1.73864$
SPO X=6.1265, Y=1.21794$
SPO X=5.3645, Y=1.17805$
SPO X=5.3645, Y=0.59487$
SPO X=6.1265, Y=0.555$
SPO X=6.1265, Y=0.3175$
SPO X=6.444, Y=0.3175$
SPO X=6.444, Y=0.0$
SPO X=0, Y=0.0$
SPO X=0, Y=5.842$
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YSTR=0.00, YEND=4.05, LSTR=1, LEND=72
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SPO X=0, Y=0.00$
SPO X=1.80, Y=0.00$
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SPO R=2.987, THETA=0.0, NT=1, IK=37, IL=1$
SPO R=3.993, THETA=0, NT=1$
SREG XSTR=0, XEND=3.993, KSTR=1, KEND=49
YSTR=0.00, YEND=4.05, LSTR=2, LEND=72
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SPO X=3.96840, Y=0.44335$
SPO X=3.94970, Y=0.58700$
SPO X=3.92580, Y=0.73000$
SPO X=3.89670, Y=0.87225$
SPO X=3.86230, Y=1.01355$
SPO X=3.82280, Y=1.15375$
SPO X=3.77805, Y=1.29265$
SPO X=3.72820, Y=1.43015$
SPO X=3.67420, Y=1.56655$
SREG XSTR=0, XEND=3.993, KSTR=1, KEND=49
YSTR=0.00, YEND=4.05, LSTR=3, LEND=73
ICONT=1, NPOINT=13, MAT=1$
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SPO X=3.57060, Y=1.76925$
SPO X=3.51140, Y=1.91255$
SPO X=3.44005, Y=2.02750$
SPO X=3.36410, Y=2.15125$
SPO X=3.28355, Y=2.27230$
SPO X=3.19845, Y=2.39050$
SPO X=3.10895, Y=2.50580$
SPO X=3.01510, Y=2.61795$
SPO X=2.91695, Y=2.72690$
SPO X=2.81545, Y=2.83340$
SPO X=1.5, Y=2.95$
SPO X=0, Y=2.95$
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YSTR=0.00, YEND=4.05, LSTR=2, LEND=72
ICONT=0, NPOINT=2, MAT=1$
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SPO X=0, Y=0, IK=1, IL=1$
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YSTR=0.0000, YEND=4.05, LSTR=2, LEND=72$

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SPO X=2.21859, Y=0.32104$
SPO X=2.23403, Y=0.16580$
SPO X=2.23623, Y=0.01010$
SPO X=1.99545, Y=0.01010$
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SPO X=2.47700, Y=0.01010$
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SPO X=2.39992, Y=0.65603$
SPO X=2.16066, Y=0.62891$
SPO X=2.19321, Y=0.47536$
SPO X=2.21859, Y=0.32104$
SPO X=2.23403, Y=0.16580$
SPO X=2.23623, Y=0.01010$
SREG IREG=9, NPOINT=11, CUR=5000.0, MAT=1$
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SPO X=2.71778, Y=0.01010$
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XSTR=0, XEND=3.993, KSTR=0, KEND=48
YSTR=0.0000, YEND=4.05, LSTR=3, LEND=73$
