PS/EA/BM/NOTE 86-11
KGR/gm - 10.3.1986

STUDIES ON THE TRANSFER OF ANTIPROTONS FROM LEAR TO THE PS NORTH HALL

D. Dumollard, K-G. Rensfelt, D.J. Simon

1. INTRODUCTION

In the planning of the experimental areas at LEAR after the installation of ACOL in 1986-87 it was early realized that many of the experiments of the second generation were considerably larger than the previous ones. As discussed in Ref. 1 this and other arguments supported a possible extension of the experimental area preferably to the North Hall. The disadvantages being that the beam line had to pass the PS main ring and the PS-RF installations in the North Hall.

The passage could take place inside the shielding walls of the PS-ring or outside: We discuss these two possibilities. In any case the beam has to be bent about 90° horizontally. Therefore only momenta lower than 300 MeV/c are considered to be transferred.

2. BEAM LINE INSIDE THE PS TUNNEL

This solution was first presented in Ref. 1. The beam ejected from LEAR is bent by about 90° in the horizontal plane in order to pass perpendicular to the shielding wall and through the PS tunnel. In the vertical plane, the beam level is increased only by about 70 cm, just enough to pass above the magnet unit number 8, but inside the openings filled with removable blocs. The cross-section through the PS tunnel (Fig. 1) demonstrates the usefulness of this elevation in the North Hall (beam level ≈ 2.34 m), well adapted to spectrometers. We see also the useful height of 8.55 m in the North Hall, compared to 4.20 m only in the South Hall. Only four small-aperture quadrupoles have to be installed inside the PS tunnel together with some vacuum components and at least one beam detector.

The beam line is computed in order to be added easily to the after-ACOL installations in the South Hall, as shown in Fig. 2 taken from Ref. 2. The initial calculation included a magnetic beam splitter as shown in Fig. 3 to allow beam-sharing between the North Hall and the South Hall (M_1 or M_2 areas). The beam envelopes given in Fig. 4 show this case. Also beam-sharing between the two beam lines in the North Hall is foreseen as indicated in Fig. 3, but with a splitter of the electrostatic type described in Ref. 1.

The proposed transfer line to the North Hall would require new components: 18 quadrupoles, 7 special bending magnets, 10 steering magnets, 35 power supplies, 75 meters of high vacuum pipes, including the pumping stations, cabling, supports, gas distribution system etc..

A few problems remain also to be studied carefully:

- shielding of the $\bar{p}$ beam against the (pulsed) PS magnet fringing field;
- a possible leakage of neutrons in the holes through the PS shielding walls.

The transfer through the RF installation calls for an important rearrangement of the RF equipment as described in the memorandum by J. Jamsek, Ref. 3, who advises that other possibilities should be investigated.

Furthermore, the installation of a transfer line through the PS tunnel accelerator imposes severe limitation of access.

3. BEAM LINE OUTSIDE THE PS TUNNEL

Beam transfer lines passing above the radiation shield of the PS tunnel and leading to two experiment stations in the North Hall have extensively been studied. The geometrical positions are shown in Fig. 5a, 5b. The beam has to be brought to two levels vertically, first from 1.66 to 6.9 m then to that of the experiments in our example 3.6 m. This means that the chromatic dispersion also in the vertical plane must be carefully considered. The optics giving the envelopes and dispersions as shown in Fig. 6 are examples and not yet fully optimized in this respect. Also beam-sharing between the North and South Hall is not taken into account. Furthermore, this line cannot simply (or at least not unexpensively) be added to the South Hall installations as the existing first switching magnet does not allow sufficient angular deviation.

Beam-sharing between the two branches of the North Hall is not investigated but is probably possible at the expense of further beam elements.

With this layout 8 bending magnets and at least 19 quadrupoles and 75 m of vacuum pipes are needed. From the computations one can draw the conclusion that it is possible to transport the $\bar{p}$ beam to the North Hall above the PS shielding without too much loss of beam quality if a sufficient number of beam elements are used.

