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BEAM LOSS AND RADIATION EFFECTS IN THE SSC LATTICE ELEMENTS

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1. Introduction

The Superconducting Super Collider (SSC) [1] is supposed to be an advanced machine with relatively low beam loss-induced radiation levels. However, a fraction of the beam lost in the lattice due to pp-collisions at the interaction points, beam-gas scattering, beam halo scraping, various instabilities and errors will result in the irradiation of conventional and superconducting components of the accelerator and experimental apparatus. The level of the beam loss and its distribution along the machine structure has impact on all of the three crucial radiation effects at the SSC: quenching of the superconducting magnets, survivability of the accelerator and detectors components in the near-beam regions and influence to the environment. This paper, based on the full-scale Monte Carlo simulation, will focus onto all the major sources of beam loss in the Collider and measures to reduce the irradiation of the accelerator components.

Basic parameters of the Supercollider accepted throghout this report are as follows. Proton energy E_0=20 TeV, injection energy is 2 TeV. Number of protons circulating in each of the collider rings is $N = 1.3\times10^{14}$. Circumference is 87.12 km. The transverse normalized emittance $\varepsilon_N(\sigma)=1\ \pi$ mm-mrad. For the regular lattice (β=305 m) the beam R.M.S. sizes are σ=0.12 mm at 20 TeV and σ=0.38 mm at the injection energy. The dipole length is 15.815 m with the effective field length of 15.165 m. The magnetic field map for B_0=6.5999 T has been calculated with POISSON program by Greg Snitchler. The turn angle of each dipole is α = 1.50027 mrad. The dipole aperture is 50 mm. Two beam pipe diameters are studied 33 and 40 mm. The operating temperature is T_0=4.35 K.

2. Tolerable Beam Loss in SC Magnets

The problem of radiation fields prediction at the high energy proton accelerator consists of two unavoidable major parts :

the beam loss distribution in a phase space should be simulated, or estimated, or guesstimated;

the complicated process of lost-proton energy dissipation in material media should be carefuly simulated taking into account all the possible kinds of particles interactions with matter, the accelerator lattice and constructions.

Only the interaction of these two parts allows one to solve all the radiation problems before the new accelerator launch. Going from the first part to the second one can obtain the estimation of doses, temperature rises, etc. Going from the second to the first one can determine the tolerable levels for the beam loss, find a correspondence of an elementary loss to radiation effects and design adequate protective measures.

It is obvious that the vital problem for superconducting accelerators is quench stability of the SC magnets[1-5]. It is related to the extremely small tolerable energy deposition in the superconducting coils [3-7] and, on the other hand, to the fact the energy stored in the beams is hundreds of megajoules. Therefore a negligible fraction of the beam lost in the lattice can cause radiation-induced quenches of the SC coils.

The quench level in the SSC magnets depends on the space-time distribution of the deposited energy and proximity of the operational point to the critical one. Taking into account the Tevatron experience [3,6], data [4,5,7] and our calculational results (see Sect.4-8 below) one can suggest as a first approach the tolerable limits on the maximal energy deposition presented in Table 1. The numbers are given for the SSC dipoles and beams with parameters taken from [1]. The spread in the limits should be eliminated as a result of the further studies. At the 50 mm dipole aperture the 33 mm beam pipe diameter limits are softer by about 30% compare to 40 mm pipe, but in general one can expect the lower beam loss rate for the larger beam pipe.

3. Calculational Approach

To calculate the beam loss distribution in the SSC lattice and the corresponding radiation effects and to design the intercepting collimators, the technique [8-12] used is as used for the same purposes at Tevatron[13] and UNK [14-16]. It is a three step approach: initial beam-"target" interaction, transport of the scattered proton or produced secondaries through the lattice creating a file of protons lost in the accelerator elements and the full-scale hadronic-electromagnetic cascade simulation in the regions of interest to determine the resulting radiation effects.

On the first step the initial source of radiation is created, consisting of two parts:

i) positively charged particles with an energy of $E < 0.7 \times E_0$, negatives, neutrons and photons;

ii) positives with $E > 0.7 \times E_0$, where E_0 is an energy of the circulating protons.

Particles of group (i) are handled promptly with the MARS10 program [12] to calculate the consequent showers and radiation effects in the relatively nearby (hundred meters) downstream regions. The (ii) group is destined for the long-term tracking. In the case of pp-collision in the Interaction Points (IP) the full ISAJET [17] events are simulated. Interactions with a bent crystal and other similar targets are calculated using MARS10.

Interaction of a circulating proton out of the beam edge or beam halo with such an initial "target" as the inner edge of scraper, collimator or septa (see Fig. 1) is calculated with sophysticated algorithm [8,10]. A similar algorithm is described in [18,19]. A proton trajectory in material is very close to the material surface. One or a few scatterings can change proton direction and position and therefore the probability to exit can be significant. The exit probabilities as functions of x or θ extracted from [10] for the SSC energies are shown in Figs. 2,3. It can be seen that for the both proton energies E_0 there is a

region of **x** or θ where the exit probability is significantly high. Therefore no scraper can absorb all the entering protons and some of them will be lost downstream of it.

On the <u>second step</u> high energy positives (mainly protons) of the (ii) group are tracked through the SSC lattice with the STRUCT program [13,14]. The SSC lattice description is taken from [20]. When the particle loss occurs, i.e. its coordinates exceed the some element apperture, the particle energy, statistical weight and phase space coordinates at the upstream end of that element are recorded for the future analysis. At this stage one can get an overall beam loss distribution and find the preliminary positions for the collimators intersepting the particles with the energy close to that of the circulating beam.

On the <u>third step</u> the shower simulation in the regions with the increased particle losses is performed with the MARS10 code using the information pre-recorded on the previous step. The hadron histories in the equipment material are followed down to about 2 MeV and electromagnetic components of showers down to 0.1 MeV. All the physical processes, details of the magnetic fields, geometry and material distribution are taken into account. The three-dimensional distributions of energy deposition density and particle fluxes are calculated for any region of interest. If necessary, muon and low energy neutron distributions in the equipment, in the tunnel and surroundings can be calculated additionaly. The possibility of installation of each scraper and intercepting collimator and optimization of their parameters are explored at this stage.

A collection of the results obtained using the described technics is presented in the rest of the paper for the variety of the SSC beam loss cases. If it is not mentioned specially the results correspond to the SSC standard cell with parameters taken from [1] (see also Sect.2).

4. Beam-Gas Scattering

The permanent source of beam loss and associated radiation is interaction of the circulating protons with the gas in the beam pipe. The effect due to this source is an unavoidable almost uniform pedestal in the overall distribution. In the warm sections of the lattice there is a residulal gas. In the cold beam tube a gas is a result of the photodesorption process induced by synchrotron radiation of the circulating protons [1].

The initial gas pressure model in the SSC can be described as follows [1]:

Section	Length (km)	Gas	Pressure (Torr)
Cold	76.14	H_2	10^{-8}
		CO	10^{-10}
		CO_2	2×10^{-11}
Warm	10.98	N	10^{-9}

Then, the calculated intensities of the 20 TeV proton-nuclei interactions for 1.3×10^{14} circulating protons are

$I = 10^3$ int./(meter × sec) in the cold section,

$I = 840$ int./(meter × sec) in the warm section.

The calculated two-dimensional energy deposition distribution in the SC coil is given in Table 2 as well as the absorbed dose for the 6000 hours year operation. The data correspond to 20 TeV circulating beam. As in the rest of the paper the azimuthal angle convention is

$\phi = 0$ - up, $\phi = 90$ - out and $\phi = 270$ - in.

As one can see the numbers are rather small, in the hottest point of the coil the annual dose is about 1 Mrad. Averaged over ϕ angle the annual doses for the larger radii are much smaller:

D = 1.8 krad/yr, superinsulation at radius = 20 cm,

D = 18 krad/yr, interconnections at radius = 10 cm,

D = 77 krad/yr, interconnections at radius = 5 cm.

5. Accidental Beam Loss

5.1. ENERGY DEPOSITION DISTRIBUTION

If accidental loss of protons from the circulating beam occurs in the regular lattice the maximal angle for striking the beam pipe can be estimated as θ=0.15 mrad. The most probable region for such an incidence is one near Φ=270 deg on the beam tube in the median plane closer to the ring center. Two dimensional distributions of maximal energy deposition density calculated with MARS10 are presented in Table 3 for protons of two energies having the corresonding phase-space distributions (see Introduction) and entering the upstream end of the dipole at Φ=270 and at distance 3σ between the beam axis and the beam pipe. At the injection energy the overall magnetic field map has been scaled as B(2)=B(20)/10. The energy deposition reaches the maximum at some distance from the entrance, which is shorter for 20 Tev beam because it has a smaller σ and therefore is closer to the beam pipe at the upstream end. For both cases there is a strong radial dependence of the deposited energy.

5.2. CATASTROPHIC LOSS

The only way to guarantee a normal operation of the superconducting machine for the HEP is to provide it with the absolutely reliable beam abort system, as it has been done at the Tevatron [3]. Such a system has to exclude completely accidental losses in the lattice of the meaningful part of the beam. But to know what a catastrophic loss of the full intensity beam means for the accelerator, this situation should be considered. So much so that the catastophic loss of the whole beam in an arbitrary place around the lattice with a frequency of once per year is at the heart of a scenario for the radiation considerations in the SSC Design [1].

Supposing catastrophic loss of the full intensity for 20 TeV beam and of 1/8 of that (=1.63×10^{13}ppp) for 2 TeV beam (see [1]) and taking the results of Sect.5.1 as an input one can get the

numbers for these extreme cases. A longitudinal distribution of the deposited energy as well as the total energy are presented in Table 4. It is almost the whole energy stored in the beam. Apart from a quench some regions in the beam pipe and in the inner coil will be melted with correspondent problems to the cryogenic and vacuum systems. Even for the "soft" case of the 2 TeV accident the slot of about 3.5 meter long will be created in the steel beam pipe (See Figs. 4,5).

5.3. QUENCH LEVEL

Taking data of Tables 1 and 3 as an input instantaneous temperature rise distributions in the beam pipe and superconducting coil can be calculated. The results are presented in Table 5 for two cases of the accidental adiabatic irradiations. Initial temperature T_0=4.35K. The temperature--dependent properties of the dipole materials are of the MARS10 system [12]. The maximal temperatures in the coil $T=T_0+\Delta T$ are close to the critical one for the corresponding magnet current [7] that is in fact a basis for the quench-level beam loss numbers given in Table 1 for the adiabatic case and is in a good agreement with the Fermilab experience. Azimuthaly averaged temperature rise is significantly lower than that at the hottest point.

As an example, assuming a steady-state operational beam loss level to be equal to 1/40 of the quench one at 20 TeV, which is Q=0.2 mW/g, one can calculate the annual dose distribution in the SC dipole. The results are shown in Table 6 for 6000 hours of operation for the maximum in the Φ-distribution, which is usually at Φ=270 deg. Just to indicate the energy dependence, data at injection energy are presented for the same Q=0.2 mW/g. The maximal dose in the coil reaches 300 Mrad and azimuthaly averaged value in the minimal radial bin is 30 Mrad per year. The numbers are rather high; these levels might occur in the limited regions of the lattice and any possible measures should be undertaken to move the operational beam loss level in the most of the ring far away from the quench level. Note the

contribution of the injection stage should be considered individually for corresponding beam loss regions (see Sect.8), not as a steady-state irradiation during a year.

6. Intercepting Collimators

All the major measures to protect the superconducting magnets against the exceeding irradiation have been incorporated in the SSC design at the very beginning. These are: the overall scheme of the collider with a separate set of the boosters, a long utility straight section with the dog-leg and collimators there, the reliable beam abort system etc. But non-uniform beam loss distribution is possible in the lattice due to various reasons. The Tevatron experience [13,18] and calculations for the UNK [8,9,14-16] confirm that.

It turns out [13] the efficient way to decrease further the beam loss in the machine is an installation of collimators at some available pre-determined places. The disposition of these in the structure is chosen according to the following rules:

- the circulating and scattered beams should be separated in the space as far as possible;
- the distance L between a collimator and a downstream SC unit should be as long as possible;
- the shorter L the smaller amount of the scattered beam can be intercepted by the collimator;
- the last is controlled by positioning of the collimator jaws at the corresponding distance δ from the circulating beam edge;
- the positioning is varied during the cycle either by a beam displacement with the correctors or by moving the jaws;
- typically the collimator length is equal to 4-5 meters of steel;
- if necessary, low-energy radiation out of the collimator can be intercepted by an additional wider aperture short collimator just upstream of the SC element.

To understand these collimators as a source of radiation, calculations have been performed for various beam distributions at the collimator, various collimator lengths (L_c) and distances between collimator and SC element (L) and for two proton energies. Results of these calculations are used in preliminary arrangement of collimators in the lattice (see Sec. 7 and 8 below). Longitudinal distributions of the maximal energy deposition in the SC coils of the first magnet 1 m downstream of the 3 m long steel collimator are shown in Fig. 6 and 7 for 2 and 20 TeV protons incident on collimator. With data of Table 1 as an input, the corresponding tolerable scraping rates on this collimator are given in Table 7. For the longer collimators and larger distances L the allowable scraping rates can be higher up to one or even two orders of magnitude.

7. pp Collisions

7.1. RADIATION IN THE LOW-β INTERACTION REGION

As it has been mentioned earlier the ISAJET code [17] is used to generate 5000 minimum bias events for the one semisphere at 40 TeV pp-collision energy. TWOJET and other high-Pt options have not been included in the present consideration because it deals with the forward region (angles from the IP less than a few mrads). The produced stable hadrons and photons are used as a source for MARS10 hadronic and electromagnetic cascades full scale simulation in the SSC low-β IR at the first 326 meters downstream of the IP.

The beam pipe diameter is supposed to be 33 mm for the first 73 meters followed by 66 mm beam pipe up to the entrance to the quad QVD at the end of the considered region. In accordance with the SDC and EMPACT experimental set-ups a forward calorimeter followed by a short collimator (40 mm inner diameter) are supposed to be installed just upstream of the first low-β quad QL1. A "Zero-angle calorimeter" is assumed at the straight forward direction at the distance of 130 m from IP either to do some physics or just to absorb the forward leakage energy.

Collimators C10 and C11 with the vertical aperture ∓7 mm are introduced in the structure to reduce significantly irradiation of the vertical bends BV1+ and downstream superconducting elements in the lattice (see Table A1).

The results are presented in Figs. 8-12 and in Table 8. The first two plots show the energy deposition ε in the SC coils and in the beam pipe at the hottest region of the low-β straight section. The value of ε varies very much reaching its maximum at the downstream end of the QL1 quad. Distributions are rather symmetrical over azimuthal angle having maxima in the horizontal or vertical planes. Increasing the beam pipe diameter up to 40 mm has just a moderate influence to the maximum energy deposition in the low-β quads SC coils.

A contribution to ε of photons produced at the interaction point is shown in Fig. 10. Due to its zero charge this component itself behaves longitudinaly very smoothly compared to the total energy deposition. For the fixed beam pipe diameter this IP photon component can be described as follows

$$\varepsilon(\mathrm{MeV/g}) \cong 1.35 - 0.013\times L \text{ , for the inner coils,}$$

$$\varepsilon(\mathrm{MeV/g}) \cong 11.8\times e^{-0.0175\times L}\text{, for the beam pipe,}$$

where L is a path length in meters.

The maximal dose rate and annual dose in the superconducting coils of the low-β elements are given in Table 8 for the maximal luminosity $10^{34}\mathrm{cm}^{-2}\mathrm{s}^{-1}$. Except for three first quads the dose rate is well below the tolerable level. For QL1 and QL2 a reserve is not enough and some measures (upstream collimator positioned close to the circulating beam, say with a controlable aperture as smal as ∓7mm) should be undertaken to reduce maximal energy deposition in there. Although the situation is ten times better at $L=10^{33}\mathrm{cm}^{-2}\mathrm{s}^{-1}$, we consider such measures as necessary noting that the maximal annual dose D is close to or even exceed the radiation limits (see Sect.11) for most of the materials in the coils (except metals). In any case special attention should be paid to the material selection of that low-β quads.

The linear density of the total energy deposited in the low-β IR beam elements is given in Fig. 11. The distribution reproduces all the major features of the ones for the inner parts (Fig. 8,9). If one removes the forward calorimeter and short collimator upstream of QL1, it gives no influence to the energy deposition ε in the beam pipe and in the superconducting coils (for 40 mm aperture of calorimeter and collimator), but increases the total power deposited in QL1 by 32%, by factor of 2.6 for the first two meters of it and much bigger for the very upstream end of QL1. Therefore, for any of the SSC experiments a collimator+forward calorimeter of total length about 4 meters for steel or shorter for the heavier materials (U, Pb etc.) with controllable jaws must be instaled just upstream of the first low-β quad. This measure is the only way to reduce both maximal dose in the coils and extremely high load to the cryogenic system because, as one can see from Table 8, about 2.2 kW power is deposited in the elements of the low-β region and half of this (1130 W) is deposited in the cold mass.

"Zero-angle calorimeter" or a beam stop should be installed in the forward direction downstream of the last of the three vertical bends BV1- to absorb particles carrying about 5 TeV of energy. A possible position for such a device is at 130 meters from the IP. High energy protons and charged mesons as well as wide range energy neutrals and muons are presented in particle spectra . Momentum distributions of these forward neutrons and photons are presented in Fig. 12 and can be fitted as

$$dN/dP = 1.2\times e^{-2.57P/PO} \quad \text{for neutrons,}$$

$$dN/dP = 16.4\times e^{-15.7P/PO} \quad \text{for photons.}$$

7.2. BEAM LOSS DOWNSTREAM OF THE IR

Among the particles being created in pp collisions at IPs protons with low momentum transfer play a separate role. They can penetrate through the lattice and be lost far from IRs due to the small difference between their momentum and the momentum

of beam protons. Therefore the loss distribution downstream of the IRs will be strongly dependent on these protons' momentum distribution along with the lattice features.

The authors don't consider the ISAJET predictions in the region of low momentum transfers as adequate for reality. This problem needs a separate investigation and will be considered later. Anyway the ISAJET allows one to fill the phase space near the circulating beam and to calculate the loss distribution of these particles downsream of the IRs. Such an approach is enough to solve the task of the superconducting magnets protection by the proper distribution of intercepting collimators in the lattice.

The results are presented in Table A1 of Appendix for the SSC structure section length of 5085 meters downstream of the IP for the two possible aperture options. These are not significantly different and therefore beam loss in this case isn't the reason for the main beam pipe diameter choice. The vertical bends placed near the IP efficiently separate the circulating beam from the secondaries, which can be intercepted by the downstream collimators with the jaws placed close to the admittance boundary.

It can be easily seen from the Table the introduced collimators C10-C17 with indicated distances between the circulating beam axis and horizontal or vertical jaws can efficiently reduce the undesirable beam loss at the superconducting elements. The full-scale cascade simulation in the collimator C10 and in the downstream region confirm the necessity and high efficiency of this collimator and show no side effect to the SC elements. Collimators C11, C12, C16 and C17 are positioned at 6-8 meters distance before the SC elements so the maximum scraping rate at these is about a few times 10^9 protons per second.

Comparing loss rates at the collimators one can see that they vary within two orders of magnitude so one might have the idea to remove "insignificant" collimators C13, C15 and C17. But remembering uncertainty in the pp interaction model and possible

lattice changes, it would be strongly recommended to avoid "improvements" of that kind.

8. Beam Abort System

8.1. LAMBERTSON AS A SOURCE OF RADIATION

In the beam abort system the extraction Lambertson septum magnet followed by horizontal and vertical scrapers (SHV) [1] should be the narrowest places in the both collider rings during the injection, acceleration and collision stages in the SSC. This way the beam halo growths due to various reasons would be prevented and the corresponding secondary particles can be rather easily intercepted in the utility straight section.

To organize that one needs to provide the circulating beam position related to the Lambertson magnet pole as indicated in Table 9 for two beam pipe diameters both for injection and collisions. The shown distances Δ are equal to the corresponding accelerator admittances.

Since the beam is close to the Lambertson septum there are some reasons to suppose that the beam periphery or halo will sometimes touch the edge of the pole. These reasons are possible instabilities of the beam position and its periphery size. No quantitative estimations of the beam fraction hitting the septum can be made at the present and the following model of the incidence on the septum is just a guesstimation.

The schematic of that model is shown in Fig.13. Starting from the beam angular sizes the value of δ_0 is determined as 0.32 mm at 2 TeV and 0.11 mm at 20 TeV. The incident beam density is assumed to be linearly decreasing down to zero at $Z=\Delta+\delta$ and δ is supposed to be the model parameter. The calculated exit probabilities for particles of the group (ii) are presented in Fig.14 as function of the parameter δ. As it can be easily seen these are not negligibly small for any reasonable value of δ. The phase space cross sections of these scattered out particles at the end of the Lambertson magnet are presented in Fig. 15-18.

There are no serious reasons to consider the Lambertson

septum as a source of group (i) radiation because these particles carry out only 2.5% and 4.5% of the all leakage energy at 2 TeV and 20 TeV, correspondingly. In addition, the nearest magnet downstream of the Lambertson is completely screened by the scraper SHV.

8.2. BEAM LOSS DOWNSTREAM OF THE UTILITY STRAIGHT SECTION

The loss distributions of protons described in the previous section throughout the collider structure downstream of the Lambertson with the total length of 7377.95 meters are presented in Tables A2-A3 (see Appendix) both for injection and collision mode. One can see the regions with significant levels of the beam loss. To reduce these, additional collimators should be instaled with parameters indicated in the same tables.

The resulting beam loss distribution when all the collimators are in is shown in the same Tables A2-A3 at the right. One can see how significantly the beam loss level could be decreased.

The "zero level" of the beam loss density in Tables A2-A3 is estimated to be less than 10^{-5} protons per element per one proton hitting the Lambertson septum when the collimators are in. If the number of protons intercepted by any collimator is comparable to the number of protons hitting the Lambertson septum the effect of re-scattering can be significant. For example, the collimator C6 at the injection energy intercepts about one third of the protons scattered out from the Lambertson septum. The addition to the beam loss distribution at 2 TeV due to protons re-scattered at C6 for the "full aperture" case is presented in Table 10. At that the maximal energy deposition in the superconducting coil of the first quad QF downstream of the collimator C6 is equal to 0.05 mJ/g under the maximal allowable beam loss at the Lambertson (2.2×10^{10}ppp, see the following section), which is well below the quench level. A corresponding maximal dose in the coil is equal to 2.4×10^{-10} rad per one 2 TeV proton hitting the septum.

All the data of Tables A2-A3 were calculated for the incidence model parameter δ=0.1 mm. Table 11 shows that the loss

distribution normalized to one proton leaving the Lambertson septum is not very sensitive to δ. Therefore the dependence of the beam loss distribution on δ is mostly the dependence of the normalization factor which can be taken from Fig. 14.

8.3. ACCIDENTAL BEAM LOSS ON THE LAMBERTSON

An improper function of the abort kicker can cause the accidental beam loss on the Lambertson septum. If the vertical deflection produced by the kicker will be less than those required to put the beam into the field-free region of the Lambertson then the beam will hit the face of the septum or its inner surface.

The calculated maximal energy deposition ε_m in GeV/g per one hitting proton is presented below for the beam incident on the face of the septum and for two values of the angle α between the septum inner surface and the incident beam axis:

E_0 , TeV	Face inc.	α=1 mrad	α=0.5 mrad
2	21.	4.6	3.0
20	1100.	250.	170.

Supposing accidental beam intensity at 20 TeV as 1.3×10^{14} and as 1/8 of this value at the injection one can estimate that instantaneous overheating of the septum will be high enough to melt it. In the case of the beam face incidence first 1.2 m and 2.6 m of the septum will be melted at 2 TeV and 20 TeV correspondingly. To protect the septum one can place a "false septum" upstream of it. But it will not work, if the missing vertical deflection of the beam will cause the incidence on the inner surface of the septum. The melted spot in this case will be similar to those shown on Fig. 4-5.

As one can see from the Table 12 the maximal dose absorbed in the Lambertson coils caused just by a single accident is rather high. Therefore, these two effects - melting and high doses in the Lambertson - are two additional serious reasons for the

creation of the extremely reliable kicker for the beam abort system.

Assuming $\Delta T=500^{0}C$ as the tolerable limit for an instantaneous temperature rise in the septum one can determine the maximum number of protons per one fast accidental beam loss at the Lambertson

$$N = 1.7\times10^{9} \text{ protons per spill at 20 TeV,}$$
$$N = 2.2\times10^{10} \text{ protons per spill at 2 TeV.}$$

Table 13 summarizes up the results of the full-scale cascade simulations in the nearby regions of the "hottest" collimators C1 and C6 for various scenarios of the beam loss at the Lambertson septum.

9. Introducing a Dispersion into the Utility Straight Section

In the current zero-dispersion structure of the SSC straight section [1] there is no way to intercept the protons with a difference in the momentum Δp, because these have a zero radial displacement $\Delta R = D \times \Delta p/p = 0$, where $D=0$ is a dispersion. In the SSCDR [1] a section between the utility and low-β regions looks as follow:

1) two cells of a dispersion suppressor;
2) six normal cells;
3) two cells of a dispersion suppressor;
4) two an a half normal cells without dipoles;
5) low-β region starting from QL6.

One can strongly recommend insertion of a segment (4) between (1) and (2) and put in that segment two collimators just downstream of the QF quad. In this case the dispersion in that segment would be equal to 1.8 meter, as in the regular lattice. The circulating beam and scattered protons having different momenta would be separated in the space and could be intercepted with the collimators. The scraping rate could be controled taking into account the results of Sect.6.

10. Bent Crystal

A use of the bent crystal for the low-intensity beam extraction from the SSC with no influence on the collider experiments is a very attractive possibility for a fixed target B physics experiment and for the test beams. There are two possible schemes of the extraction: i) prompt with the crystal in the East straight section and ii) increasing of the betatron oscillation amplitude with the crystal in the lattice and consequent extraction with the septum magnet in the straight section. The intensity calculated from the beam halo rate of such a "parasitic" extraction is about 10^7 p/sec [21]. For both schemes the beam-crystal interactions at this level are a rather moderate source of irradiation of the downstream SC magnets, giving a well below tolerable value.

11. Conclusions and SC Magnets Materials Choice

Distribution of the radiation effects along the SSC structure is rather non-uniform following the beam loss behaviour. Analyzing the results of the previous sections one can arrive at the following conclusions on the annual dose in the SC coils for 6000 hours operational year at the maximal parameters (10^{34}) in the SSC:

- the lower limit for the maximal dose D_{max} is about 1 Mrad per year;
- the upper limit for the maximal dose D_{max} in the coils can occur in a few low-β quads and is equal to about 3000 Mrad/yr;
- most probable value for the majority of the SC beam elements with all the collimators and other measures suggested in Sections 7-9 and with the corresponding low level of the beam abort system signal can be estimated as $D_{max} \cong 10$ Mrad/yr scattered in the range between a few Mrad and one hundred Mrad per year;
- maximal dose D_{max} is reached at the inner radius of the inner coils usually in the median plane; averaged over azimuth ϕ

dose is smaller $D=(0.1-0.25)D_{max}$ depending on the irradiation conditions;

- ratio of the D_{max} and the corresponding doses averaged over radii of the inner coil D_i and the outer coil D_o is 1:0.65:0.26.

Radiation resistance of the materials to be used in the SSC superconducting magnets is given in Table 14 [22]. Assuming a 20 year for the SSC life-time, taking into account all the enumerated sources of the beam loss in the Collider and choosing the appropriate materials one can estimate the reliability of the machine. Special attention should be paid to the quads in the low-β regions, where doses being reasonably small at luminosity $10^{33} cm^{-2} s^{-1}$ becomes very high at ten times greater luminosity.

12. Suggestions for the Future

1. Studies of the tolerable energy deposition in the SSC dipoles and quads as function of proton energy, irradiation conditions, time and cooling system parameters at 4.35K and 1.8K.
2. Continuous upgrade of the SSC-IHEP Monte-Carlo Package, marriage of the SYNCH/TEAPOT and MARS10 programs, standartization of file exchange formats.
3. Multi-turn beam loss calculations simulating all the possible errors in systems and the beam instabilities.
4. Calculations of the accelerator and HEP detectors interference with a continuos update of the details of the detectors description; collimators upstream of the low-β quads; zero-angle calorimeter/beam stop; irradiation of the detector components etc.
5. Introducing a dispersion into the Utility Straight Section to design an effective beam loss localization system.
6. Beam loss calculations for the beam injection and abort lines.
7. Beam halo rate full-scale re-calculations in the application to the bent crystal extraction.

8. pp-collision model update, especially for elastic and diffractive particles.
9. Muons in and around the experimental halls and the arcs; muons in bypass configuration: operational aspects.
10. Further detailed studies of the beam loss distribution and intercepting collimators in the "hot" regions of the SSC lattice with formation of low-energy neutrons sources.
11. Low energy neutrons full-scale calculations: electronics in the tunnel.
12. Low energy neutrons full-scale calculations: labyrinths and shafts.

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Table 1. Tolerable energy deposition and accidental beam loss in the SSC dipoles

Energy	Fast		Slow	
(TeV)	mJ/g	ppp	mW/g	p/sec
2	5-10	3.1×10^{8}	20	6.3×10^{8}
20	0.3-1	2.3×10^{6}	4-8	1.9×10^{7}

*) Beam loss limits are given for the larger energy deposition

Table 2. Energy deposition and annual dose due to beam-gas scattering

Φ(deg)	270-275	275-280	280-290	290-80	80-100
			Energy deposition (GeV/g per int./meter)		
Radius(mm)					
24 - 25	3.90	2.20	1.10	0.62	2.60
25 - 31	2.90	1.40	0.64	0.30	2.20
31 - 38	1.40	0.81	0.36	0.13	1.30
38 - 44	0.86	0.71	0.27	0.09	0.73
44 - 50	0.54	0.38	0.17	0.06	0.52
			Annual dose (Mrad per year=6000 hours)		
Radius(mm)					
24 - 25	1.37	0.77	0.39	0.22	0.91
25 - 31	1.02	0.49	0.22	0.11	0.77
31 - 38	0.49	0.28	0.13	0.05	0.46
38 - 44	0.30	0.25	0.10	0.03	0.26
44 - 50	0.19	0.13	0.06	0.02	0.18

*) Φ = 0 -up, Φ = 90 - out and Φ = 270 - in.