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SPO X=1.84115, Y=0.78405$
SPO X=1.78045, Y=0.92065$
SPO X=1.71065, Y=1.05350$
SPO X=1.63190, Y=1.18220$
SPO X=1.54680, Y=1.30780$
SPO X=1.76554, Y=1.40845$
SPO X=1.85339, Y=1.27663$
SPO X=1.93471, Y=1.14164$
SPO X=2.00690, Y=1.00243$
SPO X=2.06983, Y=0.85941$
SPO X=2.11647, Y=0.71081$
SPO X=1.88575, Y=0.64195$
SREG IREG=12, NPOINT=13, CUR=6250.0, MAT=1$
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SPO X=2.29850, Y=0.93478$
SPO X=2.23335, Y=1.08420$
SPO X=2.15878, Y=1.22978$
SPO X=2.07488, Y=1.37105$
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SPO X=1.93471, Y=1.14164$
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SPO X=2.11647, Y=0.71081$
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SPO X=2.34720, Y=0.77968$
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SPO X=2.23335, Y=1.08420$
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SPO X=2.38284, Y=1.31791$
SPO X=2.45980, Y=1.16598$
SPO X=2.52718, Y=1.01014$
SPO X=2.57792, Y=0.84854$
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SPO X=2.68625, Y=1.24775$
SPO X=2.60690, Y=1.40605$
SPO X=2.51785, Y=1.55990$
SPO X=2.42175, Y=1.71040$
SPO X=2.20301, Y=1.60975$
SPO X=2.29636, Y=1.46548$
SPO X=2.38284, Y=1.31791$
SPO X=2.45980, Y=1.16598$
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SPO X=2.57792, Y=0.84854$
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SPO X=1.39475, Y=1.43590$
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SPO X=1.21953, Y=1.89628$
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SPO X=1.46515, Y=1.69969$
SPO X=1.57833, Y=1.59172$
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SPO X=1.76190, Y=1.74755$
SPO X=1.64425, Y=1.86063$
SPO X=1.51935, Y=1.96645$
SPO X=1.38925, Y=2.06705$
SPO X=1.21953, Y=1.89628$

```

Fig 3. Input to AUTOMESH
(continued in next page)

SFO X= 1.34488, Y= 1.80053\$
SFO X= 1.46515, Y= 1.69969\$
SFO X= 1.57833, Y= 1.59172\$
SFO X= 1.67745, Y= 1.47158\$
SREG IREG=17, NFOINT=11, CUR= 5000.0, MAT=1\$
SFO X= 1.86535, Y= 1.62215\$
SFO X= 1.76190, Y= 1.74755\$
SFO X= 1.64425, Y= 1.86063\$
SFO X= 1.51935, Y= 1.96645\$
SFO X= 1.38925, Y= 2.06705\$
SFO X= 1.55898, Y= 2.23783\$
SFO X= 1.69383, Y= 2.13238\$
SFO X= 1.82335, Y= 2.02156\$
