Report about a Multi Channel Lens for the AMOR reflectometer

RESULT SUMMARY

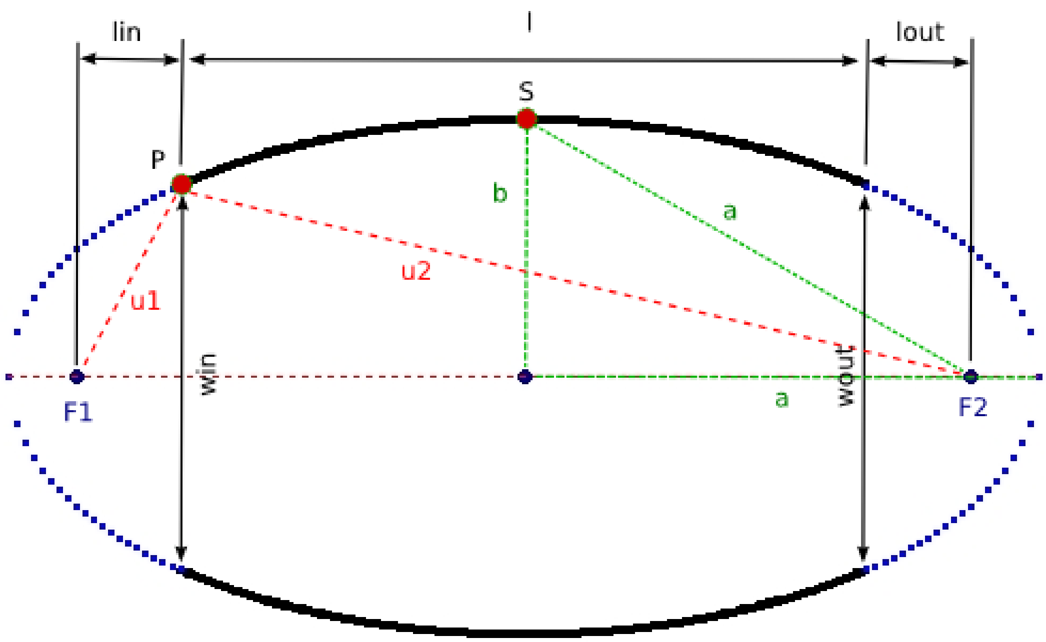
Gain-Factors

	λ = 2 Å	λ = 3 Å	λ = 5 Å	λ = 7 Å
without lens	1 (sample) 1(2D detector) 1 (1D detector)	1 1 1	1 1 1	1 1 1
with single parabolic lens FOR COMPARISION	2.13+/-0.04 2.15+/-0.05 2.15+/-0.05	2.31+/-0.06 2.26+/-0.06 2.12+/-0.05	2.40+/-0.05 2.35+/-0.05 2.19+/-0.05	2.45+/-0.06 2.41+/-0.06 2.23+/-0.07
with parabolic Inlay (fixed w1in)	2.76+/-0.05 2.77+/-0.05 2.77+/-0.05	2.63+/-0.06 2.59+/-0.06 2.59+/-0.06	2.73+/-0.05 2.70+/-0.05 2.70+/-0.05	2.76+/-0.06 2.74+/-0.06 2.74+/-0.06
with parabolic Inlay (variable w1in)	2.85+/-0.05 2.84+/-0.05 2.84+/-0.05	2.75+/-0.06 2.70+/-0.06 2.66+/-0.06	2.86+/-0.05 2.82+/-0.05 2.78+/-0.05	2.92+/-0.06 2.88+/-0.06 2.84+/-0.06
with parabolic Inlay(McStats optimized)	2.83+/-0.05 2.84+/-0.05 2.84+/-0.05	2.85+/-0.07 2.81+/-0.06 2.77+/-0.06	2.92+/-0.05 289+/-0.05 2.83+/-0.05	3.02+/-0.06 2.98+/-0.06 2.92+/-0.06
with linear inlay	2.76+/-0.06 2.78+/-0.05 2.77+/-0.05	3.01+/-0.07 2.96+/-0.07 2.82+/-0.06	3.14+/-0.06 3.09+/-0.06 2.95+/-0.05	3.25+/-0.06 3.21+/-0.06 3.06+/-0.06
with elliptical inlay (fixed w1in)	2.13+/-0.04 2.16+/-0.05 2.16+/-0.05	2.46+/-0.06 2.43+/-0.06 2.43+/-0.06	2.66+/-0.05 2.63+/-0.05 2.63+/-0.05	2.71+/-0.06 2.68+/-0.06 2.68+/-0.06
with elliptical inlay (variable w1in)	2.20+/-0.05 2.25+/-0.05 2.25+/-0.05	2.71+/-0.06 2.71+/-0.06 2.68+/-0.06	3.00+/-0.05 2.99+/-0.06 2.96+/-0.05	3.08+/-0.06 3.08+/-0.06 3.04+/-0.06
with elliptical inlay (McStats optimized at 5Å)	2.58+/-0.05 2.61+/-0.05 2.61+/-0.05	3.02 +/-0.07 2.97+/-0.07 2.85+/-0.07	3.28+/-0.06 3.23+/-0.06 3.09+/-0.06	3.33+/-0.07 3.29+/-0.07 3.16+/-0.06

The best gain factors are achieved with the linear inlay! The gain factor are basing on a reflectivity of 82 % for m=3.6 material.