The implications on beam shielding a.s.o. has not been studied but this part will be more expensive than in the previous case.

4. SUMMARY

It is possible to transfer antiprotons from LEAR to the North Hall either through the PS tunnel or above it.

In the first case the number of beam elements are less and the vertical chromatic dispersion is easier to control but it will cause strong interference with existing activities.

In the second case the disturbance to the RF and PS main ring ought to be negligible and the access to the beam transfer elements is easy, but the beam optics will be more complicated.

In both cases only small aperture beam elements are foreseen except maybe for the two last quadrupoles in each line. In order to limit the magnet costs only momenta less than about 300 MeV/c should be considered. The length of the line makes a transfer of $\bar{p}$ at a momentum very much lower than 100 MeV/c - not recommendable.

REFERENCES

1. D.J. Simon, D. Dumollard and K-G. Rensfelt, The LEAR experimental areas, status report and possible developemnts, Tigne Workshop, January 1985.

2. L. Danloy, D. Dumollard, K-G. Rensfelt et D.J. Simon, Les zones expérimentales de LEAR après le démarrage de ACOL. Etude de quelques possibilités, PS/EA/BL/NOTE 85-9.

3. Memorandum J. Jamsek, PS/RF/MEMO 85-22.

FIGURE CAPTIONS

Fig. 1 Vertical cut through the PS ring showing a possible transfer line from LEAR to the North Hall.

Fig. 2 A possible layout of the South and the North Halls (from Ref. 2, Solution C).

Fig. 3 Possible positions of splitters in the transfer line to the North Hall.

Fig. 4 Beam envelopes and chromatic dispersions of a transfer line through the PS tunnel to the North Hall.

Fig. 5 Possible layout of a transfer line above the PS tunnel to the North Hall: a) cross-section, b) top view.

Fig. 6 Example of beam envelopes and chromatic dispersions of a transfer line above the PS tunnel to the North Hall.

