On the ASR61 magnet (34^0)

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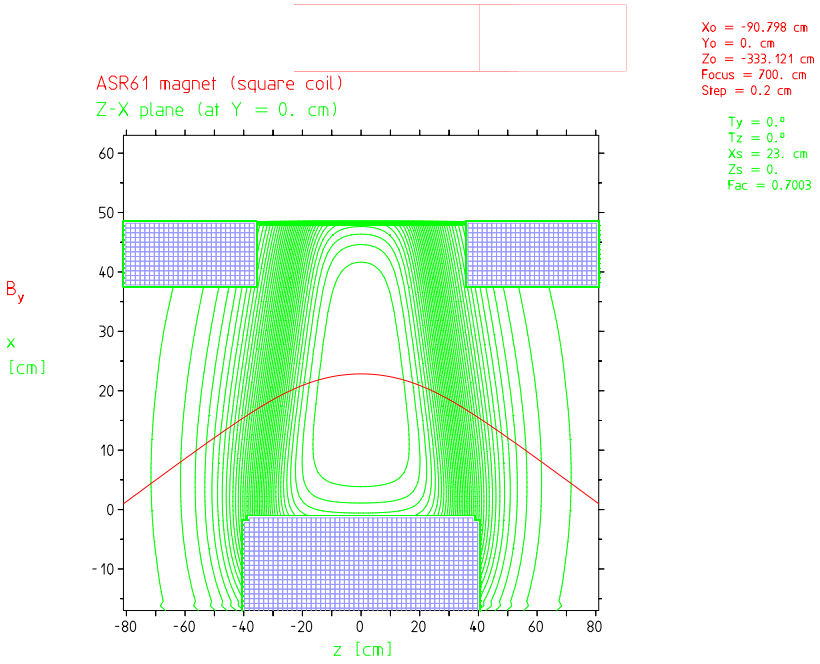

1 ASR61 bending magnet with square coil

1.1 Results from TRAJG programme

Here is the **asr61.set** file :

```
MAPINPUT
ask61

ADJUST
 1      0.700310     23.0000      0.0000      0.0000      0.0000      0.0000

KINE
   28.000   -90.798     0.000  -333.121    20.000    0.200    0.000    105.658

STANDARD
  5  0.1000E-02  0.1000E-01   9500      80.00      40.00

FOCUS
      700.0000

WINDOW
 -500.0000    500.0000   -150.0000    150.0000    -60.0000     60.0000
 -500.0000    500.0000   -150.0000    400.0000    -60.0000     60.0000
 -150.0000    800.0000   -150.0000    800.0000    -60.0000     60.0000

MATRICE
    0.5000     10.0000      0.5000     10.0000      1.0000  1

INTERPOL
Yes

CAPTION
           ASR61 magnet (square coil)

MARGE
YES

OLD
YES

ZONE
```

and the corresponding first order matrix elements

```
ASR61 magnet (square coil)
**************************

Po =    28.0000 MeV/c    dP =     0.0000 MeV/c

n    Fac       Xs [cm]     Ys [cm]     Zs [cm]     Ty []       Tz []
1        0.7003     23.0000      0.0000      0.0000      0.0000      0.0000

Deviation angle is =    39.9943

xm             ym             xpm            ypm           dpm [MeV/c]

0.5000         0.5000        10.0000        10.0000         1.0000

Xo =   -90.80 cm  Yo =     0.00 cm  Zo =  -333.12

Xa =    23.0000 cm  Ya =     0.0000 cm   Za =     0.0000 cm

Foc =   700.0000 cm    Step =     0.20 cm  Eps = 0.1000E-02

Detx = 0.9883E+00    Dety = 0.9985E+00

      Determinant = 0.9868E+00

QUADRATIC Interpolation

                   *TRANSFORM* 1

3.06244   1.40059   0.00000   0.00000   2.71161
6.04824   3.08884   0.00000   0.00000   7.94082
0.00000   0.00000  -1.99784  -0.36642   0.00000
0.00000   0.00000  -8.41938  -2.04398   0.00000
0.00000   0.00000   0.00000   0.00000   1.00000
```

Here are the levels and the effective length :