The gain factor errors are calculated by quadratic error developing function and the error outputs for for simulated intensities. The problem is what the simulated intensities for one and the same parameter set for different simulation can vary by an error which is one magnitude bigger than the given one for a single simulation.

Basics for elliptical lens:



the distance between the focus points F1 and F2 is given by: $lbh = lin + l + lout$

elliptical equation : $\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$

a and b are the half-axis of the ellipse. One important point is what the half axis $a = \overline{SF1} = \overline{SF2}$,

therefore for every point P on the ellipse the equation $2 \cdot a = \overline{PF1} + \overline{PF2} = u1 + u2$ is fulfilled.

For the given point P in the scheme u1 and u2 can be calculated by :

$$u1 = \sqrt{(lin)^2 + \left(\frac{win}{2}\right)^2}$$

$$u2 = \sqrt{(lout + l)^2 + \left(\frac{win}{2}\right)^2}$$

with u1, u2 and lbh the variables a and b can be calculated by:

$$a = \frac{u1 + u2}{2} \quad \text{and} \quad b = \sqrt{a^2 - \left(\frac{lbh}{2}\right)^2} \quad .$$

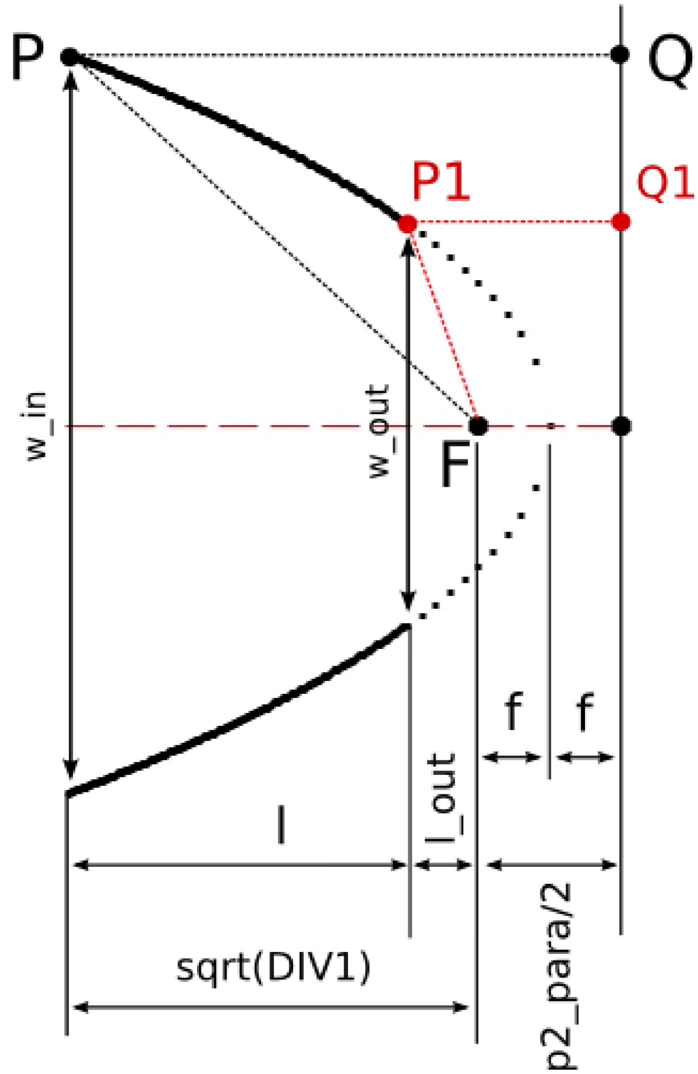
by using the elliptical equation the exit can be calculated by:

$$\frac{wout^2}{4} = b^2 - b^2 \cdot \frac{\left(\frac{lbh}{2} - lout\right)^2}{a^2}$$

$$wout = 2 \cdot b \sqrt{1 - \frac{\left(\frac{lbh}{2} - lout\right)^2}{a^2}}$$

$$wout = 2 \cdot b \cdot ellDIV \quad \text{with} \quad ellDIV = \sqrt{1 - \frac{\left(\frac{lbh}{2} - lout\right)^2}{a^2}}$$