Table 3. Energy deposition distribution in the dipole at Φ_{max} (GeV/g per 1 proton)

Depth (m)	Radius (mm) 20-21	25-30	30-35	35-40	40-45	45-50	170-220
	Beam pipe	Superconducting coil					Superins.
				2 TeV			
0.0 - 2.0	.19E-1	.72E-3	.33E-3	.12E-3	.97E-4	.55E-5	.18E-6
2.0 - 3.0	.38E+0	.17E-1	.52E-2	.21E-2	.72E-3	.53E-3	.23E-5
3.0 - 3.5	.11E+1	.61E-1	.18E-1	.67E-2	.58E-2	.21E-2	.56E-5
3.5 - 4.0	.17E+1	.78E-1	.29E-1	.11E-1	.68E-2	.32E-2	.88E-5
4.0 - 4.5	.20E+1	.13E+0	.42E-1	.14E-1	.84E-2	.44E-2	.20E-4
4.5 - 5.0	.13E+1	.11E+0	.36E-1	.17E-1	.81E-2	.55E-2	.22E-4
5.0 - 5.5	.53E+0	.68E-1	.23E-1	.11E-1	.56E-2	.36E-2	.32E-4
5.5 - 6.0	.16E+0	.36E-1	.11E-1	.60E-2	.38E-2	.19E-2	.33E-4
6.0 - 7.0	.33E-1	.18E-1	.68E-2	.42E-2	.16E-2	.11E-2	.11E-4
7.0 - 8.0	.12E-1	.85E-2	.48E-2	.15E-2	.71E-3	.44E-3	.67E-5
8.0 -10.0	.80E-2	.41E-2	.21E-2	.11E-2	.59E-3	.25E-3	.31E-5
10. -15.0	.45E-2	.18E-2	.94E-3	.56E-3	.30E-3	.16E-3	.21E-6
				20 TeV			
0.0 - 1.0	.79E-1	.34E-2	.20E-2	.91E-3	.27E-3	.20E-3	.35E-6
1.0 - 1.5	.29E+1	.13E+0	.65E-1	.30E-1	.28E-1	.98E-2	.30E-5
1.5 - 2.0	.15E+2	.79E+0	.39E+0	.29E+0	.20E+0	.16E+0	.10E-2
2.0 - 2.5	.25E+2	.19E+1	.11E+1	.76E+0	.51E+0	.35E+0	.26E-2
2.5 - 3.0	.15E+2	.17E+1	.86E+0	.60E+0	.42E+0	.31E+0	.16E-2
3.0 - 3.5	.28E+1	.69E+0	.37E+0	.26E+0	.18E+0	.13E+0	.50E-3
3.5 - 4.0	.70E+0	.28E+0	.15E+0	.11E+0	.63E-1	.33E-1	.62E-3
4.0 - 5.0	.22E+0	.11E+0	.76E-1	.59E-1	.46E-1	.41E-1	.26E-3
5.0 - 6.0	.94E-1	.58E-1	.50E-1	.36E-1	.31E-1	.22E-1	.13E-3
6.0 - 8.0	.63E-1	.58E-1	.50E-1	.31E-1	.20E-1	.16E-1	.64E-4
8.0 -10.0	.58E-1	.27E-1	.15E-1	.12E-1	.11E-1	.57E-2	.10E-3
10. -15.0	.28E-1	.60E-2	.44E-3	.28E-2	.27E-2	.26E-2	.14E-4

*) Φ-averaged at the cascade maximum and $25<r<30$ mm: 0.022 Gev/g at 2 TeV and 0.20 GeV/g at 20 TeV.

Table 4. Lateral integrated energy deposition in the dipole for catastrophic beam loss

Depth (m)	E (GeV/proton)	W (MJ/pulse)
	2 TeV	
0.0 - 1.5	2.5	0.01
1.5 - 3.0	63.2	0.16
3.0 - 4.5	560.0	1.46
4.5 - 6.0	625.0	1.63
6.0 - 7.5	236.0	0.62
7.5 - 9.0	121.0	0.32
9.0 -10.5	75.2	0.20
10.5 -12.0	45.2	0.12
12.0 -13.5	20.1	0.05
13.5 -15.0	15.9	0.04
Total	1764.1	4.61
	20 TeV	
0 - 1	14	0.02
1 - 2	1710	35.6
2 - 3	8720	181.4
3 - 4	3810	79.3
4 - 5	1410	29.3
5 - 6	805	16.7
6 - 7	508	10.6
7 - 9	682	14.2
9 - 11	330	6.9
11 - 15	313	6.5
Total	18302	380.5

*) Pulse is $N=1.63\times10^{13}$ppp for 2 TeV beam
and $N=1.30\times10^{14}$ppp for 20 TeV beam

Table 5. Instantaneous temperature rise ΔT (K) at Φ_{max}

Depth(m)	Radius (mm) 20-21	25-30	30-35	35-40	40-45	45-50
	Beam pipe	Superconducting coil				
	2 TeV at $N=3\times10^8$ ppp					
0.0 - 2.0	1.40	0.08	0.04	0.01	0.01	0.00
2.0 - 3.0	7.30	1.30	0.56	0.21	0.08	0.06
3.0 - 3.5	11.00	3.00	1.40	0.62	0.55	0.22
3.5 - 4.0	13.00	3.50	1.90	0.91	0.63	0.33
4.0 - 4.5	14.00	4.40	2.40	1.20	0.76	0.43
4.5 - 5.0	11.00	4.20	2.20	1.30	0.73	0.52
5.0 - 5.5	8.30	3.20	1.60	0.94	0.53	0.36
5.5 - 6.0	4.90	2.20	0.97	0.56	0.38	0.19
6.0 - 7.0	2.10	1.30	0.63	0.41	0.16	0.12
7.0 - 8.0	0.98	0.76	0.48	0.16	0.08	0.05
8.0 -10.0	0.72	0.41	0.22	0.12	0.06	0.03
10. -15.0	0.44	0.19	0.10	0.06	0.03	0.02
	20 TeV at $N=2\times10^6$ ppp					
0.0 - 1.0	0.057	0.003	0.002	0.001	0.000	0.000
1.0 - 1.5	1.500	0.090	0.047	0.022	0.020	0.007
1.5 - 2.0	3.900	0.500	0.270	0.200	0.140	0.110
2.0 - 2.5	5.100	1.100	0.680	0.490	0.340	0.240
2.5 - 3.0	3.900	0.970	0.540	0.390	0.280	0.220
3.0 - 3.5	1.400	0.450	0.250	0.180	0.130	0.090
3.5 - 4.0	0.450	0.200	0.110	0.078	0.046	0.024
4.0 - 5.0	0.150	0.077	0.055	0.043	0.033	0.030
5.0 - 6.0	0.068	0.043	0.037	0.026	0.023	0.016
6.0 - 8.0	0.046	0.043	0.037	0.022	0.014	0.012

*) Φ-averaged at the cascade maximum and $25<r<30$ mm:
$\Delta T=1.52$K at 2 TeV and $\Delta T=0.13$K at 20 TeV.

Table 6. Annual dose (Mrad per year) at Φ_{max} and Q=0.2 mW/g

Depth (m)	Radius (mm) 20-21	25-30	30-35	35-40	40-45	45-50	170-220
	Beam pipe	Superconducting coil					Superins.
	2 TeV at $I=3.0\times10^6$ p/sec						
0.0 - 2.0	38.00	1.44	0.66	0.24	0.19	0.01	0.00
2.0 - 3.0	760.00	34.00	10.40	4.20	1.44	1.06	0.00
3.0 - 3.5	2200.00	122.00	36.00	13.40	11.60	4.20	0.01
3.5 - 4.0	3400.00	156.00	58.00	22.00	13.60	6.40	0.02
4.0 - 4.5	4000.00	260.00	84.00	28.00	16.80	8.80	0.04
4.5 - 5.0	2600.00	220.00	72.00	34.00	16.20	11.00	0.05
5.0 - 5.5	1060.00	136.00	46.00	22.00	11.20	7.20	0.06
5.5 - 6.0	320.00	72.00	22.00	12.00	7.60	3.80	0.07
6.0 - 7.0	66.00	36.00	13.60	8.40	3.20	2.20	0.02
7.0 - 8.0	24.00	17.00	9.60	3.00	1.42	0.88	0.01
8.0 -10.0	16.00	8.20	4.20	2.00	1.18	0.50	0.00
10. -15.0	9.00	3.60	1.88	1.12.	0.60	0.32	0.00
	20 TeV at $I=4.4\times10^5$ p/sec						
0.0 - 1.0	11.85	0.51	0.30	0.14	0.04	0.03	0.00
1.0 - 1.5	435.00	19.50	9.75	4.50	4.20	1.47	0.00
1.5 - 2.0	2250.00	118.50	58.50	43.50	30.00	24.00	0.15
2.0 - 2.5	3750.00	285.00	165.00	114.00	76.50	52.50	0.39
2.5 - 3.0	2250.00	255.00	129.00	90.00	63.00	46.50	0.24
3.0 - 3.5	420.00	103.50	55.50	39.00	27.00	19.50	0.08
3.5 - 4.0	105.00	42.00	22.50	16.50	9.45	4.95	0.09
4.0 - 5.0	33.00	16.50	11.40	8.85	6.90	6.15	0.04
5.0 - 6.0	14.10	8.70	7.50	5.40	4.65	3.30	0.02
6.0 - 8.0	9.45	8.70	7.50	4.65	3.00	2.40	0.01
8.0 -10.0	8.70	4.05	2.25	1.80	1.65	0.86	0.01
10. -15.0	4.20	0.90	0.66	0.42	0.41	0.39	0.00

*) Φ-averaged at the cascade maximum and $25<r<30$ mm:
D=44 Mrad at 2 TeV and D=30 Mrad at 20 TeV.

Table 7. Tolerable scraping rate

Energy (TeV)	Fast (ppp)	Slow (p/sec)
2	6.3×10^{9}	1.3×10^{10}
20	7.8×10^{7}	6.3×10^{8}

Table 8. Maximal energy deposition ε, absorbed dose rate D' and annual dose D in the superconducting coils of the SSC low-β IR beam elements. The last column is the power P deposited in the element. Interaction rate at the IP is 10^{9} per second at $L=10^{34}cm^{-2}s^{-1}$. The operational year is 10^{7} sec.

Name	Length (m)	Path Length (m)	ε (MeV/g per 1 int.)	D' (mW/g)	D (Mrad per year)	P (W)
		0				
DL0	15.00	15.00				38.4
DL1	5.00	20.00				16.8
FWD CAL	3.00	18.00				140.8
COLLIM	2.00	20.00				24.8
QL1	15.14	35.14	20	3.20	3200	513.1
OR	0.80	35.94				3.7
QL2	11.22	47.16	12	1.92	1920	155.3
D	1.00	48.16				2.0
QL2	11.22	59.38	14	2.22	2220	260.3
OR	0.80	60.18				3.6
QL3	12.96	73.14	6	0.96	960	161.9
D3	7.00	80.14				1.0
BV1-	5.00	85.14	0.4	0.06	64	5.4
D	1.00	86.14				0.7
BV1-	5.00	91.14	0.7	0.11	112	7.6
D	1.00	92.14				0.3
BV1-	5.00	97.14	1.3	0.21	208	12.7
D	33.00	130.14				1.6
Z-CAL	1.00	131.14				809.8
D	76.00	207.14				3.6
C10	4.00	211.14				78.7
D	78.00	281.94				
BV1+	5.00	286.94				0.1
Total						2242.2

*) Maximal numbers ε, D' and D in the superconducting elements correspond to the maxima in the azimuthal distributions at the inner radii of the inner coils.

**)Outer radius for all the elements assumed to be equal to 15cm

Table 9. The circulating beam axis positions Δ related to the inner edge of the Lambertson magnet pole

Collider mode	Beam pipe diameter of standard cell quads (mm)	Beam pipe diameter of QL5, QL6, QU1 and QU2 (mm)	Beam-pole distance Δ (mm)
Injection at E=2 TeV $\beta^* = 8$ m	33 40	40 50	9.2 11.2
Collisions at E=20 TeV $\beta^* = 0.5$ m	33 40	40 50	3.0 3.6

Table 10. Contribution to the beam loss of 2 TeV protons re-scattered on collimator C6

Element No.	Element Name	Beam Loss (protons/1hp) From the Lambertson	Beam Loss (protons/1hp) From C6
263			3.9×10^{-4}
264	QF		5.7×10^{-5}
267			1.3×10^{-5}
270	C7	3.8×10^{-5}	1.2×10^{-4}
275			6.6×10^{-5}
276	QL5		4.8×10^{-5}
277			2.5×10^{-5}
278	QL4		4.0×10^{-4}
314	C8		2.3×10^{-4}
381	QL4		1.0×10^{-4}
525	C9		1.2×10^{-4}

Table 11. Beam loss downstream of the Lambertson magnet per one proton scattered out from the septum at 20 TeV. δ is the parameter of incidence model.

Element	No	4	10	11	12	22	26	51	262	489
	Name	C1	QU2	TUB	C2	C3	C4	C5	C6	QL4
δ, mm	0.1	2.6-2	7.8-4	7.5-4	3.0-2	1.2-2	2.4-2	2.6-4	3.3-1	2.6-4
	1.0	2.7-2	5.2-5	1.6-4	2.7-2	1.3-2	1.6-2	1.7-6	3.1-1	6.0-4

*) 2.6-2 = 2.6×10^{-2}

Table 12. Radiation doses to the abort Lambertson coils due to the accidental beam loss (Mrad/accident).

Section number	2 TeV 1.63×10^{13}ppp	20 TeV 1.3×10^{14}ppp
1	1.90	150.0
2	0.74	43.0
3	0.38	29.0
4	0.18	14.0
5	0.16	11.0
6	0.10	6.5
7	0.09	7.4
8	0.07	2.9
9	0.05	2.3
10	0.05	1.8
11	0.02	1.4
12	0.02	1.4
13	0.02	0.5
14	0.02	0.5
15	0.02	0.6

*) Section length is equal to 5.9 m.

Table 13. Maximal energy deposition ε, absorbed dose d and annual dose D in the coil of the first beam elements downstream of collimators C1 and C6 for various scenarios of beam loss at the Lambertson septum

Scenario	Value	B behind C1		QF behind C6	
		2 TeV	20 TeV	2 TeV	20 TeV
1	ε (mJ/g)	0.0215	0.0025	0.0528	0.0015
	d (rad)	2.15	0.25	5.28	0.15
2	D (Mrad/yr)	0.21	0.32	0.52	0.19
3	D (Mrad/yr)	7.61	11.5	18.7	6.86
ε (GeV/g per 1 p @Lamb)		6.1×10^{-6}	9.2×10^{-6}	1.5×10^{-5}	5.5×10^{-6}

*) Parameters of collimators are given in Tables A2 and A3.

Scenario 1: Maximal tolerable single accidental beam loss (2.2×10^{10}ppp at 2 TeV and 1.7×10^{9} ppp at 20 TeV)

Scenario 2: Routine operation - 10^{8} p/sec halo rate

Scenario 3: Routine operation - 10% full intensity per hour of beam scraping at the Lambertson and downstream scraper

Table 14. Radiation resistance of the selected materials

Material	Tolerable dose (Mrad)
Kapton, polyimide Kapton film Carbon-fiber reinforced tube Carbon-fiber-filled epoxy rods	5000
G11 CR tube	2000
PK102 (epoxy) Crest 7450 epoxy Fiberglass (epoxy impregnated)	1000
Fiberglass rein.polyester resin Alum.mylar Superinsulation	500 200 200
Electrical insulation	10-1000
Tefzel adhesive Cerex spunbonded nylon	50
Reemay spunbonded polyester Teflon	6 1

*) 1 Mrad = 10^4 Gy

FIGURE CAPTIONS

Fig. 1. Schematic of protons incidence on the "target" in the lattice.

Fig. 2. The exit probabilities in the case of "incidence A". PO is a momentum of the incident proton.

Fig. 3. The same as Fig. 2 in the case of "incidence B".

Fig. 4. Instantaneous temperature rise in the SSC lattice beam pipe for the accidental 2 TeV beam loss. The various curves correspond to the different azimuthal distances from the beam axis.

Fig. 5. Adiabatic isotherms in the beam pipe for the accidental 2 TeV beam loss of 1.63×10^{13} protons. Initial temperature T_0=4.35K. Isotherms are shown in Centigrades. l is a distance from the beam axis on the beam pipe in the azimuthal direction.

Fig. 6. Longitudinal distribution of the maximal energy deposition in the SC coil of the dipole 1 meter downstream of the collimator for 20 TeV beam loss on it.

Fig. 7. The same as Fig.6, for 2 TeV protons loss at the collimator.

Fig. 8. Longitudinal distribution of the maximal energy deposition in the SC coils in the low-β region downstream of the SSC IP. Results are normalized per one 20×20 TeV pp-interaction.

Fig. 9. The same as Fig.8, in the beam pipe.

Fig.10. Contribution into the maximal energy deposition of photons from the 20×20 TeV pp interaction point.

Fig.11. Energy deposited per one meter of the low-β magnetic elements downstream of the 20×20 TeV interaction point.

Fig.12. Momentum distributions of the neutrals at the zero - angle calorimeter position downstream of the 20×20 TeV interaction point.

Fig.13. Schematic of the model describing protons incidence on the Lambertson septum. Z and R are the vertical and the horizontal coordinates, correspondingly. Z' is the space angle projection to the vertical plane.

Fig.14. Probabilities of the incident proton leakage out of the Lambertson septum as function of the parameter δ.

Fig.15. Phaze space distribution of the 20 TeV scattered protons in the vertical plane at the downstream end of the Lambertson magnet.

Fig.16. The same as Fig.15, in the horizontal distribution.

Fig.17. The same as Fig.15, for 2 TeV protons.

Fig.18. The same as Fig.15, for 2 TeV protons in the horizontal plane.

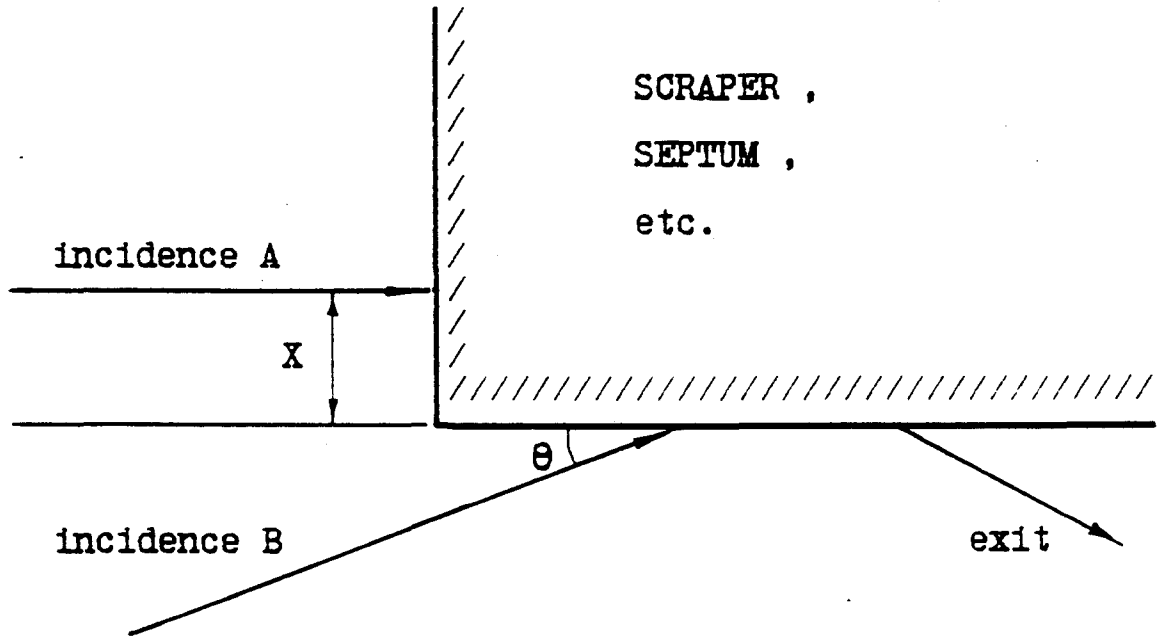


Fig. 1

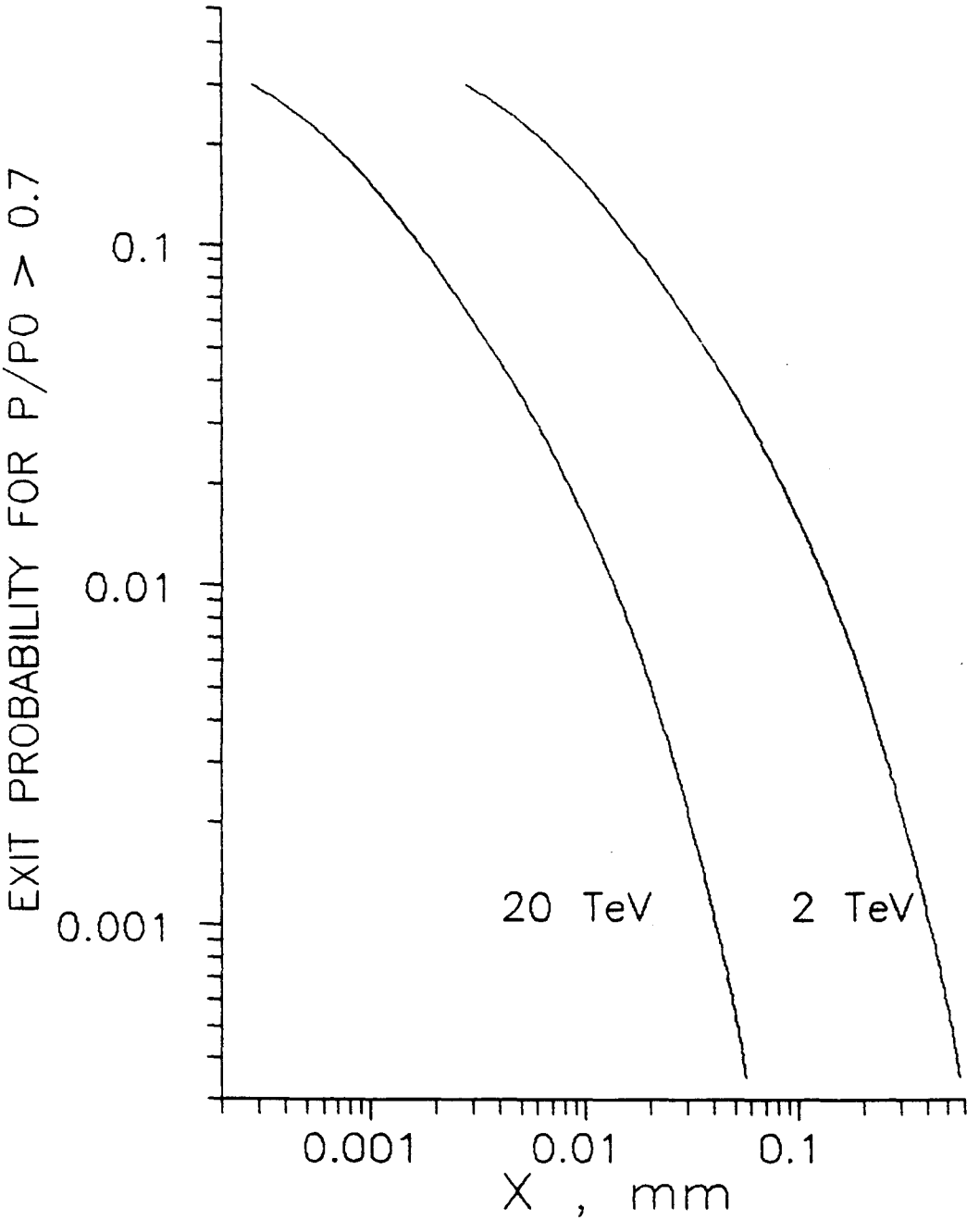

EXIT PROBABILITY FOR P/PO > 0.7
0.1
0.01
0.001
20 TeV
2 TeV
0.001
0.01
0.1
X , mm

Fig.2

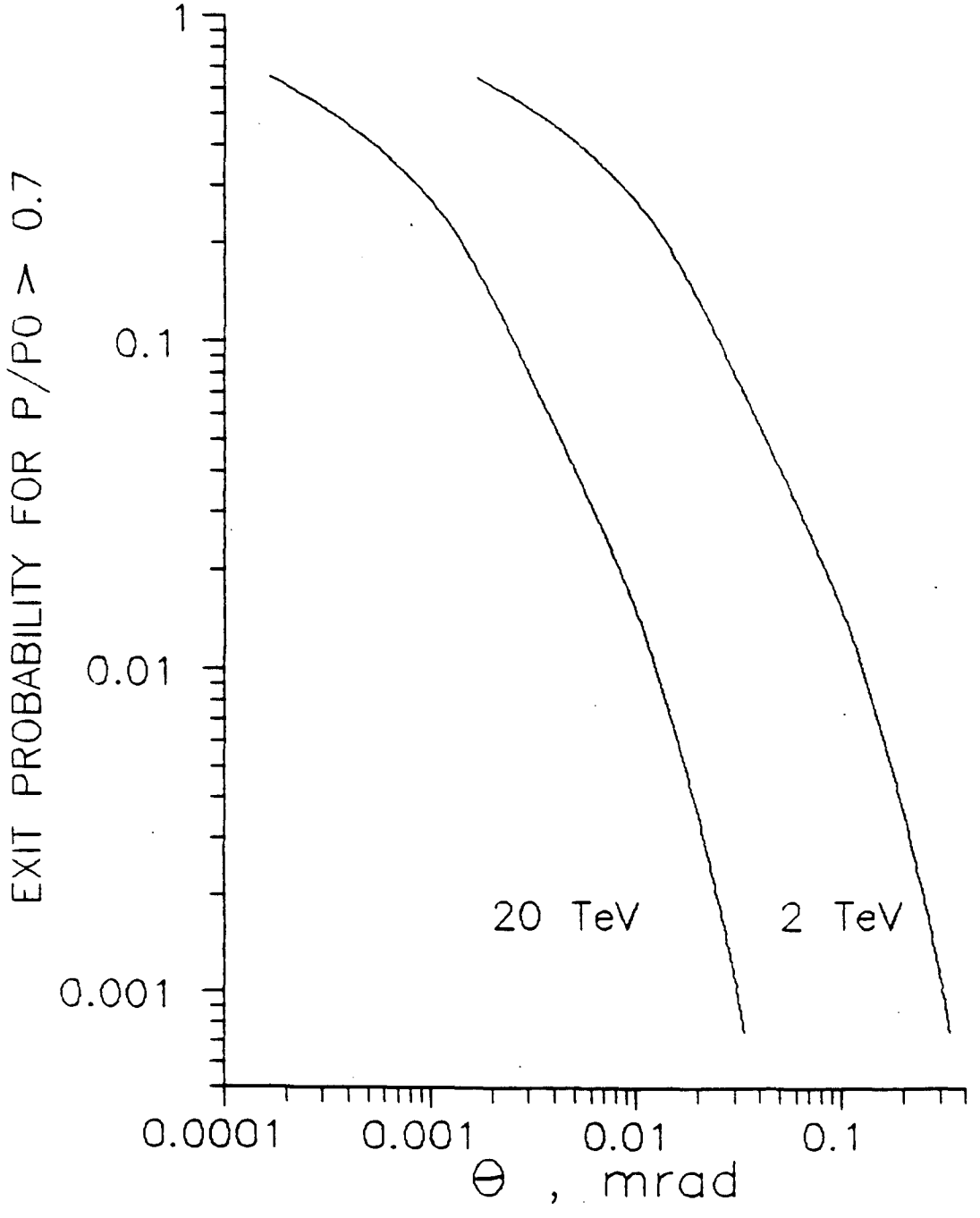

EXIT PROBABILITY FOR P/P0 > 0.7
1
0.1
0.01
0.001
20 TeV
2 TeV
0.0001
0.001
0.01
0.1
θ , mrad