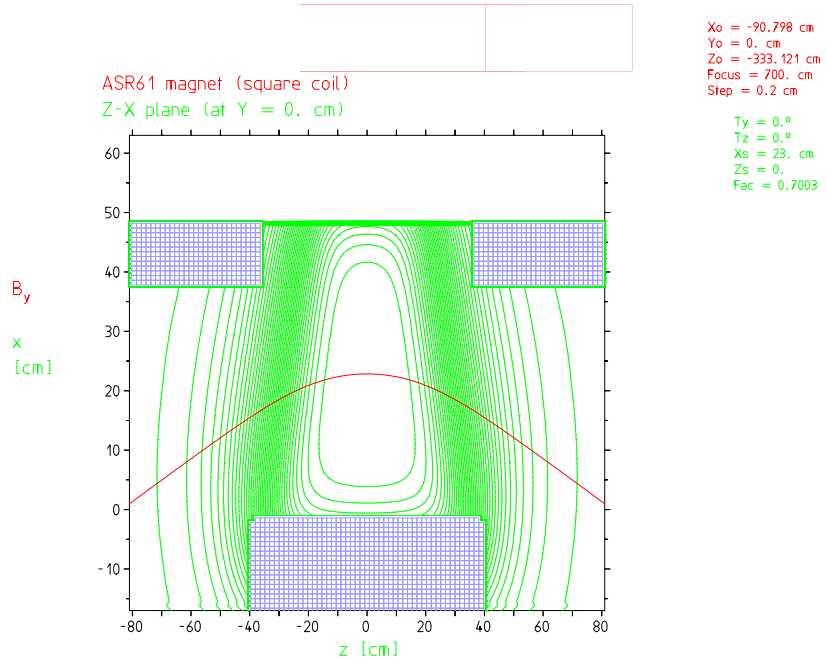

Figure 1:

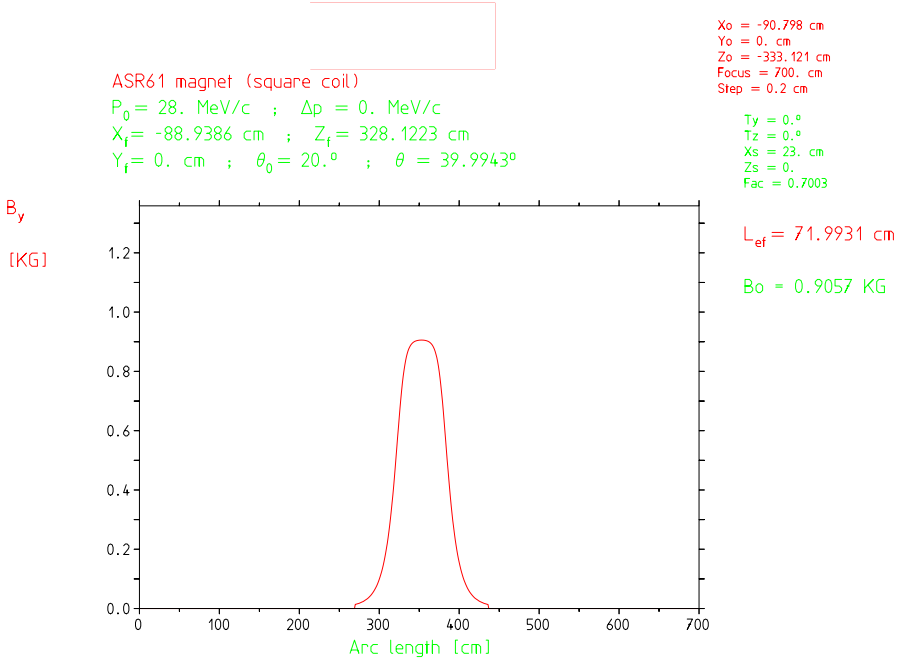

Figure 2:

Here is an example of rays through the magnet

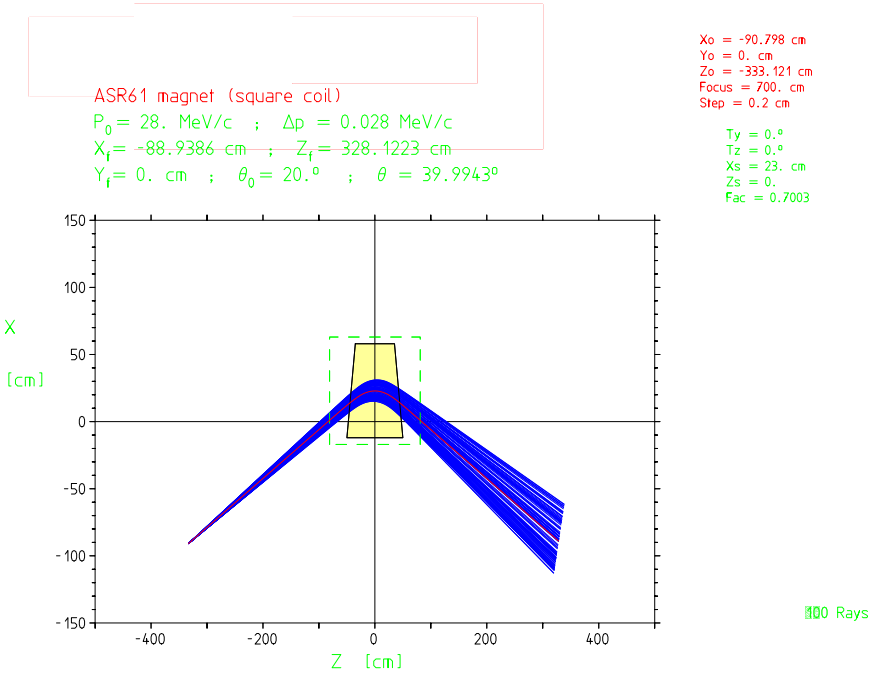

Figure 3:

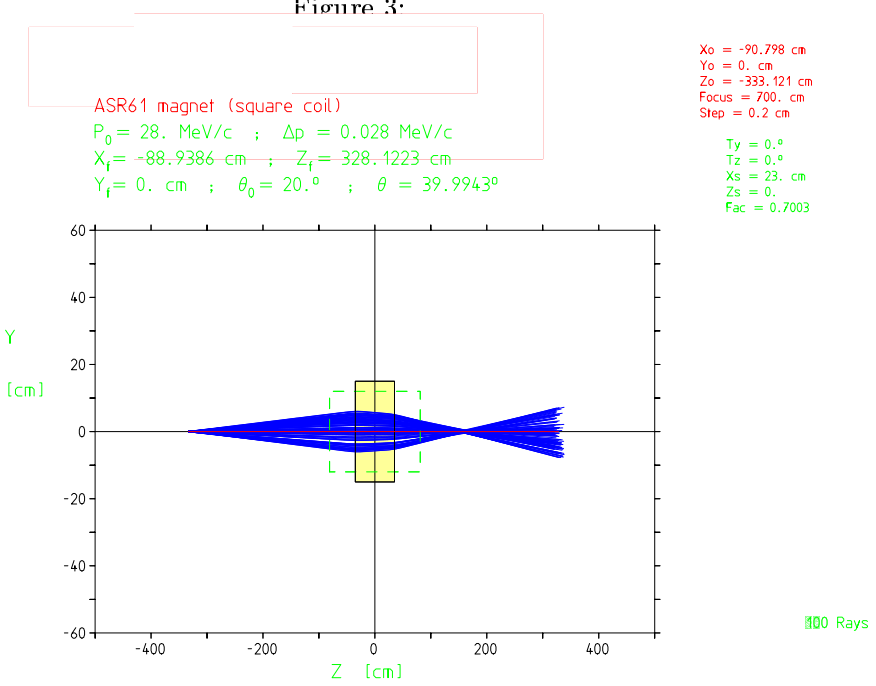

Figure 4:

In summary

L_{eff}	72 cm
Gap	24 cm
B_0	0.906 KG
θ	40^0

1.2 Results from FIELD_BIS programme

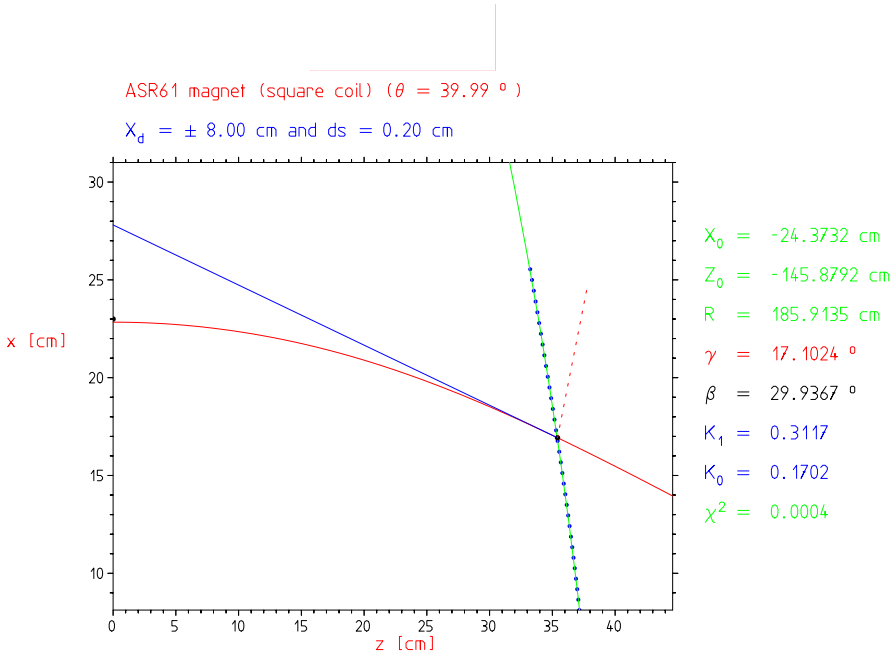

Figure 5:

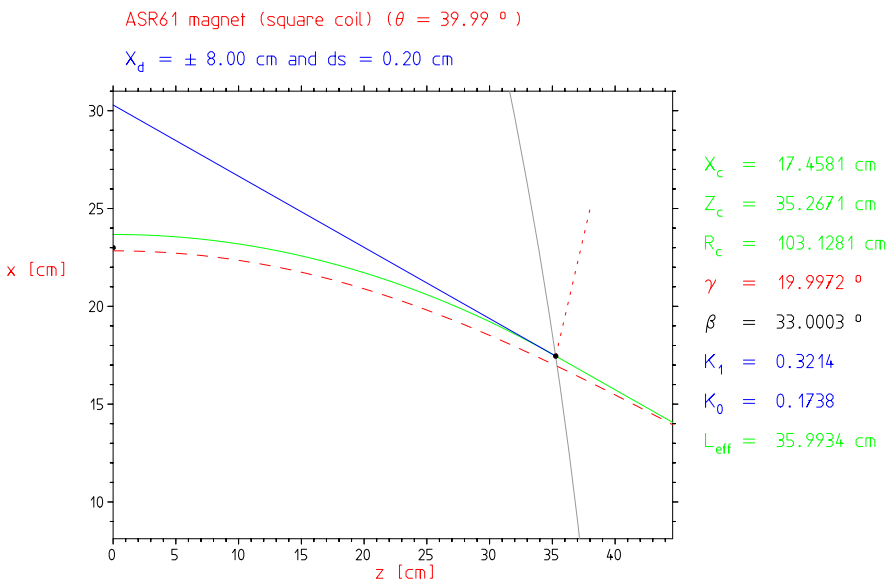

Figure 6:

In the above picture

- γ is the bending angle of the half magnet
- β is the pole face rotation
- K_1 is the K integral for the whole half magnet
- K_0 is the K integral for fringing part of the half magnet
- R is the curvature radius of ideal field boundary
- R_c is the curvature radius of ideal trajectory

Both figures are with the ideal field boundary (points or grey curve).
The first figure is with true central trajectory (in red), and the second one is with **ideal** trajectory (portion of circle in green).

From this we conclude that

$$\beta \simeq 33^0$$

$$R \simeq 1.85\,\mathrm{m}$$

$$K_1 = 3.2$$

1.3 Result from TRANS programme

Here is the used file (trans.asr61)

```
Inverted ASR61 with square coil
40.  40.  7.
.5 20. .5 20 5.  28.
D 3.17
P  33. 0.32  2.8  1.0 IN
M  40. 0.72  0.12  0.0 ASR61
P  33. 0.32  2.8  1.0 OUT
D 3.11
ZONE
```

The small difference between the two drifts is due to the difference in the **asr61.set** file, with the focus !