Basics for parabolic lens :



most important point: $\overline{PQ}=\overline{PF}$ and $\overline{P1Q1}=\overline{P1F}$

parable equation is given by : $y=a\cdot x^2$

parameter a is connected with the focal length by : $a=\frac{1}{4\cdot f}=\frac{1}{p2\ para}$

with a given entrance win the exit wout can be calculated by:

1.) $DIV1=(l+lout)^2$

2.) $$p2\ para = 2\cdot\left(\sqrt{DIV1 + \left(\frac{win}{2}\right)^2} - (l + lout)\right)$$

3.) $$\left(\frac{wout}{2}\right)^2 (lout)^2 = \left(\frac{p2\ para}{2} + lout\right)^2$$

$$wout = 2\cdot\sqrt{\left(\frac{p2\ para}{2} + lout\right)^2 - lout^2}$$

$$wout = 2\cdot\sqrt{\frac{p2\ para^2}{4} + \frac{2\cdot p2\ para\cdot lout}{2} + lout^2 - lout^2}$$

$$wout = 2\cdot\sqrt{\frac{p2\ para^2}{4} + p2\ para\cdot lout}$$

$$wout = 2\cdot\sqrt{p2\ para\cdot\left(lout + \frac{p2\ para}{4}\right)}$$

by a given exit wout the entrance win can be calculated by :

1.) $$DIV1 = (l + lout)^2$$

2.) $$p2\ para = 2\cdot\left(\sqrt{\frac{wou^2}{4} + lout^2} - lout\right)$$

3.) $$win = 2\cdot\sqrt{\left(\frac{p2\ para}{2} + lout + l\right)^2 - DIV1}$$

SIMULATION FOR DIFFERENT INLAY GEOMETRIES

All calculation are taking care on the given parameters for the existing outer lens part:

w2in=0.0045 m , tg_len_2 = 1 m , focal_2 = 0.7000744 m (see figure next side)

using these parameters, the optimal sample position for a given horizontal sample width of 0.005m is calculated to 0.619 m behind the outer lens part exit (distance between slit 3 and sample is 0.571 m)

for this sample position the reference intensities at the sample and detector positions are calculated for 4 different reference wavelengths ($\Delta\lambda/\lambda$=+/-0.1):

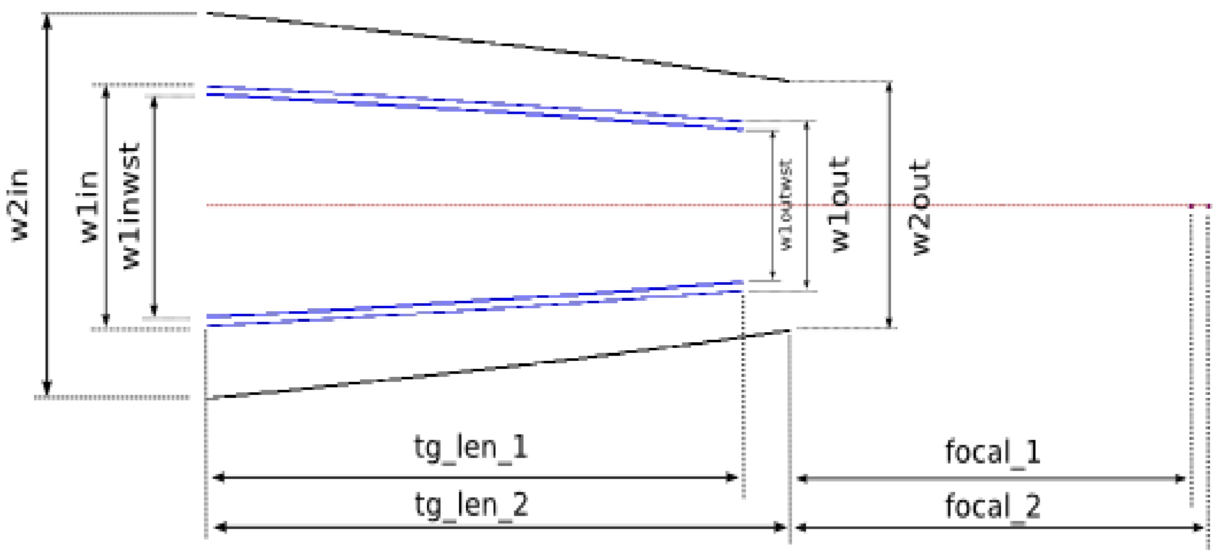
	λ = 2 Å	λ = 3 Å	λ = 5 Å	λ = 7 Å
I_{sample}	205000+/-3000	107000+/-2000	20600+/-300	5100+/-70
$I_{detector,\ big}$	204000+/-3000	107000+/-2000	20500+/-300	5070+/-70
$I_{detector,\ small}$	204000+/-3000	107000+/-2000	20500+/-300	5070+/-70

next step is the calculation of the intensities using the existing parabolic lens: (m=3.6 , R=0.82)

