Sumitomo Beamline Setup

F. Cerrina
Created 8/3/1998
Revised 10/14/1998

Initialize

```
Clear@zpos, z, y, outD
```

Source field angles

Compute the source field angles to generate the field horizontal position (assuming that the mirror collimates in horizontal)

```
middle = 25;
right = 50;
source = 3000;
```

```
theta1 = N@ArcTan@middle • source D, 20D
```

```
0.008333140440135918206
```

```
theta2 = N@ArcTan@right • source D, 20D
```

```
0.016665123713940748498
```

Mirror Movement

The mirror motion is that of a "swing" around the source point. The formula used here is just a simple geometrical approximation that doesn't take into account the change in the pole position on the mirror due to scanning.

The parameters are as specified by Toyota-san.

```
swing = 3000;
top = 1.5;
bottom = 0.95;
center = 1.2;
```

Compute the displacement of the mirror center:

```
z@t_D := swing * Sin@t DegreeD;
```

```
y@t_D := swing H1 - Cos@t DegreeDL;
```

Physical parameters:

```
dist = 4000;
t0 = 1.2;
zc = dist Tan@2 t0 DegreeD;
```

Compute location of image:

```
zpos@t_D := z@t - t0D + dist * Tan@2 H tL DegreeD;
```

```
zpos@1.25D - zpos@0.95D
```

```
57.658
```

```
out = Table@8t, t - t0, z@t - t0D, y@t - t0D, zpos@tD - zpos@t0D<,
  8t, bottom - 0.005, top, 0.005<D;
```

```
np = Length@outD
```

```
112
```

Add a header for easier interpretation:

```
titles =
 8"Angle", "Delta Angle", "M0 Delta Z", "M0 Delta Y", "Z Image Loc."<
```

```
8Angle, Delta Angle, M0 Delta Z, M0 Delta Y, Z Image Loc.<
```

```
For@i = 1, i < 6, i++, out@@1, iDD = titles@@iDDD
```

And finally we get:

```
TableForm@outD
```

Angle	Delta Angle	M0 Delta Z	M0 Delta Y	Z Image Loc.
0.95	−0.25	−13.0899	0.0285578	−48.0459
0.955	−0.245	−12.8281	0.0274269	−47.0852
0.96	−0.24	−12.5663	0.0263189	−46.1245
0.965	−0.235	−12.3045	0.0252337	−45.1638
0.97	−0.23	−12.0427	0.0241714	−44.2031
0.975	−0.225	−11.7809	0.0231319	−43.2423
0.98	−0.22	−11.5191	0.0221152	−42.2816
0.985	−0.215	−11.2573	0.0211214	−41.3209
0.99	−0.21	−10.9955	0.0201504	−40.3601
0.995	−0.205	−10.7338	0.0192023	−39.3993
1.	−0.2	−10.472	0.018277	−38.4385
1.005	−0.195	−10.2102	0.0173746	−37.4778
1.01	−0.19	−9.94836	0.016495	−36.517
1.015	−0.185	−9.68656	0.0156383	−35.5562
1.02	−0.18	−9.42476	0.0148044	−34.5954
1.025	−0.175	−9.16296	0.0139934	−33.6345
1.03	−0.17	−8.90117	0.0132052	−32.6737
1.035	−0.165	−8.63937	0.0124398	−31.7129
1.04	−0.16	−8.37757	0.0116973	−30.752
1.045	−0.155	−8.11577	0.0109776	−29.7912
1.05	−0.15	−7.85397	0.0102808	−28.8303
1.055	−0.145	−7.59217	0.00960687	−27.8694
1.06	−0.14	−7.33038	0.00895575	−26.9085
1.065	−0.135	−7.06858	0.00832747	−25.9477
1.07	−0.13	−6.80678	0.00772205	−24.9868
1.075	−0.125	−6.54498	0.00713947	−24.0258
1.08	−0.12	−6.28318	0.00657973	−23.0649
1.085	−0.115	−6.02138	0.00604285	−22.104
1.09	−0.11	−5.75958	0.0055288	−21.1431
1.095	−0.105	−5.49778	0.00503761	−20.1821
1.1	−0.1	−5.23599	0.00456926	−19.2212
1.105	−0.095	−4.97419	0.00412376	−18.2602
1.11	−0.09	−4.71239	0.0037011	−17.2992