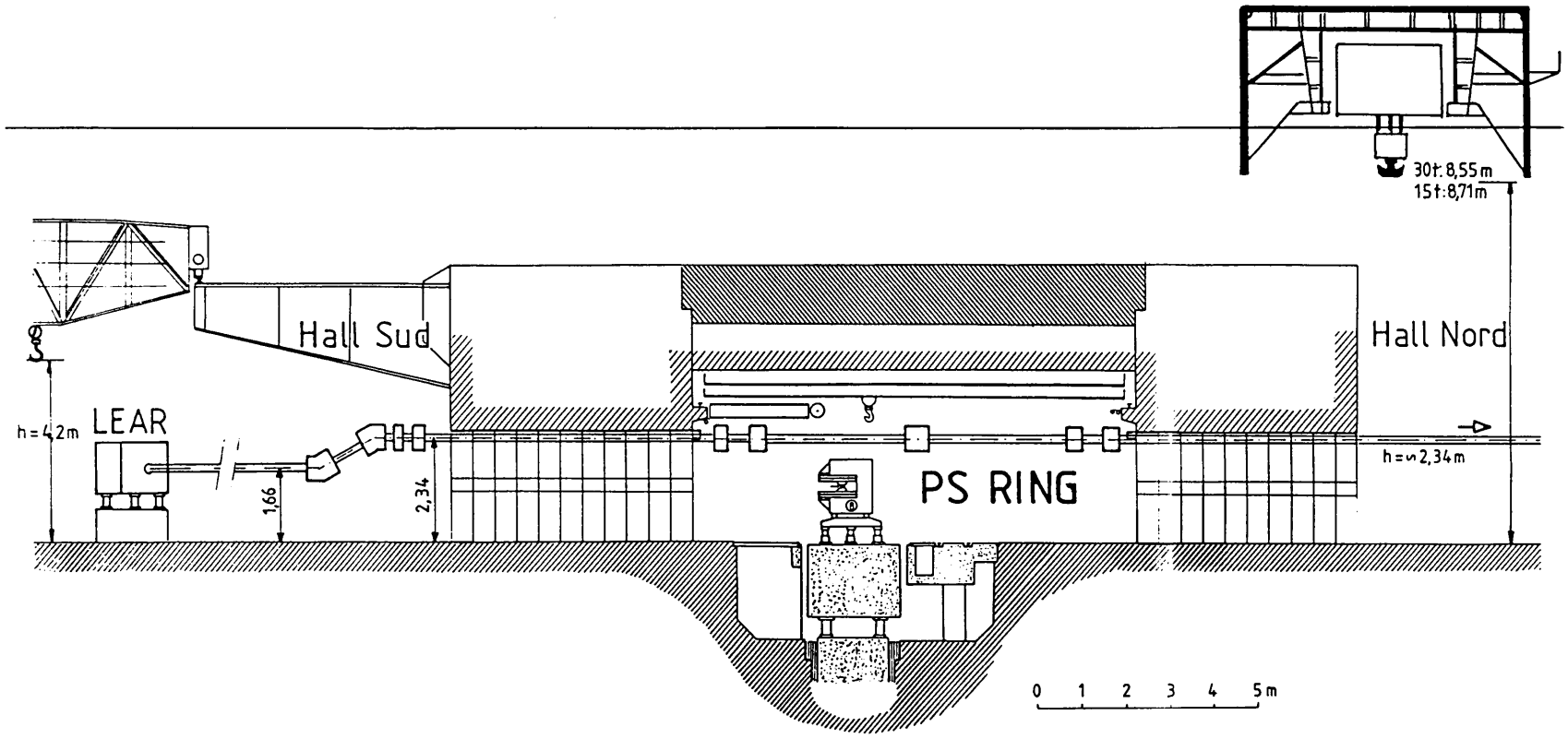

Fig. 1 - VERTICAL CUTTHROUGH THE PS-RING SHOWING A POSSIBLE TRANSFER LINE FROM LEAR TO NORTH HALL.