	λ = 2 Å	λ = 3 Å	λ = 5 Å	λ = 7 Å
I_{sample}	437000+/-5000	247000+/-3000	49500+/-500	12500+/-200
$I_{detector,\ big}$	439000+/-5000	242000+/-3000	48200+/-500	12200+/-200
$I_{detector,\ small}$	439000+/-5000	227000+/-2000	44900+/-400	11300+/-300

Parabolic Inlay:

The calculation of the inner lens part is using the exit width of the outer part as the starting parameter the entrance width of the inner part:



w2out == w1in.

By using w1in the parameter w1out is calculated.The thickness of the inlay-substrate is taking into account via the parameter wst :

w1outwst = w1out – 2*wst

A new entrance parameter w1inwst have to be calculated basing on w1outwst. For the simulation the parameters :

tg_len_1
focal_1
wst

are variable.

The thickness of the inlay substrate was set to wst = 0.001 m. The manual optimization gives a focus length of focus_1 = 0.67 m and an inlay length of tg_len_1 = 0.92 m. For these parameters the intensities are calculated to:

	λ = 2 Å	λ = 3 Å	λ = 5 Å	λ = 7 Å

I_{sample}	566000+/-5000	281000+/-3000	56200+/-500	14100 +/- 200
$I_{detector, big}$	564000+/-5000	277000+/-3000	55400+/-500	13900 +/- 200
$I_{detector, small}$	564000+/-5000	277000+/-3000	55300+/-500	13900+/- 200

In the moment the inlay has a neutron absorbing substrate material. In McStas this fact is simulated by an inverse slit – slit – system directly behind the inlay exit.
The manual manipulation of the inlay entrance and the manual optimization of the focus length and the length of the inlay gives only slightly better results:

w1in= 0.0265m ,focus_1 = 0.65 m , tg_len_1= 0.97m , wst 0.001m

	λ = 2 Å	λ = 3 Å	λ = 5 Å	λ = 7 Å
I_{sample}	584000+/-5000	294000+/-3000	59000+/-500	14900+/-200
$I_{detector, big}$	580000+/-5000	289000+/-3000	57900+/-500	14600 +/- 200
$I_{detector, small}$	580000+/-5000	285000+/-3000	57000+/-500	14400 +/- 200

McStas opimized parameters (13 iterations):

w1in= 0.0258101851851852 m ,focus_1 = 0.753395061728395 m , tg_len_1= 0.9847152777778 m ,

	λ = 2 Å	λ = 3 Å	λ = 5 Å	λ = 7 Å
I_{sample}	581000+/-5000	306000+/-3000	60200+/-500	15400+/-200
$I_{detector, big}$	579000+/-5000	301000+//-3000	59200+/-500	15100+/-200
$I_{detector, small}$	579000+/-5000	296000+/-3000	58000+/-500	14800+/-200

Linear Inlay:

In this case the parabolic inlay is replaced by an normal straight guide. The entrance and exit of the guide can vary separately from each other. To get an focusing effect the exit have to be smaller than the entrance.

After manual optimization the following parameter are found :

tg_len_1 = 1 m , w1in= 0.021m, w1out = 0.0157 m

	λ = 2 Å	λ = 3 Å	λ = 5 Å	λ = 7 Å
I_{sample}	565000+/-5000	322000+/-3000	64700+/-500	16600 +/- 200
$I_{detector, big}$	567000+/-5000	317000+/-3000	63400+/-500	16300 +/- 200
$I_{detector, small}$	566000+/-5000	302000+/-3000	60400+/-500	15500 +/- 200

Optimized parameters by McStas routine (40 iterations):

tg_len_1 = 0.9516171785693887 m , w1in= 0.02957399389701777m, w1out = 0.02000000 m

after 279 iteration without convergence:
tg_len_1 = 0.986951413396795 m , w1in= 0.0197421059426223m, w1out = 0.015391004351361 m
after 23 iteration without convergence:
tg_len_1 = 0.96325 m , w1in= 0.022778m, w1out = 0.0183333 m

after 26 iteration with convergence:
tg_len_1 = 0.9584375 m , w1in= 0.0229126667m, w1out = 0.0190277778 m

	λ = 2 Å	λ = 3 Å	λ = 5 Å	λ = 7 Å
I_{sample}	481000+/-5000	282000+/-3000	60400+/-500	15400+/-500
$I_{detector, big}$	486000+/-5000	283000+/-3000	59700+/-500	15200+/-200
$I_{detector, small}$	485000+/-5000	275000+/-3000	57800+/-500	14700+/-200

Recalculation with the manual optimized values gives still same results. McStas routine deliver worser parameters for the linear guide.