1.115	−0.085	−4.45059	0.00330129	−16.3382
1.12	−0.08	−4.18879	0.00292433	−15.3772
1.125	−0.075	−3.92699	0.00257021	−14.4162
1.13	−0.07	−3.66519	0.00223894	−13.4552
1.135	−0.065	−3.40339	0.00193051	−12.4942
1.14	−0.06	−3.14159	0.00164493	−11.5332
1.145	−0.055	−2.87979	0.0013822	−10.5721
1.15	−0.05	−2.61799	0.00114232	−9.61107
1.155	−0.045	−2.35619	0.000925275	−8.65001
1.16	−0.04	−2.09439	0.000731082	−7.68894
1.165	−0.035	−1.8326	0.000559734	−6.72785
1.17	−0.03	−1.5708	0.000411234	−5.76676
1.175	−0.025	−1.309	0.000285579	−4.80566
1.18	−0.02	−1.0472	0.00018277	−3.84455
1.185	−0.015	−0.785398	0.000102808	−2.88343
1.19	−0.01	−0.523599	0.0000456926	−1.92229
1.195	−0.005	−0.261799	0.0000114232	−0.961152
1.2	0.	0.	0.	0.
1.205	0.005	0.261799	0.0000114232	0.961163
1.21	0.01	0.523599	0.0000456926	1.92234
1.215	0.015	0.785398	0.000102808	2.88352
1.22	0.02	1.0472	0.00018277	3.84471
1.225	0.025	1.309	0.000285579	4.80592
1.23	0.03	1.5708	0.000411234	5.76713
1.235	0.035	1.8326	0.000559734	6.72836
1.24	0.04	2.09439	0.000731082	7.68959
1.245	0.045	2.35619	0.000925275	8.65084
1.25	0.05	2.61799	0.00114232	9.61209
1.255	0.055	2.87979	0.0013822	10.5734
1.26	0.06	3.14159	0.00164493	11.5346
1.265	0.065	3.40339	0.00193051	12.4959
1.27	0.07	3.66519	0.00223894	13.4572
1.275	0.075	3.92699	0.00257021	14.4185
1.28	0.08	4.18879	0.00292433	15.3799
1.285	0.085	4.45059	0.00330129	16.3412
1.29	0.09	4.71239	0.0037011	17.3025
1.295	0.095	4.97419	0.00412376	18.2639
1.3	0.1	5.23599	0.00456926	19.2253
1.305	0.105	5.49778	0.00503761	20.1866
1.31	0.11	5.75958	0.0055288	21.148
1.315	0.115	6.02138	0.00604285	22.1094
1.32	0.12	6.28318	0.00657973	23.0708
1.325	0.125	6.54498	0.00713947	24.0322
1.33	0.13	6.80678	0.00772205	24.9937
1.335	0.135	7.06858	0.00832747	25.9551
1.34	0.14	7.33038	0.00895575	26.9166
1.345	0.145	7.59217	0.00960687	27.878
1.35	0.15	7.85397	0.0102808	28.8395
1.355	0.155	8.11577	0.0109776	29.801

1.36	0.16	8.37757	0.0116973	30.7625
1.365	0.165	8.63937	0.0124398	31.724
1.37	0.17	8.90117	0.0132052	32.6855
1.375	0.175	9.16296	0.0139934	33.6471
1.38	0.18	9.42476	0.0148044	34.6086
1.385	0.185	9.68656	0.0156383	35.5702
1.39	0.19	9.94836	0.016495	36.5317
1.395	0.195	10.2102	0.0173746	37.4933
1.4	0.2	10.472	0.018277	38.4549
1.405	0.205	10.7338	0.0192023	39.4165
1.41	0.21	10.9955	0.0201504	40.3781
1.415	0.215	11.2573	0.0211214	41.3398
1.42	0.22	11.5191	0.0221152	42.3014
1.425	0.225	11.7809	0.0231319	43.2631
1.43	0.23	12.0427	0.0241714	44.2247
1.435	0.235	12.3045	0.0252337	45.1864
1.44	0.24	12.5663	0.0263189	46.1481
1.445	0.245	12.8281	0.0274269	47.1098
1.45	0.25	13.0899	0.0285578	48.0715
1.455	0.255	13.3517	0.0297116	49.0332
1.46	0.26	13.6135	0.0308882	49.995
1.465	0.265	13.8753	0.0320876	50.9567
1.47	0.27	14.1371	0.0333099	51.9185
1.475	0.275	14.3989	0.034555	52.8803
1.48	0.28	14.6607	0.0358229	53.8421
1.485	0.285	14.9225	0.0371137	54.8039
1.49	0.29	15.1843	0.0384274	55.7657
1.495	0.295	15.4461	0.0397639	56.7275
1.5	0.3	15.7079	0.0411233	57.6893

Notice the large and asymmetric overscan, caused by the need to account for the strong image bow.