SFO X= 1.94548, Y= 1.90338\$
SFO X= 2.05325, Y= 1.77272\$
SFO X= 1.86535, Y= 1.62215\$
SREG IREG=18, NFOINT=11, CUR= 5000.0, MAT=1\$
SFO X= 2.05325, Y= 1.77272\$
SFO X= 2.24115, Y= 1.92330\$
SFO X= 2.12905, Y= 2.05920\$
SFO X= 2.00245, Y= 2.18250\$
SFO X= 1.86830, Y= 2.29830\$
SFO X= 1.72870, Y= 2.40860\$
SFO X= 1.55898, Y= 2.23783\$
SFO X= 1.69383, Y= 2.13238\$
SFO X= 1.82335, Y= 2.02156\$
SFO X= 1.94548, Y= 1.90338\$
SFO X= 2.05325, Y= 1.77272\$
SREG IREG=19, NFOINT= 9, CUR= 3750.00, MAT=1\$
SFO X= 0.93665, Y= 1.77520\$
SFO X= 0.79915, Y= 1.83250\$
SFO X= 0.66040, Y= 1.88668\$
SFO X= 0.51930, Y= 1.93458\$
SFO X= 0.59596, Y= 2.16259\$
SFO X= 0.74349, Y= 2.11264\$
SFO X= 0.88858, Y= 2.05605\$
SFO X= 0.93235, Y= 1.99613\$
SFO X= 0.93665, Y= 1.77520\$
SREG IREG=20, NFOINT= 9, CUR= 3750.00, MAT=1\$
SFO X= 1.03235, Y= 1.99613\$
SFO X= 1.12805, Y= 2.21705\$
SFO X= 0.97800, Y= 2.27960\$
SFO X= 0.82658, Y= 2.33863\$
SFO X= 0.67263, Y= 2.39083\$
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SFO X= 0.82658, Y= 2.33863\$
SFO X= 0.67263, Y= 2.39083\$
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SFO X= 0.90966, Y= 2.56461\$
SFO X= 1.06743, Y= 2.50315\$
SFO X= 1.22375, Y= 2.43798\$
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SFO X= 0.99275, Y= 2.79060\$
SFO X= 0.82595, Y= 2.84730\$
SFO X= 0.74929, Y= 2.61906\$
SFO X= 0.90966, Y= 2.56461\$
SFO X= 1.06743, Y= 2.50315\$
SFO X= 1.22375, Y= 2.43798\$
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XSTR=0.0, XEND=3.993, XSTR=1, XEND=49
YSTR=0.0000, YEND=4.05, YSTR=2, YEND=72\$
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SFO X= 2.98430, Y= 0.13370\$
SFO X= 2.97670, Y= 0.25710\$
SFO X= 2.96430, Y= 0.38015\$
SFO X= 2.94720, Y= 0.50280\$
SFO X= 2.92530, Y= 0.62480\$
SFO X= 2.89850, Y= 0.74615\$
SFO X= 2.86710, Y= 0.86655\$
SFO X= 2.83080, Y= 0.98590\$
SFO X= 2.78985, Y= 1.10405\$
SFO X= 2.74410, Y= 1.22095\$
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SFO X= 3.14805, Y= 0.77768\$
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SFO X= 3.22800, Y= 0.26763\$
SFO X= 3.23575, Y= 0.13897\$
SFO X= 3.23710, Y= 0.01020\$
SFO X= 2.98560, Y= 0.01020\$
SREG IREG=24, NFOINT=25, CUR= 13750.00, MAT=1\$
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SFO X= 3.48860, Y= 0.01020\$