Elliptical Inlay:

Here the inlay get an elliptical shape. For a given entrance width

w1in == w2out = 0.028877 ;

the optimized parameters are:

tg_len_1=0.84 m ; focal_1=0.5m ; focal_1_in = 0.6m

	λ = 2 Å	λ = 3 Å	λ = 5 Å	λ = 7 Å
I_{sample}	437000+/-5000	263000+/-3000	54700+/-500	13800 +/- 200
$I_{detector, big}$	440000+/-5000	260000+/-3000	54000+/-500	13600 +/- 200
$I_{detector, small}$	440000+/-5000	260000+/-3000	54000+/-500	13600 +/- 200

For a variable entrance width the manual optimized parameters are :

w1in = 0.0265m

tg_len_1=0.97 m ; focal_1=0.58 m ; focal_1_in = 0.55m

	λ = 2 Å	λ = 3 Å	λ = 5 Å	λ = 7 Å
I_{sample}	451000+/-5000	290000+/-3000	61800+/-500	15700+/-200

$I_{detector, big}$	458000+/-5000	290000+/-3000	61200+/-500	15600+/-200
$I_{detector, small}$	458000+/-5000	287000+/-3000	60600+/-500	15400+/-200

Optimized parameters by McStas routine (241 iterations):

w1in = 0.0220783511m

tg_len_1=0.99503889661054m ; focal_1=0.611919140809576 m ; focal_1_in = 0.630437221718177m

	λ = 2 Å	λ = 3 Å	λ = 5 Å	λ = 7 Å
I_{sample}	529000+/-5000	323000+/-3000	67600+/-500	17000+/-200
$I_{detector, big}$	532000+/-5000	318000+/-3000	66300+/-500	16700+/-200
$I_{detector, small}$	532000+/-5000	305000+/-3000	63400+/-500	16000+/-200

Needed changes in the instrument script of AMOR:0.

parabolic inlay geometry:

```
INITIALIZE
%{

...

DIV1=(tg_len_2+focal_1)*(tg_len_2+focal_1);
printf("DIV1 %f \n",DIV1);
p2_para_1=2*(sqrt(DIV1+(w1in*w1in/4))-sqrt(DIV1));
printf("p2_para_in %f \n",p2_para_1);
w1out=2*sqrt(p2_para_1*(tg_len_2-tg_len_1+focal_1+p2_para_1/4));
printf("w1out %f \n",w1out);

w1outwst=w1out-2*wst;
printf("w1outwst %f \n",w1outwst);

p2_para_1_wst=2*(sqrt((w1outwst*w1outwst)/4+((tg_len_2-tg_len_1+focal_1)*(tg_len_2-
tg_len_1+focal_1)))-(tg_len_2-tg_len_1+focal_1));
w1inwst=2*(sqrt((sqrt(DIV1)+p2_para_1_wst/2)*(sqrt(DIV1)+p2_para_1_wst/2)-DIV1));
printf("w1inwst %f \n",w1inwst);

DIV2=(tg_len_2+focal_2)*(tg_len_2+focal_2);
p2_para_2=2*(sqrt(DIV2+(w2in*w2in/4))-sqrt(DIV2));
```

```
w2out=2*sqrt(p2_para_2*(focal_2+tg_len_2-tg_len_1+p2_para_2/4));
printf("w1out %f \n",w2out);

... }%



TRACE


....
```

*** *INLAY : have to be at the first position of the group; the group has the length of the inlay, the rest of the outer lens part is simulated by an additional component after the slit group glass****

```
COMPONENT para_guide1 = Guide_tapering(
    option = "parabolical", segno = 100, w1 =w1inwst, h1 = 0.03,
    l =tg_len_1, linw = 0.0, loutw =tg_len_2-tg_len_1+focal_1, linh = 0.0, louth = 0.0,
    alphax = 2.57, alphay = 0, Qcx = 0.0217,  Qcy = 0.0217,
    mx = mxtp, my = 0)
  AT (0, 0, 0.005) RELATIVE  slit2_B
  GROUP lense EXTEND
 %{
     if (SCATTERED) outer=0;
  %}
```