Prepare to writing to a file:

```
outfile = "f:•sumitomo•tracing•mirrro_move.dat"
```

```
f:•sumitomo•tracing•mirrro_move.dat
```

The following commands are some incredible girations necessary to write out data without the darn brackets. Can be ignored. First, create a string from the data:

```
line@i_D := ToString@Table@out@@i, jDD, 8j, 1, 5<DD;
```

Then remove { and } like so:

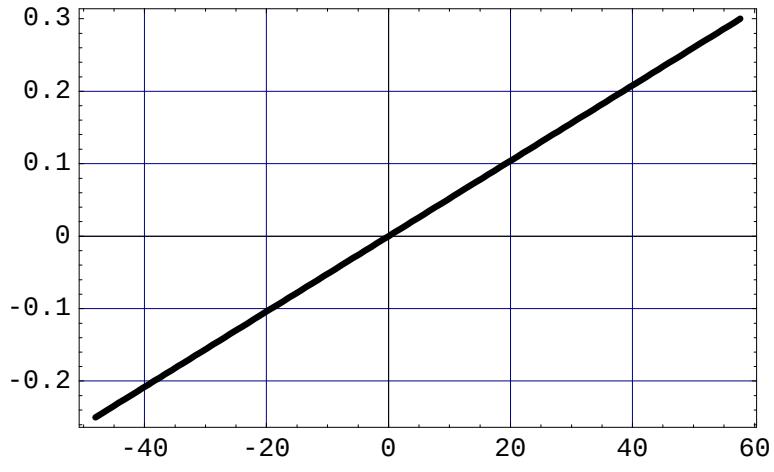
```
StringReplace@line@2D, 8"<" -> "", "8" -> ""<D;
```

Now we can generate the table and write it out:

```
fileout = OpenWrite@outfile, DOSTextFormat -> TrueD;
WriteString@fileout, ColumnForm@
  Table@StringReplace@line@iD, 8"<" -> "", "8" -> ""<D, 8i, 1, np<DDD ;
Close@fileoutD;
```

```
tout = Transpose@outD;
```

```
ListPlot@Table@8tout@@5, iDD, tout@@2, iDD<, 8i, 2, 112<D,
 GridLines -> Automatic, Frame -> True, PlotJoined -> True,
 PlotStyle -> Thickness@0.01DD;
```



Because of the small values of the angles, the plot is essentially linear.

Determination of the field angles for source

```
Clear@workdirD
disk = "f:•"
root = "Sumitomo•Tracing•Overview•"
workdir = StringJoin@disk, rootD
infile = StringJoin@workdir, "preplot2.dat"D
```

```
f:•
```

```
Sumitomo•Tracing•Overview•
```

```
f:•Sumitomo•Tracing•Overview•
```

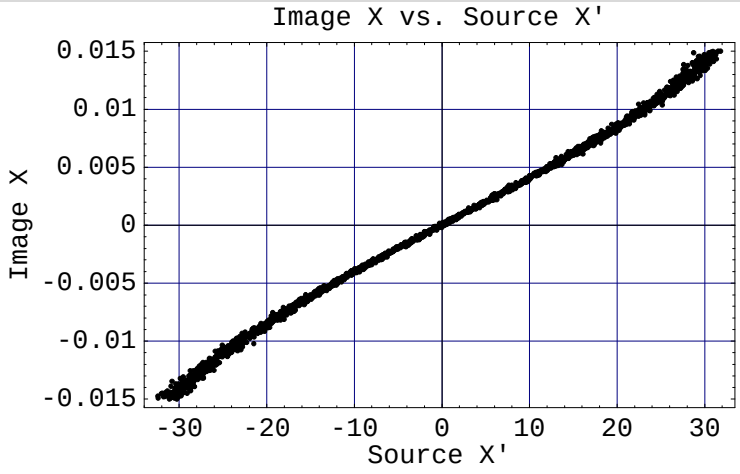
```
f:•Sumitomo•Tracing•Overview•preplot2.dat
```

```
OpenRead@infileD;
phase = ReadList@infile, Number, RecordLists -> TrueD;
Close@infileD;
np = Length@phaseD
H* dataplot = Take@phase,5000D; *L
```

```
2000
```

The plot represents the landing position (X) versus the source (X').

```
ListPlot@phase, GridLines -> Automatic,
 Frame -> True, PlotLabel -> "Image X vs. Source X'",
 FrameLabel -> 8"Source X'", "Image X"<D;
```