Fig.3

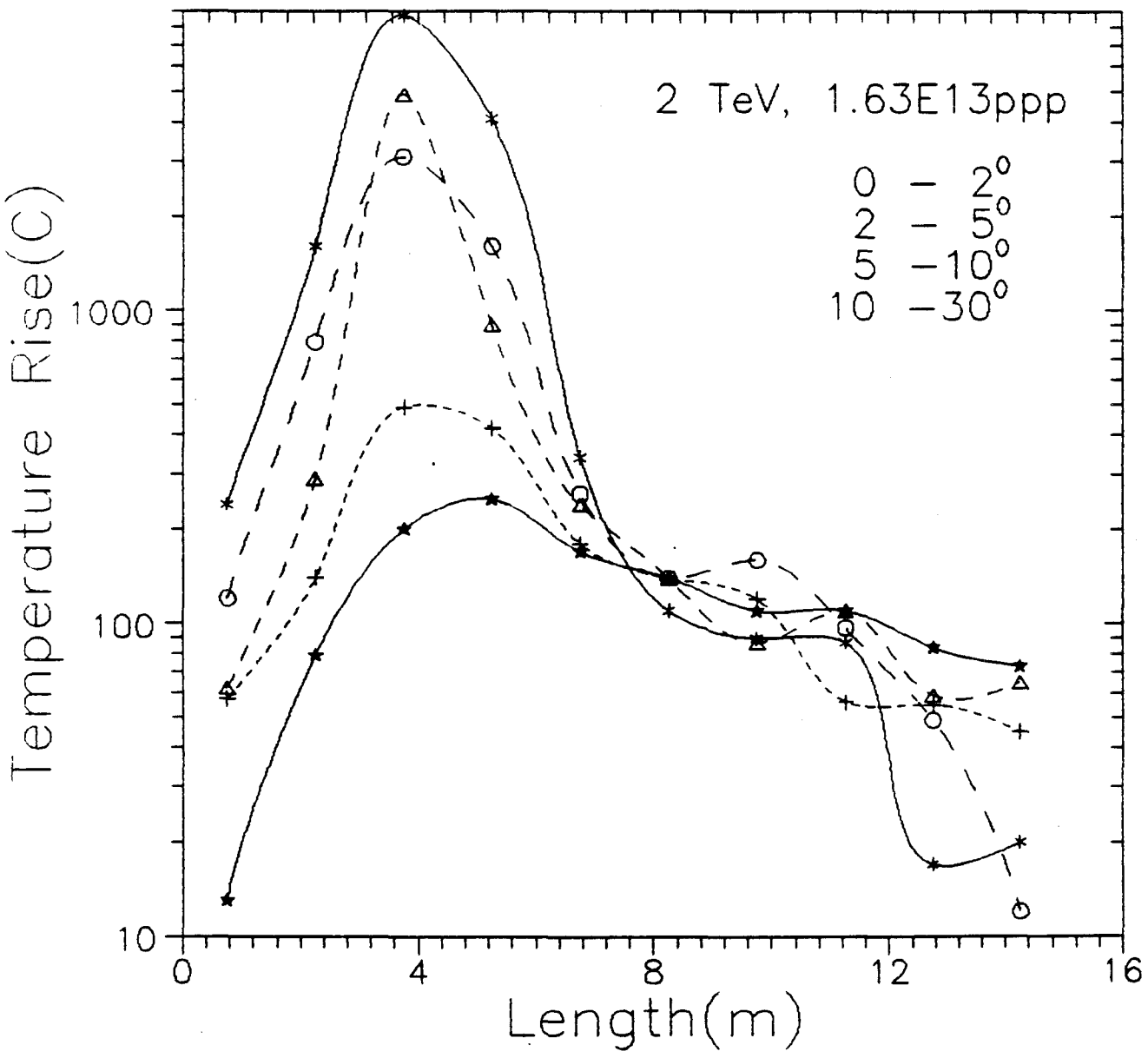

2 TeV, 1.63E13ppp
0 - 2°
2 - 5°
5 -10°
10 -30°
Temperature Rise(C)
1000
100
10
0
4
8
12
16
Length(m)

Fig.4

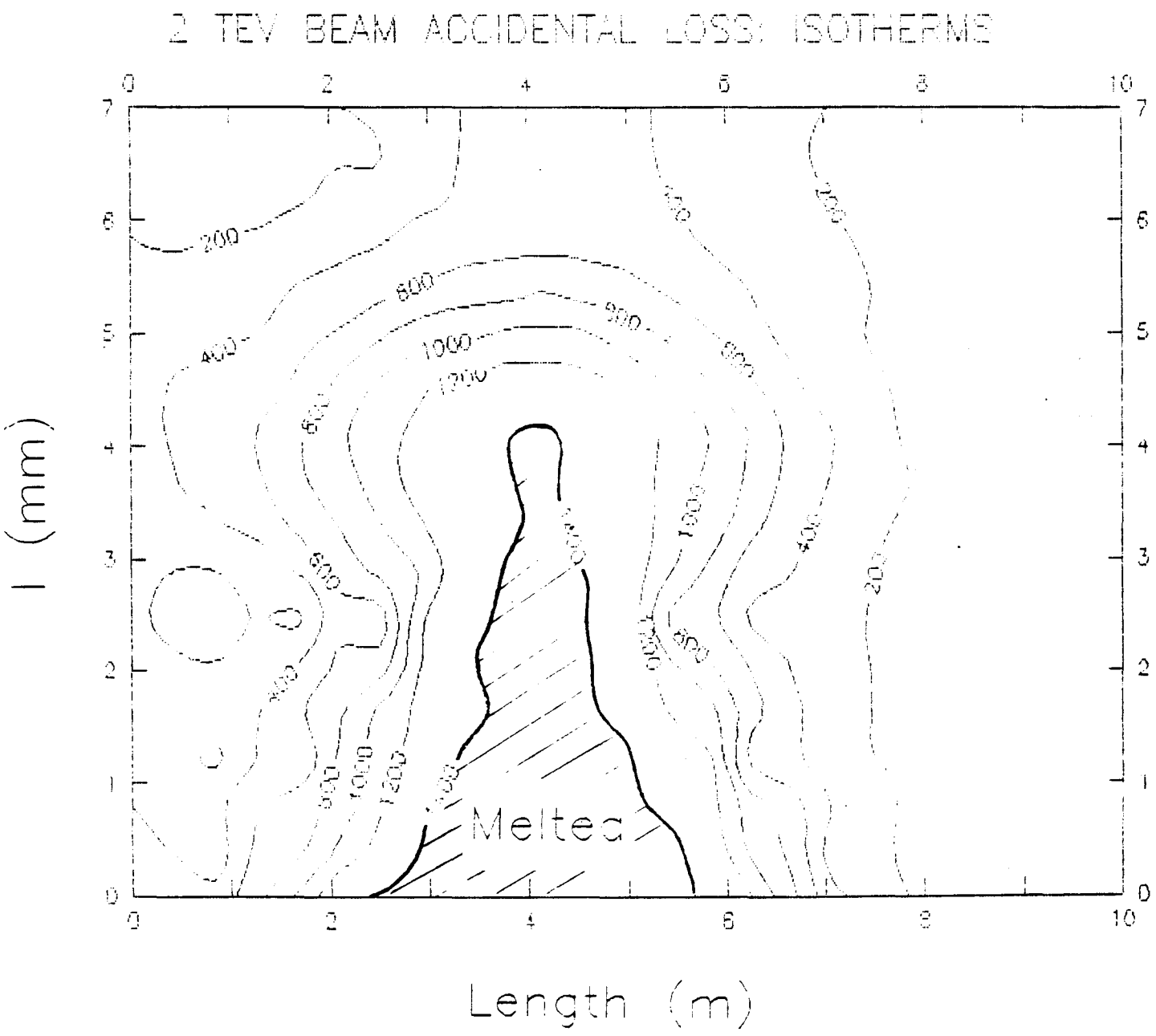

2 TEV BEAM ACCIDENTAL LOSS: ISOTHERME
Melted
Length (m)
l (mm)
200
400
600
800
1000
1200

Fig.5

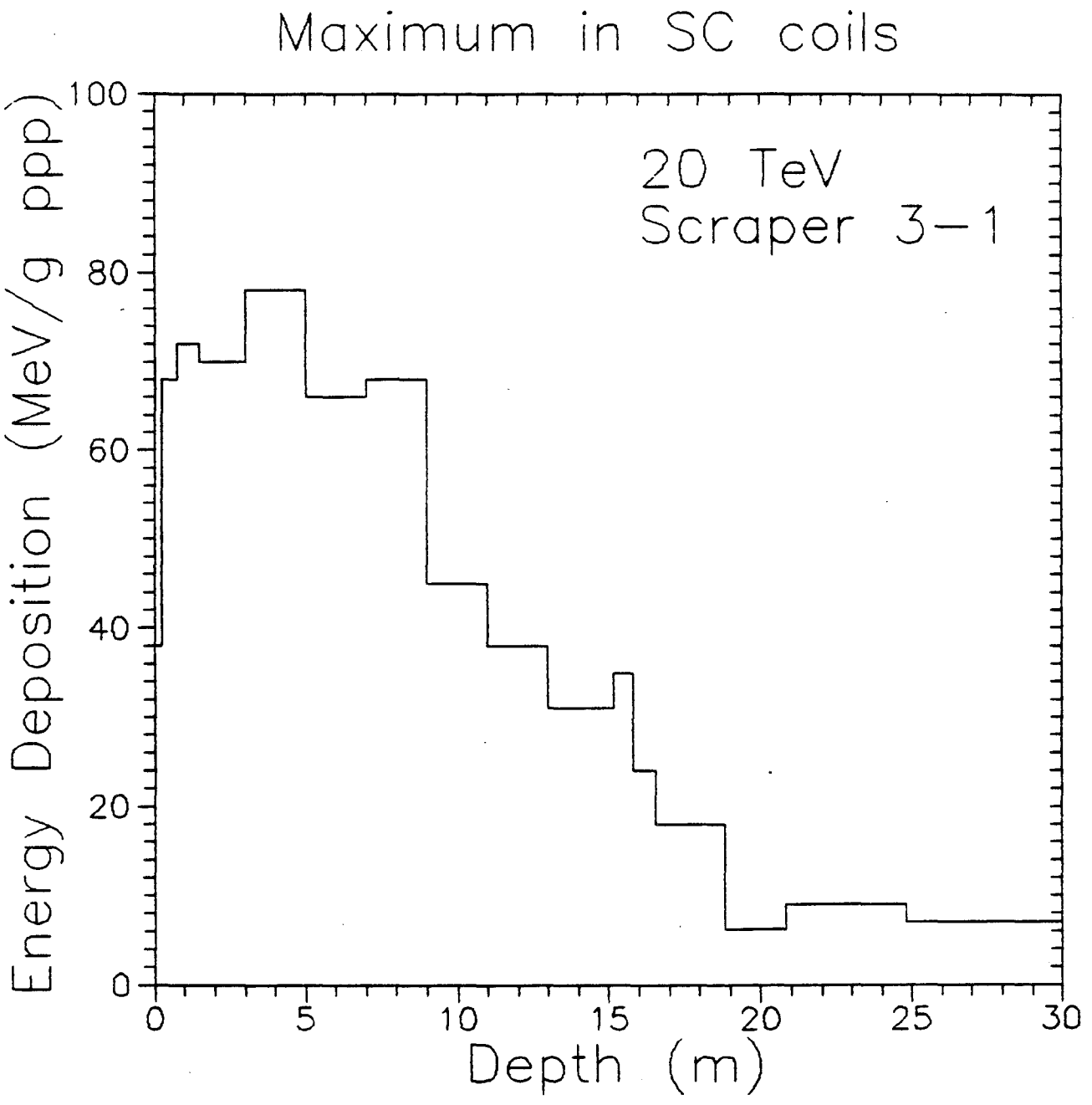

Maximum in SC coils
20 TeV
Scraper 3-1
Energy Deposition (MeV/g ppp)
Depth (m)
0
20
40
60
80
100
0
5
10
15
20
25
30

Fig.6

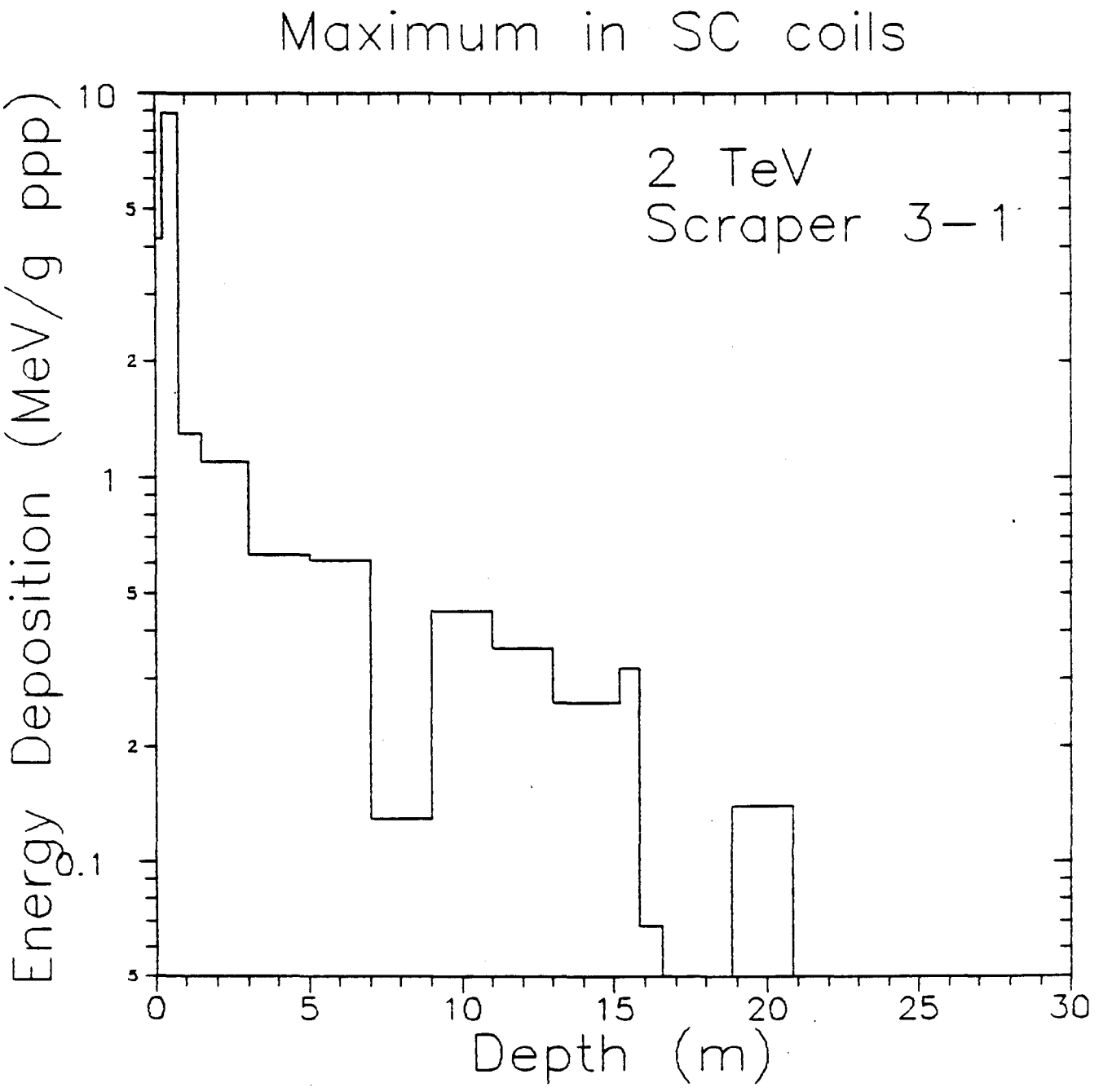

Maximum in SC coils
2 TeV
Scraper 3-1
Energy Deposition (MeV/g ppp)
10
5
2
1
5
2
0.1
5
0
5
10
15
20
25
30
Depth (m)

Fig.7

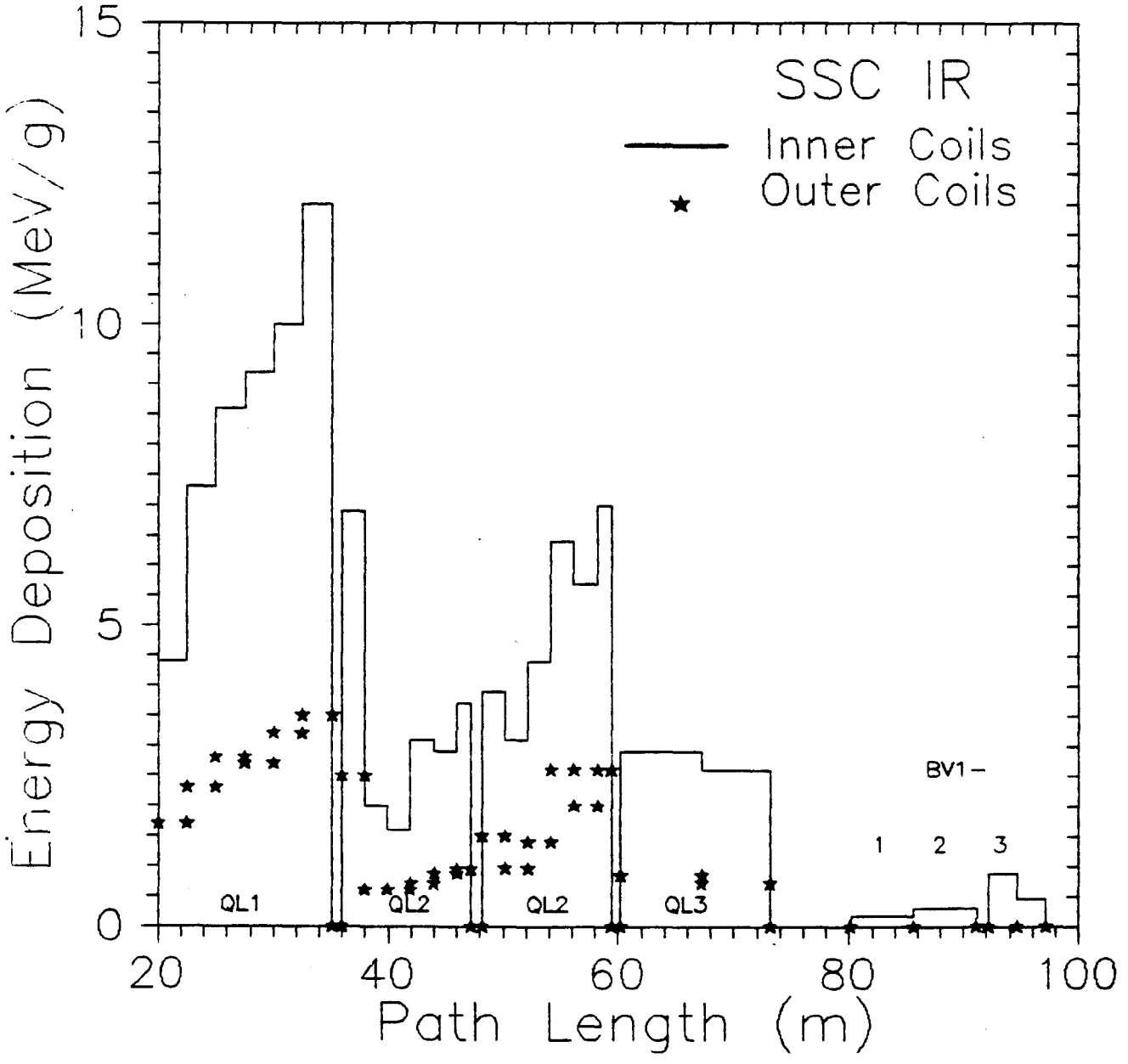

SSC IR
Inner Coils
Outer Coils
Energy Deposition (MeV/g)
Path Length (m)
15
10
5
0
20
40
60
80
100
QL1
QL2
QL2
QL3
BV1
1
2
3

Fig.8

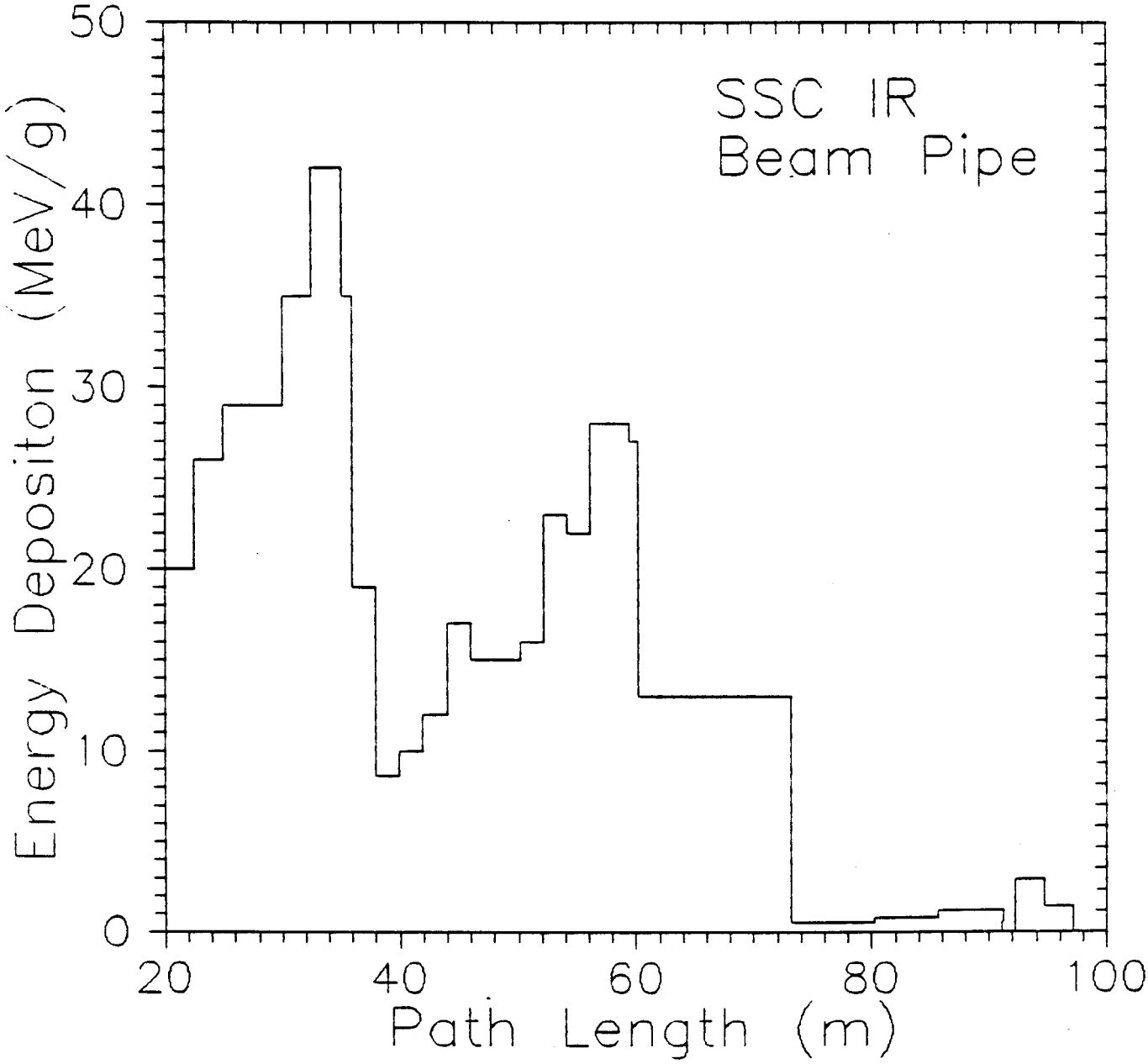

SSC IR
Beam Pipe
Energy Depositon (MeV/g)
Path Length (m)
0
10
20
30
40
50
20
40
60
80
100

Fig.9

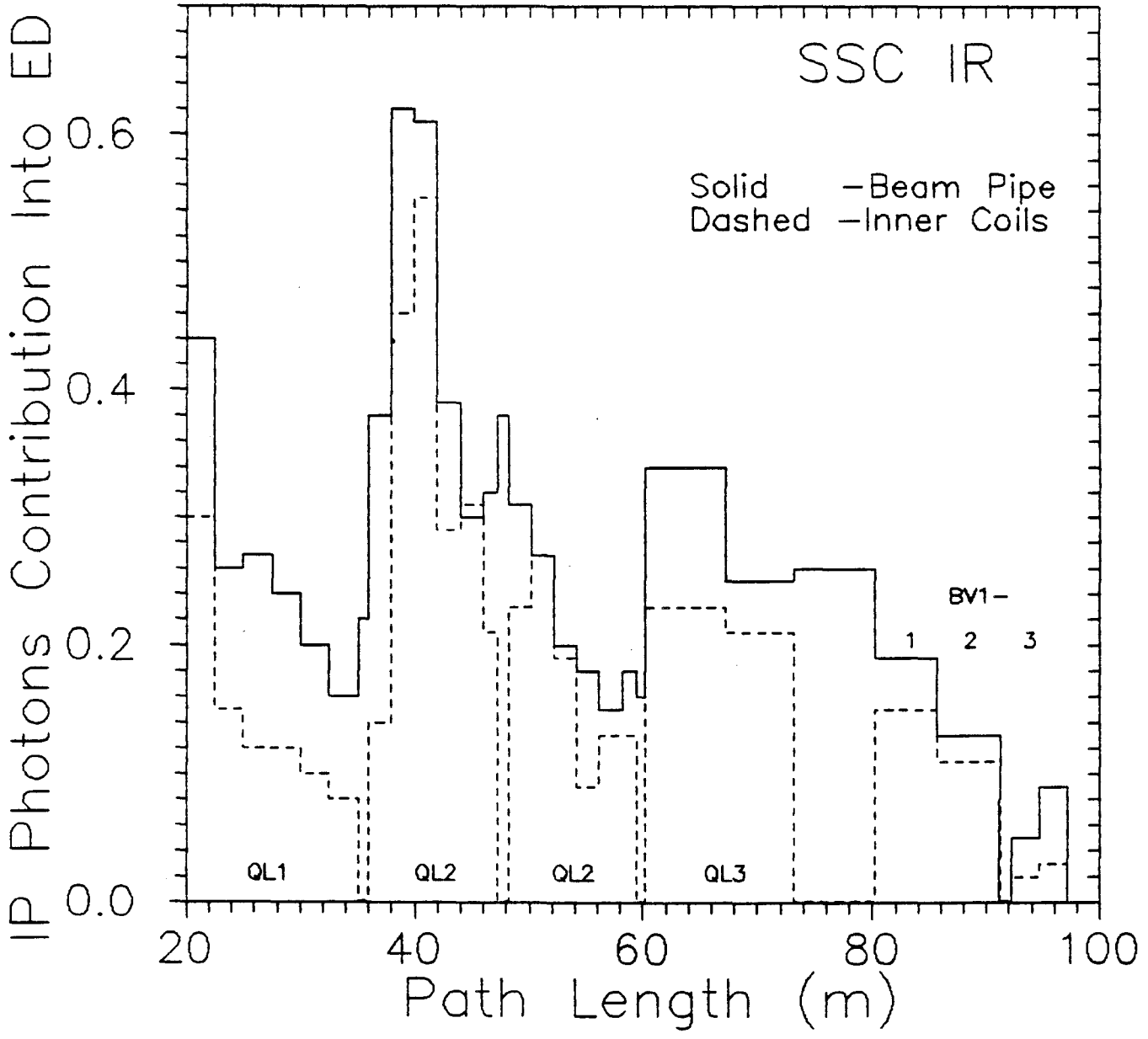

SSC IR
Solid —Beam Pipe
Dashed —Inner Coils
IP Photons Contribution Into ED
0.0
0.2
0.4
0.6
20
40
60
80
100
Path Length (m)
QL1
QL2
QL2
QL3
BV1 –
1
2
3

Fig.10

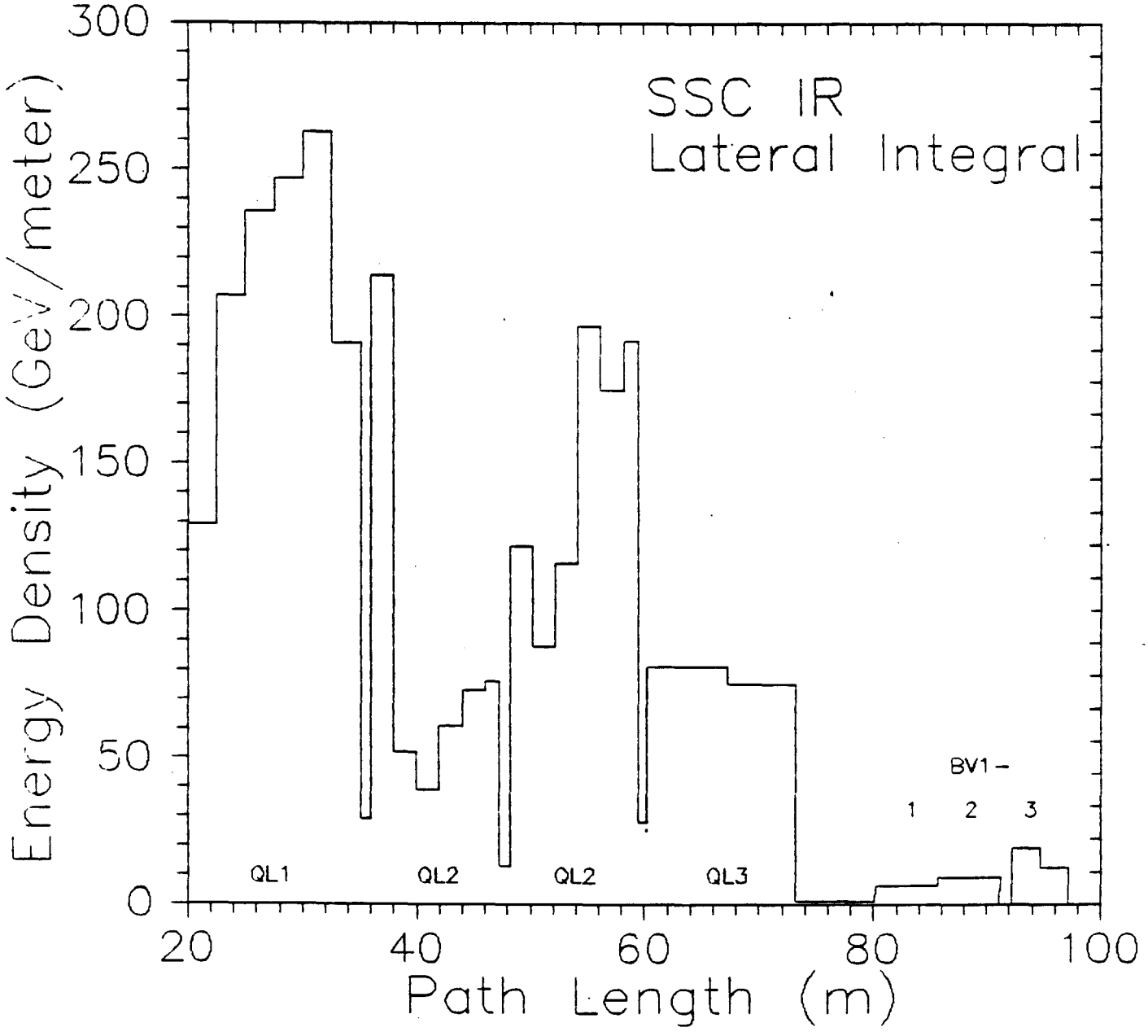
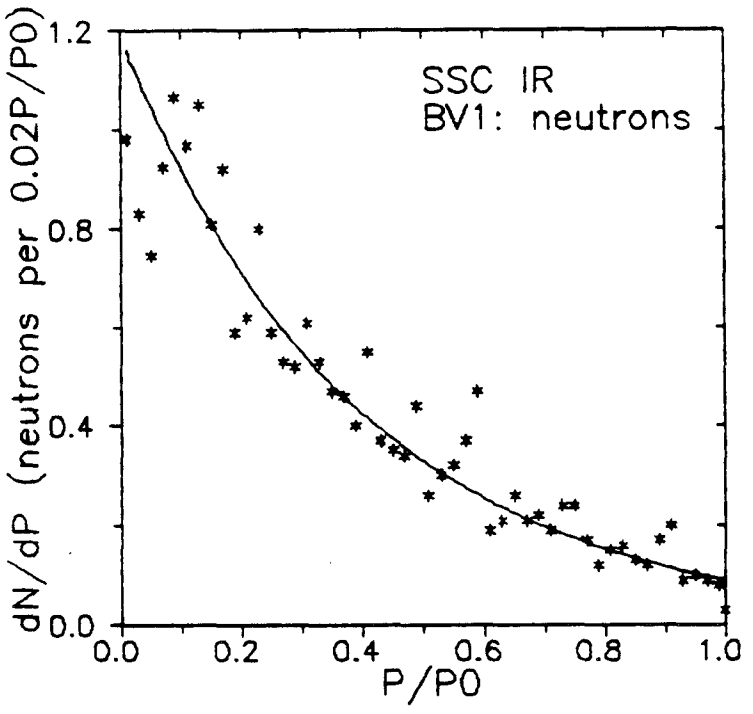

SSC IR
Lateral Integral
Energy Density (GeV/meter)
Path Length (m)
300
250
200
150
100
50
0
20
40
60
80
100
QL1
QL2
QL2
QL3
BV1 –
1
2
3

Fig.11


SSC IR
BV1: neutrons
dN/dP (neutrons per 0.02P/P0)
P/P0
0.0
0.4
0.8
1.2
0.0
0.2
0.4
0.6
0.8
1.0