The corresponding first order matrix elements is :

```
Inverted ASR61 with 35 pole face rotation and square coil

0.5000    20.0000     0.5000    20.0000     5.0000    28.0000

Focus = 7.0000 m

                First order matrix

+3.0629     +1.4053     +0.0000     +0.0000     +2.7129
+6.0432     +3.0992     +0.0000     +0.0000     +7.9472
+0.0000     +0.0000     -1.9120     -0.3352     +0.0000
+0.0000     +0.0000     -8.2050     -1.9613     +0.0000
+0.0000     +0.0000     +0.0000     +0.0000     +1.0000

            Detx  = +1.0000 ; Dety = +1.0000

                   Det  = 1.0000
```

Here are the corresponding envelope

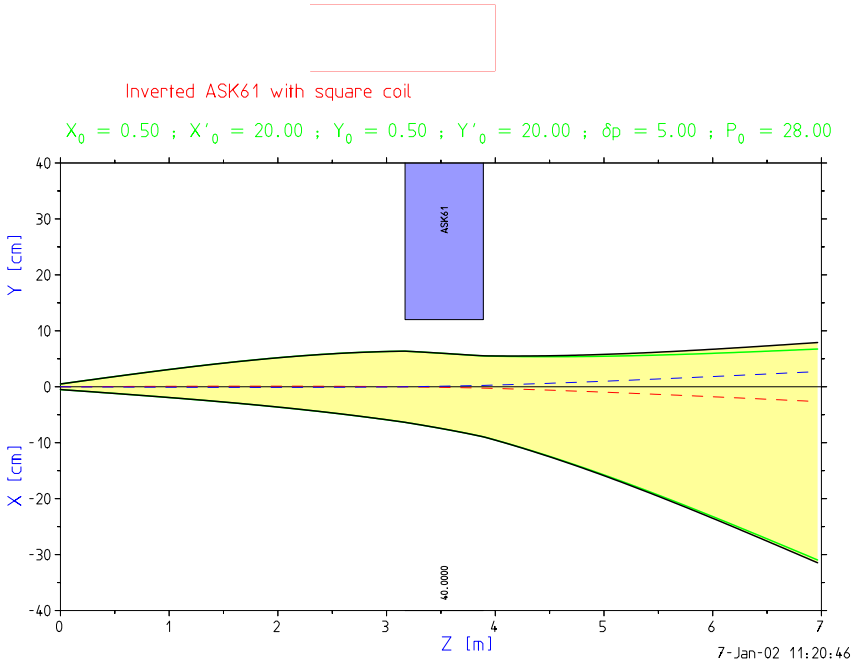

Figure 7:

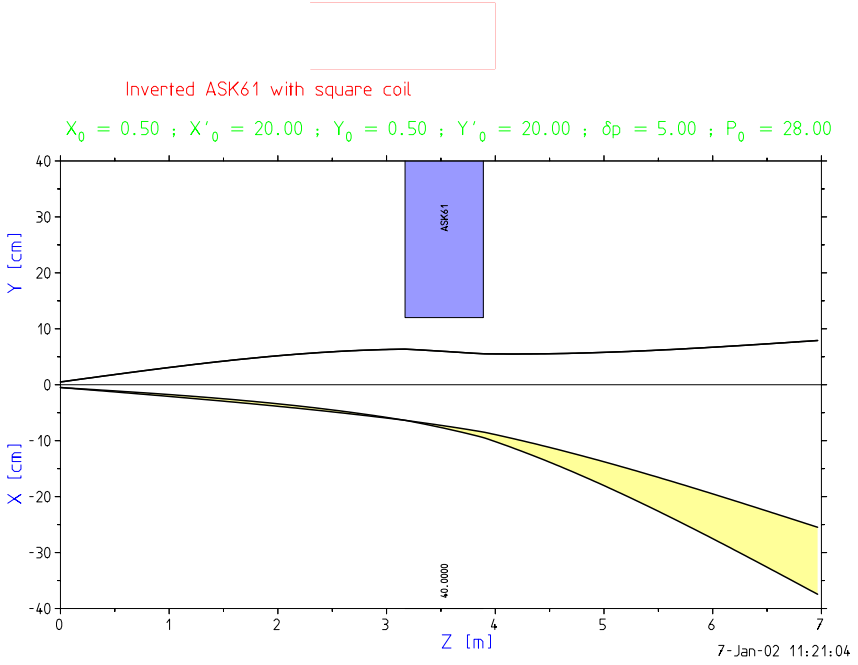

Figure 8:

Notice that with the "classical" value $\beta = 35^0$ and $K_1 = 0.3$ we don't have so good an agreement with **trajg** programme

```
 Inverted ASR61 with square coil
 40.   40.   7.
 .5 20. .5 20 5.  28.
 D 3.17
 P  35. 0.30  2.8  0.67 IN
 M  40. 0.72  0.12  0.0 ASR61
 P  35. 0.30  2.8  0.67 OUT
 D 3.11
 ZONE
```

```
Inverted ASR61 with square coil

0.5000        20.0000         0.5000        20.0000         5.0000        28.0000

Focus = 7.0000 m

                First order matrix

+3.4631     +1.5423     +0.0000     +0.0000     +2.7498
+7.2251     +3.5065     +0.0000     +0.0000     +8.0660
+0.0000     +0.0000     -2.1232     -0.4124     +0.0000
+0.0000     +0.0000     -8.7775     -2.1758     +0.0000
+0.0000     +0.0000     +0.0000     +0.0000     +1.0000

Detx  = +1.0000 ; Dety = +1.0000

              Det  = 1.0000
```

1.4 Rotated ASR61 magnet

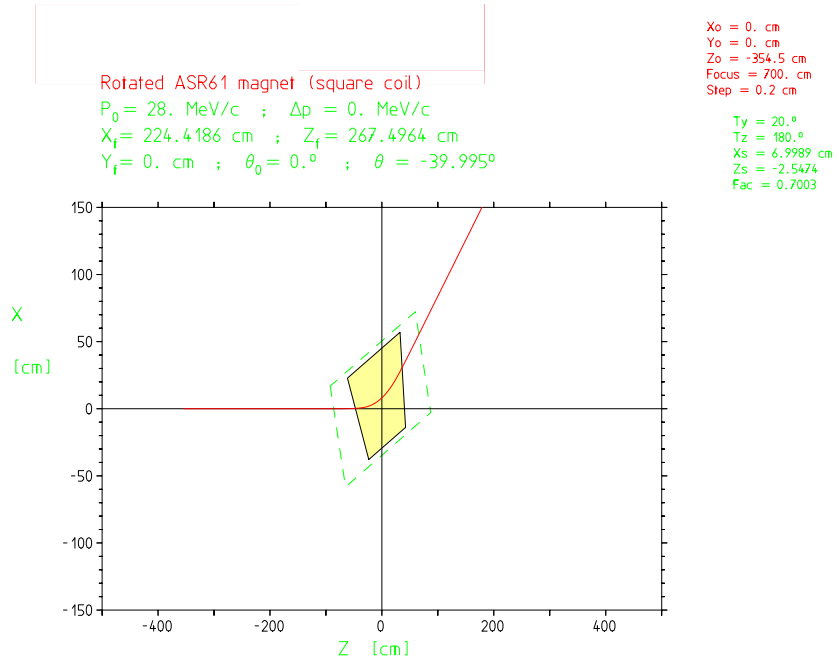

Figure 9:

According to my report : On positioning of dipoles, updated version PSI 2000, we have for the rotated ASR61 magnet :

$$
\begin{aligned}
\Gamma &= -333.121\,\mathrm{tg}(20) + 90.798 + 23 &&= -7.4481 \\
X_d &= -7.4481\cos(20) &&= -6.9989 \\
Z_d &= -7.4481\sin(20) &&= -2.5474 \\
Z'_d &= \frac{-333.121}{\cos(20)} &&= -354.4999
\end{aligned}
$$

For a horizontal incoming beam the corresponding *.set file (**asr61r.set**) is :

```
MAPINPUT
asr61

ADJUST
 1       0.700310      6.9989       0.0000       -2.5474      20.0000      180.0000

KINE
   28.000     0.000      0.000    -354.500     0.000      0.200     0.000     105.658

STANDARD
  5  0.1000E-02  0.1000E-01   9500       80.00       40.00

FOCUS
      700.0000

WINDOW
 -500.0000     500.0000    -150.0000     150.0000     -60.0000      60.0000
 -500.0000     500.0000    -150.0000     400.0000     -60.0000      60.0000
 -150.0000     800.0000    -150.0000     800.0000     -60.0000      60.0000

MATRICE
    0.5000      10.0000       0.5000      10.0000       1.0000  1

INTERPOL
Yes

CAPTION
          Rotated ASR61 magnet (square coil)

MARGE
YES

OLD
YES

ZONE
```

