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NOTE ON THE USE OF DAVITRAMP, A MODIFICATION OF TRAMP TO INCORPORATE SEXTUPOLES

The programme TRAMP of Gardner and Whiteside is described in their report[1]. We shall assume a familiarity with this report and refer to page numbers in it. We also assume that the author's previous report[2] has been read.

The original TRAMP uses 2 x 2 matrices to trace rays through a beam system, independently for horizontal and vertical planes according to which is specified. If a sextupole is one of the beam elements this independence is violated: we must integrate the equation of motion for x and y, the displacement (in cm) for the horizontal and vertical planes respectively. These are

$$\frac{d^2x}{dZ^2} = 0.006 \frac{K}{p} xy$$

$$\frac{d^2y}{dZ^2} = 0.003 \frac{K}{p} (x^2-y^2)$$

with initial condition in both planes at the entrance to the sextupole given by TRAMP up to that point. The units are those of TRAMP, x, y in cm, p in GeV/c, x', y' in hundredths of radians (cm per meter), Z in meters. One is at liberty to normalize K, the sextupole "gradient"; we have chosen constants so that if r is the radius of the aperture in cm, Kr^2 is the field at the pole tip (K is in gauss/cm^2).

TRAMP has been modified so that a special <u>tracking routine</u>, T = 7, will trace rays in both planes simultaneously and jump to an INT STEP routine for any sextupole encountered, then continue normally. All other tracking routines (T = 1 to 6) are unaltered -- they will treat the sextupole as a drift space.

A new <u>matching</u> routine, again specified by T = 7 in the matching section, will find the "best" sextupole strength by Newton's method, for a given momentum bite. In general positive and negative momentum deviation are corrected differently (because they pass through the sextupole at different heights) and the routine equalizes the deviations (so that these end up with the same sign).

1) TRAMP - J.W. Gardner and D. Whiteside, NIRL/M/21, obtainable from Rutherford Laboratory, Harwell.

2) Note on sextupole correction of chromatic aberration - G. Chadwick CERN/TC/HBC81 62/22

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All matching routines have been altered so that matching may be performed between any drift spaces, not necessarily the same ones for both planes. Thus matching must be specified between two beginning and two end points.

A further tracking routine will change the values in the stored system (see below).

Specification of input data

It is suggested that interested people should pencil in the following notations in NIRL/M/21.

Page 9: Sextupole specification at any point in system.

A = 6 B = effective length (m) C = gradient (K in gauss/cm^2)

D = 0

Page 10: Specification of all old matching routines.

M and N are specified for the horizontal plane, followed by any one set of routine numbers as shown in the table, then M and N are again specified for the vertical plane, and followed by a set of routine numbers. e.g.

M	N	T	M'	N'	T'
1	10	2	1	12	4

For the sextupole match, only the sextupole strength is altered and M and N are specified only for the vertical plane. This routine number is 7, and is to be followed by the half momentum bite in percent. e.g.

M	N	T	$\frac{\Delta p}{p}$
1	12	7	1.0

This routine will normally follow all other matching routines.

Page 12: Tracking.

For T = 7, initial condition in both planes are specified. e.g.

T	x(cm)	x'(rad./100)	y(cm)	y'(rad/100)
7	0	1	0	0.5

For T = 25, one number in the stored system is changed. The 25 is followed by the number of the value to be altered, counted four per element from the beginning of the "Details of elements" (see p. 15), and then the new value. For example

T	I	AI	
25	8	0	would cause the first quadrupole to remain fixed in gradient during a matching operation.

Page 13: Print out

For all but T = 7, print out is the same. For T = 7 the horizontal and vertical displacements and divergences are printed in five columns side by side, horizontal first. After M = 501 the unwanted ray, horizontal and vertical, is printed in five columns and after T = 10 both unwanted and reference ray are printed in five columns. Unfortunately the vertical reference ray gives all zeros and horizontal rays are only slightly different (identical if sextupole fields are zero) for wanted and unwanted particles.

The T = 7 routine prints out all rays referred to the optic axis of the system rather than to the "reference ray". However, we have not bothered to suppress these reference rays since they may be useful for the other routines.