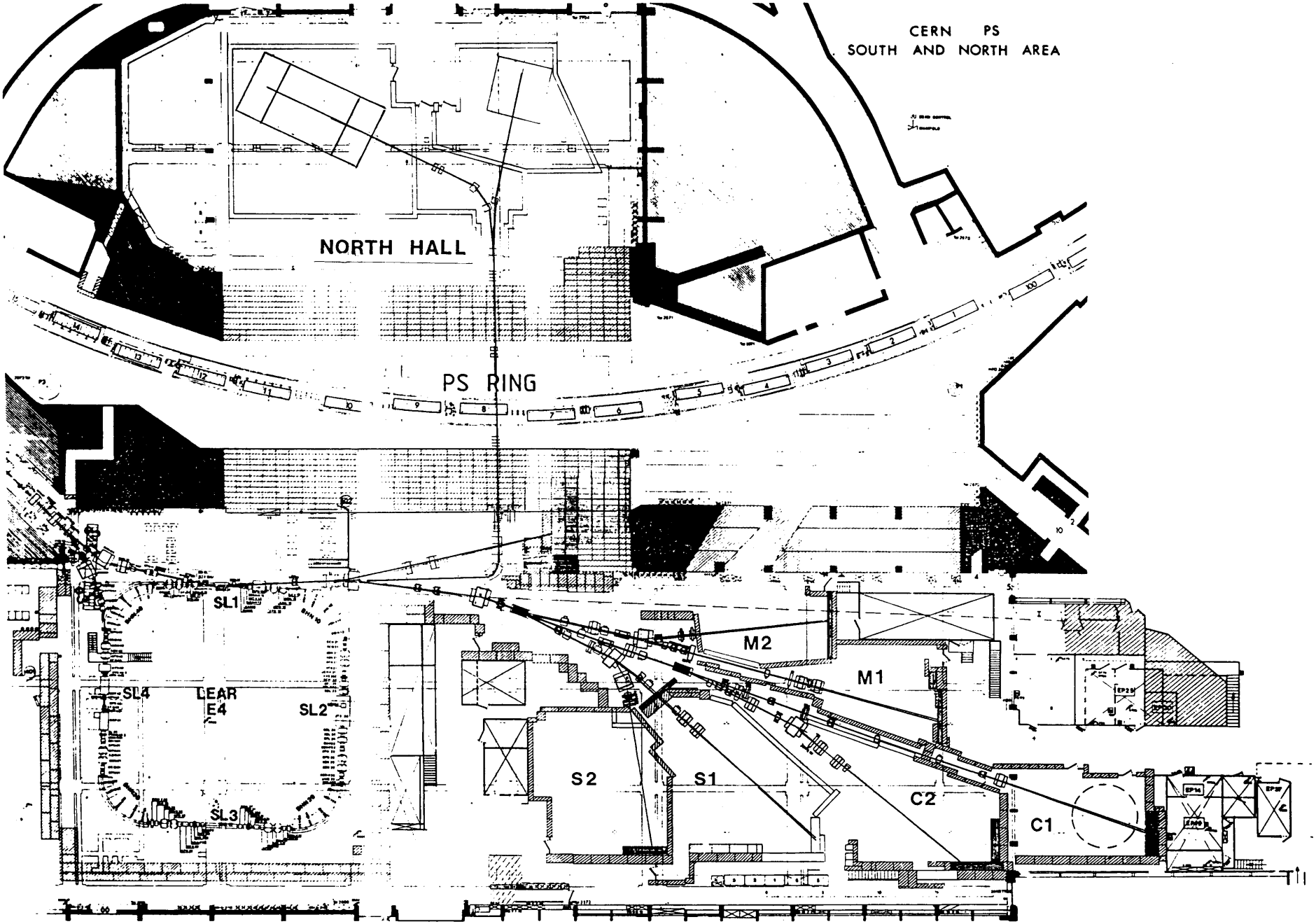

Fig. 2 - A POSSIBLE LAYOUT OF THE SOUTH AND NORTH HALLS
(from ref. 2, solution C).