*** *outer lens part : taken over from existing AMOR scrpit****

```
COMPONENT para_guide2 = Guide_tapering(
    option = "parabolical", segno = 100, w1 =w2in, h1 = 0.03,
    l =tg_len_1, linw = 0.0, loutw =tg_len_2-tg_len_1+focal_2, linh = 0.0, louth = 0.0,
    alphax = 2.57, alphay = 0,Qcx = 0.0217,  Qcy = 0.0217,
    mx = mxtp, my = 0)
  AT (0, 0, 0.005) RELATIVE PREVIOUS
 GROUP lense EXTEND
 %{
      if (SCATTERED) outer=1; else outer=0;
  %}
```

*** *slit : this part is necessary to let the straight neutrons pass the guide !!* ***

```
COMPONENT lense_slit = Slit(
    xmin = -w1outwst/2, xmax =w1outwst/2, ymin = -0.015, ymax = 0.015)
  AT (0, 0, 0.005) RELATIVE  slit2_B
  GROUP lense  EXTEND
 %{
     if (SCATTERED) outer=2;
  %}
```

```
COMPONENT PosTapGui = PSD_monitor(
    nx = 100, ny = 100, filename = "PosTapGui_1", xmin = -0.0255,
    xmax = 0.0255, ymin = -0.006, ymax = 0.006)
  AT (0, 0, tg_len_1+0.0001) RELATIVE PREVIOUS
```

*** *slit group glass : this group is needed to prevent transition from neutron reflected at the outer lens part through the inlay substrate; this group have is also take care on the inlay substrate thickness****

```
COMPONENT lense_slit_A=Slit_invers(
            xmin=-w1out/2, xmax=w1out/2,
            ymin=-0.015, ymax=0.015)
            WHEN(outer==1)
            AT (0,0,0.0001) RELATIVE PosTapGui
            GROUP glas EXTEND
            %{
            if (SCATTERED) top1=1; else top1=0;
            %}

COMPONENT lense_slit_B=Slit(
            xmin=-w1outwst/2, xmax=w1outwst/2,
            ymin=-0.015, ymax=0.015)
            WHEN(outer==0)
            AT (0,0,0.0001) RELATIVE PosTapGui
            GROUP glas EXTEND
            %{
            if (SCATTERED) top1=2; else top1=0;
            %}

COMPONENT lense_slit_C=Slit(
            xmin=-w1outwst/2, xmax=w1outwst/2,
            ymin=-0.015, ymax=0.015)
            WHEN(outer==2)
            AT (0,0,0.0001) RELATIVE PosTapGui
            GROUP glas EXTEND
             %{
            if (SCATTERED) top1=3; else top1=0;
             %}

COMPONENT PosTapGui2 = PSD_monitor(
    nx = 100, ny = 100, filename = "PosTapGui_2", xmin = -0.0255,
    xmax = 0.0255, ymin = -0.006, ymax = 0.006)
  AT (0, 0, 0.0001) RELATIVE PREVIOUS
```

*** *last part of the lens: this represents this part of the outer lens part wich is longer than the inlay*
***

```
COMPONENT para_guideEnd = Guide_tapering(
    option = "parabolical", segno = 100, w1 =w2out, h1 = 0.03,
    l =tg_len_2-tg_len_1-0.0005, linw = 0.0, loutw =0.7000744, linh = 0.0, louth = 0.0,
    alphax = 2.57, alphay = 0,Qcx = 0.0217,  Qcy = 0.0217,
    mx = mxtp, my = 0)
  AT (0, 0, 0.0001) RELATIVE PREVIOUS

COMPONENT PosTapGui3 = PSD_monitor(
    nx = 100, ny = 100, filename = "PosTapGui3", xmin = -0.0225,
    xmax = 0.0225, ymin = -0.006, ymax = 0.006)
  AT (0, 0, tg_len_2-tg_len_1-0.0003) RELATIVE PREVIOUS

....
```

linear inlay geometry:

```
INITIALIZE
%{


...


w1outwst=w1out-2*wst;
printf("w1outwst %f \n",w1outwst);


w1inwst=w1in-2*wst;
printf("w1inwst %f \n",w1inwst);

DIV2=(tg_len_2+focal_2)*(tg_len_2+focal_2);
p2_para_2=2*(sqrt(DIV2+(w2in*w2in/4))-sqrt(DIV2));
w2out=2*sqrt(p2_para_2*(focal_2+tg_len_2-tg_len_1+p2_para_2/4));
printf("w1out %f \n",w2out);

%}

TRACE

...
```