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SFO X= 3.46635, Y= 0.41175\$
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SFO X= 3.19783, Y= 0.52385\$
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SFO X= 3.23575, Y= 0.13897\$
SFO X= 3.23710, Y= 0.01020\$
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SFO X= 3.48720, Y= 0.14425\$
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SFO X= 3.46635, Y= 0.41175\$
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SFO X= 3.42555, Y= 0.67740\$
SFO X= 3.39760, Y= 0.80920\$
SFO X= 3.36470, Y= 0.94005\$
SFO X= 3.32680, Y= 1.06983\$
SFO X= 3.28395, Y= 1.19835\$
SFO X= 3.23615, Y= 1.32553\$
SFO X= 3.18450, Y= 1.45163\$
SFO X= 3.42935, Y= 1.50909\$
SFO X= 3.48218, Y= 1.37784\$
SFO X= 3.53100, Y= 1.24550\$
SFO X= 3.57480, Y= 1.11179\$
SFO X= 3.61350, Y= 0.97680\$
SFO X= 3.64715, Y= 0.84073\$
SFO X= 3.67568, Y= 0.70370\$
SFO X= 3.69908, Y= 0.56595\$
SFO X= 3.71738, Y= 0.42755\$
SFO X= 3.73060, Y= 0.28868\$
SFO X= 3.73865, Y= 0.14953\$
SFO X= 3.74010, Y= 0.01020\$
SFO X= 3.48860, Y= 0.01020\$
SREG IREG=26, NFOINT=25, CUR= 13750.00, MAT=1\$
SFO X= 3.74010, Y= 0.01020\$
SFO X= 3.99160, Y= 0.01020\$
SFO X= 3.99010, Y= 0.15480\$
SFO X= 3.98190, Y= 0.29920\$
SFO X= 3.96840, Y= 0.44335\$
SFO X= 3.94970, Y= 0.58700\$
SFO X= 3.92580, Y= 0.73000\$
SFO X= 3.89670, Y= 0.87225\$
SFO X= 3.86230, Y= 1.01355\$
SFO X= 3.82280, Y= 1.15375\$
SFO X= 3.77805, Y= 1.29265\$
SFO X= 3.72820, Y= 1.43015\$
SFO X= 3.67420, Y= 1.56655\$
SFO X= 3.42935, Y= 1.50909\$
SFO X= 3.48218, Y= 1.37784\$
SFO X= 3.53100, Y= 1.24550\$
SFO X= 3.57480, Y= 1.11179\$
SFO X= 3.61350, Y= 0.97680\$
SFO X= 3.64715, Y= 0.84073\$
SFO X= 3.67568, Y= 0.70370\$
SFO X= 3.69908, Y= 0.56595\$
SFO X= 3.71738, Y= 0.42755\$
SFO X= 3.73060, Y= 0.28868\$
SFO X= 3.73865, Y= 0.14953\$
SFO X= 3.74010, Y= 0.01020\$
SREG IREG=27, NFOINT=21, CUR= 11250.00, MAT=1,
XSTR=0.0, XEND=3.993, XSTR=1, XEND=49
YSTR=0.0000, YEND=4.05, YSTR=3, YEND=73\$
SFO X= 2.64835, Y= 1.36715\$
SFO X= 2.59785, Y= 1.47985\$
SFO X= 2.53555, Y= 1.58710\$

SFO X= 2.46900, Y= 1.69195\$
SFO X= 2.39825, Y= 1.79435\$
SFO X= 2.32335, Y= 1.89415\$
SFO X= 2.24445, Y= 1.99120\$
SFO X= 2.16160, Y= 2.08520\$
SFO X= 2.07480, Y= 2.17650\$
SFO X= 1.98490, Y= 2.26550\$
SFO X= 1.92554, Y= 2.40748\$
SFO X= 2.28534, Y= 2.31410\$
SFO X= 2.37498, Y= 2.21850\$