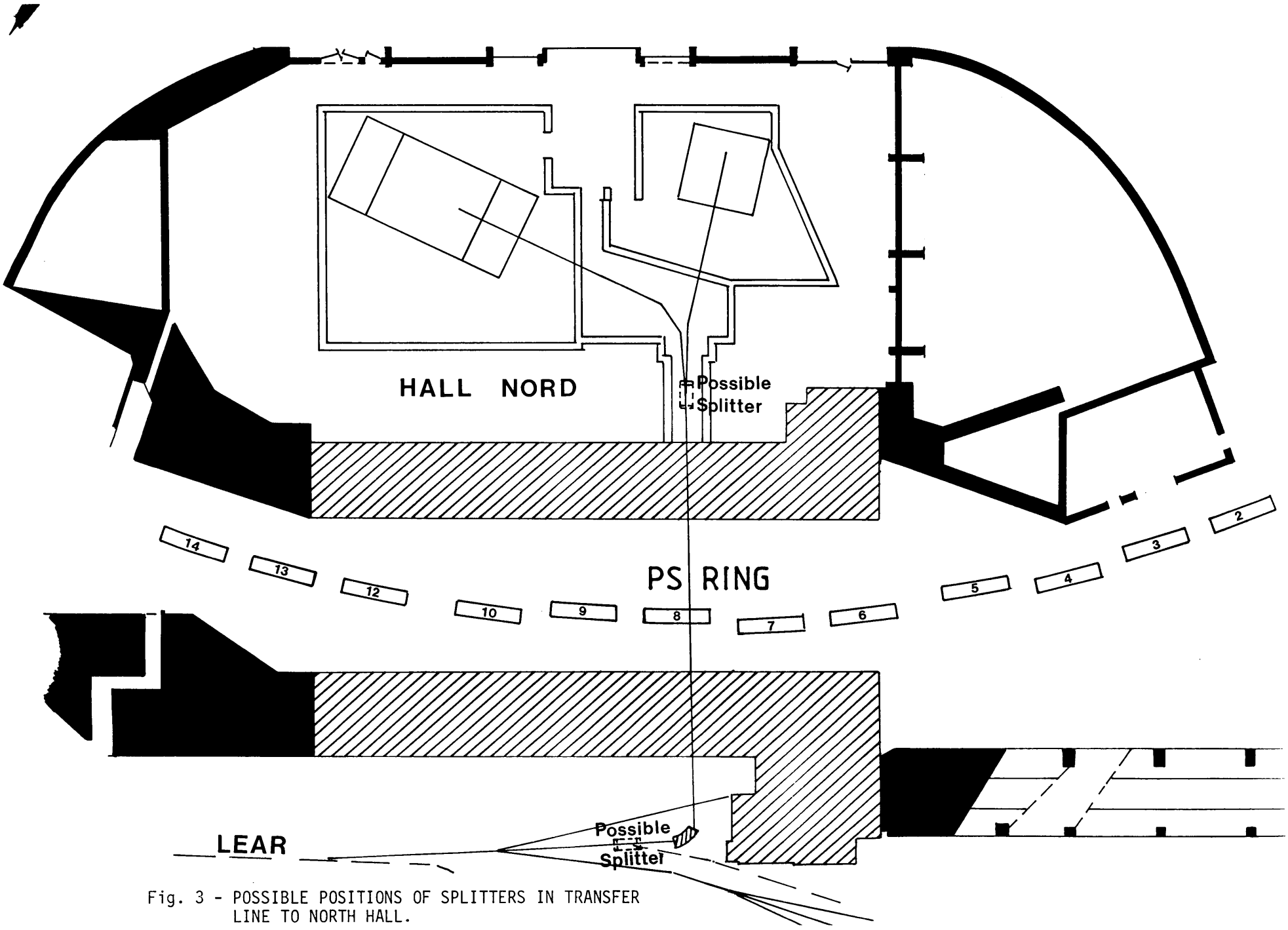

Fig. 3 - POSSIBLE POSITIONS OF SPLITTERS IN TRANSFER LINE TO NORTH HALL.