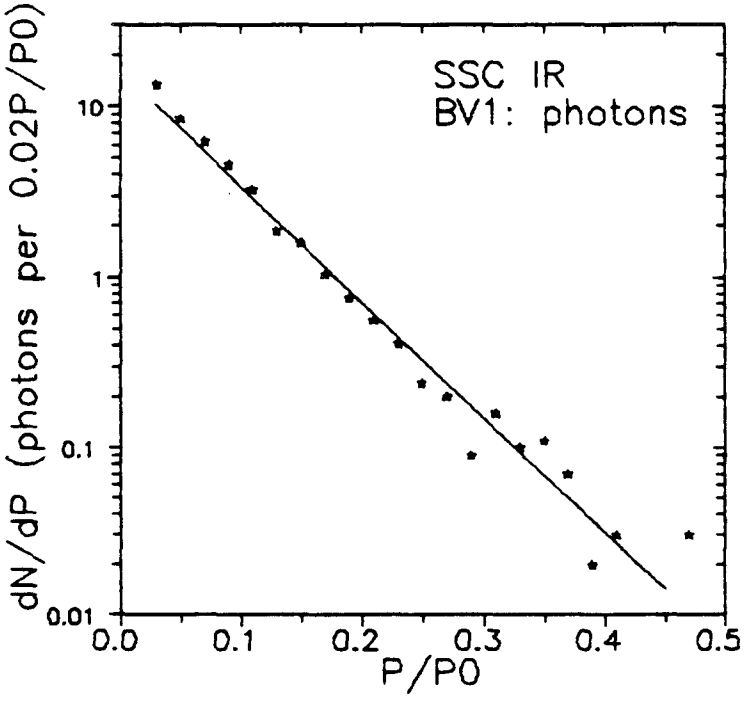

SSC IR
BV1: photons
dN/dP (photons per 0.02P/P0)
P/P0
0.01
0.1
1
10
0.0
0.1
0.2
0.3
0.4
0.5

Fig.12

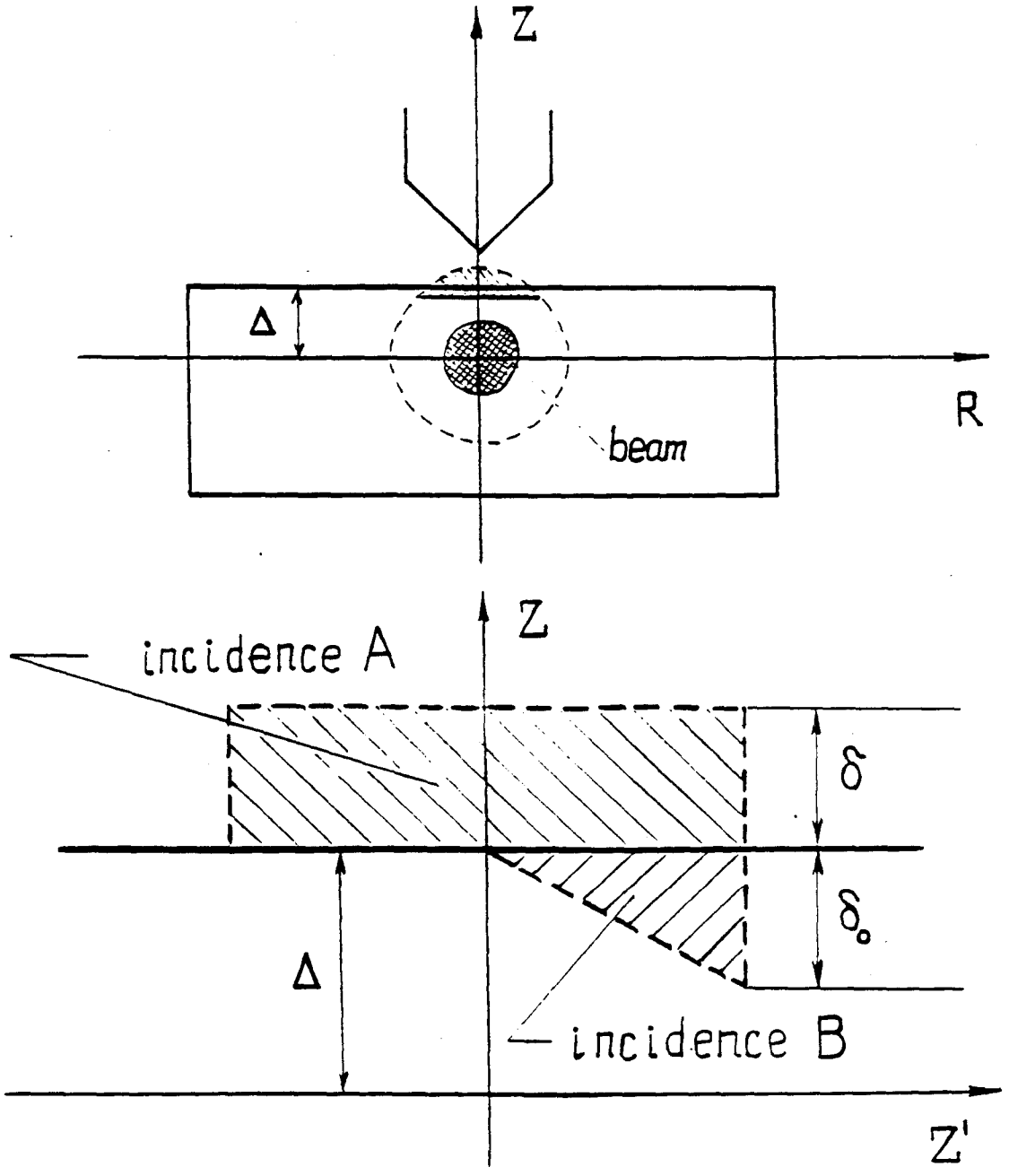


Fig. 13

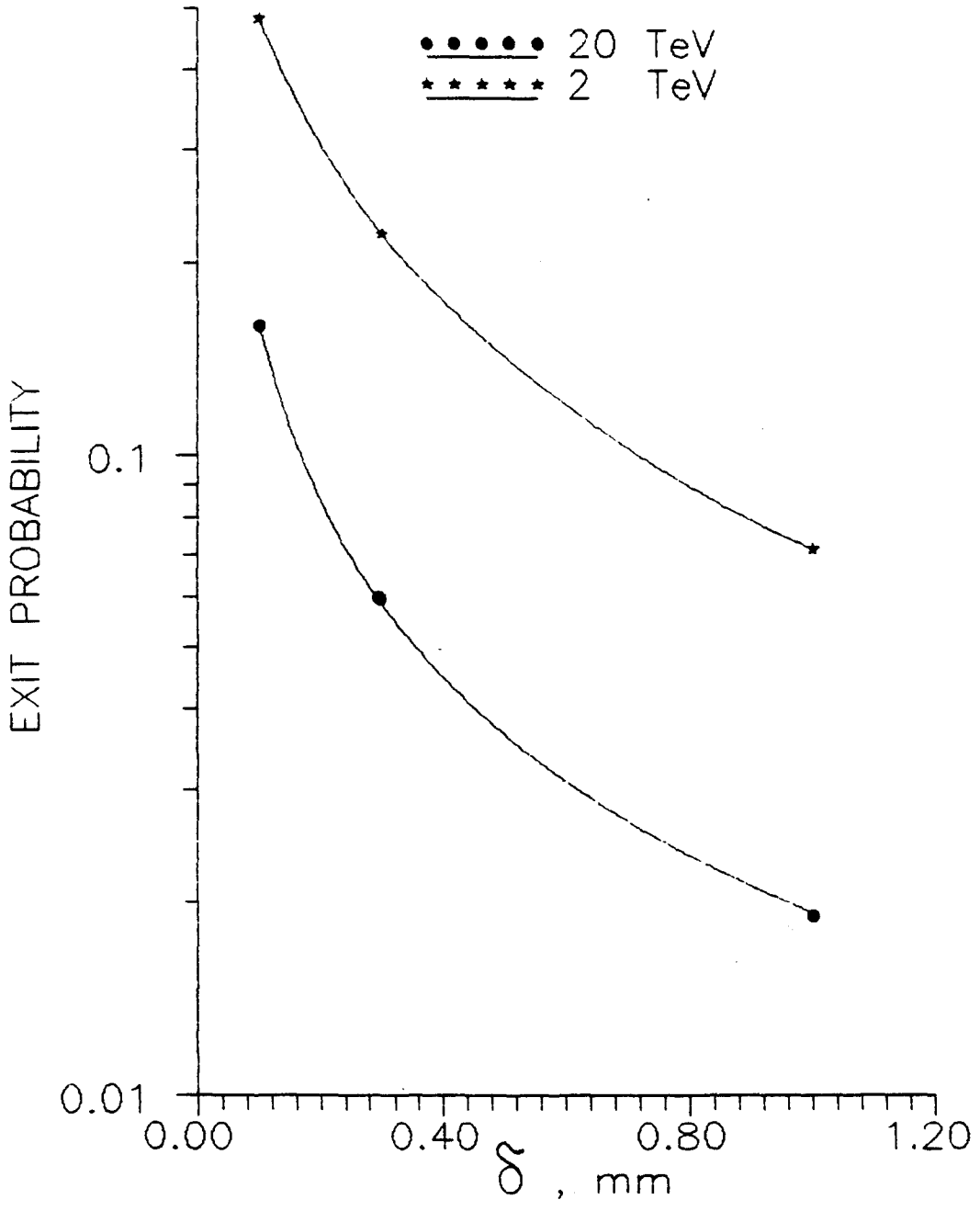


Fig.14

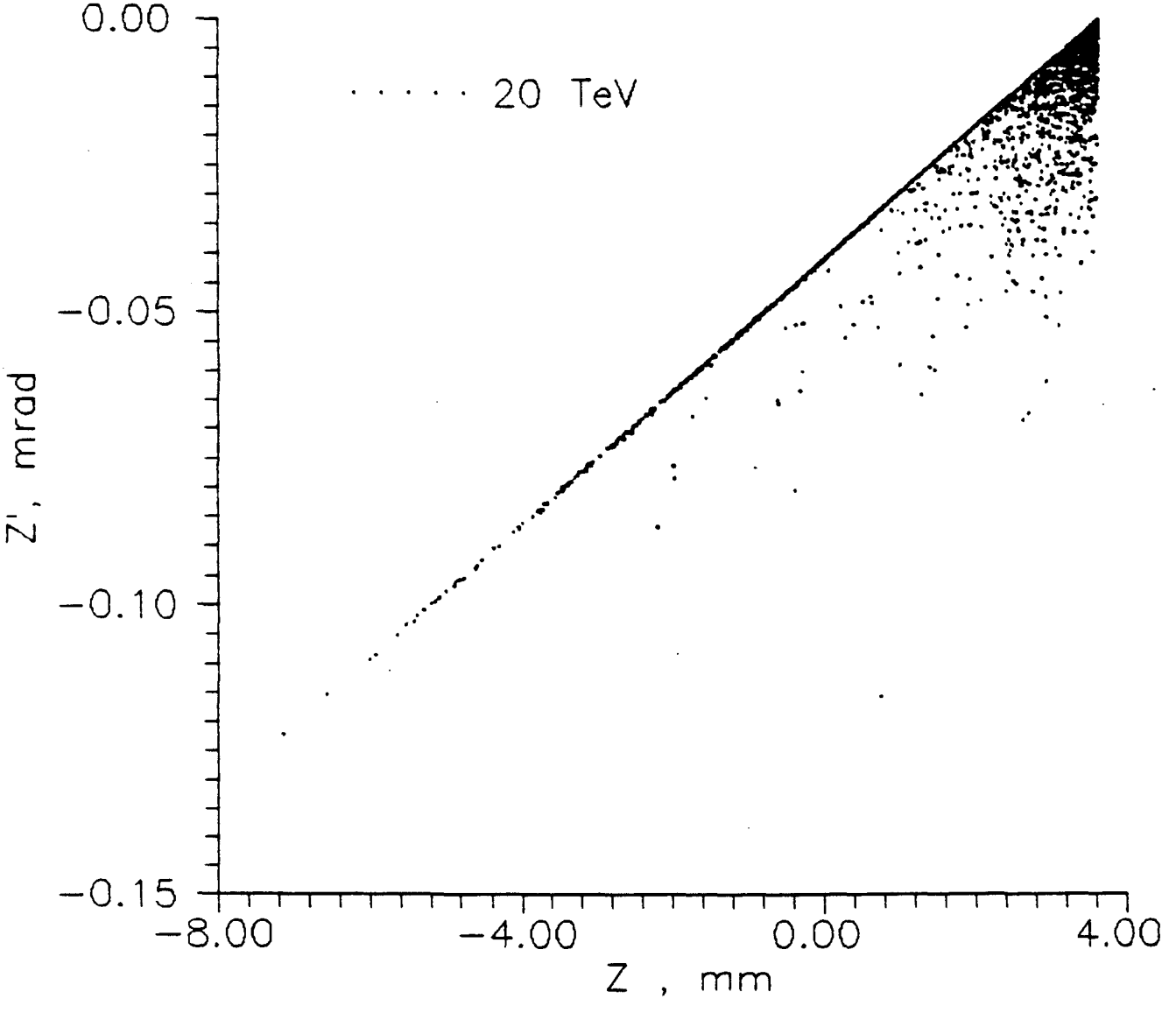


Fig.15

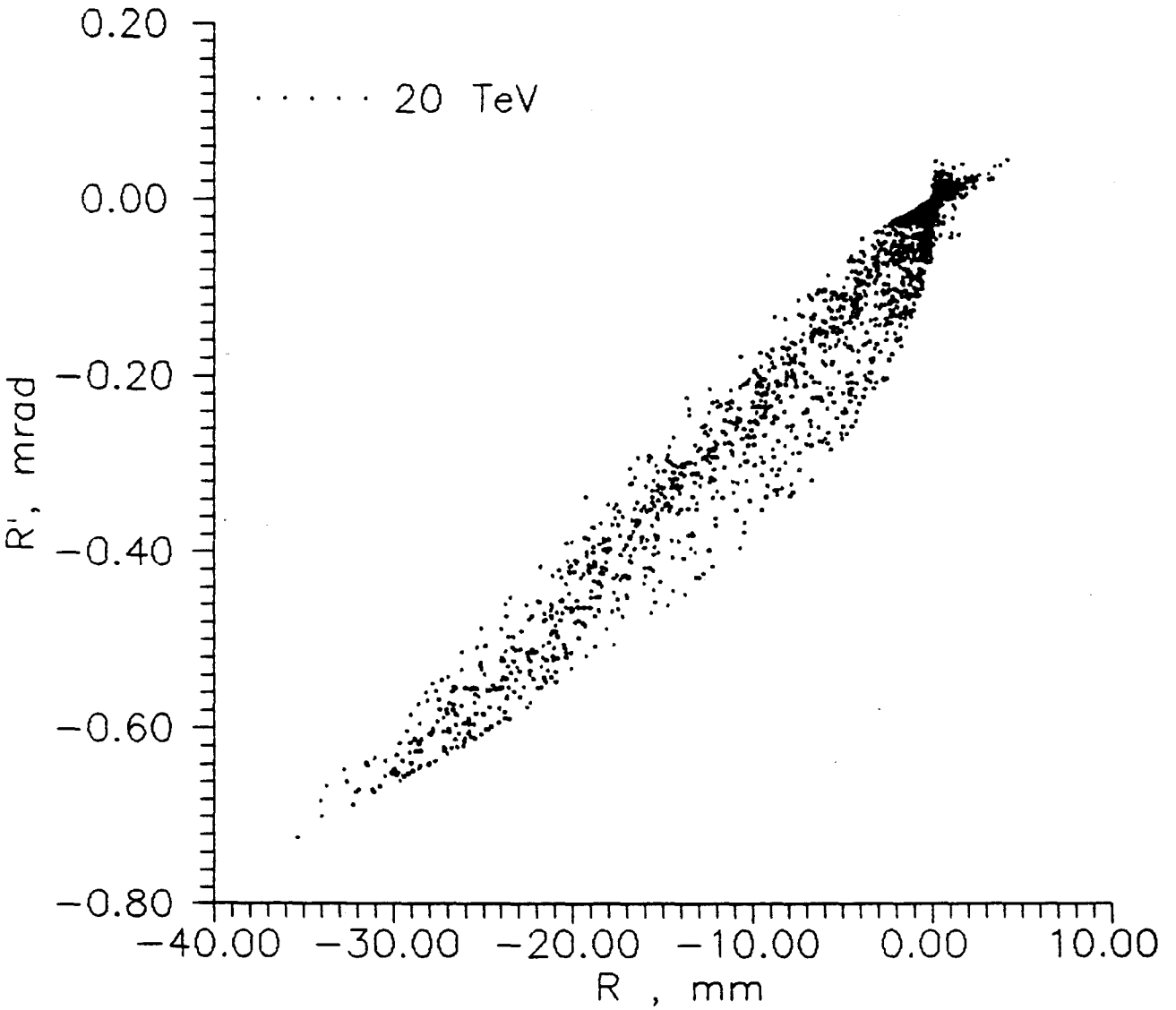

0.20
0.00
−0.20
−0.40
−0.60
−0.80
R', mrad
20 TeV
−40.00
−30.00
−20.00
−10.00
0.00
10.00
R , mm

Fig.16

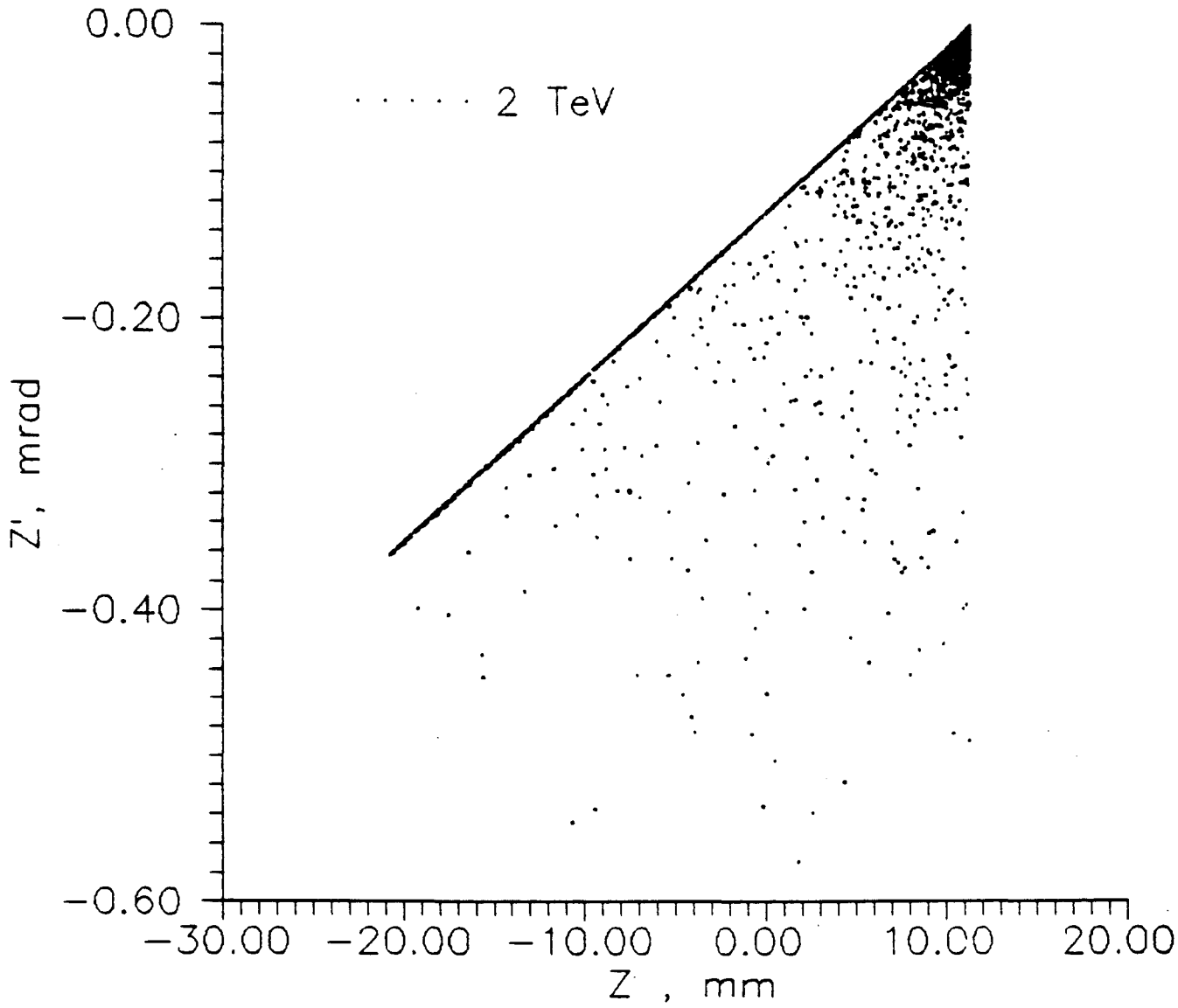


Fig.17

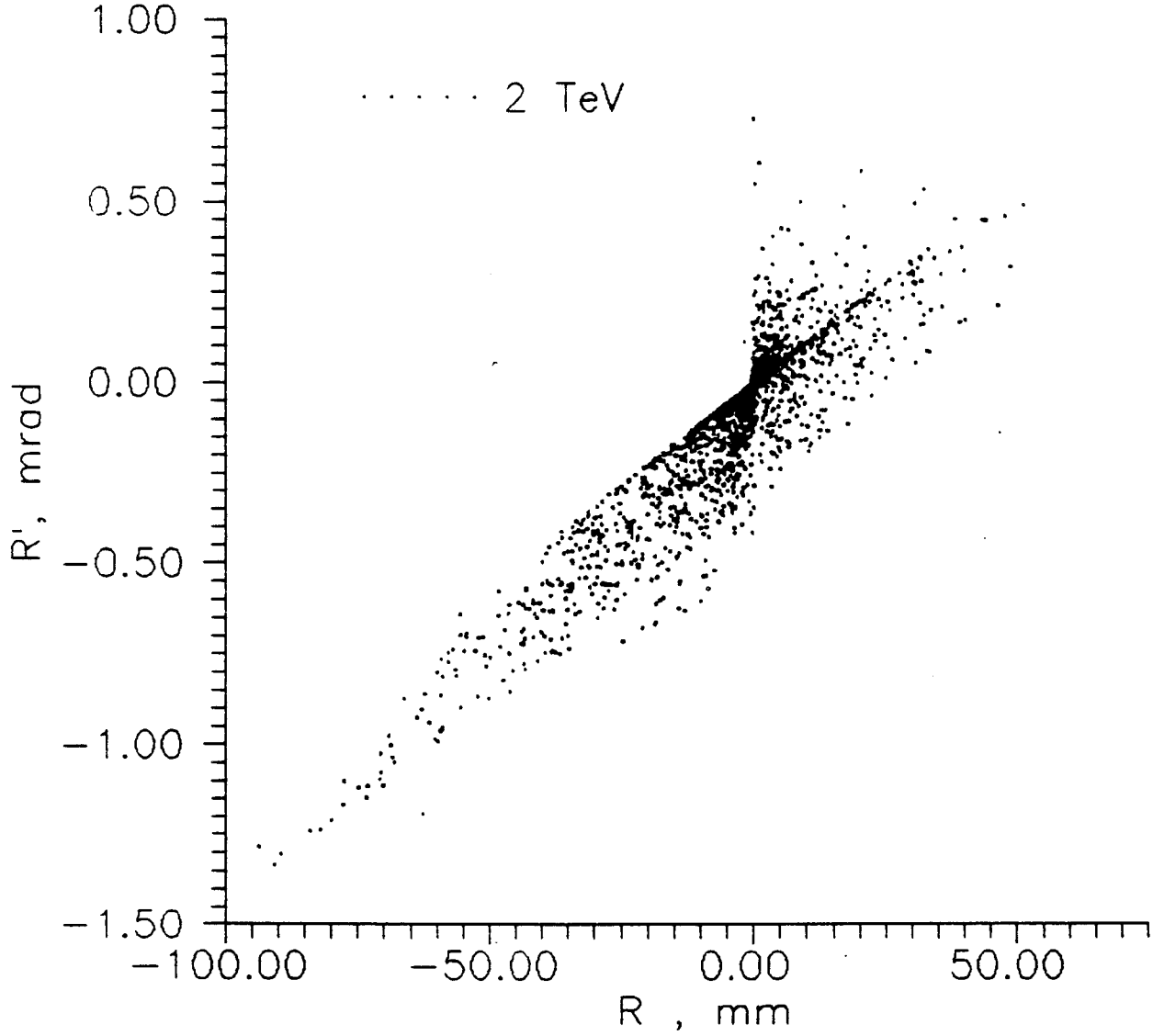


Fig.18

Appendix. Tables A1 - A3.

Table A1. Beam loss downstream of the low-β IR.
Elements names correspond to the SSCD[1] besides and C10-C17 for the suggested collimators. Distance is measured between the interaction point and the end of the element. "Full" aperture corresponds to the 40 mm inner diameter of the beam pipe in the lattice and the "small" one corresponds to the 33 mm beam pipe diameter. Loss rates are presented for 10**8 interactions per second at IR.

	Lattice elements						Loss rate			
No	Name	Length	Distance	Apertures, mm				prot/(m*s)		prot/s	
		meters		full		small		coll. off		coll. on	
				hor.	ver.	hor.	ver.	full	small	full	small
1		20.00	20.00	20.0	20.0	16.5	16.5				
2	QL1	15.14	35.14	20.0	20.0	16.5	16.5				
3		.80	35.94	20.0	20.0	16.5	16.5				
4	QL2	11.22	47.16	20.0	20.0	16.5	16.5				
5		1.00	48.16	20.0	20.0	16.5	16.5				
6	QL2	11.22	59.38	20.0	20.0	16.5	16.5				
7		.80	60.18	20.0	20.0	16.5	16.5				
8	QL3	12.96	73.14	20.0	20.0	16.5	16.5				
9		7.00	80.14	33.0	33.0	33.0	33.0				
10	SVM	5.00	85.14	33.0	33.0	33.0	33.0				
11		1.00	86.14	33.0	33.0	33.0	33.0				
12	SVM	5.00	91.14	33.0	33.0	33.0	33.0				
13		1.00	92.14	33.0	33.0	33.0	33.0				
14	SVM	5.00	97.14	33.0	33.0	33.0	33.0				
15		110.00	207.14	33.0	33.0	33.0	33.0	8.3+3	8.3+3	9.1+5	9.1+5
16	C10	4.00	211.14	20.0	7.0	16.5	6.5	*	**	*	4.9+6	5.0+6
17		70.00	281.14	33.0	33.0	33.0	33.0	3.4+4	3.4+4		
18		.80	281.93	33.0	33.0	33.0	33.0	1.8+4	1.8+4		
19	SVM	5.00	286.93	33.0	33.0	33.0	33.0	1.6+4	1.6+4		
20		1.00	287.93	33.0	33.0	33.0	33.0	5.3+4	5.3+4		
21	SVM	5.00	292.93	33.0	33.0	33.0	33.0	8.0+3	8.0+3		
22		1.00	293.93	33.0	33.0	33.0	33.0				
23	SVM	5.00	298.93	33.0	33.0	33.0	33.0				
24		2.07	301.01	33.0	33.0	33.0	33.0				
25	C11	5.00	306.01	20.0	5.0	16.5	4.0	*	**	*	8.7+5	9.6+5
26		6.00	312.01	33.0	33.0	33.0	33.0	2.2+3	2.2+3		
27	QVD	14.25	326.26	25.0	25.0	20.0	20.0	6.1+4	1.1+5		
28		.80	327.06	25.0	25.0	20.0	20.0				
29	QVF	14.25	341.31	25.0	25.0	20.0	20.0				
30		4.20	345.51	25.0	25.0	20.0	20.0				
31	QVF	14.25	359.76	25.0	25.0	20.0	20.0		9.3+2		
32		.80	360.56	25.0	25.0	20.0	20.0				
33	QVD	14.25	374.81	25.0	25.0	20.0	20.0	4.7+3	2.8+3		
34		4.20	379.01	25.0	25.0	20.0	20.0				
35	QVD	14.25	393.26	25.0	25.0	20.0	20.0				
36		.80	394.06	25.0	25.0	20.0	20.0				
37	QVF	14.25	408.31	25.0	25.0	20.0	20.0				
38		4.20	412.51	25.0	25.0	20.0	20.0				
39	QVF	14.25	426.76	25.0	25.0	20.0	20.0				
40		.80	427.56	25.0	25.0	20.0	20.0				
41	QVD	14.25	441.81	25.0	25.0	20.0	20.0				
42		4.96	446.77	25.0	25.0	20.0	20.0				
43	VM	12.64	459.41	25.0	25.0	20.0	20.0				
44		1.00	460.41	25.0	25.0	20.0	20.0				
45	VM	12.64	473.05	25.0	25.0	20.0	20.0				
46		1.00	474.05	25.0	25.0	20.0	20.0	1.3+4			