*** the only change comparing with the parabolic inlay : here a normal linear guide is used ****

```
COMPONENT trompeten_guide1 = Guide(
    w1 =w1inwst, h1 = 0.03,w2=w1outwst,h2 = 0.03,
```

```
   l =tg_len_1, R0=0.99, Qc = 0.0217,  alpha=2.57,
   m = mxtp)
 AT (0, 0, 0.005) RELATIVE  slit2_B
 GROUP lense EXTEND
%{
   if (SCATTERED) outer=0;
 %}


COMPONENT para_guide2 = Guide_tapering(
   option = "parabolical", segno = 100, w1 =w2in, h1 = 0.03,
   l =tg_len_1, linw = 0.0, loutw =tg_len_2-tg_len_1+focal_2, linh = 0.0, louth = 0.0,
   alphax = 2.57, alphay = 0,Qcx = 0.0217,  Qcy = 0.0217,
   mx = mxtp, my = 0)
 AT (0, 0, 0.005) RELATIVE PREVIOUS
GROUP lense EXTEND
%{
    if (SCATTERED) outer=1; else outer=0;
 %}

COMPONENT lense_slit = Slit(
   xmin = -w1outwst/2, xmax =w1outwst/2, ymin = -0.015, ymax = 0.015)
 AT (0, 0, 0.005) RELATIVE  slit2_B
 GROUP lense  EXTEND
%{
   if (SCATTERED) outer=2;
 %}



COMPONENT PosTapGui = PSD_monitor(
   nx = 100, ny = 100, filename = "PosTapGui_1", xmin = -0.0255,
   xmax = 0.0255, ymin = -0.006, ymax = 0.006)
 AT (0, 0, tg_len_1+0.0001) RELATIVE PREVIOUS


COMPONENT lense_slit_A=Slit_invers(
        xmin=-w1out/2, xmax=w1out/2,
        ymin=-0.015, ymax=0.015)
        WHEN(outer==1)
        AT (0,0,0.0001) RELATIVE PosTapGui
        GROUP glas EXTEND
        %{
        if (SCATTERED) top1=1; else top1=0;
        %}

COMPONENT lense_slit_B=Slit(
        xmin=-w1outwst/2, xmax=w1outwst/2,
        ymin=-0.015, ymax=0.015)
```

```
          WHEN(outer==0)
          AT (0,0,0.0001) RELATIVE PosTapGui
          GROUP glas EXTEND
          %{
          if (SCATTERED) top1=2; else top1=0;
          %}

COMPONENT lense_slit_C=Slit(
          xmin=-w1outwst/2, xmax=w1outwst/2,
          ymin=-0.015, ymax=0.015)
          WHEN(outer==2)
          AT (0,0,0.0001) RELATIVE PosTapGui
          GROUP glas EXTEND
           %{
          if (SCATTERED) top1=3; else top1=0;
           %}

COMPONENT PosTapGui2 = PSD_monitor(
    nx = 100, ny = 100, filename = "PosTapGui_2", xmin = -0.0255,
    xmax = 0.0255, ymin = -0.006, ymax = 0.006)
  AT (0, 0, 0.0001) RELATIVE PREVIOUS

COMPONENT para_guideEnd = Guide_tapering(
    option = "parabolical", segno = 100, w1 =w2out, h1 = 0.03,
    l =tg_len_2-tg_len_1-0.0005, linw = 0.0, loutw =0.7000744, linh = 0.0, louth = 0.0,
    alphax = 2.57, alphay = 0,Qcx = 0.0217,  Qcy = 0.0217,
    mx = mxtp, my = 0)
  AT (0, 0, 0.0001) RELATIVE PREVIOUS


COMPONENT PosTapGui3 = PSD_monitor(
    nx = 100, ny = 100, filename = "PosTapGui3", xmin = -0.0225,
    xmax = 0.0225, ymin = -0.006, ymax = 0.006)
  AT (0, 0, tg_len_2-tg_len_1-0.0003) RELATIVE PREVIOUS

....
```

elliptical inlay geometry:

```
INITIALIZE
%{


 ...


ell_lin=tg_len_2+focal_1_in;
```

```
ell_lout=tg_len_2-tg_len_1+focal_1;
printf("ell_lout %f \n",ell_lout);

lbh=ell_lin+tg_len_1+ell_lout;
printf("lbh %f \n",lbh);

ell_u1=sqrt((ell_lin*ell_lin)+(w1in*w1in/4));
printf("ell_u1 %f \n",ell_u1);

ell_u2=sqrt(((ell_lout+tg_len_1)*(ell_lout+tg_len_1))+(w1in*w1in/4));
printf("ell_u2 %f \n",ell_u2);

ell_a=(ell_u1+ell_u2)/2;
printf("ell_a %f \n",ell_a);

ell_b=sqrt((ell_a*ell_a)-(lbh*lbh/4));
printf("ell_b %f \n",ell_b);


ell_DIV=sqrt(1-((lbh/2-ell_lout)*(lbh/2-ell_lout)/(ell_a*ell_a)));
printf("ell_DIV %f \n",ell_DIV);

w1out=2*ell_b*ell_DIV;
printf("w1out %f \n",w1out);

w1outwst=w1out-2*wst;
printf("w1outwst %f \n",w1outwst);

w1inwst=w1outwst/ell_DIV;
printf("w1inwst %f \n",w1inwst);



DIV2=(tg_len_2+focal_2)*(tg_len_2+focal_2);
p2_para_2=2*(sqrt(DIV2+(w2in*w2in/4))-sqrt(DIV2));
w2out=2*sqrt(p2_para_2*(focal_2+tg_len_2-tg_len_1+p2_para_2/4));
printf("w1out %f \n",w2out);

%}



TRACE

....
```