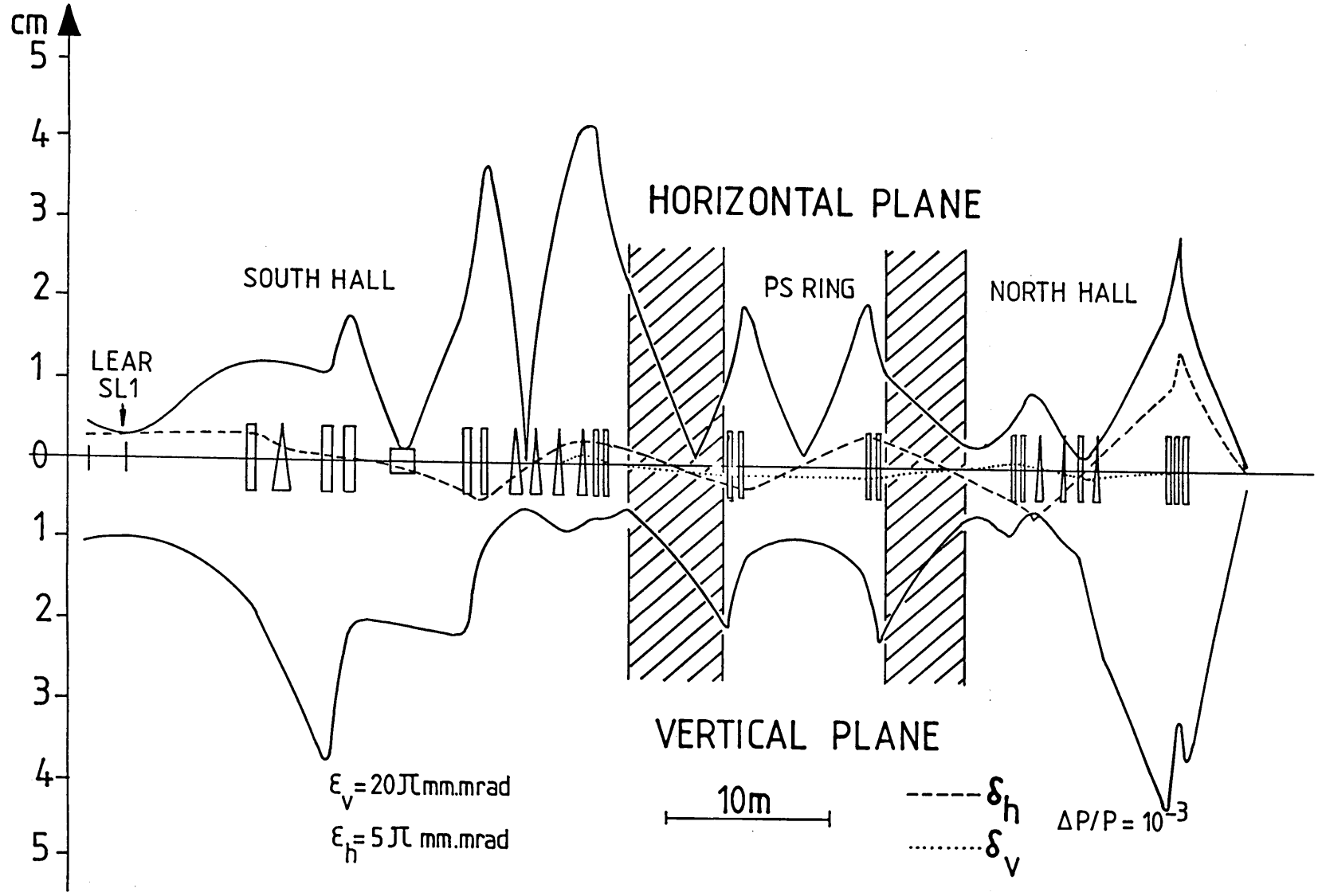

Fig. 4 - BEAM ENVELOPES AND CHROMATIC DISPERSIONS OF A TRANSFER LINE THROUGH THE PS TUNNEL TO THE NORTH HALL.

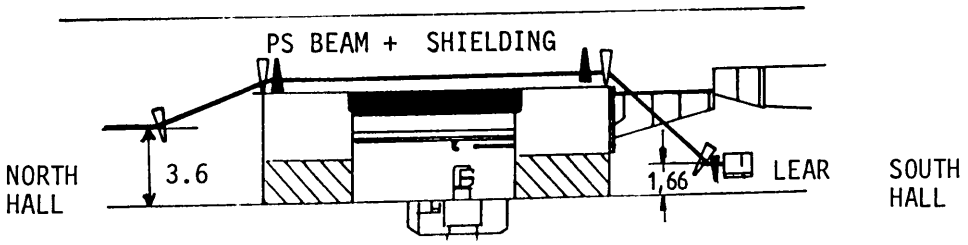

Fig.5_a Cross-section.