SFO X= 2.46058, Y= 2.11985\$
SFO X= 2.54212, Y= 2.01824\$
SFO X= 2.61958, Y= 1.91384\$
SFO X= 2.69278, Y= 1.80677\$
SFO X= 2.76168, Y= 1.69720\$
SFO X= 2.82624, Y= 1.58520\$
SFO X= 2.87891, Y= 1.46768\$
SFO X= 2.64835, Y= 1.36715\$
SREG IREG=28, NFOINT=21, CUR= 11250.00, MAT=1\$
SFO X= 2.87891, Y= 1.46768\$
SFO X= 3.10948, Y= 1.56820\$
SFO X= 3.05463, Y= 1.69055\$
SFO X= 2.98780, Y= 1.80730\$
SFO X= 2.91655, Y= 1.92160\$
SFO X= 2.84090, Y= 2.03332\$
SFO X= 2.76090, Y= 2.14233\$
SFO X= 2.67670, Y= 2.24850\$
SFO X= 2.58835, Y= 2.35165\$
SFO X= 2.49588, Y= 2.45170\$
SFO X= 2.40017, Y= 2.54945\$
SFO X= 2.19254, Y= 2.40748\$
SFO X= 2.28534, Y= 2.31410\$
SFO X= 2.37498, Y= 2.21850\$
SFO X= 2.46058, Y= 2.11985\$
SFO X= 2.54212, Y= 2.01824\$
SFO X= 2.61958, Y= 1.91384\$
SFO X= 2.69278, Y= 1.80677\$
SFO X= 2.76168, Y= 1.69720\$
SFO X= 2.82624, Y= 1.58520\$
SFO X= 2.87891, Y= 1.46768\$
SREG IREG=29, NFOINT=21, CUR= 11250.00, MAT=1\$
SFO X= 3.10948, Y= 1.56820\$
SFO X= 3.05463, Y= 1.69055\$
SFO X= 2.98780, Y= 1.80730\$
SFO X= 2.91655, Y= 1.92160\$
SFO X= 2.84090, Y= 2.03332\$
SFO X= 2.76090, Y= 2.14233\$
SFO X= 2.67670, Y= 2.24850\$
SFO X= 2.58835, Y= 2.35165\$
SFO X= 2.49588, Y= 2.45170\$
SFO X= 2.40017, Y= 2.54945\$
SFO X= 2.60781, Y= 2.69143\$
SFO X= 2.70641, Y= 2.58930\$
SFO X= 2.80173, Y= 2.48480\$
SFO X= 2.89283, Y= 2.37715\$
SFO X= 2.97968, Y= 2.26641\$
SFO X= 3.06223, Y= 2.15281\$
SFO X= 3.14033, Y= 2.03643\$
SFO X= 3.21393, Y= 1.91740\$
SFO X= 3.28301, Y= 1.79590\$

SFO X= 3.34004, Y= 1.66873\$
SFO X= 3.10948, Y= 1.56820\$
SREG IREG=30, NFOINT=21, CUR= 11250.00\$
SFO X= 3.34004, Y= 1.66873\$
SFO X= 3.57060, Y= 1.76925\$
SFO X= 3.51140, Y= 1.90125\$
SFO X= 3.44005, Y= 2.02750\$
SFO X= 3.36410, Y= 2.15125\$
SFO X= 3.28355, Y= 2.27230\$
SFO X= 3.19845, Y= 2.39050\$
SFO X= 3.10895, Y= 2.50580\$
SFO X= 3.01510, Y= 2.61795\$
SFO X= 2.91695, Y= 2.72690\$
SFO X= 2.81545, Y= 2.83340\$
SFO X= 2.60781, Y= 2.69143\$
SFO X= 2.70641, Y= 2.58930\$
SFO X= 2.80173, Y= 2.48480\$
SFO X= 2.89283, Y= 2.37715\$
SFO X= 2.97968, Y= 2.26641\$
SFO X= 3.06223, Y= 2.15281\$
SFO X= 3.14033, Y= 2.03643\$
SFO X= 3.21393, Y= 1.91740\$
SFO X= 3.28301, Y= 1.79590\$
SFO X= 3.34004, Y= 1.66873\$

Input to AUTOMESH
(continued from last page)

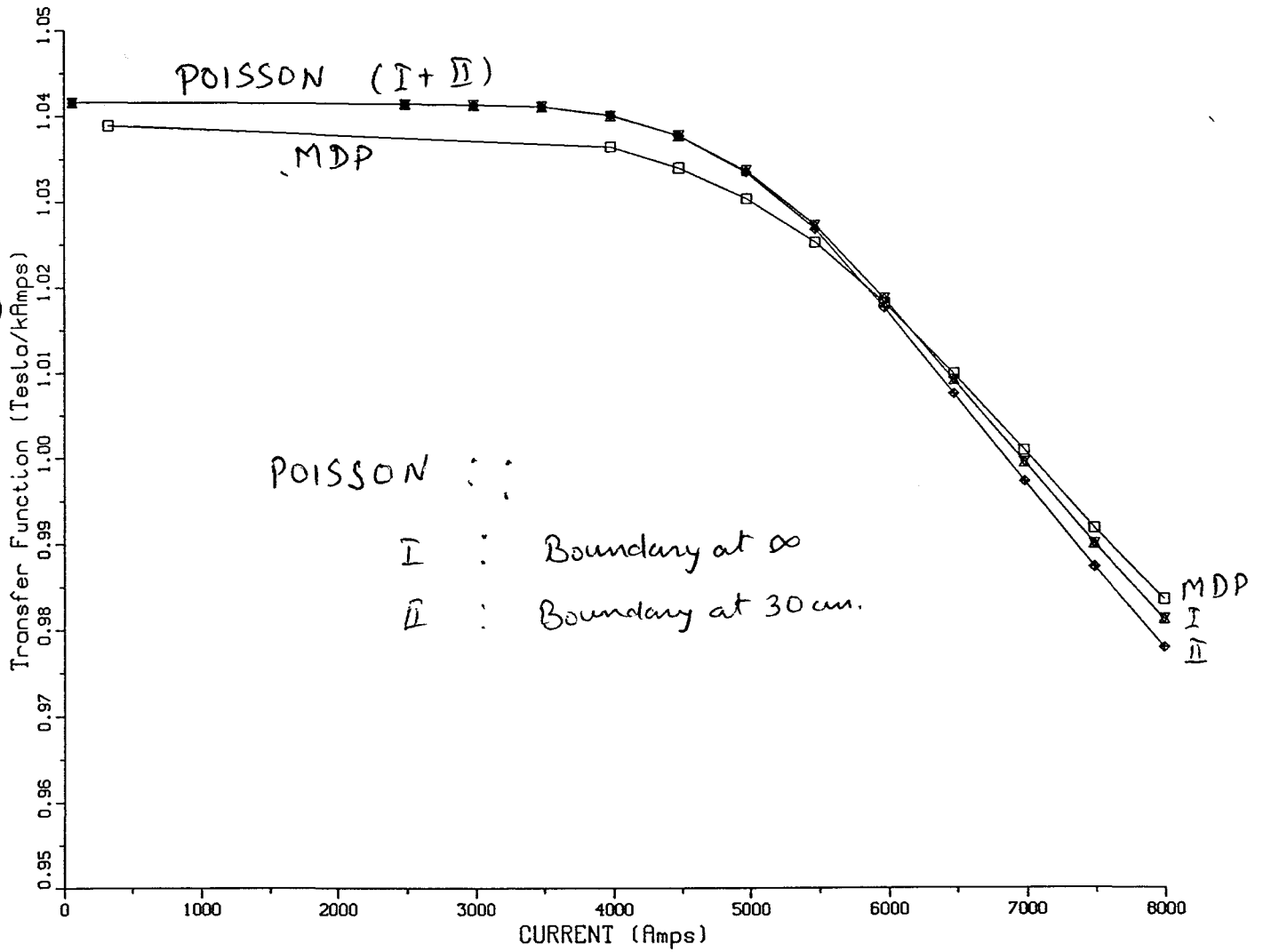


Fig 4.