and here is the corresponding first order matrix :

```
Rotated ASR61 magnet (square coil)
**********************************

Po =    28.0000 MeV/c    dP =     0.0000 MeV/c

n    Fac         Xs [cm]     Ys [cm]     Zs [cm]     Ty []    Tz []
1        0.7003      6.9989      0.0000     -2.5474     20.0000    180.0000

The deviation angle is =   -39.9950

xm             ym             xpm            ypm           dpm [MeV/c]
0.5000         0.5000         10.0000        10.0000         1.0000

Xo =     0.00 cm  Yo =     0.00 cm  Zo =  -354.50

Xa =     6.9989 cm  Ya =     0.0000 cm   Za =    -2.5474 cm

Foc =   700.0000 cm    Step =     0.20 cm  Eps = 0.1000E-02

Detx = 0.9742E+00    Dety = 0.9985E+00

           Determinant = 0.9728E+00

QUADRATIC Interpolation

                    *TRANSFORM* 1

3.05701   1.40011   0.00000   0.00000   -2.71350
6.04651   3.08798   0.00000   0.00000   -7.94130
0.00000   0.00000  -1.99778  -0.36639   0.00000
0.00000   0.00000  -8.41923  -2.04389   0.00000
0.00000   0.00000   0.00000   0.00000   1.00000
```

The first figure shows two rays in blue having 28 $\pm$ 3 MeV/c, and the second one indicates the center of the magnet.

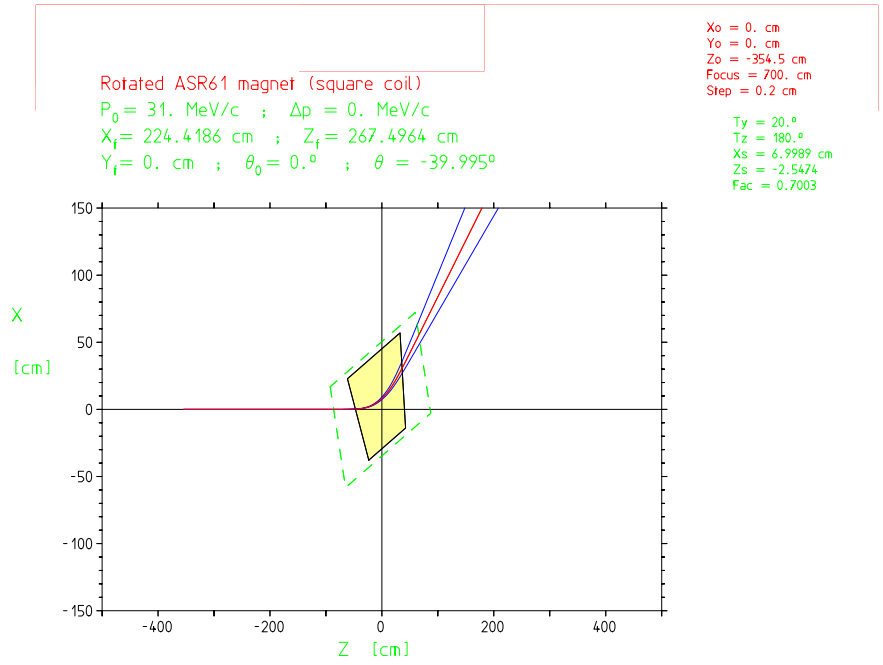

Figure 10:

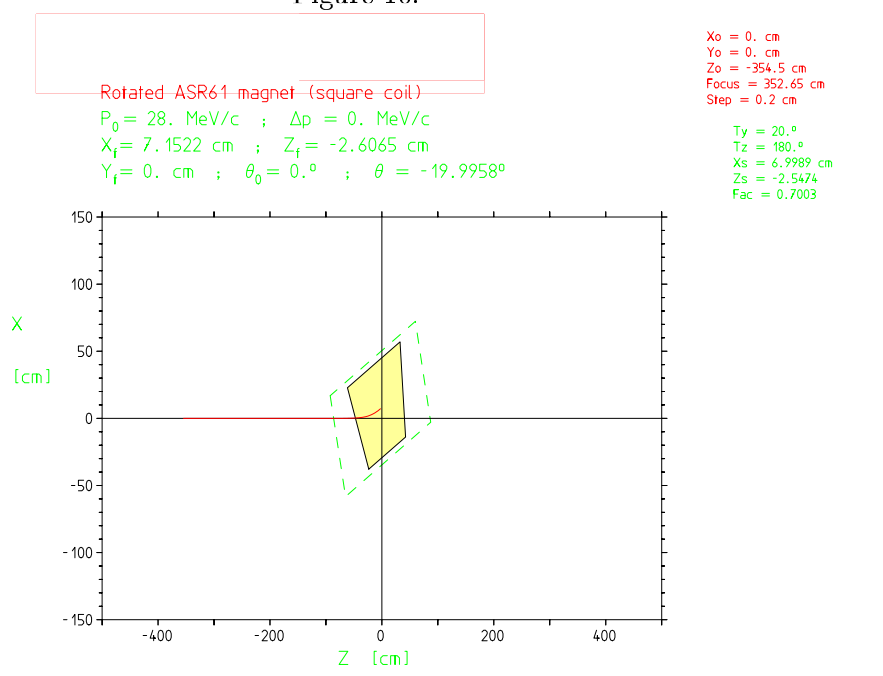

Figure 11:

1.5 Final positioning

Here we have :

$$X_d = 6.9989$$

$$Z_d = 300 - 2.5474$$

Giving the following *.set file

```
MAPINPUT
asr61

ADJUST
 1       0.700310      6.9989       0.0000      297.4526     20.0000      180.0000

KINE
   28.000     0.000       0.000    0.000      0.000       0.200      0.000     105.658

STANDARD
  5  0.1000E-02  0.1000E-01    9500       80.00       40.00

FOCUS
      500.0000

WINDOW
 0.0000     500.0000    -150.0000     150.0000     -60.0000      60.0000
 0.0000     500.0000    -150.0000     400.0000     -60.0000      60.0000
 0.0000     800.0000    -150.0000     800.0000     -60.0000      60.0000

MATRICE
    0.5000      10.0000       0.5000      10.0000       1.0000  1

INTERPOL
Yes

CAPTION
          Rotated ASR61 magnet (square coil) final positioning

ZONE
```

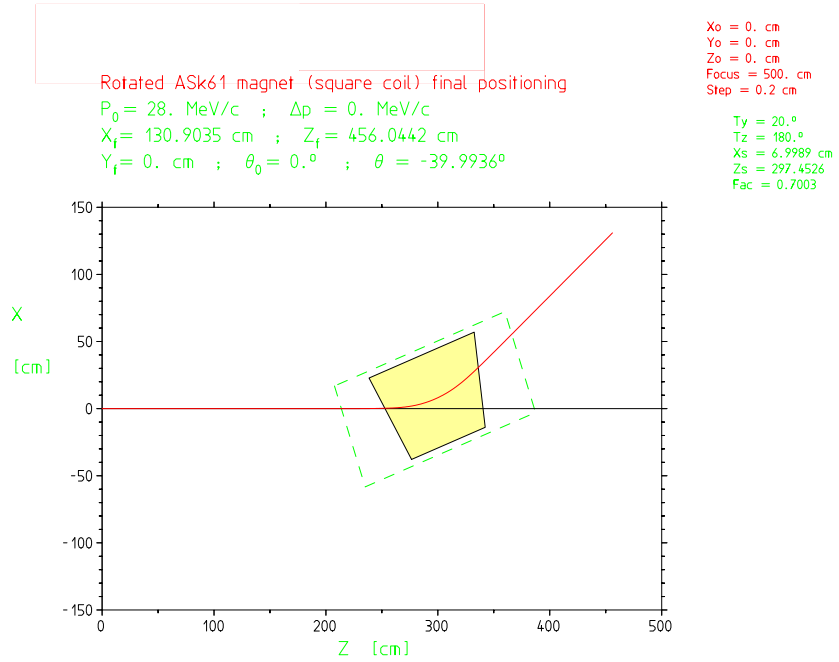
Rotated ASk61 magnet (square coil) final positioning
P0 = 28. MeV/c ; Δp = 0. MeV/c
Xf = 130.9035 cm ; Zf = 456.0442 cm
Yf = 0. cm ; θ0 = 0.° ; θ = -39.9936°
Xo = 0. cm
Yo = 0. cm
Zo = 0. cm
Focus = 500. cm
Step = 0.2 cm
Ty = 20.°
Tz = 180.°
Xs = 6.9989 cm
Zs = 297.4526
Fac = 0.7003
X
[cm]
150
100
50
0
-50
-100
-150
0
100
200
300
400
500
Z [cm]

Figure 12:

Contents