Another feature of dubious value is the following. If hand switch 4 is set the stored system is not printed. This means that if tracking only is required, print out can be drastically reduced, and this result obtained by asking for suppression of quiries (there are no quiries in the programme). However operators are liable to change hand switch 4 after programme read-in, so that it is best to specify hand switch 4 up or down separately.

The programme is addressed as No 1154P2 in the CERN Mercury file.

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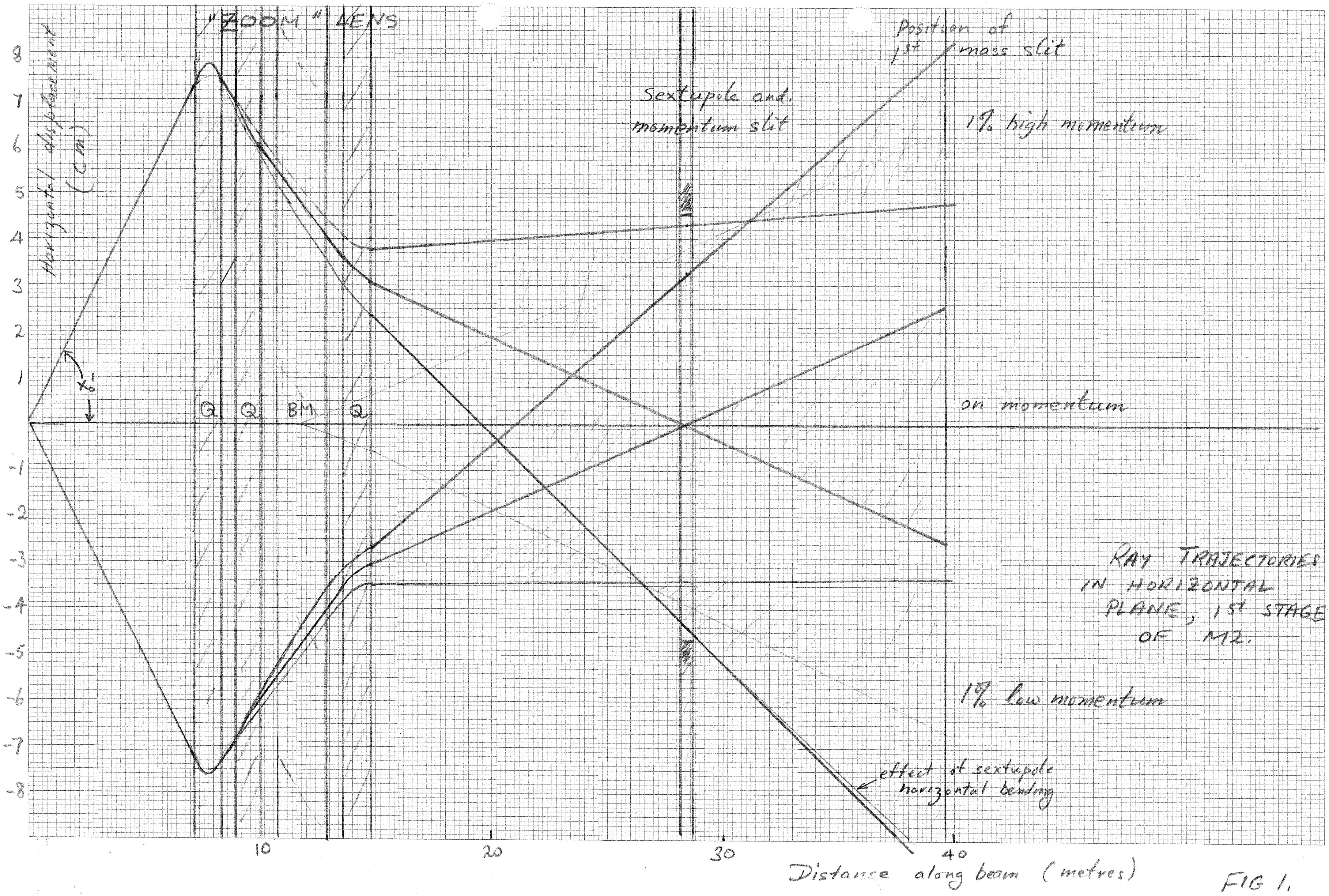
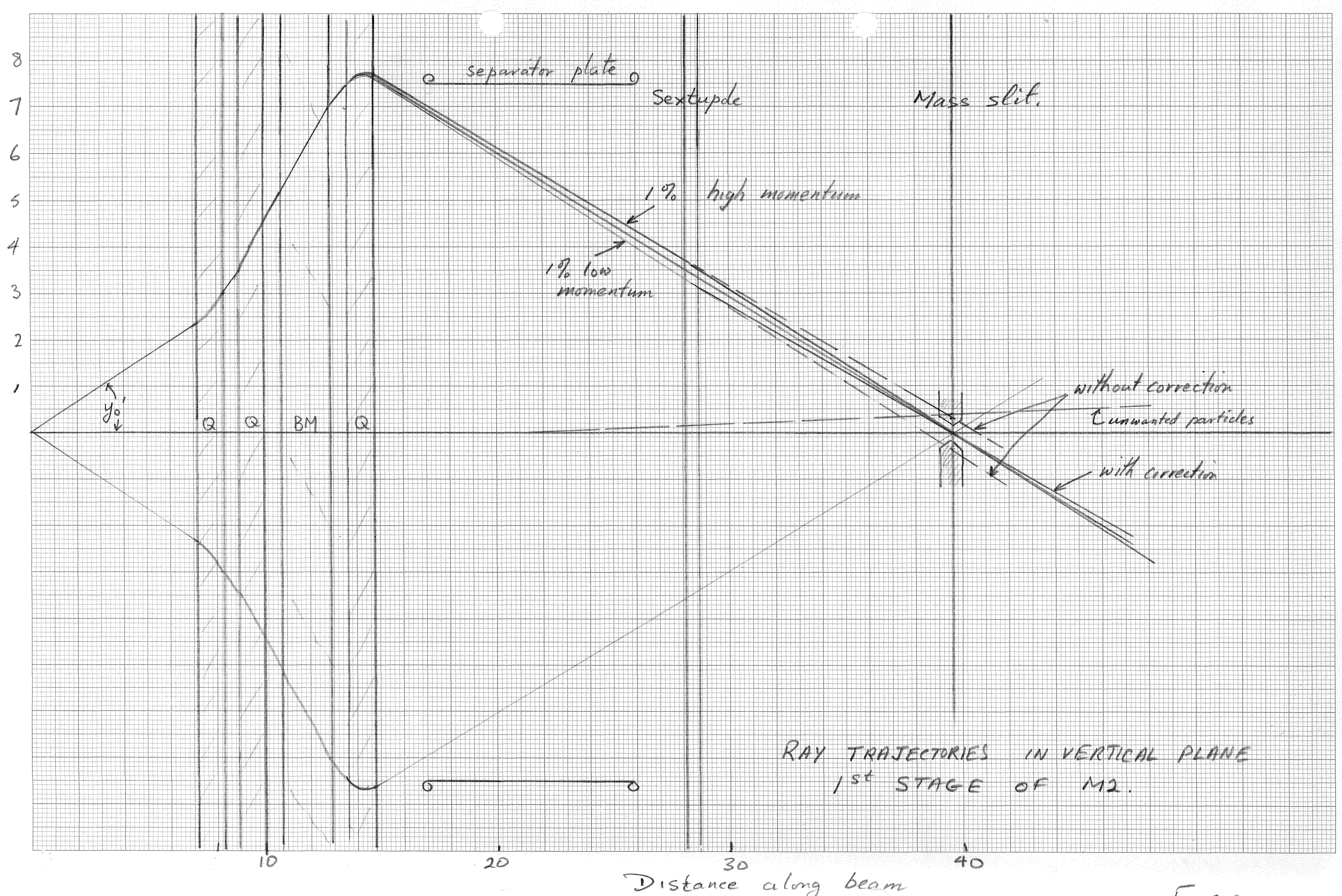