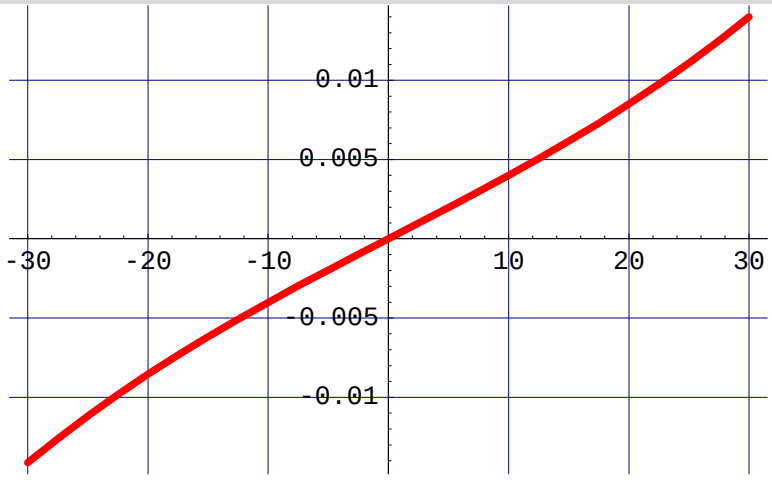


Notice that in a given Delta X there are more rays at large field angles than near the center. Let's fit the data with a 3-rd order polynomial:

```
ClearAll@outD
out@x_D = Fit@phase, 81, x, x^2, x^3<, xD
```

$$2.05636 \times 10^{-6} + 0.000391736\, x - 6.7723 \times 10^{-8}\, x^2 + 8.57537 \times 10^{-8}\, x^3$$

```
Plot@out@xD, 8x, -30, 30<, GridLines -> Automatic,
 PlotStyle -> 8Thickness@0.01D, Hue@0D<D;
```



```
Print@"In order to have x= ",
 12.5, " the angle must be ", out@12.5D, " rads"D
Print@
 "In order to have x= ", 25, " the angle must be ", out@25D, " rads"D
```

```
In order to have x= 12.5 the angle must be 0.00505566 rads
```

```
In order to have x= 25 the angle must be 0.011093 rads
```

Verification of runs

```
workdir
```

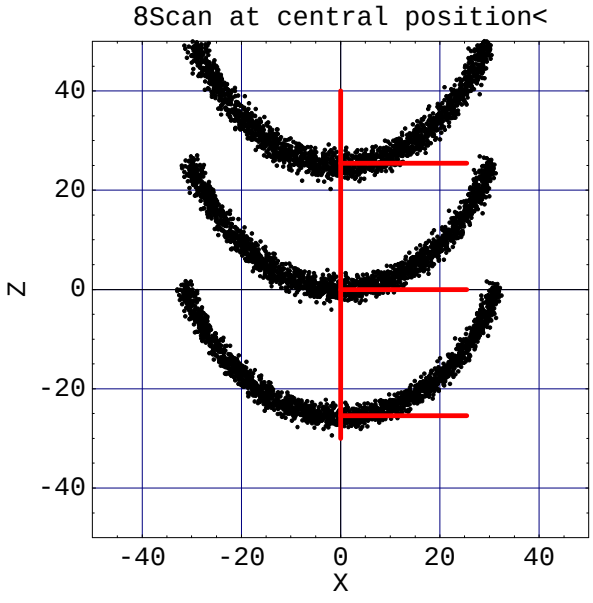
```
f:•Sumitomo•Tracing•Overview•
```

After running SHADOW, we must make sure that the images are indeed loacted where we expect them to be.

These are the footprint corresponding to the beam being on the CENTRAL, MIDDLE and then RIGHT position