No	Name	Length meters	Distance	Lattice elements Apertures, mm full hor.	full ver.	small hor.	small ver.	Loss rate prot/(m*s) coll. off full	small	prot/s coll. on full	small
47	VM	12.64	486.68	25.0	25.0	20.0	20.0	1.1+3	1.1+3		
48		1.41	488.09	25.0	25.0	20.0	20.0	9.4+3	9.4+3		
49	C12	5.00	493.09	2.0	20.0	2.0	16.5	*	**	*	1.3+4
50		7.00	500.09	25.0	25.0	20.0	20.0	5.7+3	3.8+3		
51	VM	12.64	512.73	25.0	25.0	20.0	20.0	4.2+3	2.1+3		
52		1.00	513.73	25.0	25.0	20.0	20.0				
53	VM	12.64	526.37	25.0	25.0	20.0	20.0	5.3+3	1.1+3		
54		1.00	527.37	25.0	25.0	20.0	20.0				
55	VM	12.64	540.01	25.0	25.0	20.0	20.0	3.2+3	1.1+3		
56		.80	540.81	25.0	25.0	20.0	20.0				
57	QL4	10.63	551.43	20.0	20.0	16.5	16.5	3.1+4	1.4+4		
58		.80	552.23	25.0	25.0	20.0	20.0				
59	QL5	14.08	566.32	25.0	25.0	20.0	20.0	5.7+3	3.8+3		
60		4.00	570.32	25.0	25.0	20.0	20.0	1.3+4	6.6+3		
61	C13	5.00	575.32	20.0	3.0	16.5	3.0	*	**	*	1.3+4 1.3+4
62		95.00	670.32	25.0	25.0	20.0	20.0	4.2+3	2.5+3		
63	QL6	4.68	675.00	25.0	25.0	20.0	20.0				
64		4.00	679.00	25.0	25.0	20.0	20.0				
65	C14	5.00	684.00	20.0	3.5	16.5	3.0	*	**	*	8.0+4 5.3+4
66		78.40	762.40	25.0	25.0	20.0	20.0				
67	QF	5.20	767.60	20.0	20.0	16.5	16.5				
68		4.00	771.60	20.0	20.0	16.5	16.5				
69	C15	5.00	776.60	4.0	20.0	3.0	16.5	*	**	*	1.3+4
70		75.80	852.40	20.0	20.0	16.5	16.5				
71	QD	5.20	857.60	20.0	20.0	16.5	16.5				
72		84.80	942.40	20.0	20.0	16.5	16.5				
73	QF	2.60	945.00	20.0	20.0	16.5	16.5				
74	QSF	3.52	948.52	20.0	20.0	16.5	16.5				
75		6.80	955.32	20.0	20.0	16.5	16.5				
76	SM	12.64	967.96	20.0	20.0	16.5	16.5				
77		.65	968.61	20.0	20.0	16.5	16.5				
78	SM	12.64	981.25	20.0	20.0	16.5	16.5				
79		.65	981.90	20.0	20.0	16.5	16.5				
80	SM	12.64	994.54	20.0	20.0	16.5	16.5				
81		.65	995.19	20.0	20.0	16.5	16.5				
82	SM	12.64	1007.82	20.0	20.0	16.5	16.5	1.1+3	1.9+3		
83		1.15	1008.98	20.0	20.0	16.5	16.5		2.3+4		
84	QSD	7.05	1016.52	20.0	20.0	16.5	16.5	9.4+3	3.8+3		
85		12.33	1028.36	20.0	20.0	16.5	16.5	1.6+4	2.1+4		
86	SM	12.64	1041.00	20.0	20.0	16.5	16.5	2.1+4	2.2+4		
87		.65	1041.65	20.0	20.0	16.5	16.5				
88	SM	12.64	1054.28	20.0	20.0	16.5	16.5	2.3+4	2.1+4		
89		.65	1054.93	20.0	20.0	16.5	16.5	4.1+4	2.0+4		
90	SM	12.64	1067.57	20.0	20.0	16.5	16.5	1.2+4	1.2+4		
91		8.90	1076.48	20.0	20.0	16.5	16.5	1.4+4	1.1+4	1.3+4	
92	QSF	7.05	1083.52	20.0	20.0	16.5	16.5		1.9+3		
93		13.35	1096.87	20.0	20.0	16.5	16.5				
94	SM	12.64	1109.51	20.0	20.0	16.5	16.5				
95		.65	1110.16	20.0	20.0	16.5	16.5				
96	SM	12.64	1122.80	20.0	20.0	16.5	16.5				
97		.65	1123.45	20.0	20.0	16.5	16.5				
98	SM	12.64	1136.08	20.0	20.0	16.5	16.5				

No	Name	Length meters	Distance	Apertures, mm full hor.	full ver.	small hor.	small ver.	Loss rate prot/(mts) coll. off full	small	prot/s coll. on full	small
99		7.89	1143.98	20.0	20.0	16.5	16.5				
100	QSD	7.05	1151.02	20.0	20.0	16.5	16.5				
101		2.00	1153.02	20.0	20.0	16.5	16.5				
102	C16	3.00	1156.02	2.0	20.0	2.0	16.5	*	**	* 9.7+5	8.4+5
103		8.42	1164.45	20.0	20.0	16.5	16.5				
104	SM	12.64	1177.09	20.0	20.0	16.5	16.5	2.1+3	2.1+3		
105		.65	1177.74	20.0	20.0	16.5	16.5	2.0+4			
106	SM	12.64	1190.37	20.0	20.0	16.5	16.5	9.5+3	7.7+3		
107		.65	1191.02	20.0	20.0	16.5	16.5	2.0+4			
108	SM	12.64	1203.66	20.0	20.0	16.5	16.5	5.3+3	5.3+3		
109		7.82	1211.48	20.0	20.0	16.5	16.5	6.8+3	5.1+3		
110	QSF	3.52	1215.00	20.0	20.0	16.5	16.5				
111	QF	2.60	1217.60	20.0	20.0	16.5	16.5				
112		3.19	1220.79	20.0	20.0	16.5	16.5				
113	M	15.16	1235.95	20.0	20.0	16.5	16.5				
114		.65	1236.60	20.0	20.0	16.5	16.5				
115	M	15.16	1251.77	20.0	20.0	16.5	16.5				
116		.65	1252.42	20.0	20.0	16.5	16.5				
117	M	15.16	1267.58	20.0	20.0	16.5	16.5				
118		.65	1268.23	20.0	20.0	16.5	16.5				
119	M	15.16	1283.40	20.0	20.0	16.5	16.5				
120		.65	1284.05	20.0	20.0	16.5	16.5				
121	M	15.16	1299.21	20.0	20.0	16.5	16.5				
122		3.19	1302.40	20.0	20.0	16.5	16.5				
123	QD	2.60	1305.00	20.0	20.0	16.5	16.5				
124	QSD	3.52	1308.52	20.0	20.0	16.5	16.5				
125		7.82	1316.34	20.0	20.0	16.5	16.5				
126	SM	12.64	1328.98	20.0	20.0	16.5	16.5				
127		.65	1329.63	20.0	20.0	16.5	16.5				
128	SM	12.64	1342.26	20.0	20.0	16.5	16.5				
129		.65	1342.91	20.0	20.0	16.5	16.5				
130	SM	12.64	1355.55	20.0	20.0	16.5	16.5				
131		13.42	1368.98	20.0	20.0	16.5	16.5		2.0+3		
132	QSF	7.05	1376.02	20.0	20.0	16.5	16.5				
133		7.89	1383.92	20.0	20.0	16.5	16.5				
134	SM	12.64	1396.55	20.0	20.0	16.5	16.5				
135		.65	1397.20	20.0	20.0	16.5	16.5				
136	SM	12.64	1409.84	20.0	20.0	16.5	16.5				
137		.65	1410.49	20.0	20.0	16.5	16.5				
138	SM	12.64	1423.13	20.0	20.0	16.5	16.5				
139		2.00	1425.13	20.0	20.0	16.5	16.5				
140	C17	3.00	1428.13	2.0	20.0	2.0	16.5	*	**	* 1.3+4	1.3+4
141		8.35	1436.48	20.0	20.0	16.5	16.5				
142	QSD	7.05	1443.52	20.0	20.0	16.5	16.5				
143		8.90	1452.43	20.0	20.0	16.5	16.5				
144	SM	12.64	1465.07	20.0	20.0	16.5	16.5				
145		.65	1465.72	20.0	20.0	16.5	16.5				
146	SM	12.64	1478.35	20.0	20.0	16.5	16.5				
147		.65	1479.00	20.0	20.0	16.5	16.5				
148	SM	12.64	1491.64	20.0	20.0	16.5	16.5				
149		12.33	1503.98	20.0	20.0	16.5	16.5				

No	Name	Length meters	Distance	Lattice elements Apertures, mm full hor.	full ver.	small hor.	small ver.	Loss rate prot/(m*s) coll. off full	small	prot/s coll. on full	small
150	QSF	7.05	1511.02	20.0	20.0	16.5	16.5				
151		1.15	1512.18	20.0	20.0	16.5	16.5				
152	SM	12.64	1524.81	20.0	20.0	16.5	16.5				
153		.65	1525.46	20.0	20.0	16.5	16.5				
154	SM	12.64	1538.10	20.0	20.0	16.5	16.5				
155		.65	1538.75	20.0	20.0	16.5	16.5				
156	SM	12.64	1551.39	20.0	20.0	16.5	16.5				
157		.65	1552.04	20.0	20.0	16.5	16.5				
158	SM	12.64	1564.68	20.0	20.0	16.5	16.5				
159		6.80	1571.48	20.0	20.0	16.5	16.5				
160	QSD	3.52	1575.00	20.0	20.0	16.5	16.5				
161	QD	2.60	1577.60	20.0	20.0	16.5	16.5				
162		84.80	1662.40	20.0	20.0	16.5	16.5				
163	QF	5.20	1667.60	20.0	20.0	16.5	16.5				
164		84.80	1752.40	20.0	20.0	16.5	16.5				
165	QD	5.20	1757.60	20.0	20.0	16.5	16.5				
166		87.40	1845.00	25.0	25.0	20.0	20.0				
167	QL6	4.68	1849.68	25.0	25.0	20.0	20.0				
168		104.00	1953.68	25.0	25.0	20.0	20.0				
169	QL5	14.08	1967.77	25.0	25.0	20.0	20.0				
170		.80	1968.57	25.0	25.0	20.0	20.0				
171	QL4	10.63	1979.19	20.0	20.0	16.5	16.5				
172		.80	1979.99	25.0	25.0	20.0	20.0				
173	VM	12.64	1992.63	25.0	25.0	20.0	20.0				
174		1.00	1993.63	25.0	25.0	20.0	20.0				
175	VM	12.64	2006.27	25.0	25.0	20.0	20.0				
176		1.00	2007.27	25.0	25.0	20.0	20.0				
177	VM	12.64	2019.91	25.0	25.0	20.0	20.0				
178		13.41	2033.32	25.0	25.0	20.0	20.0				
179	VM	12.64	2045.95	25.0	25.0	20.0	20.0				
180		1.00	2046.95	25.0	25.0	20.0	20.0				
181	VM	12.64	2059.59	25.0	25.0	20.0	20.0				
182		1.00	2060.59	25.0	25.0	20.0	20.0				
183	VM	12.64	2073.23	25.0	25.0	20.0	20.0				
184		4.96	2078.19	25.0	25.0	20.0	20.0				
185	QVF	14.25	2092.44	25.0	25.0	20.0	20.0				
186		.80	2093.24	25.0	25.0	20.0	20.0				
187	QVD	14.25	2107.49	25.0	25.0	20.0	20.0				
188		4.20	2111.69	25.0	25.0	20.0	20.0				
189	QVD	14.25	2125.94	25.0	25.0	20.0	20.0				
190		.80	2126.74	25.0	25.0	20.0	20.0				
191	QVF	14.25	2140.99	25.0	25.0	20.0	20.0				
192		4.20	2145.19	25.0	25.0	20.0	20.0				
193	QVF	14.25	2159.44	25.0	25.0	20.0	20.0				
194		.80	2160.24	25.0	25.0	20.0	20.0				
195	QVD	14.25	2174.49	25.0	25.0	20.0	20.0				
196		4.20	2178.69	25.0	25.0	20.0	20.0				
197	QVD	14.25	2192.94	25.0	25.0	20.0	20.0				
198		.80	2193.74	25.0	25.0	20.0	20.0				
199	QVF	14.25	2207.99	25.0	25.0	20.0	20.0				
200		13.07	2221.07	33.0	33.0	33.0	33.0				
201	SVM	5.00	2226.07	33.0	33.0	33.0	33.0				
202		1.00	2227.07	33.0	33.0	33.0	33.0				

No	Name	Length meters	Distance	Apertures, mm full hor.	full ver.	small hor.	small ver.	Loss rate prot/(m4s) coll. off full	small	prot/s coll. on full	small
203	SVM	5.00	2232.07	33.0	33.0	33.0	33.0				
204		1.00	2233.07	33.0	33.0	33.0	33.0				
205	SVM	5.00	2238.07	33.0	33.0	33.0	33.0				
206		90.00	2328.07	33.0	33.0	33.0	33.0				
207	C9	4.00	2332.07	20.0	10.0	16.5	8.0				
208		90.00	2422.07	33.0	33.0	33.0	33.0				
209		.80	2422.86	33.0	33.0	33.0	33.0				
210	SVM	5.00	2427.86	33.0	33.0	33.0	33.0				
211		1.00	2428.86	33.0	33.0	33.0	33.0				
212	SVM	5.00	2433.86	33.0	33.0	33.0	33.0				
213		1.00	2434.86	33.0	33.0	33.0	33.0				
214	SVM	5.00	2439.86	33.0	33.0	33.0	33.0				
215		7.00	2446.86	33.0	33.0	33.0	33.0				
216	QL3	12.96	2459.82	20.0	20.0	16.5	16.5	1.0+3	1.0+3		
217		.80	2460.62	20.0	20.0	16.5	16.5				
218	QL2	11.22	2471.84	20.0	20.0	16.5	16.5				
219		1.00	2472.84	20.0	20.0	16.5	16.5				
220	QL2	11.22	2484.06	20.0	20.0	16.5	16.5				
221		.80	2484.86	20.0	20.0	16.5	16.5				
222	QL1	15.14	2500.00	20.0	20.0	16.5	16.5				
223		20.00	2520.00	20.0	20.0	16.5	16.5				
224		20.00	2540.00	20.0	20.0	16.5	16.5				
225	QL1	15.14	2555.14	20.0	20.0	16.5	16.5				
226		.80	2555.94	20.0	20.0	16.5	16.5				
227	QL2	11.22	2567.16	20.0	20.0	16.5	16.5				
228		1.00	2568.16	20.0	20.0	16.5	16.5				
229	QL2	11.22	2579.38	20.0	20.0	16.5	16.5				
230		.80	2580.18	20.0	20.0	16.5	16.5				
231	QL3	12.96	2593.14	20.0	20.0	16.5	16.5				
232		7.00	2600.14	33.0	33.0	33.0	33.0				
233	SVM	5.00	2605.14	33.0	33.0	33.0	33.0				
234		1.00	2606.14	33.0	33.0	33.0	33.0				
235	SVM	5.00	2611.14	33.0	33.0	33.0	33.0				
236		1.00	2612.14	33.0	33.0	33.0	33.0				
237	SVM	5.00	2617.14	33.0	33.0	33.0	33.0				
238		184.00	2801.14	33.0	33.0	33.0	33.0				
239		.80	2801.93	33.0	33.0	33.0	33.0				
240	SVM	5.00	2806.93	33.0	33.0	33.0	33.0				
241		1.00	2807.93	33.0	33.0	33.0	33.0				
242	SVM	5.00	2812.93	33.0	33.0	33.0	33.0				
243		1.00	2813.93	33.0	33.0	33.0	33.0				
244	SVM	5.00	2818.93	33.0	33.0	33.0	33.0				
245		13.07	2832.01	33.0	33.0	33.0	33.0				
246	QVD	14.25	2846.26	25.0	25.0	20.0	20.0				
247		.80	2847.06	25.0	25.0	20.0	20.0				
248	QVF	14.25	2861.31	25.0	25.0	20.0	20.0				
249		4.20	2865.51	25.0	25.0	20.0	20.0				
250	QVF	14.25	2879.76	25.0	25.0	20.0	20.0				
251		.80	2880.56	25.0	25.0	20.0	20.0				
252	QVD	14.25	2894.81	25.0	25.0	20.0	20.0				
253		4.20	2899.01	25.0	25.0	20.0	20.0				
254	QVD	14.25	2913.26	25.0	25.0	20.0	20.0				

No	Name	Length meters	Distance	Apertures, mm full hor.	full ver.	small hor.	small ver.	Loss rate prot/(m*s) coll. off full	small	prot/s coll. on full	small
255		.80	2914.06	25.0	25.0	20.0	20.0				
256	QVF	14.25	2928.31	25.0	25.0	20.0	20.0				
257		4.20	2932.51	25.0	25.0	20.0	20.0				
258	QVF	14.25	2946.76	25.0	25.0	20.0	20.0				
259		.80	2947.56	25.0	25.0	20.0	20.0				
260	QVD	14.25	2961.81	25.0	25.0	20.0	20.0				
261		4.96	2966.77	25.0	25.0	20.0	20.0				
262	VM	12.64	2979.41	25.0	25.0	20.0	20.0				
263		1.00	2980.41	25.0	25.0	20.0	20.0				
264	VM	12.64	2993.05	25.0	25.0	20.0	20.0				
265		1.00	2994.05	25.0	25.0	20.0	20.0				
266	VM	12.64	3006.68	25.0	25.0	20.0	20.0				
267		13.41	3020.09	25.0	25.0	20.0	20.0				
268	VM	12.64	3032.73	25.0	25.0	20.0	20.0				
269		1.00	3033.73	25.0	25.0	20.0	20.0				
270	VM	12.64	3046.37	25.0	25.0	20.0	20.0				
271		1.00	3047.37	25.0	25.0	20.0	20.0				
272	VM	12.64	3060.01	25.0	25.0	20.0	20.0				
273		.80	3060.81	25.0	25.0	20.0	20.0				
274	QL4	10.63	3071.43	20.0	20.0	16.5	16.5				
275		.80	3072.23	25.0	25.0	20.0	20.0				
276	QL5	14.08	3086.32	25.0	25.0	20.0	20.0				
277		104.00	3190.32	25.0	25.0	20.0	20.0				
278	QL6	4.68	3195.00	25.0	25.0	20.0	20.0				
279		87.40	3282.40	25.0	25.0	20.0	20.0				
280	QF	5.20	3287.60	20.0	20.0	16.5	16.5				
281		84.80	3372.40	20.0	20.0	16.5	16.5				
282	QD	5.20	3377.60	20.0	20.0	16.5	16.5				
283		84.80	3462.40	20.0	20.0	16.5	16.5				
284	QF	5.20	3467.60	20.0	20.0	16.5	16.5				
285		84.80	3552.40	20.0	20.0	16.5	16.5				
286	QD	5.20	3557.60	20.0	20.0	16.5	16.5				
287		84.80	3642.40	20.0	20.0	16.5	16.5				
288	QF	2.60	3645.00	20.0	20.0	16.5	16.5	5.1+3	5.1+3		
289	QSF	3.52	3648.52	20.0	20.0	16.5	16.5				
290		2.31	3650.84	20.0	20.0	16.5	16.5				
291	SM	12.64	3663.47	20.0	20.0	16.5	16.5				
292		.65	3664.12	20.0	20.0	16.5	16.5				
293	SM	12.64	3676.76	20.0	20.0	16.5	16.5				
294		.65	3677.41	20.0	20.0	16.5	16.5				
295	SM	12.64	3690.05	20.0	20.0	16.5	16.5				
296		.65	3690.70	20.0	20.0	16.5	16.5				
297	SM	12.64	3703.34	20.0	20.0	16.5	16.5				
298		5.64	3708.98	20.0	20.0	16.5	16.5				
299	QSD	7.05	3716.52	20.0	20.0	16.5	16.5				
300		2.91	3718.94	20.0	20.0	16.5	16.5				
301	SM	12.64	3731.58	20.0	20.0	16.5	16.5				
302		.65	3732.23	20.0	20.0	16.5	16.5				
303	SM	12.64	3744.86	20.0	20.0	16.5	16.5				
304		.65	3745.51	20.0	20.0	16.5	16.5				
305	SM	12.64	3758.15	20.0	20.0	16.5	16.5				
306		.65	3758.80	20.0	20.0	16.5	16.5				
307	SM	12.64	3771.44	20.0	20.0	16.5	16.5				

Lattice elements								Loss rate			
No	Name	Length meters	Distance	Apertures, mm full hor.	full ver.	small hor.	small ver.	prot/(m*s) coll. off full	prot/(m*s) coll. off small	prot/s coll. on full	prot/s coll. on small
308		5.04	3776.48	20.0	20.0	16.5	16.5				
309	QSF	7.05	3783.52	20.0	20.0	16.5	16.5				
310		2.41	3785.93	20.0	20.0	16.5	16.5				
311	SM	12.64	3798.57	20.0	20.0	16.5	16.5				
312		.65	3799.22	20.0	20.0	16.5	16.5				
313	SM	12.64	3811.86	20.0	20.0	16.5	16.5				
314		.65	3812.51	20.0	20.0	16.5	16.5				
315	SM	12.64	3825.15	20.0	20.0	16.5	16.5				
316		.65	3825.80	20.0	20.0	16.5	16.5				
317	SM	12.64	3838.43	20.0	20.0	16.5	16.5				
318		5.54	3843.98	20.0	20.0	16.5	16.5				
319	QSD	7.05	3851.02	20.0	20.0	16.5	16.5				
320		3.04	3854.07	20.0	20.0	16.5	16.5		4.4+3		
321	SM	12.64	3866.70	20.0	20.0	16.5	16.5	4.2+3	2.1+3		
322		.65	3867.35	20.0	20.0	16.5	16.5				
323	SM	12.64	3879.99	20.0	20.0	16.5	16.5	3.2+3	3.2+3		
324		.65	3880.64	20.0	20.0	16.5	16.5				
325	SM	12.64	3893.28	20.0	20.0	16.5	16.5	4.2+3	3.2+3		
326		.65	3893.93	20.0	20.0	16.5	16.5				
327	SM	12.64	3906.57	20.0	20.0	16.5	16.5	4.2+3	7.4+3		
328		4.91	3911.48	20.0	20.0	16.5	16.5	2.7+3	2.7+3		
329	QSF	3.52	3915.00	20.0	20.0	16.5	16.5	7.6+3			
330	QF	2.60	3917.60	20.0	20.0	16.5	16.5				
331		.65	3918.25	20.0	20.0	16.5	16.5				
332	M	15.16	3933.42	20.0	20.0	16.5	16.5				
333		.65	3934.06	20.0	20.0	16.5	16.5				
334	M	15.16	3949.23	20.0	20.0	16.5	16.5				
335		.65	3949.88	20.0	20.0	16.5	16.5				
336	M	15.16	3965.04	20.0	20.0	16.5	16.5				
337		1.15	3966.20	20.0	20.0	16.5	16.5				
338	M	15.16	3981.36	20.0	20.0	16.5	16.5				
339		.65	3982.01	20.0	20.0	16.5	16.5				
340	M	15.16	3997.18	20.0	20.0	16.5	16.5				
341		5.22	4002.40	20.0	20.0	16.5	16.5				
342	QD	2.60	4005.00	20.0	20.0	16.5	16.5				
343	QD	2.60	4007.60	20.0	20.0	16.5	16.5				
344		.65	4008.25	20.0	20.0	16.5	16.5				
345	M	15.16	4023.42	20.0	20.0	16.5	16.5				
346		.65	4024.06	20.0	20.0	16.5	16.5				
347	M	15.16	4039.23	20.0	20.0	16.5	16.5				
348		.65	4039.88	20.0	20.0	16.5	16.5				
349	M	15.16	4055.04	20.0	20.0	16.5	16.5				
350		1.15	4056.20	20.0	20.0	16.5	16.5				
351	M	15.16	4071.36	20.0	20.0	16.5	16.5				
352		.65	4072.01	20.0	20.0	16.5	16.5				
353	M	15.16	4087.18	20.0	20.0	16.5	16.5	8.8+2			
354		5.22	4092.40	20.0	20.0	16.5	16.5				
355	QF	5.20	4097.60	20.0	20.0	16.5	16.5				
356		.65	4098.25	20.0	20.0	16.5	16.5				
357	M	15.16	4113.42	20.0	20.0	16.5	16.5				
358		.65	4114.06	20.0	20.0	16.5	16.5				
359	M	15.16	4129.23	20.0	20.0	16.5	16.5				

No	Name	Lattice elements Length meters	Distance	Apertures, mm full hor.	full ver.	small hor.	small ver.	Loss rate prot/(m4s) coll. off full	coll. off small	prot/s coll. on full	coll. on small
360		.65	4129.88	20.0	20.0	16.5	16.5				
361	M	15.16	4145.04	20.0	20.0	16.5	16.5				
362		1.15	4146.19	20.0	20.0	16.5	16.5				
363	M	15.16	4161.36	20.0	20.0	16.5	16.5				
364		.65	4162.01	20.0	20.0	16.5	16.5				
365	M	15.16	4177.17	20.0	20.0	16.5	16.5				
366		5.22	4182.40	20.0	20.0	16.5	16.5				
367	QD	5.20	4187.60	20.0	20.0	16.5	16.5				
368		.65	4188.25	20.0	20.0	16.5	16.5				
369	M	15.16	4203.42	20.0	20.0	16.5	16.5				
370		.65	4204.06	20.0	20.0	16.5	16.5				
371	M	15.16	4219.23	20.0	20.0	16.5	16.5				
372		.65	4219.88	20.0	20.0	16.5	16.5				
373	M	15.16	4235.04	20.0	20.0	16.5	16.5				
374		1.15	4236.19	20.0	20.0	16.5	16.5				
375	M	15.16	4251.36	20.0	20.0	16.5	16.5				
376		.65	4252.01	20.0	20.0	16.5	16.5				
377	M	15.16	4267.17	20.0	20.0	16.5	16.5				
378		5.22	4272.40	20.0	20.0	16.5	16.5		2.6+3		
379	QF	5.20	4277.60	20.0	20.0	16.5	16.5				
380		.65	4278.25	20.0	20.0	16.5	16.5				
381	M	15.16	4293.42	20.0	20.0	16.5	16.5				
382		.65	4294.06	20.0	20.0	16.5	16.5				
383	M	15.16	4309.23	20.0	20.0	16.5	16.5				
384		.65	4309.88	20.0	20.0	16.5	16.5				
385	M	15.16	4325.04	20.0	20.0	16.5	16.5				
386		1.15	4326.19	20.0	20.0	16.5	16.5				
387	M	15.16	4341.36	20.0	20.0	16.5	16.5				
388		.65	4342.01	20.0	20.0	16.5	16.5				
389	M	15.16	4357.17	20.0	20.0	16.5	16.5				
390		5.22	4362.40	20.0	20.0	16.5	16.5				
391	QD	5.20	4367.60	20.0	20.0	16.5	16.5				
392		.65	4368.25	20.0	20.0	16.5	16.5				
393	M	15.16	4383.42	20.0	20.0	16.5	16.5				
394		.65	4384.06	20.0	20.0	16.5	16.5				
395	M	15.16	4399.23	20.0	20.0	16.5	16.5				
396		.65	4399.88	20.0	20.0	16.5	16.5				
397	M	15.16	4415.04	20.0	20.0	16.5	16.5				
398		1.15	4416.19	20.0	20.0	16.5	16.5				
399	M	15.16	4431.36	20.0	20.0	16.5	16.5				
400		.65	4432.01	20.0	20.0	16.5	16.5				
401	M	15.16	4447.17	20.0	20.0	16.5	16.5				
402		5.22	4452.40	20.0	20.0	16.5	16.5	5.1+3			
403	QF	5.20	4457.60	20.0	20.0	16.5	16.5				
404		.65	4458.25	20.0	20.0	16.5	16.5				
405	M	15.16	4473.42	20.0	20.0	16.5	16.5				
406		.65	4474.06	20.0	20.0	16.5	16.5				
407	M	15.16	4489.23	20.0	20.0	16.5	16.5				
408		.65	4489.88	20.0	20.0	16.5	16.5				
409	M	15.16	4505.04	20.0	20.0	16.5	16.5				
410		1.15	4506.19	20.0	20.0	16.5	16.5				
411	M	15.16	4521.36	20.0	20.0	16.5	16.5				

No	Name	Length meters	Distance	Apertures, mm full hor.	full ver.	small hor.	small ver.	Loss rate prot/(m*s) coll. off full	coll. off small	prot/s coll. on full	coll. on small
412		.65	4522.01	20.0	20.0	16.5	16.5				
413	M	15.16	4537.17	20.0	20.0	16.5	16.5				
414		5.22	4542.40	20.0	20.0	16.5	16.5				
415	QD	5.20	4547.60	20.0	20.0	16.5	16.5				
416		.65	4548.25	20.0	20.0	16.5	16.5				
417	M	15.16	4563.42	20.0	20.0	16.5	16.5				
418		.65	4564.06	20.0	20.0	16.5	16.5				
419	M	15.16	4579.23	20.0	20.0	16.5	16.5				
420		.65	4579.88	20.0	20.0	16.5	16.5				
421	M	15.16	4595.04	20.0	20.0	16.5	16.5				
422		1.15	4596.19	20.0	20.0	16.5	16.5				
423	M	15.16	4611.36	20.0	20.0	16.5	16.5				
424		.65	4612.01	20.0	20.0	16.5	16.5				
425	M	15.16	4627.17	20.0	20.0	16.5	16.5				
426		5.22	4632.40	20.0	20.0	16.5	16.5				
427	QF	5.20	4637.60	20.0	20.0	16.5	16.5				
428		.65	4638.25	20.0	20.0	16.5	16.5				
429	M	15.16	4653.42	20.0	20.0	16.5	16.5				
430		.65	4654.06	20.0	20.0	16.5	16.5				
431	M	15.16	4669.23	20.0	20.0	16.5	16.5				
432		.65	4669.88	20.0	20.0	16.5	16.5				
433	M	15.16	4685.04	20.0	20.0	16.5	16.5				
434		1.15	4686.19	20.0	20.0	16.5	16.5				
435	M	15.16	4701.36	20.0	20.0	16.5	16.5				
436		.65	4702.01	20.0	20.0	16.5	16.5				
437	M	15.16	4717.17	20.0	20.0	16.5	16.5				
438		5.22	4722.40	20.0	20.0	16.5	16.5				
439	QD	5.20	4727.60	20.0	20.0	16.5	16.5				
440		.65	4728.25	20.0	20.0	16.5	16.5				
441	M	15.16	4743.42	20.0	20.0	16.5	16.5				
442		.65	4744.06	20.0	20.0	16.5	16.5				
443	M	15.16	4759.23	20.0	20.0	16.5	16.5				
444		.65	4759.88	20.0	20.0	16.5	16.5				
445	M	15.16	4775.04	20.0	20.0	16.5	16.5				
446		1.15	4776.19	20.0	20.0	16.5	16.5				
447	M	15.16	4791.36	20.0	20.0	16.5	16.5				
448		.65	4792.01	20.0	20.0	16.5	16.5				
449	M	15.16	4807.17	20.0	20.0	16.5	16.5				
450		5.22	4812.40	20.0	20.0	16.5	16.5				
451	QF	5.20	4817.60	20.0	20.0	16.5	16.5				
452		.65	4818.25	20.0	20.0	16.5	16.5				
453	M	15.16	4833.42	20.0	20.0	16.5	16.5				
454		.65	4834.06	20.0	20.0	16.5	16.5				
455	M	15.16	4849.23	20.0	20.0	16.5	16.5				
456		.65	4849.88	20.0	20.0	16.5	16.5				
457	M	15.16	4865.04	20.0	20.0	16.5	16.5				
458		1.15	4866.19	20.0	20.0	16.5	16.5				
459	M	15.16	4881.36	20.0	20.0	16.5	16.5				
460		.65	4882.01	20.0	20.0	16.5	16.5				
461	M	15.16	4897.17	20.0	20.0	16.5	16.5				
462		5.22	4902.40	20.0	20.0	16.5	16.5				
463	QD	5.20	4907.60	20.0	20.0	16.5	16.5				

No	Name	Lattice elements Length meters	Distance	Aperatures, mm full hor.	full ver.	small hor.	small ver.	Loss rate prot/(mts) coil. off full	small	prot/s coil. on full	small
464		.65	4908.25	20.0	20.0	16.5	16.5				
465	M	15.16	4923.42	20.0	20.0	16.5	16.5				
466		.65	4924.06	20.0	20.0	16.5	16.5				
467	M	15.16	4939.23	20.0	20.0	16.5	16.5				
468		.65	4939.88	20.0	20.0	16.5	16.5				
469	M	15.16	4955.04	20.0	20.0	16.5	16.5				
470		1.15	4956.19	20.0	20.0	16.5	16.5				
471	M	15.16	4971.36	20.0	20.0	16.5	16.5				
472		.65	4972.01	20.0	20.0	16.5	16.5				
473	M	15.16	4987.17	20.0	20.0	16.5	16.5				
474		5.22	4992.40	20.0	20.0	16.5	16.5				
475	QF	5.20	4997.60	20.0	20.0	16.5	16.5				
476		.65	4998.25	20.0	20.0	16.5	16.5				
477	M	15.16	5013.42	20.0	20.0	16.5	16.5				
478		.65	5014.06	20.0	20.0	16.5	16.5				
479	M	15.16	5029.23	20.0	20.0	16.5	16.5				
480		.65	5029.88	20.0	20.0	16.5	16.5				
481	M	15.16	5045.04	20.0	20.0	16.5	16.5				
482		1.15	5046.19	20.0	20.0	16.5	16.5				
483	M	15.16	5061.36	20.0	20.0	16.5	16.5				
484		.65	5062.01	20.0	20.0	16.5	16.5				
485	M	15.16	5077.17	20.0	20.0	16.5	16.5				
486		5.22	5082.40	20.0	20.0	16.5	16.5				
487	QD	2.60	5085.00	20.0	20.0	16.5	16.5				

Table A2. Beam loss downstream of the abort Lambertson at 20 TeV. Elements names correspond to the SSCD[1] besides C1-C9 for the suggested collimators. Distance is measured between the end of the Lambertson and the end of the element. "Full" aperture corresponds to the 40 mm inner diameter of the beam pipe in the lattice and the "small" one corresponds to the 33 mm beam pipe diameter. Beam loss density is normalized to 1 proton hitting the Lambertson septum (1hp).