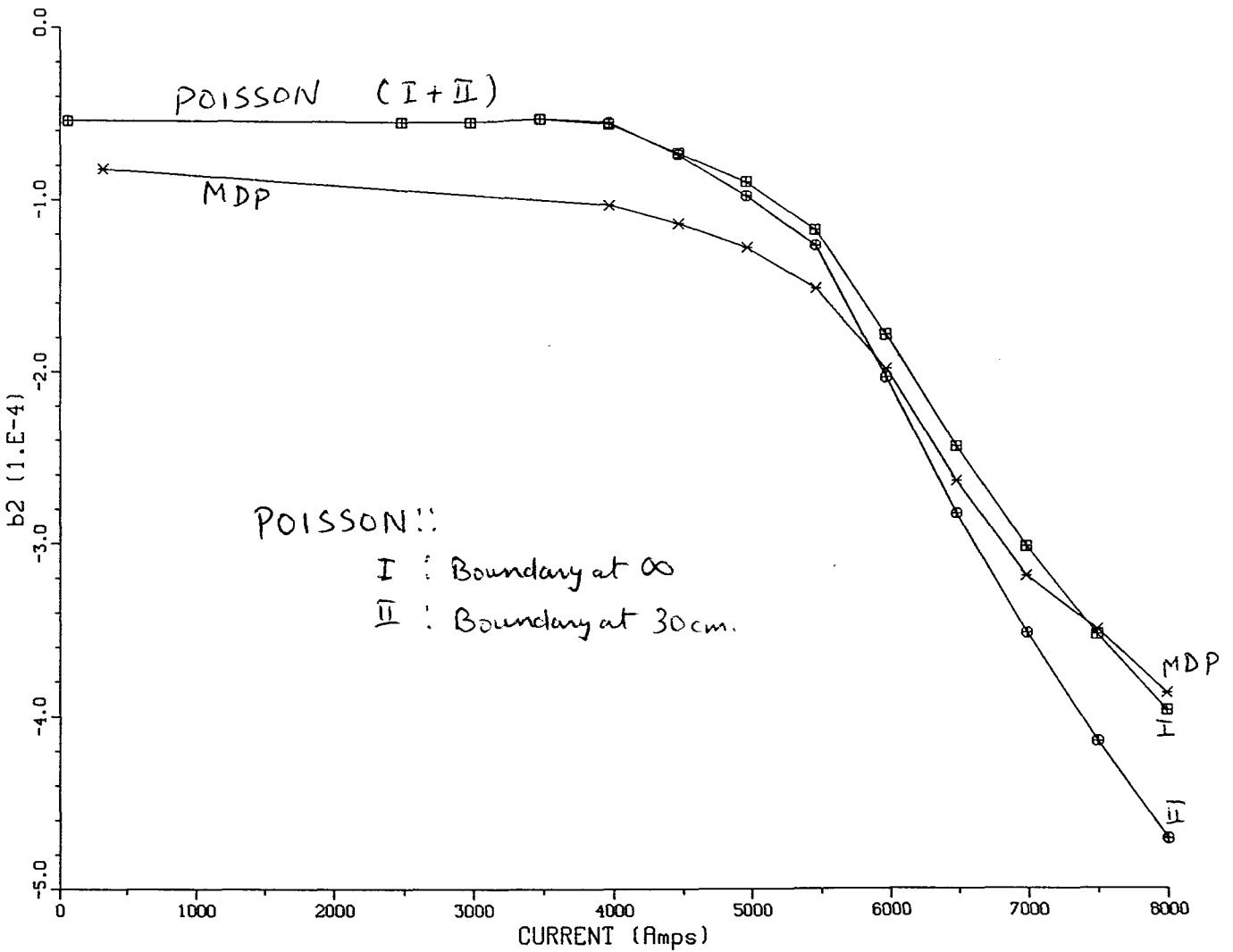


Fig 5. Sextupole Harmonic

Table 1.