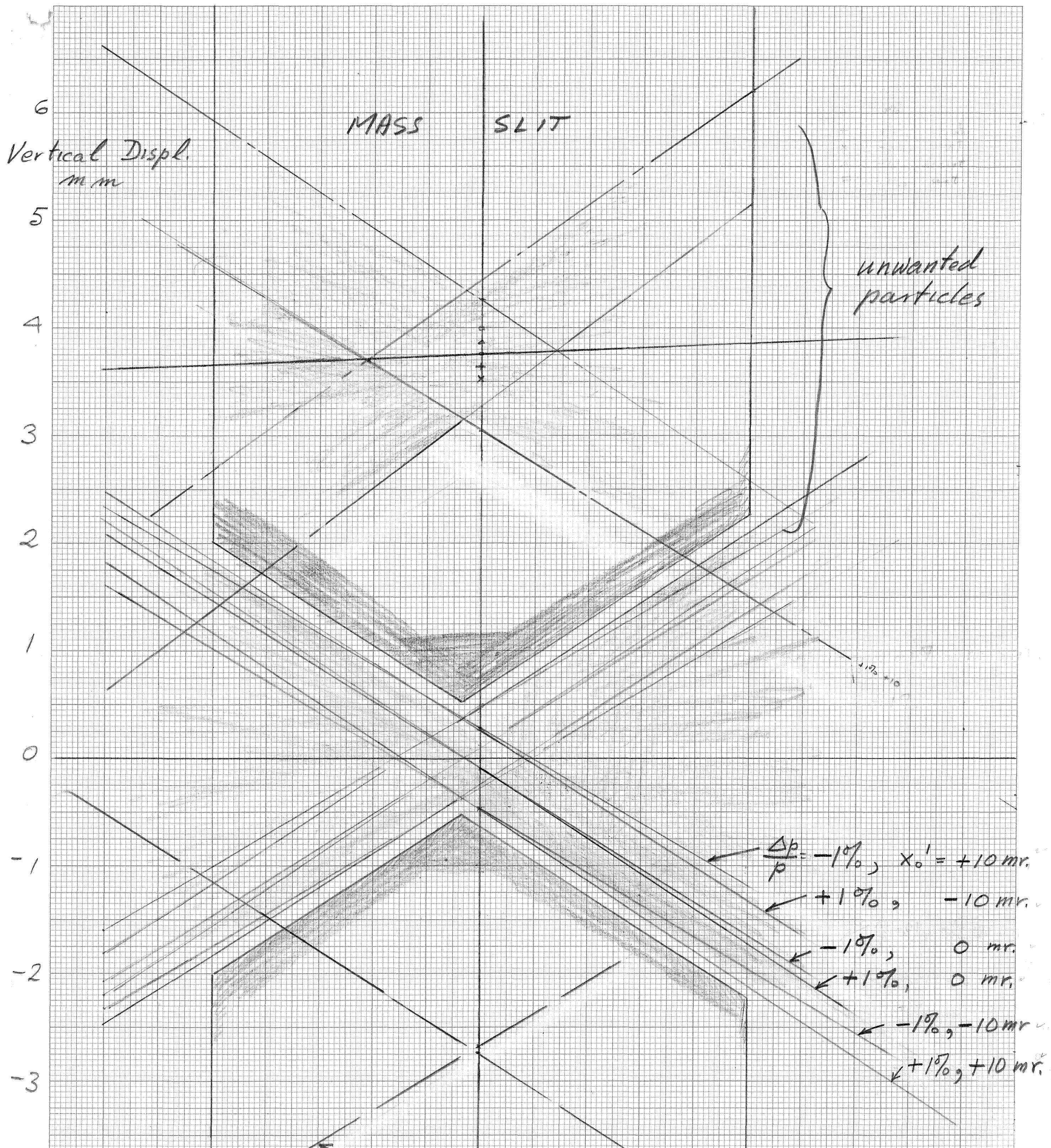
"ZOOM" LENS
Position of 1st mass slit
Sextupole and momentum slit
1% high momentum
on momentum
1% low momentum
Horizontal displacement (cm)
8
7
6
5
4
3
2
1
-1
-2
-3
-4
-5
-6
-7
-8
x_0'
Q
Q
BM
Q
RAY TRAJECTORIES IN HORIZONTAL PLANE, 1st STAGE OF M2.
effect of sextupole horizontal bending
10
20
30
40
Distance along beam (metres)

FIG 1.



separator plate
Sextupole
Mass slit.
1% high momentum
1% low momentum
without correction
unwanted particles
with correction
Q
Q
BM
Q
y₀'
RAY TRAJECTORIES IN VERTICAL PLANE
1st STAGE OF M2.
Distance along beam

FIG 2



ENLARGEMENT OF VERTICAL PLANE
RAY TRAJECTORIES AT THE MASS SLIT.
(ZERO TARGET SIZE)

FIG 3