		Lattice elements						Loss density			
No	Name	Length	Distance	Apertures, mm				prot/(m*1hp)		prot/1hp	
		meters		full		small		coll. off		coll. on	
				hor.	ver.	hor.	ver.	full	small	full	small
1		3.00	3.00	20.0	20.0	16.5	16.5	.12-3	.17-3	.37-3	.50-3
2	SHV	10.00	13.00	4.2	4.2	3.5	3.5			.12-2	.12-2
3		150.63	163.63	20.0	20.0	16.5	16.5	.85-5	.85-5	.15-3	.11-3
4	C1	10.00	173.63	4.8	20.0	4.0	16.5	*	** *	.15-2	.18-2
5		.32	173.95	20.0	20.0	16.5	16.5	.86-4	.99-4		
6	B	27.50	201.45	63.0	23.0	63.0	23.0				
7		1.50	202.95	25.0	25.0	20.0	20.0	.44-5	.19-4		
8	QU1	11.29	214.24	25.0	25.0	20.0	20.0	.47-7	.22-7		
9		1.25	215.49	25.0	25.0	20.0	20.0				
10	QU2	11.00	226.49	25.0	25.0	20.0	20.0	.22-7	.36-6	.20-7	
11		119.84	346.33	25.0	25.0	20.0	20.0	.21-5	.27-5	.67-4	.91-4
12	C2	5.00	351.33	2.4	4.2	2.0	3.5	*	** *	.13-2	.16-2
13		1.00	352.33	20.0	20.0	16.5	16.5	.16-3	.64-4		
14	LI	37.00	389.33	20.0	20.0	16.5	16.5	.12-5	.14-5		
15		1.00	390.33	20.0	20.0	16.5	16.5				
16	QU3	9.17	399.50	20.0	20.0	16.5	16.5				
17		17.82	417.32	20.0	20.0	16.5	16.5	.21-6	.78-6		
18	QU4	7.05	424.37	20.0	20.0	16.5	16.5	.47-7	.20-6		
19		1.00	425.37	20.0	20.0	16.5	16.5				
20	TUD	10.00	435.37	20.0	20.0	16.5	16.5				
21		5.00	440.37	20.0	20.0	16.5	16.5				
22	C3	5.00	445.37	20.0	4.2	16.5	3.5	*	** *	.10-2	.12-2
23		89.98	535.35	20.0	20.0	16.5	16.5	.37-5	.27-5		
24	QF	5.20	540.55	20.0	20.0	16.5	16.5		.71-6		
25		65.80	606.35	20.0	20.0	16.5	16.5				
26	C4	5.00	611.35	2.4	20.0	2.0	16.5	*	** *	.78-3	.13-2
27		1.00	612.35	20.0	20.0	16.5	16.5				
28	KI	12.00	624.35	20.0	20.0	16.5	16.5				
29		1.00	625.35	20.0	20.0	16.5	16.5				
30	QD	2.60	627.95	20.0	20.0	16.5	16.5				
31	QSD	3.52	631.47	20.0	20.0	16.5	16.5				
32		2.31	633.79	20.0	20.0	16.5	16.5				
33	SM	12.64	646.42	20.0	20.0	16.5	16.5				
34		.65	647.07	20.0	20.0	16.5	16.5				
35	SM	12.64	659.71	20.0	20.0	16.5	16.5				
36		.65	660.36	20.0	20.0	16.5	16.5				
37	SM	12.64	673.00	20.0	20.0	16.5	16.5		.94-7		
38		.65	673.65	20.0	20.0	16.5	16.5				
39	SM	12.64	686.29	20.0	20.0	16.5	16.5	.29-6	.15-5		
40		5.64	691.93	20.0	20.0	16.5	16.5	.18-5	.52-5		
41	QSF	7.05	698.97	20.0	20.0	16.5	16.5	.12-5	.10-5		
42		2.91	701.89	20.0	20.0	16.5	16.5				
43	SM	12.64	714.53	20.0	20.0	16.5	16.5				
44		.65	715.18	20.0	20.0	16.5	16.5				
45	SM	12.64	727.81	20.0	20.0	16.5	16.5				
46		.65	728.46	20.0	20.0	16.5	16.5				

No	Name	Lattice elements Length meters	Distance meters	Apertures, mm full hor.	full ver.	small hor.	small ver.	Loss density prot/(m*lhp) coll. off full	small	prot/lhp coll. on full	small
47	SM	12.64	741.10	20.0	20.0	16.5	16.5	.45-7			
48		.65	741.75	20.0	20.0	16.5	16.5				
49	SM	12.64	754.39	20.0	20.0	16.5	16.5	.49-6	.17-6		
50		.04	754.43	20.0	20.0	16.5	16.5				
51	C5	4.00	758.43	2.4	20.0	2.0	16.5	*	** *	.95-4	.10-3
52		1.00	759.43	20.0	20.0	16.5	16.5		.11-5		
53	QSD	7.05	766.47	20.0	20.0	16.5	16.5	.44-5	.20-5		
54		2.41	768.88	20.0	20.0	16.5	16.5	.72-5	.11-4		
55	SM	12.64	781.52	20.0	20.0	16.5	16.5	.65-5	.50-5		
56		.65	782.17	20.0	20.0	16.5	16.5	.19-4	.26-5		
57	SM	12.64	794.81	20.0	20.0	16.5	16.5	.27-5	.44-5		
58		.65	795.46	20.0	20.0	16.5	16.5	.25-6	.78-5		
59	SM	12.64	808.10	20.0	20.0	16.5	16.5	.48-5	.21-5		
60		.65	808.75	20.0	20.0	16.5	16.5	.81-5			
61	SM	12.64	821.38	20.0	20.0	16.5	16.5	.18-5	.49-5		
62		5.54	826.93	20.0	20.0	16.5	16.5	.30-5	.48-5		
63	QSF	7.05	833.97	20.0	20.0	16.5	16.5	.15-5			
64		3.04	837.02	20.0	20.0	16.5	16.5				
65	SM	12.64	849.65	20.0	20.0	16.5	16.5				
66		.65	850.30	20.0	20.0	16.5	16.5				
67	SM	12.64	862.94	20.0	20.0	16.5	16.5				
68		.65	863.59	20.0	20.0	16.5	16.5				
69	SM	12.64	876.23	20.0	20.0	16.5	16.5				
70		.65	876.88	20.0	20.0	16.5	16.5				
71	SM	12.64	889.52	20.0	20.0	16.5	16.5				
72		4.91	894.43	20.0	20.0	16.5	16.5				
73	QSD	3.52	897.95	20.0	20.0	16.5	16.5				
74	QD	2.60	900.55	20.0	20.0	16.5	16.5				
75		.65	901.20	20.0	20.0	16.5	16.5				
76	M	15.16	916.36	20.0	20.0	16.5	16.5				
77		.65	917.02	20.0	20.0	16.5	16.5				
78	M	15.16	932.18	20.0	20.0	16.5	16.5				
79		.65	932.83	20.0	20.0	16.5	16.5				
80	M	15.16	947.99	20.0	20.0	16.5	16.5				
81		1.15	949.15	20.0	20.0	16.5	16.5	.72-7	.44-5		
82	M	15.16	964.31	20.0	20.0	16.5	16.5	.69-6	.84-6		
83		.65	964.96	20.0	20.0	16.5	16.5				
84	M	15.16	980.13	20.0	20.0	16.5	16.5	.31-5	.16-5		
85		5.22	985.35	20.0	20.0	16.5	16.5	.20-5	.21-5		
86	QF	5.20	990.55	20.0	20.0	16.5	16.5		.93-6		
87		.65	991.20	20.0	20.0	16.5	16.5				
88	M	15.16	1006.36	20.0	20.0	16.5	16.5				
89		.65	1007.02	20.0	20.0	16.5	16.5				
90	M	15.16	1022.18	20.0	20.0	16.5	16.5				
91		.65	1022.83	20.0	20.0	16.5	16.5				
92	M	15.16	1037.99	20.0	20.0	16.5	16.5				
93		1.15	1039.15	20.0	20.0	16.5	16.5				
94	M	15.16	1054.31	20.0	20.0	16.5	16.5				
95		.65	1054.96	20.0	20.0	16.5	16.5				
96	M	15.16	1070.13	20.0	20.0	16.5	16.5				
97		5.22	1075.35	20.0	20.0	16.5	16.5				
98	QD	5.20	1080.55	20.0	20.0	16.5	16.5		.17-5		
99		.65	1081.20	20.0	20.0	16.5	16.5				

Lattice elements								Loss density			
No	Name	Length	Distance meters	Apertures, mm full hor.	full ver.	small hor.	small ver.	prot/(m*1hp) coll. off full	small	prot/1hp coll. on full	small
100	M	15.16	1096.36	20.0	20.0	16.5	16.5		.32-6		
101		.65	1097.02	20.0	20.0	16.5	16.5		.72-5		
102	M	15.16	1112.18	20.0	20.0	16.5	16.5	.16-5	.16-5		
103		.65	1112.83	20.0	20.0	16.5	16.5		.38-7		
104	M	15.16	1127.99	20.0	20.0	16.5	16.5	.23-5	.16-5		
105		1.15	1129.15	20.0	20.0	16.5	16.5	.41-5			
106	M	15.16	1144.31	20.0	20.0	16.5	16.5	.22-5	.36-5		
107		.65	1144.96	20.0	20.0	16.5	16.5	.73-5	.12-4		
108	M	15.16	1160.13	20.0	20.0	16.5	16.5	.19-5	.69-5		
109		5.22	1165.35	20.0	20.0	16.5	16.5	.53-5	.25-5		
110	QF	5.20	1170.55	20.0	20.0	16.5	16.5				
111		.65	1171.20	20.0	20.0	16.5	16.5				
112	M	15.16	1186.36	20.0	20.0	16.5	16.5				
113		.65	1187.02	20.0	20.0	16.5	16.5				
114	M	15.16	1202.18	20.0	20.0	16.5	16.5				
115		.65	1202.83	20.0	20.0	16.5	16.5				
116	M	15.16	1217.99	20.0	20.0	16.5	16.5				
117		1.15	1219.15	20.0	20.0	16.5	16.5				
118	M	15.16	1234.31	20.0	20.0	16.5	16.5				
119		.65	1234.96	20.0	20.0	16.5	16.5				
120	M	15.16	1250.13	20.0	20.0	16.5	16.5				
121		5.22	1255.35	20.0	20.0	16.5	16.5				
122	QD	5.20	1260.55	20.0	20.0	16.5	16.5				
123		.65	1261.20	20.0	20.0	16.5	16.5				
124	M	15.16	1276.36	20.0	20.0	16.5	16.5				
125		.65	1277.02	20.0	20.0	16.5	16.5				
126	M	15.16	1292.18	20.0	20.0	16.5	16.5				
127		.65	1292.83	20.0	20.0	16.5	16.5				
128	M	15.16	1307.99	20.0	20.0	16.5	16.5				
129		1.15	1309.15	20.0	20.0	16.5	16.5				
130	M	15.16	1324.31	20.0	20.0	16.5	16.5				
131		.65	1324.96	20.0	20.0	16.5	16.5				
132	M	15.16	1340.13	20.0	20.0	16.5	16.5	.33-6	.62-6		
133		5.22	1345.35	20.0	20.0	16.5	16.5		.89-6		
134	QF	5.20	1350.55	20.0	20.0	16.5	16.5				
135		.65	1351.20	20.0	20.0	16.5	16.5				
136	M	15.16	1366.36	20.0	20.0	16.5	16.5				
137		.65	1367.02	20.0	20.0	16.5	16.5				
138	M	15.16	1382.18	20.0	20.0	16.5	16.5				
139		.65	1382.83	20.0	20.0	16.5	16.5				
140	M	15.16	1397.99	20.0	20.0	16.5	16.5				
141		1.15	1399.15	20.0	20.0	16.5	16.5				
142	M	15.16	1414.31	20.0	20.0	16.5	16.5				
143		.65	1414.96	20.0	20.0	16.5	16.5				
144	M	15.16	1430.13	20.0	20.0	16.5	16.5				
145		5.22	1435.35	20.0	20.0	16.5	16.5				
146	QD	5.20	1440.55	20.0	20.0	16.5	16.5				
147		.65	1441.20	20.0	20.0	16.5	16.5				
148	M	15.16	1456.36	20.0	20.0	16.5	16.5				
149		.65	1457.02	20.0	20.0	16.5	16.5				

No	Name	Lattice elements Length meters	Distance	Apertures, mm full hor.	full ver.	small hor.	small ver.	Loss density prot/(m*1hp) coll. off full	small	prot/1hp coll. on full	small
150	M	15.16	1472.18	20.0	20.0	16.5	16.5				
151		.65	1472.83	20.0	20.0	16.5	16.5				
152	M	15.16	1487.99	20.0	20.0	16.5	16.5				
153		1.15	1489.15	20.0	20.0	16.5	16.5				
154	M	15.16	1504.31	20.0	20.0	16.5	16.5				
155		.65	1504.96	20.0	20.0	16.5	16.5				
156	M	15.16	1520.13	20.0	20.0	16.5	16.5	.50-6	.20-7		
157		5.22	1525.35	20.0	20.0	16.5	16.5	.45-7			
158	QF	5.20	1530.55	20.0	20.0	16.5	16.5				
159		.65	1531.20	20.0	20.0	16.5	16.5				
160	M	15.16	1546.36	20.0	20.0	16.5	16.5				
161		.65	1547.02	20.0	20.0	16.5	16.5				
162	M	15.16	1562.18	20.0	20.0	16.5	16.5				
163		.65	1562.83	20.0	20.0	16.5	16.5				
164	M	15.16	1577.99	20.0	20.0	16.5	16.5				
165		1.15	1579.15	20.0	20.0	16.5	16.5				
166	M	15.16	1594.31	20.0	20.0	16.5	16.5				
167		.65	1594.96	20.0	20.0	16.5	16.5				
168	M	15.16	1610.13	20.0	20.0	16.5	16.5				
169		5.22	1615.35	20.0	20.0	16.5	16.5				
170	QD	5.20	1620.55	20.0	20.0	16.5	16.5				
171		.65	1621.20	20.0	20.0	16.5	16.5				
172	M	15.16	1636.36	20.0	20.0	16.5	16.5				
173		.65	1637.02	20.0	20.0	16.5	16.5				
174	M	15.16	1652.18	20.0	20.0	16.5	16.5				
175		.65	1652.83	20.0	20.0	16.5	16.5				
176	M	15.16	1667.99	20.0	20.0	16.5	16.5				
177		1.15	1669.15	20.0	20.0	16.5	16.5				
178	M	15.16	1684.31	20.0	20.0	16.5	16.5				
179		.65	1684.96	20.0	20.0	16.5	16.5				
180	M	15.16	1700.13	20.0	20.0	16.5	16.5				
181		5.22	1705.35	20.0	20.0	16.5	16.5				
182	QF	5.20	1710.55	20.0	20.0	16.5	16.5				
183		.65	1711.20	20.0	20.0	16.5	16.5				
184	M	15.16	1726.36	20.0	20.0	16.5	16.5				
185		.65	1727.02	20.0	20.0	16.5	16.5				
186	M	15.16	1742.18	20.0	20.0	16.5	16.5				
187		.65	1742.83	20.0	20.0	16.5	16.5				
188	M	15.16	1757.99	20.0	20.0	16.5	16.5				
189		1.15	1759.15	20.0	20.0	16.5	16.5				
190	M	15.16	1774.31	20.0	20.0	16.5	16.5				
191		.65	1774.96	20.0	20.0	16.5	16.5				
192	M	15.16	1790.13	20.0	20.0	16.5	16.5				
193		5.22	1795.35	20.0	20.0	16.5	16.5				
194	QD	5.20	1800.55	20.0	20.0	16.5	16.5				
195		.65	1801.20	20.0	20.0	16.5	16.5				
196	M	15.16	1816.36	20.0	20.0	16.5	16.5				
197		.65	1817.02	20.0	20.0	16.5	16.5				
198	M	15.16	1832.18	20.0	20.0	16.5	16.5				
199		.65	1832.83	20.0	20.0	16.5	16.5				

No	Name	Lattice elements Length meters	Distance	Apertures, mm full hor.	full ver.	small hor.	small ver.	Loss density prot/(m*lhp) coll. off full	coll. off small	prot/lhp coll. on full	coll. on small
200	M	15.16	1847.99	20.0	20.0	16.5	16.5				
201		1.15	1849.15	20.0	20.0	16.5	16.5				
202	M	15.16	1864.31	20.0	20.0	16.5	16.5				
203		.65	1864.96	20.0	20.0	16.5	16.5				
204	M	15.16	1880.13	20.0	20.0	16.5	16.5				
205		5.22	1885.35	20.0	20.0	16.5	16.5	.89-6	.94-5		
206	QF	5.20	1890.55	20.0	20.0	16.5	16.5	.86-6			
207		.65	1891.20	20.0	20.0	16.5	16.5				
208	M	15.16	1906.36	20.0	20.0	16.5	16.5				
209		.65	1907.02	20.0	20.0	16.5	16.5				
210	M	15.16	1922.18	20.0	20.0	16.5	16.5				
211		.65	1922.83	20.0	20.0	16.5	16.5				
212	M	15.16	1937.99	20.0	20.0	16.5	16.5				
213		1.15	1939.15	20.0	20.0	16.5	16.5				
214	M	15.16	1954.31	20.0	20.0	16.5	16.5				
215		.65	1954.96	20.0	20.0	16.5	16.5				
216	M	15.16	1970.13	20.0	20.0	16.5	16.5				
217		5.22	1975.35	20.0	20.0	16.5	16.5				
218	QD	2.60	1977.95	20.0	20.0	16.5	16.5				
219	QSD	3.52	1981.47	20.0	20.0	16.5	16.5				
220		2.31	1983.79	20.0	20.0	16.5	16.5				
221	SM	12.64	1996.42	20.0	20.0	16.5	16.5				
222		.65	1997.07	20.0	20.0	16.5	16.5				
223	SM	12.64	2009.71	20.0	20.0	16.5	16.5				
224		.65	2010.36	20.0	20.0	16.5	16.5				
225	SM	12.64	2023.00	20.0	20.0	16.5	16.5				
226		.65	2023.65	20.0	20.0	16.5	16.5				
227	SM	12.64	2036.29	20.0	20.0	16.5	16.5				
228		5.64	2041.93	20.0	20.0	16.5	16.5				
229	QSF	7.05	2048.97	20.0	20.0	16.5	16.5				
230		2.91	2051.89	20.0	20.0	16.5	16.5				
231	SM	12.64	2064.53	20.0	20.0	16.5	16.5				
232		.65	2065.18	20.0	20.0	16.5	16.5				
233	SM	12.64	2077.81	20.0	20.0	16.5	16.5				
234		.65	2078.46	20.0	20.0	16.5	16.5				
235	SM	12.64	2091.10	20.0	20.0	16.5	16.5				
236		.65	2091.75	20.0	20.0	16.5	16.5				
237	SM	12.64	2104.39	20.0	20.0	16.5	16.5				
238		5.04	2109.43	20.0	20.0	16.5	16.5				
239	QSD	7.05	2116.47	20.0	20.0	16.5	16.5				
240		2.41	2118.88	20.0	20.0	16.5	16.5				
241	SM	12.64	2131.52	20.0	20.0	16.5	16.5				
242		.65	2132.17	20.0	20.0	16.5	16.5				
243	SM	12.64	2144.81	20.0	20.0	16.5	16.5				
244		.65	2145.46	20.0	20.0	16.5	16.5				
245	SM	12.64	2158.10	20.0	20.0	16.5	16.5				
246		.65	2158.75	20.0	20.0	16.5	16.5				
247	SM	12.64	2171.38	20.0	20.0	16.5	16.5				
248		5.54	2176.93	20.0	20.0	16.5	16.5				
249	QSF	7.05	2183.97	20.0	20.0	16.5	16.5				

No	Name	Lattice elements Length meters	Distance	Apertures, mm full hor.	full ver.	small hor.	small ver.	Loss density prot/(m*lhp) coll. off full	small	prot/lhp coll. on full	small
250		3.04	2187.02	20.0	20.0	16.5	16.5				
251	SM	12.64	2199.65	20.0	20.0	16.5	16.5				
252		.65	2200.30	20.0	20.0	16.5	16.5				
253	SM	12.64	2212.94	20.0	20.0	16.5	16.5				
254		.65	2213.59	20.0	20.0	16.5	16.5				
255	SM	12.64	2226.23	20.0	20.0	16.5	16.5				
256		.65	2226.88	20.0	20.0	16.5	16.5				
257	SM	12.64	2239.52	20.0	20.0	16.5	16.5				
258		4.91	2244.43	20.0	20.0	16.5	16.5				
259	QSD	3.52	2247.95	20.0	20.0	16.5	16.5				
260	QD	2.60	2250.55	20.0	20.0	16.5	16.5				
261		4.00	2254.55	20.0	20.0	16.5	16.5				
262	C6	5.00	2259.55	20.0	4.0	16.5	3.5	*	**	* .19-2	.16-2
263		75.80	2335.35	20.0	20.0	16.5	16.5				
264	QF	5.20	2340.55	20.0	20.0	16.5	16.5				
265		84.80	2425.35	20.0	20.0	16.5	16.5				
266	QD	5.20	2430.55	20.0	20.0	16.5	16.5				
267		84.80	2515.35	20.0	20.0	16.5	16.5				
268	QF	5.20	2520.55	20.0	20.0	16.5	16.5				
269		4.00	2524.55	20.0	20.0	16.5	16.5				
270	C7	5.00	2529.55	3.4	20.0	3.0	16.5	*	**	* .12-2	.94-3
271		75.80	2605.35	20.0	20.0	16.5	16.5				
272	QD	5.20	2610.55	20.0	20.0	16.5	16.5				
273		87.40	2697.95	25.0	25.0	20.0	20.0				
274	QL6	4.68	2702.63	25.0	25.0	20.0	20.0				
275		104.00	2806.63	25.0	25.0	20.0	20.0				
276	QL5	14.08	2820.72	25.0	25.0	20.0	20.0				
277		.80	2821.52	25.0	25.0	20.0	20.0		.45-5		
278	QL4	10.63	2832.14	20.0	20.0	16.5	16.5	.58-5	.16-4		
279		.80	2832.94	25.0	25.0	20.0	20.0				
280	VM	12.64	2845.58	25.0	25.0	20.0	20.0				
281		1.00	2846.58	25.0	25.0	20.0	20.0				
282	VM	12.64	2859.22	25.0	25.0	20.0	20.0				
283		1.00	2860.22	25.0	25.0	20.0	20.0				
284	VM	12.64	2872.86	25.0	25.0	20.0	20.0				
285		13.41	2886.27	25.0	25.0	20.0	20.0				
286	VM	12.64	2898.90	25.0	25.0	20.0	20.0				
287		1.00	2899.90	25.0	25.0	20.0	20.0				
288	VM	12.64	2912.54	25.0	25.0	20.0	20.0				
289		1.00	2913.54	25.0	25.0	20.0	20.0				
290	VM	12.64	2926.18	25.0	25.0	20.0	20.0				
291		4.96	2931.14	25.0	25.0	20.0	20.0				
292	QVF	14.25	2945.39	25.0	25.0	20.0	20.0				
293		.80	2946.19	25.0	25.0	20.0	20.0				
294	QVD	14.25	2960.44	25.0	25.0	20.0	20.0				
295		4.20	2964.64	25.0	25.0	20.0	20.0				
296	QVD	14.25	2978.89	25.0	25.0	20.0	20.0				
297		.80	2979.69	25.0	25.0	20.0	20.0				
298	QVF	14.25	2993.94	25.0	25.0	20.0	20.0				
299		4.20	2998.14	25.0	25.0	20.0	20.0				

No	Name	Lattice elements Length meters	Distance	Apertures, mm full hor.	full ver.	small hor.	small ver.	Loss density prot/(m*1hp) coll. off full	coll. off small	prot/1hp coll. on full	coll. on small
300	QVF	14.25	3012.39	25.0	25.0	20.0	20.0				
301		.80	3013.19	25.0	25.0	20.0	20.0				
302	QVD	14.25	3027.44	25.0	25.0	20.0	20.0				
303		4.20	3031.64	25.0	25.0	20.0	20.0				
304	QVD	14.25	3045.89	25.0	25.0	20.0	20.0				
305		.80	3046.69	25.0	25.0	20.0	20.0				
306	QVF	14.25	3060.94	25.0	25.0	20.0	20.0				
307		13.07	3074.02	33.0	33.0	33.0	33.0				
308	SVM	5.00	3079.02	33.0	33.0	33.0	33.0				
309		1.00	3080.02	33.0	33.0	33.0	33.0				
310	SVM	5.00	3085.02	33.0	33.0	33.0	33.0				
311		1.00	3086.52	33.0	33.0	33.0	33.0				
312	SVM	5.00	3091.02	33.0	33.0	33.0	33.0				
313		90.00	3181.02	33.0	33.0	33.0	33.0	.84-6	.81-7		
314	C8	4.00	3185.02	20.0	10.0	16.5	8.5	*	** *	.41-3	.36-3
315		90.00	3275.02	33.0	33.0	33.0	33.0	.86-5	.67-5		
316		.80	3275.81	33.0	33.0	33.0	33.0				
317	SVM	5.00	3280.81	33.0	33.0	33.0	33.0	.32-5	.12-4		
318		1.00	3281.81	33.0	33.0	33.0	33.0	.53-4			
319	SVM	5.00	3286.81	33.0	33.0	33.0	33.0	.20-4	.20-4		
320		1.00	3287.81	33.0	33.0	33.0	33.0		.49-4		
321	SVM	5.00	3292.81	33.0	33.0	33.0	33.0	.11-4	.82-6		
322		7.00	3299.81	33.0	33.0	33.0	33.0	.75-5	.88-5		
323	QL3	12.96	3312.77	20.0	20.0	16.5	16.5	.21-3	.32-3		.49-4
324		.80	3313.57	20.0	20.0	16.5	16.5		.25-3		
325	QL2	11.22	3324.79	20.0	20.0	16.5	16.5	.50-4	.63-4		
326		1.00	3325.79	20.0	20.0	16.5	16.5				
327	QL2	11.22	3337.01	20.0	20.0	16.5	16.5				
328		.80	3337.81	20.0	20.0	16.5	16.5				
329	QL1	15.14	3352.95	20.0	20.0	16.5	16.5				
330		20.00	3372.95	20.0	20.0	16.5	16.5				
331		20.00	3392.95	20.0	20.0	16.5	16.5				
332	QL1	15.14	3408.09	20.0	20.0	16.5	16.5				
333		.80	3408.89	20.0	20.0	16.5	16.5				
334	QL2	11.22	3420.11	20.0	20.0	16.5	16.5				
335		1.00	3421.11	20.0	20.0	16.5	16.5				
336	QL2	11.22	3432.33	20.0	20.0	16.5	16.5				
337		.80	3433.13	20.0	20.0	16.5	16.5				
338	QL3	12.96	3446.59	20.0	20.0	16.5	16.5	.38-5	.38-5		.49-4
339		7.00	3453.09	33.0	33.0	33.0	33.0				
340	SVM	5.00	3458.09	33.0	33.0	33.0	33.0				
341		1.00	3459.09	33.0	33.0	33.0	33.0				
342	SVM	5.00	3464.09	33.0	33.0	33.0	33.0				
343		1.00	3465.09	33.0	33.0	33.0	33.0				
344	SVM	5.00	3470.09	33.0	33.0	33.0	33.0				
345		184.00	3654.09	33.0	33.0	33.0	33.0				
346		.80	3654.88	33.0	33.0	33.0	33.0				
347	SVM	5.00	3659.88	33.0	33.0	33.0	33.0				
348		1.00	3660.88	33.0	33.0	33.0	33.0				
349	SVM	5.00	3665.88	33.0	33.0	33.0	33.0				