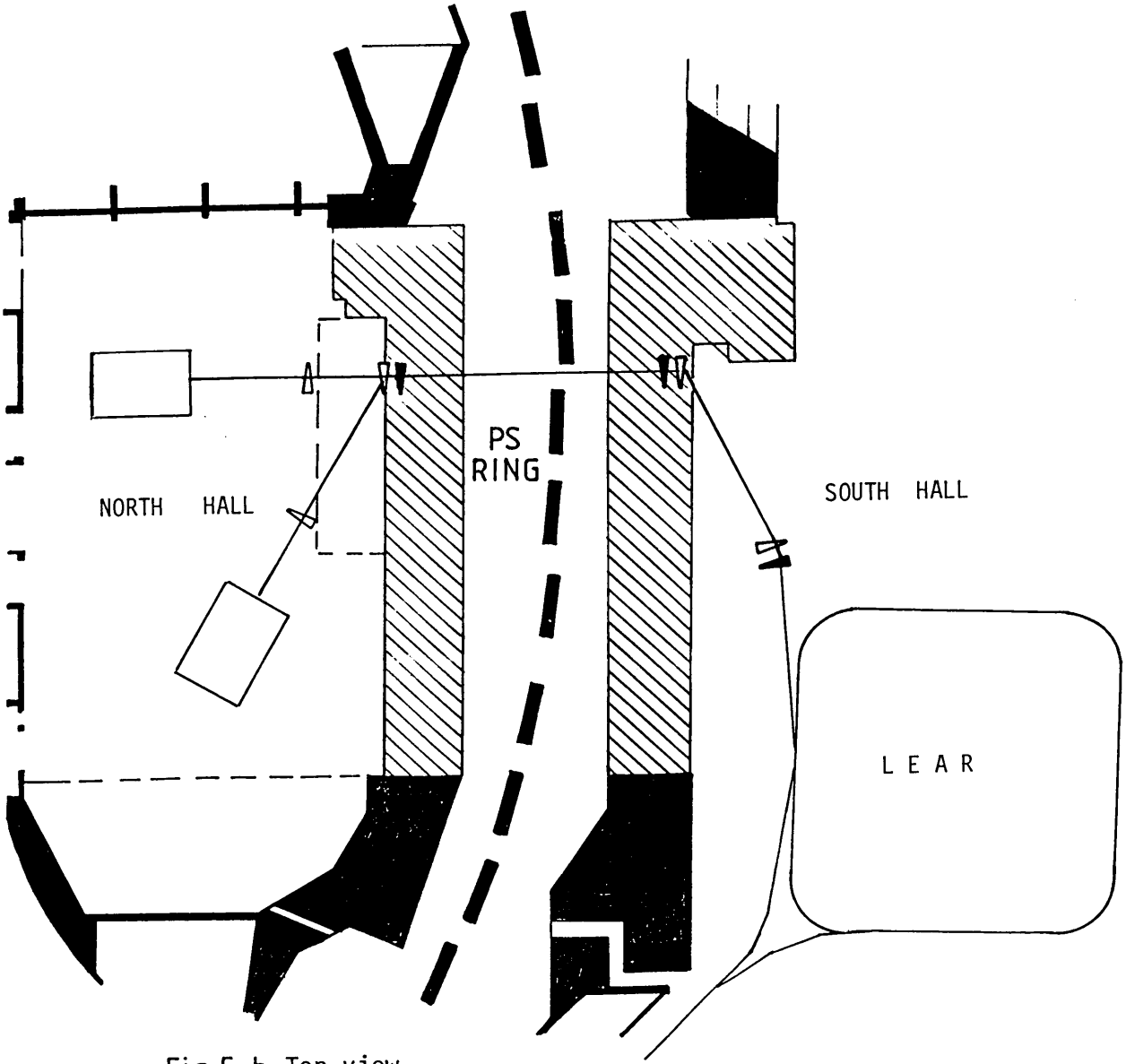

Fig.5_b Top view.

HORZ.
VERT.

Fig. 5 - POSSIBLE LAYOUT OF A TRANSFER LINE ABOVE THE PS TUNNEL TO THE NORTH HALL.