The results of the field computations with special boundary element.

I (Amps)	B (T)	B/I (T/kA)	b'_{2-4} 10^{-4}	b'_{4-4} 10^{-4}	b'_{6-4} 10^{-4}	b'_{8-4} 10^{-4}	b'_{10-4} 10^{-4}	b'_{12-4} 10^{-4}
Inf mu	-	-	0.54	-0.09	0.01	0.01	0.07	-0.01
2500.0	2.603	1.041	-0.55	-0.09	0.01	0.01	0.07	-0.01
3000.0	3.124	1.041	-0.55	-0.09	0.01	0.01	0.07	-0.01
3500.0	3.644	1.041	-0.53	-0.09	0.01	0.01	0.07	-0.01
4000.0	4.160	1.040	-0.56	-0.10	0.01	0.01	0.07	-0.01
4500.0	4.670	1.038	-0.73	-0.11	0.01	0.01	0.08	-0.01
5000.0	5.168	1.034	-0.90	-0.13	0.01	0.01	0.08	-0.01
5500.0	5.649	1.027	-1.18	-0.13	0.01	0.01	0.08	-0.01
6000.0	6.111	1.019	-1.79	-0.13	0.01	0.01	0.08	-0.01
6500.0	6.559	1.009	-2.44	-0.12	0.01	0.01	0.08	-0.01
7000.0	6.996	1.000	-3.02	-0.11	0.01	0.01	0.08	-0.01
7500.0	7.425	0.990	-3.53	-0.10	0.01	0.01	0.08	-0.01
8000.0	7.849	0.981	-3.97	-0.09	0.01	0.01	0.08	-0.01

Table 2. Comparison between the MDP and the POISSON results

<----- MDP ----->			<----- POISSON ----->			
			Boundary at 30cm.		Boundary at Inf.	
<----->			<----->		<----->	
Current (Amps.)	T.F. (T/kA)	b_2 (10^{-4})	T.F. (T/kA)	b_2 (10^{-4})	T.F. (T/kA)	b_2 (10^{-4})
Inf mu	-	-	1.0416	-0.54	1.0416	-0.54
320.	1.0389	-0.82	-	-	-	-
2500.	-	-	1.0414	-0.55	1.0414	-0.55
3000.	-	-	1.0413	-0.55	1.0413	-0.55
3500.	-	-	1.0411	-0.53	1.0411	-0.53
4000.	1.0364	-1.03	1.0401	-0.55	1.0400	-0.56
4500.	1.0339	-1.14	1.0377	-0.74	1.0377	-0.73
5000.	1.0303	-1.28	1.0334	-0.98	1.0336	-0.90
5500.	1.0252	-1.52	1.0267	-1.27	1.0272	-1.18
6000.	1.0181	-1.99	1.0175	-2.04	1.0186	-1.79
6500.	1.0098	-2.64	1.0075	-2.83	1.0091	-2.44
7000.	1.0009	-3.19	0.9973	-3.52	0.9995	-3.02
7500.	0.9918	-3.50	0.9873	-4.15	0.9900	-3.53
8000.	0.9835	-3.87	0.9779	-4.71	0.9812	-3.97