No	Name	Length	Distance	Apertures, mm full hor.	full ver.	small hor.	small ver.	Loss density prot/(m*lhp) coll. off full	small	prot/lhp coll. on full	small
		Lattice elements meters									
350		1.00	3666.88	33.0	33.0	33.0	33.0				
351	SVM	5.00	3671.88	33.0	33.0	33.0	33.0				
352		13.07	3684.96	33.0	33.0	33.0	33.0				
353	QVD	14.25	3699.21	25.0	25.0	20.0	20.0				
354		.80	3700.01	25.0	25.0	20.0	20.0				
355	QVF	14.25	3714.26	25.0	25.0	20.0	20.0				
356		4.20	3718.46	25.0	25.0	20.0	20.0				
357	QVF	14.25	3732.71	25.0	25.0	20.0	20.0				
358		.80	3733.51	25.0	25.0	20.0	20.0				
359	QVD	14.25	3747.76	25.0	25.0	20.0	20.0				
360		4.20	3751.96	25.0	25.0	20.0	20.0				
361	QVD	14.25	3766.21	25.0	25.0	20.0	20.0				
362		.80	3767.01	25.0	25.0	20.0	20.0				
363	QVF	14.25	3781.26	25.0	25.0	20.0	20.0				
364		4.20	3785.46	25.0	25.0	20.0	20.0				
365	QVF	14.25	3799.71	25.0	25.0	20.0	20.0				
366		.80	3800.51	25.0	25.0	20.0	20.0				
367	QVD	14.25	3814.76	25.0	25.0	20.0	20.0				
368		4.96	3819.72	25.0	25.0	20.0	20.0				
369	VM	12.64	3832.36	25.0	25.0	20.0	20.0				
370		1.00	3833.36	25.0	25.0	20.0	20.0				
371	VM	12.64	3846.50	25.0	25.0	20.0	20.0				
372		1.00	3847.00	25.0	25.0	20.0	20.0				
373	VM	12.64	3859.63	25.0	25.0	20.0	20.0				
374		13.41	3873.04	25.0	25.0	20.0	20.0				
375	VM	12.64	3885.68	25.0	25.0	20.0	20.0				
376		1.00	3886.68	25.0	25.0	20.0	20.0				
377	VM	12.64	3899.32	25.0	25.0	20.0	20.0				
378		1.00	3900.32	25.0	25.0	20.0	20.0				
379	VM	12.64	3912.96	25.0	25.0	20.0	20.0				
380		.80	3913.76	25.0	25.0	20.0	20.0				
381	QL4	10.63	3924.38	20.0	20.0	16.5	16.5				
382		.80	3925.18	25.0	25.0	20.0	20.0				
383	QL5	14.08	3939.27	25.0	25.0	20.0	20.0				
384		104.00	4043.27	25.0	25.0	20.0	20.0				
385	QL6	4.68	4047.95	25.0	25.0	20.0	20.0				
386		87.40	4135.35	25.0	25.0	20.0	20.0				
387	QF	5.20	4140.55	20.0	20.0	16.5	16.5				
388		84.80	4225.35	20.0	20.0	16.5	16.5				
389	QD	5.20	4230.55	20.0	20.0	16.5	16.5				
390		84.80	4315.35	20.0	20.0	16.5	16.5				
391	QF	2.60	4317.95	20.0	20.0	16.5	16.5				
392	QSF	3.52	4321.47	20.0	20.0	16.5	16.5				
393		6.80	4328.27	20.0	20.0	16.5	16.5				
394	SM	12.64	4340.91	20.0	20.0	16.5	16.5				
395		.65	4341.56	20.0	20.0	16.5	16.5				
396	SM	12.64	4354.20	20.0	20.0	16.5	16.5				
397		.65	4354.85	20.0	20.0	16.5	16.5				
398	SM	12.64	4367.49	20.0	20.0	16.5	16.5				
399		.65	4368.14	20.0	20.0	16.5	16.5				

Lattice elements				Apertures, mm				Loss density			
No	Name	Length	Distance meters	full		small		prot/(m*lhp) coll. off		prot/lhp coll. on	
				hor.	ver.	hor.	ver.	full	small	full	small
400	SM	12.64	4380.77	20.0	20.0	16.5	16.5				
401		1.15	4381.93	20.0	20.0	16.5	16.5				
402	QSD	7.05	4388.97	20.0	20.0	16.5	16.5				
403		12.33	4401.31	20.0	20.0	16.5	16.5				
404	SM	12.64	4413.95	20.0	20.0	16.5	16.5				
405		.65	4414.60	20.0	20.0	16.5	16.5				
406	SM	12.64	4427.23	20.0	20.0	16.5	16.5				
407		.65	4427.88	20.0	20.0	16.5	16.5				
408	SM	12.64	4440.52	20.0	20.0	16.5	16.5				
409		8.90	4449.43	20.0	20.0	16.5	16.5				
410	QSF	7.05	4456.47	20.0	20.0	16.5	16.5				
411		13.35	4469.82	20.0	20.0	16.5	16.5				
412	SM	12.64	4482.46	20.0	20.0	16.5	16.5				
413		.65	4483.11	20.0	20.0	16.5	16.5				
414	SM	12.64	4495.75	20.0	20.0	16.5	16.5				
415		.65	4496.40	20.0	20.0	16.5	16.5				
416	SM	12.64	4509.04	20.0	20.0	16.5	16.5				
417		7.89	4516.93	20.0	20.0	16.5	16.5				
418	QSD	7.05	4523.97	20.0	20.0	16.5	16.5				
419		2.00	4525.97	20.0	20.0	16.5	16.5				
420	SH4	3.00	4528.97	20.0	20.0	16.5	16.5				
421		8.42	4537.40	20.0	20.0	16.5	16.5				
422	SM	12.64	4550.04	20.0	20.0	16.5	16.5				
423		.65	4550.69	20.0	20.0	16.5	16.5				
424	SM	12.64	4563.32	20.0	20.0	16.5	16.5				
425		.65	4563.97	20.0	20.0	16.5	16.5				
426	SM	12.64	4576.61	20.0	20.0	16.5	16.5				
427		7.82	4584.43	20.0	20.0	16.5	16.5				
428	QSF	3.52	4587.95	20.0	20.0	16.5	16.5				
429	QF	2.60	4590.55	20.0	20.0	16.5	16.5				
430		3.19	4593.74	20.0	20.0	16.5	16.5				
431	M	15.16	4608.90	20.0	20.0	16.5	16.5				
432		.65	4609.55	20.0	20.0	16.5	16.5				
433	M	15.16	4624.72	20.0	20.0	16.5	16.5				
434		.65	4625.37	20.0	20.0	16.5	16.5				
435	M	15.16	4640.53	20.0	20.0	16.5	16.5				
436		.65	4641.18	20.0	20.0	16.5	16.5				
437	M	15.16	4656.35	20.0	20.0	16.5	16.5				
438		.65	4657.00	20.0	20.0	16.5	16.5				
439	M	15.16	4672.16	20.0	20.0	16.5	16.5				
440		3.19	4675.35	20.0	20.0	16.5	16.5				
441	QD	2.60	4677.95	20.0	20.0	16.5	16.5				
442	QSD	3.52	4681.47	20.0	20.0	16.5	16.5				
443		7.82	4689.29	20.0	20.0	16.5	16.5				
444	SM	12.64	4701.93	20.0	20.0	16.5	16.5				
445		.65	4702.58	20.0	20.0	16.5	16.5				
446	SM	12.64	4715.21	20.0	20.0	16.5	16.5				
447		.65	4715.86	20.0	20.0	16.5	16.5				
448	SM	12.64	4728.50	20.0	20.0	16.5	16.5	.37-6			
449		13.42	4741.93	20.0	20.0	16.5	16.5				

No	Name	Lattice elements Length meters	Distance	Apertures, mm full hor.	full ver.	small hor.	small ver.	Loss density prot/(m&lhp) coll. off full	coll. off small	prot/lhp coll. on full	coll. on small
450	QSF	7.05	4748.97	20.0	20.0	16.5	16.5				
451		7.89	4756.87	20.0	20.0	16.5	16.5				
452	SM	12.64	4769.50	20.0	20.0	16.5	16.5				
453		.65	4770.15	20.0	20.0	16.5	16.5				
454	SM	12.64	4782.79	20.0	20.0	16.5	16.5				
455		.65	4783.44	20.0	20.0	16.5	16.5				
456	SM	12.64	4796.58	20.0	20.0	16.5	16.5				
457		2.00	4798.08	20.0	20.0	16.5	16.5				
458	SH5	3.00	4801.08	20.0	20.0	16.5	16.5				
459		8.35	4809.43	20.0	20.0	16.5	16.5				
460	QSD	7.05	4816.47	20.0	20.0	16.5	16.5				
461		8.90	4825.38	20.0	20.0	16.5	16.5				
462	SM	12.64	4838.02	20.0	20.0	16.5	16.5				
463		.65	4838.67	20.0	20.0	16.5	16.5				
464	SM	12.64	4851.30	20.0	20.0	16.5	16.5				
465		.65	4851.95	20.0	20.0	16.5	16.5				
466	SM	12.64	4864.59	20.0	20.0	16.5	16.5				
467		12.33	4876.93	20.0	20.0	16.5	16.5				
468	QSF	7.05	4883.97	20.0	20.0	16.5	16.5				
469		1.15	4885.13	20.0	20.0	16.5	16.5				
470	SM	12.64	4897.76	20.0	20.0	16.5	16.5				
471		.65	4898.41	20.0	20.0	16.5	16.5				
472	SM	12.64	4911.05	20.0	20.0	16.5	16.5				
473		.65	4911.70	20.0	20.0	16.5	16.5				
474	SM	12.64	4924.34	20.0	20.0	16.5	16.5				
475		.65	4924.99	20.0	20.0	16.5	16.5				
476	SM	12.64	4937.63	20.0	20.0	16.5	16.5				
477		6.80	4944.43	20.0	20.0	16.5	16.5				
478	QSD	3.52	4947.95	20.0	20.0	16.5	16.5				
479	QD	2.60	4950.55	20.0	20.0	16.5	16.5				
480		84.80	5035.35	20.0	20.0	16.5	16.5				
481	QF	5.20	5040.55	20.0	20.0	16.5	16.5				
482		84.80	5125.35	20.0	20.0	16.5	16.5				
483	QD	5.20	5130.55	20.0	20.0	16.5	16.5				
484		87.40	5217.95	25.0	25.0	20.0	20.0				
485	QL6	4.68	5222.63	25.0	25.0	20.0	20.0				
486		104.00	5326.63	25.0	25.0	20.0	20.0				
487	QL5	14.08	5340.72	25.0	25.0	20.0	20.0				
488		.80	5341.52	25.0	25.0	20.0	20.0				
489	QL4	10.63	5352.14	20.0	20.0	16.5	16.5				
490		.80	5352.94	25.0	25.0	20.0	20.0				
491	VM	12.64	5365.58	25.0	25.0	20.0	20.0				
492		1.00	5366.58	25.0	25.0	20.0	20.0				
493	VM	12.64	5379.22	25.0	25.0	20.0	20.0				
494		1.00	5380.22	25.0	25.0	20.0	20.0				
495	VM	12.64	5392.86	25.0	25.0	20.0	20.0				
496		13.41	5406.27	25.0	25.0	20.0	20.0				
497	VM	12.64	5418.90	25.0	25.0	20.0	20.0				
498		1.00	5419.90	25.0	25.0	20.0	20.0				
499	VM	12.64	5432.54	25.0	25.0	20.0	20.0				

No	Name	Lattice elements Length meters	Distance	Apertures, mm full hor.	full ver.	small hor.	small ver.	Loss density prot/(m*lhp) coll. off full	small	prot/lhp coll. on full	small
500		1.00	5433.54	25.0	25.0	20.0	20.0				
501	VM	12.64	5446.18	25.0	25.0	20.0	20.0				
502		4.96	5451.14	25.0	25.0	20.0	20.0				
503	QVF	14.25	5465.39	25.0	25.0	20.0	20.0				
504		.80	5466.19	25.0	25.0	20.0	20.0				
505	QVD	14.25	5480.44	25.0	25.0	20.0	20.0				
506		4.20	5484.64	25.0	25.0	20.0	20.0				
507	QVD	14.25	5498.89	25.0	25.0	20.0	20.0				
508		.80	5499.69	25.0	25.0	20.0	20.0				
509	QVF	14.25	5513.94	25.0	25.0	20.0	20.0				
510		4.20	5518.14	25.0	25.0	20.0	20.0				
511	QVF	14.25	5532.39	25.0	25.0	20.0	20.0				
512		.80	5533.19	25.0	25.0	20.0	20.0				
513	QVD	14.25	5547.44	25.0	25.0	20.0	20.0				
514		4.20	5551.64	25.0	25.0	20.0	20.0				
515	QVD	14.25	5565.89	25.0	25.0	20.0	20.0				
516		.80	5566.69	25.0	25.0	20.0	20.0				
517	QVF	14.25	5580.94	25.0	25.0	20.0	20.0				
518		13.07	5594.02	33.0	33.0	33.0	33.0				
519	SVM	5.00	5599.02	33.0	33.0	33.0	33.0				
520		1.00	5600.02	33.0	33.0	33.0	33.0				
521	SVM	5.00	5605.02	33.0	33.0	33.0	33.0				
522		1.00	5606.52	33.0	33.0	33.0	33.0				
523	SVM	5.00	5611.02	33.0	33.0	33.0	33.0				
524		90.00	5701.02	33.0	33.0	33.0	33.0				
525	C9	4.00	5705.02	20.0	10.0	16.5	8.5	*	**	* .29-1	.23-1
526		90.00	5795.02	33.0	33.0	33.0	33.0	.22-6	.51-7		
527		.80	5795.81	33.0	33.0	33.0	33.0				
528	SVM	5.00	5800.81	33.0	33.0	33.0	33.0				
529		1.00	5801.81	33.0	33.0	33.0	33.0				
530	SVM	5.00	5806.81	33.0	33.0	33.0	33.0				
531		1.00	5807.81	33.0	33.0	33.0	33.0				
532	SVM	5.00	5812.81	33.0	33.0	33.0	33.0				
533		7.00	5819.81	33.0	33.0	33.0	33.0	.63-6			
534	QL3	12.96	5832.77	20.0	20.0	16.5	16.5	.15-3	.33-3	.44-5	.21-6
535		.80	5833.57	20.0	20.0	16.5	16.5				
536	QL2	11.22	5844.79	20.0	20.0	16.5	16.5	.44-5	.39-6	.49-4	
537		1.00	5845.79	20.0	20.0	16.5	16.5				
538	QL2	11.22	5857.01	20.0	20.0	16.5	16.5				
539		.80	5857.81	20.0	20.0	16.5	16.5				
540	QL1	15.14	5872.95	20.0	20.0	16.5	16.5				
541		20.00	5892.95	20.0	20.0	16.5	16.5				
542		20.00	5912.95	20.0	20.0	16.5	16.5				
543	QL1	15.14	5928.09	20.0	20.0	16.5	16.5				
544		.80	5928.89	20.0	20.0	16.5	16.5				
545	QL2	11.22	5940.11	20.0	20.0	16.5	16.5		.44-5		
546		1.00	5941.11	20.0	20.0	16.5	16.5	.20-3	.15-3		
547	QL2	11.22	5952.33	20.0	20.0	16.5	16.5				
548		.80	5953.13	20.0	20.0	16.5	16.5				
549	QL3	12.96	5966.59	20.0	20.0	16.5	16.5				

No	Name	Length	Distance	Apertures, mm full hor.	full ver.	small hor.	small ver.	Loss density prot/(m*lhp) coll. off full	small	prot/lhp coll. on full	small
		Lattice elements meters									
550		7.00	5973.09	33.0	33.0	33.0	33.0				
551	SVM	5.00	5978.09	33.0	33.0	33.0	33.0				
552		1.00	5979.09	33.0	33.0	33.0	33.0				
553	SVM	5.00	5984.09	33.0	33.0	33.0	33.0				
554		1.00	5985.09	33.0	33.0	33.0	33.0				
555	SVM	5.00	5990.09	33.0	33.0	33.0	33.0				
556		184.00	6174.09	33.0	33.0	33.0	33.0				
557		.80	6174.88	33.0	33.0	33.0	33.0				
558	SVM	5.00	6179.88	33.0	33.0	33.0	33.0				
559		1.00	6180.88	33.0	33.0	33.0	33.0				
560	SVM	5.00	6185.88	33.0	33.0	33.0	33.0				
561		1.00	6186.88	33.0	33.0	33.0	33.0				
562	SVM	5.00	6191.88	33.0	33.0	33.0	33.0				
563		13.07	6204.96	33.0	33.0	33.0	33.0				
564	QVD	14.25	6219.21	25.0	25.0	20.0	20.0				
565		.80	6220.01	25.0	25.0	20.0	20.0				
566	QVF	14.25	6234.26	25.0	25.0	20.0	20.0				
567		4.20	6238.46	25.0	25.0	20.0	20.0				
568	QVF	14.25	6252.71	25.0	25.0	20.0	20.0				
569		.80	6253.51	25.0	25.0	20.0	20.0				
570	QVD	14.25	6267.76	25.0	25.0	20.0	20.0				
571		4.20	6271.96	25.0	25.0	20.0	20.0				
572	QVD	14.25	6286.21	25.0	25.0	20.0	20.0				
573		.80	6287.01	25.0	25.0	20.0	20.0				
574	QVF	14.25	6301.26	25.0	25.0	20.0	20.0				
575		4.20	6305.46	25.0	25.0	20.0	20.0				
576	QVF	14.25	6319.71	25.0	25.0	20.0	20.0				
577		.80	6320.51	25.0	25.0	20.0	20.0				
578	QVD	14.25	6334.76	25.0	25.0	20.0	20.0				
579		4.96	6339.72	25.0	25.0	20.0	20.0				
580	VM	12.64	6352.36	25.0	25.0	20.0	20.0				
581		1.00	6353.36	25.0	25.0	20.0	20.0				
582	VM	12.64	6366.50	25.0	25.0	20.0	20.0				
583		1.00	6367.00	25.0	25.0	20.0	20.0				
584	VM	12.64	6379.63	25.0	25.0	20.0	20.0				
585		13.41	6393.04	25.0	25.0	20.0	20.0				
586	VM	12.64	6405.68	25.0	25.0	20.0	20.0				
587		1.00	6406.68	25.0	25.0	20.0	20.0				
588	VM	12.64	6419.32	25.0	25.0	20.0	20.0				
589		1.00	6420.32	25.0	25.0	20.0	20.0				
590	VM	12.64	6432.96	25.0	25.0	20.0	20.0				
591		.80	6433.76	25.0	25.0	20.0	20.0				
592	QL4	10.63	6444.38	20.0	20.0	16.5	16.5				
593		.80	6445.18	25.0	25.0	20.0	20.0				
594	QL5	14.08	6459.27	25.0	25.0	20.0	20.0				
595		104.00	6563.27	25.0	25.0	20.0	20.0				
596	QL6	4.68	6567.95	25.0	25.0	20.0	20.0				
597		87.40	6655.35	25.0	25.0	20.0	20.0				
598	QF	5.20	6660.55	20.0	20.0	16.5	16.5				
599		84.80	6745.35	20.0	20.0	16.5	16.5				

No	Name	Lattice elements Length meters	Distance	Apertures, mm full hor.	full ver.	small hor.	small ver.	Loss density prot/(m*lhp) coll. off full	small	prot/lhp coll. on full	small
600	QD	5.20	6750.55	20.0	20.0	16.5	16.5				
601		84.80	6835.35	20.0	20.0	16.5	16.5				
602	QF	5.20	6840.55	20.0	20.0	16.5	16.5				
603		84.80	6925.35	20.0	20.0	16.5	16.5				
604	QD	5.20	6930.55	20.0	20.0	16.5	16.5				
605		84.80	7015.35	20.0	20.0	16.5	16.5				
606	QF	2.60	7017.95	20.0	20.0	16.5	16.5				
607	QSF	3.52	7021.47	20.0	20.0	16.5	16.5				
608		2.31	7023.79	20.0	20.0	16.5	16.5				
609	SM	12.64	7036.42	20.0	20.0	16.5	16.5				
610		.65	7037.07	20.0	20.0	16.5	16.5				
611	SM	12.64	7049.71	20.0	20.0	16.5	16.5				
612		.65	7050.36	20.0	20.0	16.5	16.5				
613	SM	12.64	7063.00	20.0	20.0	16.5	16.5				
614		.65	7063.65	20.0	20.0	16.5	16.5				
615	SM	12.64	7076.29	20.0	20.0	16.5	16.5				
616		5.64	7081.93	20.0	20.0	16.5	16.5				
617	QSD	7.05	7088.97	20.0	20.0	16.5	16.5				
618		2.91	7091.89	20.0	20.0	16.5	16.5				
619	SM	12.64	7104.53	20.0	20.0	16.5	16.5				
620		.65	7105.18	20.0	20.0	16.5	16.5				
621	SM	12.64	7117.81	20.0	20.0	16.5	16.5				
622		.65	7118.46	20.0	20.0	16.5	16.5				
623	SM	12.64	7131.10	20.0	20.0	16.5	16.5				
624		.65	7131.75	20.0	20.0	16.5	16.5				
625	SM	12.64	7144.39	20.0	20.0	16.5	16.5				
626		5.04	7149.43	20.0	20.0	16.5	16.5				
627	QSF	7.05	7156.47	20.0	20.0	16.5	16.5				
628		2.41	7158.88	20.0	20.0	16.5	16.5				
629	SM	12.64	7171.52	20.0	20.0	16.5	16.5				
630		.65	7172.17	20.0	20.0	16.5	16.5				
631	SM	12.64	7184.81	20.0	20.0	16.5	16.5				
632		.65	7185.46	20.0	20.0	16.5	16.5				
633	SM	12.64	7198.10	20.0	20.0	16.5	16.5				
634		.65	7198.75	20.0	20.0	16.5	16.5				
635	SM	12.64	7211.38	20.0	20.0	16.5	16.5				
636		5.54	7216.93	20.0	20.0	16.5	16.5				
637	QSD	7.05	7223.97	20.0	20.0	16.5	16.5				
638		3.04	7227.02	20.0	20.0	16.5	16.5				
639	SM	12.64	7239.65	20.0	20.0	16.5	16.5				
640		.65	7240.30	20.0	20.0	16.5	16.5				
641	SM	12.64	7252.94	20.0	20.0	16.5	16.5				
642		.65	7253.59	20.0	20.0	16.5	16.5				
643	SM	12.64	7266.23	20.0	20.0	16.5	16.5				
644		.65	7266.88	20.0	20.0	16.5	16.5				
645	SM	12.64	7279.52	20.0	20.0	16.5	16.5				
646		4.91	7284.43	20.0	20.0	16.5	16.5				
647	QSF	3.52	7287.95	20.0	20.0	16.5	16.5				
648	QF	2.60	7290.55	20.0	20.0	16.5	16.5				
649		.65	7291.20	20.0	20.0	16.5	16.5				

Lattice elements								Loss density			
No	Name	Length	Distance	Apertures, mm				prot/(m*1hp)		prot/1hp	
		meters		full		small		coll. off		coll. on	
				hor.	ver.	hor.	ver.	full	small	full	small
650	M	15.16	7306.37	20.0	20.0	16.5	16.5				
651		.65	7307.02	20.0	20.0	16.5	16.5				
652	M	15.16	7322.18	20.0	20.0	16.5	16.5				
653		.65	7322.83	20.0	20.0	16.5	16.5				
654	M	15.16	7338.00	20.0	20.0	16.5	16.5				
655		1.15	7339.15	20.0	20.0	16.5	16.5				
656	M	15.16	7354.31	20.0	20.0	16.5	16.5				
657		.65	7354.96	20.0	20.0	16.5	16.5				
658	M	15.16	7370.13	20.0	20.0	16.5	16.5				
659		5.22	7375.35	20.0	20.0	16.5	16.5				
660	QD	2.60	7377.95	20.0	20.0	16.5	16.5				

Table A3. Beam loss downstream of the abort Lambertson at 2 TeV (injection). Elements names correspond to the SSCD[1] besides C1-C9 for the suggested collimators. Distance is measured between the end of the Lambertson and the end of the element. "Full" aperture corresponds to the 40 mm inner diameter of the beam pipe in the lattice and the "small" one corresponds to the 33 mm beam pipe diameter. Beam loss density is normalized to 1 proton hitting the Lambertson septum (1hp).

Lattice elements								Loss density			
No	Name	Length	Distance	Apertures, mm				prot/(m*1hp)		prot/1hp	
		meters		full		small		coll. off		coll. on	
				hor.	ver.	hor.	ver.	full	small	full	small
1		3.00	3.00	20.0	20.0	16.5	16.5	.12-2	.20-2	.36-2	.61-2
2	SHV	10.00	13.00	11.2	11.2	9.2	9.2			.81-2	.90-2
3		150.63	163.63	20.0	20.0	16.5	16.5	.15-3	.18-3	.15-1	.18-1
4	C1	10.00	173.63	13.2	13.2	10.9	10.9	*	** *	.12-1	.15-1
5		.32	173.95	20.0	20.0	16.5	16.5	.36-2	.82-2		
6	B	27.50	201.45	63.0	23.0	63.0	23.0				
7		1.50	202.95	25.0	25.0	20.0	20.0	.33-4	.92-5		
8	QU1	11.29	214.24	25.0	25.0	20.0	20.0	.34-4	.97-4		.14-4
9		1.25	215.49	25.0	25.0	20.0	20.0	.21-3	.40-3		.13-3
10	QU2	11.00	226.49	25.0	25.0	20.0	20.0	.11-3	.87-4	.38-3	.18-3
11		119.84	346.33	25.0	25.0	20.0	20.0	.35-5	.23-5	.36-3	.23-3
12	C2	5.00	351.33	5.5	11.0	4.5	9.1	*	** *	.14-1	.16-1
13		1.00	352.33	20.0	20.0	16.5	16.5	.55-3	.86-3		
14	LI	37.00	389.33	20.0	20.0	16.5	16.5	.27-5	.26-5		
15		1.00	390.33	20.0	20.0	16.5	16.5				
16	QU3	9.17	399.50	20.0	20.0	16.5	16.5	.82-4	.29-4		
17		17.82	417.32	20.0	20.0	16.5	16.5	.29-3	.24-3		
18	QU4	7.05	424.37	20.0	20.0	16.5	16.5	.13-3	.12-3	.96-5	.13-3
19		1.00	425.37	20.0	20.0	16.5	16.5				
20	TUD	10.00	435.37	20.0	20.0	16.5	16.5				
21		5.00	440.37	20.0	20.0	16.5	16.5				
22	C3	5.00	445.37	20.0	11.5	16.5	9.5	*	** *	.57-2	.71-2
23		89.98	535.35	20.0	20.0	16.5	16.5	.80-4	.89-4		
24	QF	5.20	540.55	20.0	20.0	16.5	16.5				
25		65.80	606.35	20.0	20.0	16.5	16.5				
26	C4	5.00	611.35	5.5	20.0	4.5	16.5	*	** *	.12-1	.13-1
27		1.00	612.35	20.0	20.0	16.5	16.5				
28	KI	12.00	624.35	20.0	20.0	16.5	16.5				
29		1.00	625.35	20.0	20.0	16.5	16.5	.25-3			
30	QD	2.60	627.95	20.0	20.0	16.5	16.5				
31	QSD	3.52	631.47	20.0	20.0	16.5	16.5				
32		2.31	633.79	20.0	20.0	16.5	16.5				
33	SM	12.64	646.42	20.0	20.0	16.5	16.5				
34		.65	647.07	20.0	20.0	16.5	16.5				
35	SM	12.64	659.71	20.0	20.0	16.5	16.5				
36		.65	660.36	20.0	20.0	16.5	16.5				
37	SM	12.64	673.00	20.0	20.0	16.5	16.5				
38		.65	673.65	20.0	20.0	16.5	16.5				
39	SM	12.64	686.29	20.0	20.0	16.5	16.5	.16-5			
40		5.64	691.93	20.0	20.0	16.5	16.5				
41	QSF	7.05	698.97	20.0	20.0	16.5	16.5				
42		2.91	701.89	20.0	20.0	16.5	16.5				
43	SM	12.64	714.53	20.0	20.0	16.5	16.5				
44		.65	715.18	20.0	20.0	16.5	16.5				
45	SM	12.64	727.81	20.0	20.0	16.5	16.5				
46		.65	728.46	20.0	20.0	16.5	16.5				

No	Name	Length	Distance	Apertures, mm full hor.	full ver.	small hor.	small ver.	Loss density prot/(m*lhp) coll. off full	coll. off small	prot/lhp coll. on full	coll. on small
		Lattice elements meters									
47	SM	12.64	741.10	20.0	20.0	16.5	16.5				
48		.65	741.75	20.0	20.0	16.5	16.5				
49	SM	12.64	754.39	20.0	20.0	16.5	16.5	.79-6	.52-6		
50		.04	754.43	20.0	20.0	16.5	16.5				
51	CS	4.00	758.43	4.0	20.0	3.3	16.5	*	** *	.13-3	.13-3
52		1.00	759.43	20.0	20.0	16.5	16.5		.10-4		
53	QSD	7.05	766.47	20.0	20.0	16.5	16.5				
54		2.41	768.88	20.0	20.0	16.5	16.5	.27-5	.38-5		
55	SM	12.64	781.52	20.0	20.0	16.5	16.5	.22-5	.40-6		
56		.65	782.17	20.0	20.0	16.5	16.5				
57	SM	12.64	794.81	20.0	20.0	16.5	16.5	.40-7			
58		.65	795.46	20.0	20.0	16.5	16.5				
59	SM	12.64	808.10	20.0	20.0	16.5	16.5	.11-5	.11-4		
60		.65	808.75	20.0	20.0	16.5	16.5				
61	SM	12.64	821.38	20.0	20.0	16.5	16.5	.99-5			
62		5.54	826.93	20.0	20.0	16.5	16.5	.15-5			
63	QSF	7.05	833.97	20.0	20.0	16.5	16.5				
64		3.04	837.02	20.0	20.0	16.5	16.5				
65	SM	12.64	849.65	20.0	20.0	16.5	16.5				
66		.65	850.30	20.0	20.0	16.5	16.5				
67	SM	12.64	862.94	20.0	20.0	16.5	16.5				
68		.65	863.59	20.0	20.0	16.5	16.5				
69	SM	12.64	876.23	20.0	20.0	16.5	16.5				
70		.65	876.88	20.0	20.0	16.5	16.5				
71	SM	12.64	889.52	20.0	20.0	16.5	16.5				
72		4.91	894.43	20.0	20.0	16.5	16.5				
73	QSD	3.52	897.95	20.0	20.0	16.5	16.5				
74	QD	2.60	900.55	20.0	20.0	16.5	16.5				
75		.65	901.20	20.0	20.0	16.5	16.5				
76	M	15.16	916.36	20.0	20.0	16.5	16.5				
77		.65	917.02	20.0	20.0	16.5	16.5				
78	M	15.16	932.18	20.0	20.0	16.5	16.5				
79		.65	932.83	20.0	20.0	16.5	16.5				
80	M	15.16	947.99	20.0	20.0	16.5	16.5				
81		1.15	949.15	20.0	20.0	16.5	16.5				
82	M	15.16	964.31	20.0	20.0	16.5	16.5				
83		.65	964.96	20.0	20.0	16.5	16.5				
84	M	15.16	980.13	20.0	20.0	16.5	16.5				
85		5.22	985.35	20.0	20.0	16.5	16.5				
86	QF	5.20	990.55	20.0	20.0	16.5	16.5				
87		.65	991.20	20.0	20.0	16.5	16.5				
88	M	15.16	1006.36	20.0	20.0	16.5	16.5				
89		.65	1007.02	20.0	20.0	16.5	16.5				
90	M	15.16	1022.18	20.0	20.0	16.5	16.5				
91		.65	1022.83	20.0	20.0	16.5	16.5				
92	M	15.16	1037.99	20.0	20.0	16.5	16.5				
93		1.15	1039.15	20.0	20.0	16.5	16.5				
94	M	15.16	1054.31	20.0	20.0	16.5	16.5				
95		.65	1054.96	20.0	20.0	16.5	16.5				
96	M	15.16	1070.13	20.0	20.0	16.5	16.5				
97		5.22	1075.35	20.0	20.0	16.5	16.5				
98	QD	5.20	1080.55	20.0	20.0	16.5	16.5				