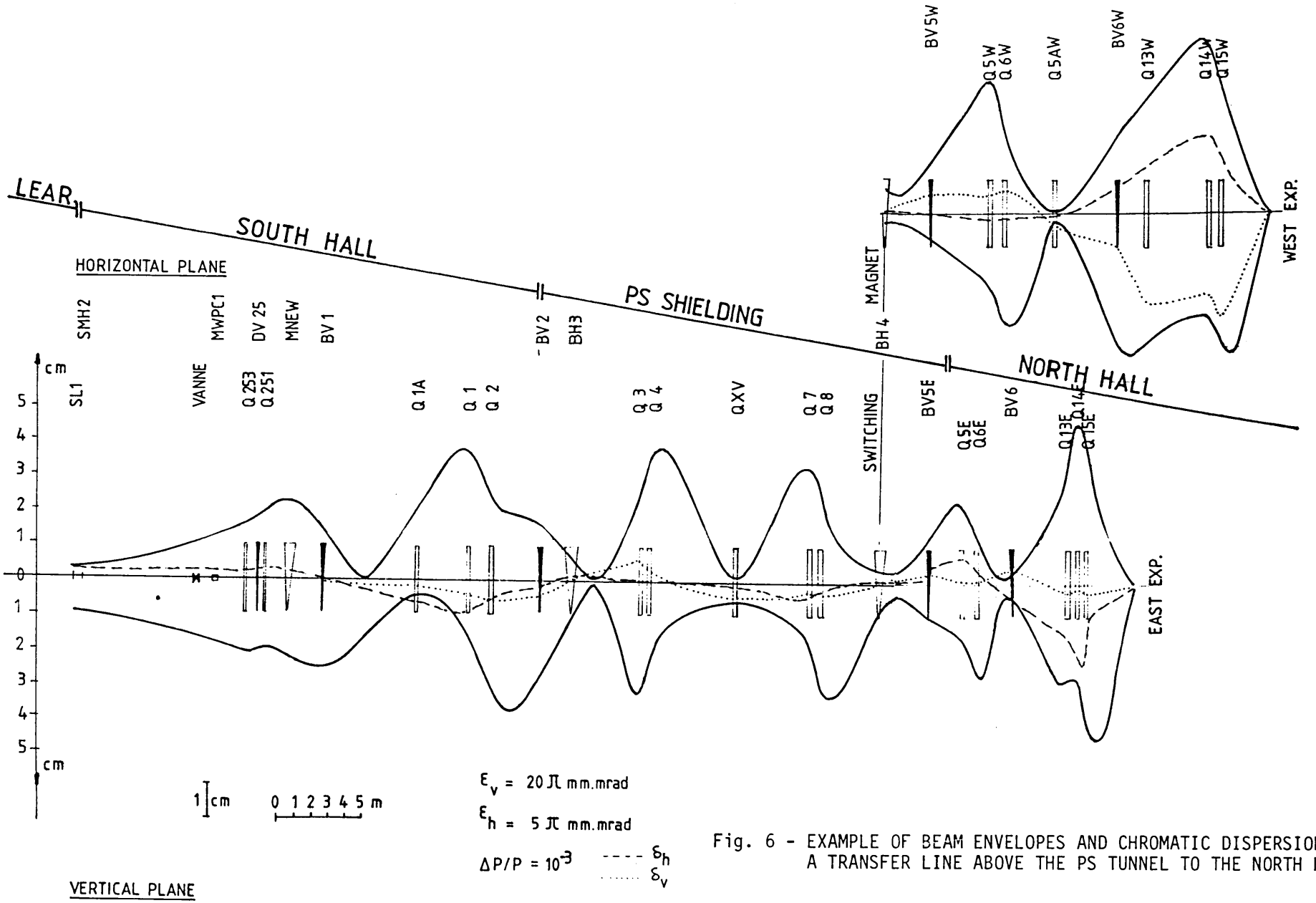

Fig. 6 - EXAMPLE OF BEAM ENVELOPES AND CHROMATIC DISPERSIONS OF A TRANSFER LINE ABOVE THE PS TUNNEL TO THE NORTH HALL.