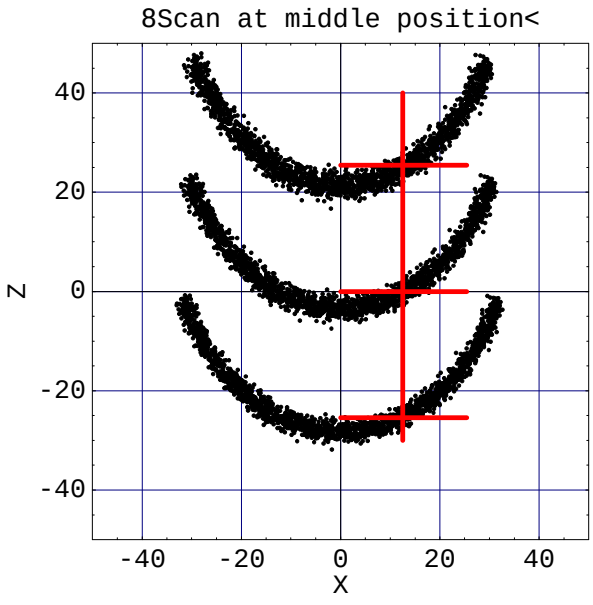
```
infile = workdir <> "overview_c.txt";
OpenRead@infileD;
dataplot = ReadList@infile, Number, RecordLists -> TrueD;
Close@infileD;
np = Length@dataplotD;
Print@"Read ", np, " records from: ", infileD
pp = ListPlot@dataplot, GridLines -> Automatic,
  Frame -> True, PlotLabel -> 8"Scan at central position"<,
  FrameLabel -> 8"X", "Z"<, PlotRange -> 88-50, 50<, 8-50, 50<<,
 AspectRatio -> 1D;
refline = Line@880, -30<, 80, 40<<D;
refline1 = Line@8825.4, 0<, 80, 0<<D;
refline2 = Line@8825.4, -25.4<, 80, -25.4<<D;
refline3 = Line@8825.4, 25.4<, 80, 25.4<<D;
addref = Graphics@
  8Thickness@0.01D, Hue@0D, refline, refline1, refline2, refline3<D;
Show@pp, addrefD;
```

```
Read 6000 records from: f:•Sumitomo•Tracing•Overview•overview_c.txt
```



```
infile = workdir <> "overview_m.txt";
OpenRead@infileD;
dataplot = ReadList@infile, Number, RecordLists -> TrueD;
Close@infileD;
np = Length@dataplotD;
Print@"Read ", np, " records from: ", infileD
pp = ListPlot@dataplot, GridLines -> Automatic,
  Frame -> True, PlotLabel -> 8"Scan at middle position"<,
  FrameLabel -> 8"X", "Z"<, PlotRange -> 88-50, 50<, 8-50, 50<<,
 AspectRatio -> 1D;
refline = Line@8812.5, -30<, 812.5, 40<<D;
refline1 = Line@8825.4, 0<, 80, 0<<D;
refline2 = Line@8825.4, -25.4<, 80, -25.4<<D;
refline3 = Line@8825.4, 25.4<, 80, 25.4<<D;
addref = Graphics@
  8Thickness@0.01D, Hue@0D, refline, refline1, refline2, refline3<D;
Show@pp, addrefD;
```

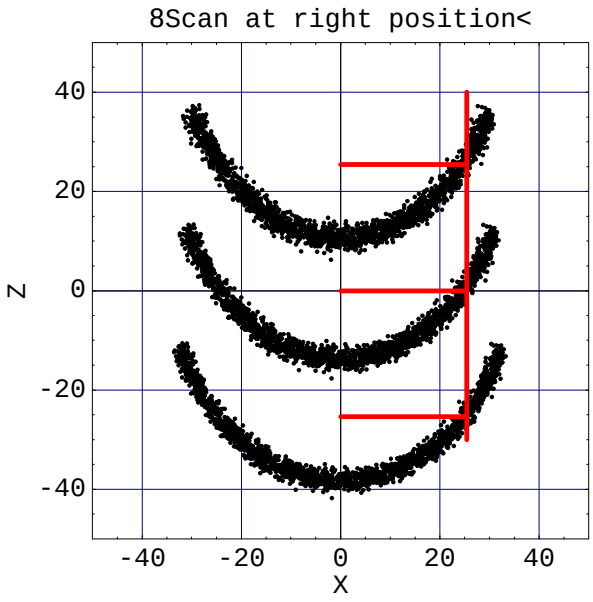
```
Read 6000 records from: f:•Sumitomo•Tracing•Overview•overview_m.txt
```



```
infile = workdir <> "overview_r.txt"
OpenRead@infileD;
dataplot = ReadList@infile, Number, RecordLists -> TrueD;
Close@infileD;
np = Length@dataplotD;
Print@"Read ", np, " records from: ", infileD
pp = ListPlot@dataplot, GridLines -> Automatic, Frame -> True,
  PlotLabel -> 8"Scan at right position"<, FrameLabel -> 8"X", "Z"<,
 PlotRange -> 88-50, 50<, 8-50, 50<<,
 AspectRatio -> 1D;
refline = Line@8825.4, -30<, 825.4, 40<<D;
refline1 = Line@8825.4, 0<, 80, 0<<D;
refline2 = Line@8825.4, -25.4<, 80, -25.4<<D;
refline3 = Line@8825.4, 25.4<, 80, 25.4<<D;
addref = Graphics@
  8Thickness@0.01D, Hue@0D, refline, refline1, refline2, refline3<D;
Show@pp, addrefD;
```

```
f:•Sumitomo•Tracing•Overview•overview_r.txt
```

```
Read 6000 records from: f:•Sumitomo•Tracing•Overview•overview_r.txt
```



The results are as expected.