*** the only change comparing with the parabolic inlay : here a elliptical tapering guide is used ****

```
COMPONENT para_guide1 = Guide_tapering(
```

```
    option = "elliptical", segno = 100, w1 =w1inwst, h1 = 0.03,
    l =tg_len_1, linw =tg_len_2+focal_1_in, loutw =tg_len_2-tg_len_1+focal_1, linh = 0.0, louth = 0.0,
    alphax = 2.57, alphay = 0, Qcx = 0.0217,  Qcy = 0.0217,
    mx = mxtp, my = 0)
  AT (0, 0, 0.005) RELATIVE  slit2_B
  GROUP lense EXTEND
 %{
     if (SCATTERED) outer=0;
  %}


COMPONENT para_guide2 = Guide_tapering(
    option = "parabolical", segno = 100, w1 =w2in, h1 = 0.03,
    l =tg_len_1, linw = 0.0, loutw =tg_len_2-tg_len_1+focal_2, linh = 0.0, louth = 0.0,
    alphax = 2.57, alphay = 0,Qcx = 0.0217,  Qcy = 0.0217,
    mx = mxtp, my = 0)
  AT (0, 0, 0.005) RELATIVE slit2_B
 GROUP lense EXTEND
 %{
      if (SCATTERED) outer=1; else outer=0;
  %}

COMPONENT lense_slit = Slit(
    xmin = -w1outwst/2, xmax =w1outwst/2, ymin = -0.015, ymax = 0.015)
  AT (0, 0, 0.005) RELATIVE  slit2_B
  GROUP lense  EXTEND
 %{
     if (SCATTERED) outer=2;
  %}



COMPONENT PosTapGui = PSD_monitor(
    nx = 100, ny = 100, filename = "PosTapGui_1", xmin = -0.0255,
    xmax = 0.0255, ymin = -0.006, ymax = 0.006)
  AT (0, 0, tg_len_1+0.0001) RELATIVE PREVIOUS


COMPONENT lense_slit_A=Slit_invers(
            xmin=-w1out/2, xmax=w1out/2,
            ymin=-0.015, ymax=0.015)
            WHEN(outer==1)
            AT (0,0,0.0001) RELATIVE PosTapGui
            GROUP glas EXTEND
            %{
            if (SCATTERED) top1=1; else top1=0;
            %}

COMPONENT lense_slit_B=Slit(
```

```
        xmin=-w1outwst/2, xmax=w1outwst/2,
        ymin=-0.015, ymax=0.015)
        WHEN(outer==0)
        AT (0,0,0.0001) RELATIVE PosTapGui
        GROUP glas EXTEND
        %{
        if (SCATTERED) top1=2; else top1=0;
        %}

COMPONENT lense_slit_C=Slit(
        xmin=-w1outwst/2, xmax=w1outwst/2,
        ymin=-0.015, ymax=0.015)
        WHEN(outer==2)
        AT (0,0,0.0001) RELATIVE PosTapGui
        GROUP glas EXTEND
         %{
        if (SCATTERED) top1=3; else top1=0;
         %}

COMPONENT PosTapGui2 = PSD_monitor(
   nx = 100, ny = 100, filename = "PosTapGui_2", xmin = -0.0255,
   xmax = 0.0255, ymin = -0.006, ymax = 0.006)
 AT (0, 0, 0.0001) RELATIVE PREVIOUS

COMPONENT para_guideEnd = Guide_tapering(
   option = "parabolical", segno = 100, w1 =w2out, h1 = 0.03,
   l =tg_len_2-tg_len_1-0.0005, linw = 0.0, loutw =0.7000744, linh = 0.0, louth = 0.0,
   alphax = 2.57, alphay = 0,Qcx = 0.0217,  Qcy = 0.0217,
   mx = mxtp, my = 0)
 AT (0, 0, 0.0001) RELATIVE PREVIOUS


COMPONENT PosTapGui3 = PSD_monitor(
   nx = 100, ny = 100, filename = "PosTapGui3", xmin = -0.0225,
   xmax = 0.0225, ymin = -0.006, ymax = 0.006)
 AT (0, 0, tg_len_2-tg_len_1-0.0003) RELATIVE PREVIOUS
```