Lattice elements								Loss density			
No	Name	Length	Distance	Apertures, mm				prot/(m*lhp)		prot/lhp	
		meters		full		small		coll. off		coll. on	
				hor.	ver.	hor.	ver.	full	small	full	small
99		.65	1081.20	20.0	20.0	16.5	16.5				
100	M	15.16	1096.36	20.0	20.0	16.5	16.5				
101		.65	1097.02	20.0	20.0	16.5	16.5				
102	M	15.16	1112.18	20.0	20.0	16.5	16.5	.19-6			
103		.65	1112.83	20.0	20.0	16.5	16.5				
104	M	15.16	1127.99	20.0	20.0	16.5	16.5				
105		1.15	1129.15	20.0	20.0	16.5	16.5				
106	M	15.16	1144.31	20.0	20.0	16.5	16.5				
107		.65	1144.96	20.0	20.0	16.5	16.5				
108	M	15.16	1160.13	20.0	20.0	16.5	16.5		.27-4		
109		5.22	1165.35	20.0	20.0	16.5	16.5	.24-4	.96-4		
110	QF	5.20	1170.55	20.0	20.0	16.5	16.5	.48-4			
111		.65	1171.20	20.0	20.0	16.5	16.5				
112	M	15.16	1186.36	20.0	20.0	16.5	16.5				
113		.65	1187.02	20.0	20.0	16.5	16.5				
114	M	15.16	1202.18	20.0	20.0	16.5	16.5				
115		.65	1202.83	20.0	20.0	16.5	16.5				
116	M	15.16	1217.99	20.0	20.0	16.5	16.5				
117		1.15	1219.15	20.0	20.0	16.5	16.5				
118	M	15.16	1234.31	20.0	20.0	16.5	16.5				
119		.65	1234.96	20.0	20.0	16.5	16.5				
120	M	15.16	1250.13	20.0	20.0	16.5	16.5				
121		5.22	1255.35	20.0	20.0	16.5	16.5				
122	QD	5.20	1260.55	20.0	20.0	16.5	16.5				
123		.65	1261.20	20.0	20.0	16.5	16.5				
124	M	15.16	1276.36	20.0	20.0	16.5	16.5				
125		.65	1277.02	20.0	20.0	16.5	16.5				
126	M	15.16	1292.18	20.0	20.0	16.5	16.5				
127		.65	1292.83	20.0	20.0	16.5	16.5				
128	M	15.16	1307.99	20.0	20.0	16.5	16.5				
129		1.15	1309.15	20.0	20.0	16.5	16.5				
130	M	15.16	1324.31	20.0	20.0	16.5	16.5				
131		.65	1324.96	20.0	20.0	16.5	16.5				
132	M	15.16	1340.13	20.0	20.0	16.5	16.5				
133		5.22	1345.35	20.0	20.0	16.5	16.5				
134	QF	5.20	1350.55	20.0	20.0	16.5	16.5				
135		.65	1351.20	20.0	20.0	16.5	16.5				
136	M	15.16	1366.36	20.0	20.0	16.5	16.5				
137		.65	1367.02	20.0	20.0	16.5	16.5				
138	M	15.16	1382.18	20.0	20.0	16.5	16.5				
139		.65	1382.83	20.0	20.0	16.5	16.5				
140	M	15.16	1397.99	20.0	20.0	16.5	16.5				
141		1.15	1399.15	20.0	20.0	16.5	16.5				
142	M	15.16	1414.31	20.0	20.0	16.5	16.5				
143		.65	1414.96	20.0	20.0	16.5	16.5				
144	M	15.16	1430.13	20.0	20.0	16.5	16.5				
145		5.22	1435.35	20.0	20.0	16.5	16.5				
146	QD	5.20	1440.55	20.0	20.0	16.5	16.5				
147		.65	1441.20	20.0	20.0	16.5	16.5				
148	M	15.16	1456.36	20.0	20.0	16.5	16.5				
149		.65	1457.02	20.0	20.0	16.5	16.5				

No	Name	Lattice elements Length meters	Distance	Apertures, mm full hor.	full ver.	small hor.	small ver.	Loss density prot/(m*lhp) coll. off full	coll. off small	prot/lhp coll. on full	coll. on small
150	M	15.16	1472.18	20.0	20.0	16.5	16.5				
151		.65	1472.83	20.0	20.0	16.5	16.5				
152	M	15.16	1487.99	20.0	20.0	16.5	16.5				
153		1.15	1489.15	20.0	20.0	16.5	16.5				
154	M	15.16	1504.31	20.0	20.0	16.5	16.5				
155		.65	1504.96	20.0	20.0	16.5	16.5				
156	M	15.16	1520.13	20.0	20.0	16.5	16.5	.49-6	.82-5		
157		5.22	1525.35	20.0	20.0	16.5	16.5		.96-4		
158	QF	5.20	1530.55	20.0	20.0	16.5	16.5	.24-4			
159		.65	1531.20	20.0	20.0	16.5	16.5				
160	M	15.16	1546.36	20.0	20.0	16.5	16.5				
161		.65	1547.02	20.0	20.0	16.5	16.5				
162	M	15.16	1562.18	20.0	20.0	16.5	16.5				
163		.65	1562.83	20.0	20.0	16.5	16.5				
164	M	15.16	1577.99	20.0	20.0	16.5	16.5				
165		1.15	1579.15	20.0	20.0	16.5	16.5				
166	M	15.16	1594.31	20.0	20.0	16.5	16.5				
167		.65	1594.96	20.0	20.0	16.5	16.5				
168	M	15.16	1610.13	20.0	20.0	16.5	16.5				
169		5.22	1615.35	20.0	20.0	16.5	16.5				
170	QD	5.20	1620.55	20.0	20.0	16.5	16.5				
171		.65	1621.20	20.0	20.0	16.5	16.5				
172	M	15.16	1636.36	20.0	20.0	16.5	16.5				
173		.65	1637.02	20.0	20.0	16.5	16.5				
174	M	15.16	1652.18	20.0	20.0	16.5	16.5				
175		.65	1652.83	20.0	20.0	16.5	16.5				
176	M	15.16	1667.99	20.0	20.0	16.5	16.5				
177		1.15	1669.15	20.0	20.0	16.5	16.5				
178	M	15.16	1684.31	20.0	20.0	16.5	16.5				
179		.65	1684.96	20.0	20.0	16.5	16.5				
180	M	15.16	1700.13	20.0	20.0	16.5	16.5				
181		5.22	1705.35	20.0	20.0	16.5	16.5				
182	QF	5.20	1710.55	20.0	20.0	16.5	16.5				
183		.65	1711.20	20.0	20.0	16.5	16.5				
184	M	15.16	1726.36	20.0	20.0	16.5	16.5				
185		.65	1727.02	20.0	20.0	16.5	16.5				
186	M	15.16	1742.18	20.0	20.0	16.5	16.5				
187		.65	1742.83	20.0	20.0	16.5	16.5				
188	M	15.16	1757.99	20.0	20.0	16.5	16.5				
189		1.15	1759.15	20.0	20.0	16.5	16.5				
190	M	15.16	1774.31	20.0	20.0	16.5	16.5				
191		.65	1774.96	20.0	20.0	16.5	16.5				
192	M	15.16	1790.13	20.0	20.0	16.5	16.5				
193		5.22	1795.35	20.0	20.0	16.5	16.5				
194	QD	5.20	1800.55	20.0	20.0	16.5	16.5				
195		.65	1801.20	20.0	20.0	16.5	16.5				
196	M	15.16	1816.36	20.0	20.0	16.5	16.5				
197		.65	1817.02	20.0	20.0	16.5	16.5				
198	M	15.16	1832.18	20.0	20.0	16.5	16.5				
199		.65	1832.83	20.0	20.0	16.5	16.5				

No	Name	Length	Distance meters	Apertures, mm full hor.	full ver.	small hor.	small ver.	Loss density prot/(m*lhp) coll. off full	small	prot/lhp coll. on full	small
200	M	15.16	1847.99	20.0	20.0	16.5	16.5				
201		1.15	1849.15	20.0	20.0	16.5	16.5				
202	M	15.16	1864.31	20.0	20.0	16.5	16.5				
203		.65	1864.96	20.0	20.0	16.5	16.5				
204	M	15.16	1880.13	20.0	20.0	16.5	16.5				
205		5.22	1885.35	20.0	20.0	16.5	16.5				
206	QF	5.20	1890.55	20.0	20.0	16.5	16.5	.24-4			
207		.65	1891.20	20.0	20.0	16.5	16.5				
208	M	15.16	1906.36	20.0	20.0	16.5	16.5				
209		.65	1907.02	20.0	20.0	16.5	16.5				
210	M	15.16	1922.18	20.0	20.0	16.5	16.5				
211		.65	1922.83	20.0	20.0	16.5	16.5				
212	M	15.16	1937.99	20.0	20.0	16.5	16.5				
213		1.15	1939.15	20.0	20.0	16.5	16.5				
214	M	15.16	1954.31	20.0	20.0	16.5	16.5				
215		.65	1954.96	20.0	20.0	16.5	16.5				
216	M	15.16	1970.13	20.0	20.0	16.5	16.5				
217		5.22	1975.35	20.0	20.0	16.5	16.5				
218	QD	2.60	1977.95	20.0	20.0	16.5	16.5				
219	QSD	3.52	1981.47	20.0	20.0	16.5	16.5				
220		2.31	1983.79	20.0	20.0	16.5	16.5				
221	SM	12.64	1996.42	20.0	20.0	16.5	16.5				
222		.65	1997.07	20.0	20.0	16.5	16.5				
223	SM	12.64	2009.71	20.0	20.0	16.5	16.5				
224		.65	2010.36	20.0	20.0	16.5	16.5				
225	SM	12.64	2023.00	20.0	20.0	16.5	16.5				
226		.65	2023.65	20.0	20.0	16.5	16.5				
227	SM	12.64	2036.29	20.0	20.0	16.5	16.5				
228		5.64	2041.93	20.0	20.0	16.5	16.5				
229	QSF	7.05	2048.97	20.0	20.0	16.5	16.5				
230		2.91	2051.89	20.0	20.0	16.5	16.5				
231	SM	12.64	2064.53	20.0	20.0	16.5	16.5				
232		.65	2065.18	20.0	20.0	16.5	16.5				
233	SM	12.64	2077.81	20.0	20.0	16.5	16.5				
234		.65	2078.46	20.0	20.0	16.5	16.5				
235	SM	12.64	2091.10	20.0	20.0	16.5	16.5				
236		.65	2091.75	20.0	20.0	16.5	16.5				
237	SM	12.64	2104.39	20.0	20.0	16.5	16.5				
238		5.04	2109.43	20.0	20.0	16.5	16.5				
239	QSD	7.05	2116.47	20.0	20.0	16.5	16.5				
240		2.41	2118.88	20.0	20.0	16.5	16.5				
241	SM	12.64	2131.52	20.0	20.0	16.5	16.5				
242		.65	2132.17	20.0	20.0	16.5	16.5				
243	SM	12.64	2144.81	20.0	20.0	16.5	16.5				
244		.65	2145.46	20.0	20.0	16.5	16.5				
245	SM	12.64	2158.10	20.0	20.0	16.5	16.5				
246		.65	2158.75	20.0	20.0	16.5	16.5				
247	SM	12.64	2171.38	20.0	20.0	16.5	16.5				
248		5.54	2176.93	20.0	20.0	16.5	16.5				
249	QSF	7.05	2183.97	20.0	20.0	16.5	16.5				

No	Name	Lattice elements Length meters	Distance	Apertures, mm full hor.	full ver.	small hor.	small ver.	Loss density prot/(m*lhp) coll. off full	small	prot/lhp coll. on full	small
250		3.04	2187.02	20.0	20.0	16.5	16.5				
251	SM	12.64	2199.65	20.0	20.0	16.5	16.5				
252		.65	2200.30	20.0	20.0	16.5	16.5				
253	SM	12.64	2212.94	20.0	20.0	16.5	16.5				
254		.65	2213.59	20.0	20.0	16.5	16.5				
255	SM	12.64	2226.23	20.0	20.0	16.5	16.5				
256		.65	2226.88	20.0	20.0	16.5	16.5				
257	SM	12.64	2239.52	20.0	20.0	16.5	16.5				
258		4.91	2244.43	20.0	20.0	16.5	16.5				
259	QSD	3.52	2247.95	20.0	20.0	16.5	16.5				
260	QD	2.60	2250.55	20.0	20.0	16.5	16.5				
261		4.00	2254.55	20.0	20.0	16.5	16.5				
262	C6	5.00	2259.55	20.0	10.0	16.5	8.3	*	** *	.16	.15
263		75.80	2335.35	20.0	20.0	16.5	16.5				
264	QF	5.20	2340.55	20.0	20.0	16.5	16.5				
265		84.80	2425.35	20.0	20.0	16.5	16.5				
266	QD	5.20	2430.55	20.0	20.0	16.5	16.5				
267		84.80	2515.35	20.0	20.0	16.5	16.5				
268	QF	5.20	2520.55	20.0	20.0	16.5	16.5				
269		4.00	2524.55	20.0	20.0	16.5	16.5				
270	C7	5.00	2529.55	10.0	20.0	8.0	16.5	*	** *		
271		75.80	2605.35	20.0	20.0	16.5	16.5				
272	QD	5.20	2610.55	20.0	20.0	16.5	16.5				
273		87.40	2697.95	25.0	25.0	20.0	20.0				
274	QL6	4.68	2702.63	25.0	25.0	20.0	20.0				
275		104.00	2806.63	25.0	25.0	20.0	20.0				
276	QL5	14.08	2820.72	25.0	25.0	20.0	20.0	.17-3	.45-3		
277		.80	2821.52	25.0	25.0	20.0	20.0	.16-2	.14-2		
278	QL4	10.63	2832.14	20.0	20.0	16.5	16.5	.16-2	.15-2		
279		.80	2832.94	25.0	25.0	20.0	20.0				
280	VM	12.64	2845.58	25.0	25.0	20.0	20.0				
281		1.00	2846.58	25.0	25.0	20.0	20.0				
282	VM	12.64	2859.22	25.0	25.0	20.0	20.0				
283		1.00	2860.22	25.0	25.0	20.0	20.0				
284	VM	12.64	2872.86	25.0	25.0	20.0	20.0				
285		13.41	2886.27	25.0	25.0	20.0	20.0				
286	VM	12.64	2898.90	25.0	25.0	20.0	20.0				
287		1.00	2899.90	25.0	25.0	20.0	20.0				
288	VM	12.64	2912.54	25.0	25.0	20.0	20.0				
289		1.00	2913.54	25.0	25.0	20.0	20.0				
290	VM	12.64	2926.18	25.0	25.0	20.0	20.0				
291		4.96	2931.14	25.0	25.0	20.0	20.0				
292	QVF	14.25	2945.39	25.0	25.0	20.0	20.0				
293		.80	2946.19	25.0	25.0	20.0	20.0				
294	QVD	14.25	2960.44	25.0	25.0	20.0	20.0				
295		4.20	2964.64	25.0	25.0	20.0	20.0				
296	QVD	14.25	2978.89	25.0	25.0	20.0	20.0				
297		.80	2979.69	25.0	25.0	20.0	20.0				
298	QVF	14.25	2993.94	25.0	25.0	20.0	20.0				
299		4.20	2998.14	25.0	25.0	20.0	20.0				

No	Name	Lattice elements Length meters	Distance meters	Apertures, mm full hor.	full ver.	small hor.	small ver.	Loss density prot/(m*1hp) coll. off full	coll. off small	prot/1hp coll. on full	coll. on small
300	QVF	14.25	3012.39	25.0	25.0	20.0	20.0				
301		.80	3013.19	25.0	25.0	20.0	20.0				
302	QVD	14.25	3027.44	25.0	25.0	20.0	20.0				
303		4.20	3031.64	25.0	25.0	20.0	20.0				
304	QVD	14.25	3045.89	25.0	25.0	20.0	20.0				
305		.80	3046.69	25.0	25.0	20.0	20.0				
306	QVF	14.25	3060.94	25.0	25.0	20.0	20.0				
307		13.07	3074.02	33.0	33.0	33.0	33.0				
308	SVM	5.00	3079.02	33.0	33.0	33.0	33.0				
309		1.00	3080.02	33.0	33.0	33.0	33.0				
310	SVM	5.00	3085.02	33.0	33.0	33.0	33.0				
311		1.00	3086.52	33.0	33.0	33.0	33.0				
312	SVM	5.00	3091.02	33.0	33.0	33.0	33.0				
313		90.00	3181.02	33.0	33.0	33.0	33.0				
314	CB	4.00	3185.02	20.0	6.5	16.5	5.0	*	**	*	
315		90.00	3275.02	33.0	33.0	33.0	33.0				
316		.80	3275.81	33.0	33.0	33.0	33.0				
317	SVM	5.00	3280.81	33.0	33.0	33.0	33.0				
318		1.00	3281.81	33.0	33.0	33.0	33.0				
319	SVM	5.00	3286.81	33.0	33.0	33.0	33.0				
320		1.00	3287.81	33.0	33.0	33.0	33.0				
321	SVM	5.00	3292.81	33.0	33.0	33.0	33.0				
322		7.00	3299.81	33.0	33.0	33.0	33.0				
323	QL3	12.96	3312.77	20.0	20.0	16.5	16.5	.58-4	.68-4		
324		.80	3313.57	20.0	20.0	16.5	16.5	.94-3	.47-3		
325	QL2	11.22	3324.79	20.0	20.0	16.5	16.5	.25-3	.23-3		
326		1.00	3325.79	20.0	20.0	16.5	16.5				
327	QL2	11.22	3337.01	20.0	20.0	16.5	16.5				
328		.80	3337.81	20.0	20.0	16.5	16.5				
329	QL1	15.14	3352.95	20.0	20.0	16.5	16.5				
330		20.00	3372.95	20.0	20.0	16.5	16.5				
331		20.00	3392.95	20.0	20.0	16.5	16.5				
332	QL1	15.14	3408.09	20.0	20.0	16.5	16.5				
333		.80	3408.89	20.0	20.0	16.5	16.5				
334	QL2	11.22	3420.11	20.0	20.0	16.5	16.5				
335		1.00	3421.11	20.0	20.0	16.5	16.5				
336	QL2	11.22	3432.33	20.0	20.0	16.5	16.5				
337		.80	3433.13	20.0	20.0	16.5	16.5				
338	QL3	12.96	3446.59	20.0	20.0	16.5	16.5				
339		7.00	3453.09	33.0	33.0	33.0	33.0				
340	SVM	5.00	3458.09	33.0	33.0	33.0	33.0				
341		1.00	3459.09	33.0	33.0	33.0	33.0				
342	SVM	5.00	3464.09	33.0	33.0	33.0	33.0				
343		1.00	3465.09	33.0	33.0	33.0	33.0				
344	SVM	5.00	3470.09	33.0	33.0	33.0	33.0				
345		184.00	3654.09	33.0	33.0	33.0	33.0				
346		.80	3654.88	33.0	33.0	33.0	33.0				
347	SVM	5.00	3659.88	33.0	33.0	33.0	33.0				
348		1.00	3660.88	33.0	33.0	33.0	33.0				
349	SVM	5.00	3665.88	33.0	33.0	33.0	33.0				

No	Name	Lattice elements Length meters	Distance	Apertures, mm full hor.	full ver.	small hor.	small ver.	Loss prot/(m*lhp) coll. off full	coll. off small	prot/lhp coll. on full	coll. on small
350		1.00	3666.88	33.0	33.0	33.0	33.0				
351	SVM	5.00	3671.88	33.0	33.0	33.0	33.0				
352		13.07	3684.96	33.0	33.0	33.0	33.0				
353	QVD	14.25	3699.21	25.0	25.0	20.0	20.0				
354		.80	3700.01	25.0	25.0	20.0	20.0				
355	QVF	14.25	3714.26	25.0	25.0	20.0	20.0				
356		4.20	3718.46	25.0	25.0	20.0	20.0				
357	QVF	14.25	3732.71	25.0	25.0	20.0	20.0				
358		.80	3733.51	25.0	25.0	20.0	20.0				
359	QVD	14.25	3747.76	25.0	25.0	20.0	20.0				
360		4.20	3751.96	25.0	25.0	20.0	20.0				
361	QVD	14.25	3766.21	25.0	25.0	20.0	20.0				
362		.80	3767.01	25.0	25.0	20.0	20.0				
363	QVF	14.25	3781.26	25.0	25.0	20.0	20.0				
364		4.20	3785.46	25.0	25.0	20.0	20.0				
365	QVF	14.25	3799.71	25.0	25.0	20.0	20.0				
366		.80	3800.51	25.0	25.0	20.0	20.0				
367	QVD	14.25	3814.76	25.0	25.0	20.0	20.0				
368		4.96	3819.72	25.0	25.0	20.0	20.0				
369	VM	12.64	3832.36	25.0	25.0	20.0	20.0				
370		1.00	3833.36	25.0	25.0	20.0	20.0				
371	VM	12.64	3846.50	25.0	25.0	20.0	20.0				
372		1.00	3847.00	25.0	25.0	20.0	20.0				
373	VM	12.64	3859.63	25.0	25.0	20.0	20.0				
374		13.41	3873.04	25.0	25.0	20.0	20.0				
375	VM	12.64	3885.68	25.0	25.0	20.0	20.0				
376		1.00	3886.68	25.0	25.0	20.0	20.0				
377	VM	12.64	3899.32	25.0	25.0	20.0	20.0				
378		1.00	3900.32	25.0	25.0	20.0	20.0				
379	VM	12.64	3912.96	25.0	25.0	20.0	20.0				
380		.80	3913.76	25.0	25.0	20.0	20.0				
381	QL4	10.63	3924.38	20.0	20.0	16.5	16.5	.34-2	.36-2		
382		.80	3925.18	25.0	25.0	20.0	20.0				
383	QL5	14.08	3939.27	25.0	25.0	20.0	20.0		.19-3		
384		104.00	4043.27	25.0	25.0	20.0	20.0				
385	QL6	4.68	4047.95	25.0	25.0	20.0	20.0				
386		87.40	4135.35	25.0	25.0	20.0	20.0				
387	QF	5.20	4140.55	20.0	20.0	16.5	16.5				
388		84.80	4225.35	20.0	20.0	16.5	16.5				
389	QD	5.20	4230.55	20.0	20.0	16.5	16.5				
390		84.80	4315.35	20.0	20.0	16.5	16.5				
391	QF	2.60	4317.95	20.0	20.0	16.5	16.5				
392	QSF	3.52	4321.47	20.0	20.0	16.5	16.5				
393		6.80	4328.27	20.0	20.0	16.5	16.5				
394	SM	12.64	4340.91	20.0	20.0	16.5	16.5				
395		.65	4341.56	20.0	20.0	16.5	16.5				
396	SM	12.64	4354.20	20.0	20.0	16.5	16.5				
397		.65	4354.85	20.0	20.0	16.5	16.5				
398	SM	12.64	4367.49	20.0	20.0	16.5	16.5				
399		.65	4368.14	20.0	20.0	16.5	16.5				

No	Name	Lattice elements Length meters	Distance	Apertures, mm full hor.	full ver.	small hor.	small ver.	Loss density prot/(m*1hp) coll. off full	small	prot/1hp coll. on full	small
400	SM	12.64	4380.77	20.0	20.0	16.5	16.5				
401		1.15	4381.93	20.0	20.0	16.5	16.5				
402	QSD	7.05	4388.97	20.0	20.0	16.5	16.5				
403		12.33	4401.31	20.0	20.0	16.5	16.5				
404	SM	12.64	4413.95	20.0	20.0	16.5	16.5				
405		.65	4414.60	20.0	20.0	16.5	16.5				
406	SM	12.64	4427.23	20.0	20.0	16.5	16.5				
407		.65	4427.88	20.0	20.0	16.5	16.5				
408	SM	12.64	4440.52	20.0	20.0	16.5	16.5				
409		8.90	4449.43	20.0	20.0	16.5	16.5				
410	QSF	7.05	4456.47	20.0	20.0	16.5	16.5				
411		13.35	4469.82	20.0	20.0	16.5	16.5				
412	SM	12.64	4482.46	20.0	20.0	16.5	16.5				
413		.65	4483.11	20.0	20.0	16.5	16.5				
414	SM	12.64	4495.75	20.0	20.0	16.5	16.5				
415		.65	4496.40	20.0	20.0	16.5	16.5				
416	SM	12.64	4509.04	20.0	20.0	16.5	16.5				
417		7.89	4516.93	20.0	20.0	16.5	16.5				
418	QSD	7.05	4523.97	20.0	20.0	16.5	16.5				
419		2.00	4525.97	20.0	20.0	16.5	16.5				
420	SH4	3.00	4528.97	20.0	20.0	16.5	16.5				
421		8.42	4537.40	20.0	20.0	16.5	16.5				
422	SM	12.64	4550.04	20.0	20.0	16.5	16.5				
423		.65	4550.69	20.0	20.0	16.5	16.5				
424	SM	12.64	4563.32	20.0	20.0	16.5	16.5				
425		.65	4563.97	20.0	20.0	16.5	16.5				
426	SM	12.64	4576.61	20.0	20.0	16.5	16.5				
427		7.82	4584.43	20.0	20.0	16.5	16.5				
428	QSF	3.52	4587.95	20.0	20.0	16.5	16.5				
429	QF	2.60	4590.55	20.0	20.0	16.5	16.5				
430		3.19	4593.74	20.0	20.0	16.5	16.5				
431	M	15.16	4608.90	20.0	20.0	16.5	16.5				
432		.65	4609.55	20.0	20.0	16.5	16.5				
433	M	15.16	4624.72	20.0	20.0	16.5	16.5				
434		.65	4625.37	20.0	20.0	16.5	16.5				
435	M	15.16	4640.53	20.0	20.0	16.5	16.5				
436		.65	4641.18	20.0	20.0	16.5	16.5				
437	M	15.16	4656.35	20.0	20.0	16.5	16.5				
438		.65	4657.00	20.0	20.0	16.5	16.5				
439	M	15.16	4672.16	20.0	20.0	16.5	16.5				
440		3.19	4675.35	20.0	20.0	16.5	16.5				
441	QD	2.60	4677.95	20.0	20.0	16.5	16.5				
442	QSD	3.52	4681.47	20.0	20.0	16.5	16.5				
443		7.82	4689.29	20.0	20.0	16.5	16.5				
444	SM	12.64	4701.93	20.0	20.0	16.5	16.5				
445		.65	4702.58	20.0	20.0	16.5	16.5				
446	SM	12.64	4715.21	20.0	20.0	16.5	16.5				
447		.65	4715.86	20.0	20.0	16.5	16.5				
448	SM	12.64	4728.50	20.0	20.0	16.5	16.5				
449		13.42	4741.93	20.0	20.0	16.5	16.5				

No	Name	Lattice elements Length meters	Distance meters	Apertures, mm full hor.	full ver.	small hor.	small ver.	Loss density prot/(m&1hp) coll. off full	coll. off small	prot/1hp coll. on full	coll. on small
450	QSF	7.05	4748.97	20.0	20.0	16.5	16.5				
451		7.89	4756.87	20.0	20.0	16.5	16.5				
452	SM	12.64	4769.50	20.0	20.0	16.5	16.5				
453		.65	4770.15	20.0	20.0	16.5	16.5				
454	SM	12.64	4782.79	20.0	20.0	16.5	16.5				
455		.65	4783.44	20.0	20.0	16.5	16.5				
456	SM	12.64	4796.58	20.0	20.0	16.5	16.5				
457		2.00	4798.08	20.0	20.0	16.5	16.5				
458	SH5	3.00	4801.08	20.0	20.0	16.5	16.5				
459		8.35	4809.43	20.0	20.0	16.5	16.5				
460	QSD	7.05	4816.47	20.0	20.0	16.5	16.5				
461		8.90	4825.38	20.0	20.0	16.5	16.5				
462	SM	12.64	4838.02	20.0	20.0	16.5	16.5				
463		.65	4838.67	20.0	20.0	16.5	16.5				
464	SM	12.64	4851.30	20.0	20.0	16.5	16.5				
465		.65	4851.95	20.0	20.0	16.5	16.5				
466	SM	12.64	4864.59	20.0	20.0	16.5	16.5				
467		12.33	4876.93	20.0	20.0	16.5	16.5				
468	QSF	7.05	4883.97	20.0	20.0	16.5	16.5				
469		1.15	4885.13	20.0	20.0	16.5	16.5				
470	SM	12.64	4897.76	20.0	20.0	16.5	16.5				
471		.65	4898.41	20.0	20.0	16.5	16.5				
472	SM	12.64	4911.05	20.0	20.0	16.5	16.5				
473		.65	4911.70	20.0	20.0	16.5	16.5				
474	SM	12.64	4924.34	20.0	20.0	16.5	16.5				
475		.65	4924.99	20.0	20.0	16.5	16.5				
476	SM	12.64	4937.63	20.0	20.0	16.5	16.5				
477		6.80	4944.43	20.0	20.0	16.5	16.5				
478	QSD	3.52	4947.95	20.0	20.0	16.5	16.5				
479	QD	2.60	4950.55	20.0	20.0	16.5	16.5				
480		84.80	5035.35	20.0	20.0	16.5	16.5				
481	QF	5.20	5040.55	20.0	20.0	16.5	16.5				
482		84.80	5125.35	20.0	20.0	16.5	16.5				
483	QD	5.20	5130.55	20.0	20.0	16.5	16.5				
484		87.40	5217.95	25.0	25.0	20.0	20.0				
485	QL6	4.68	5222.63	25.0	25.0	20.0	20.0				
486		104.00	5326.63	25.0	25.0	20.0	20.0	.23-4	.38-4		
487	QL5	14.08	5340.72	25.0	25.0	20.0	20.0				
488		.80	5341.52	25.0	25.0	20.0	20.0				
489	QL4	10.63	5352.14	20.0	20.0	16.5	16.5	.14-3	.14-3	.13-3	
490		.80	5352.94	25.0	25.0	20.0	20.0				
491	VM	12.64	5365.58	25.0	25.0	20.0	20.0				
492		1.00	5366.58	25.0	25.0	20.0	20.0				
493	VM	12.64	5379.22	25.0	25.0	20.0	20.0				
494		1.00	5380.22	25.0	25.0	20.0	20.0				
495	VM	12.64	5392.86	25.0	25.0	20.0	20.0				
496		13.41	5406.27	25.0	25.0	20.0	20.0				
497	VM	12.64	5418.90	25.0	25.0	20.0	20.0				
498		1.00	5419.90	25.0	25.0	20.0	20.0				
499	VM	12.64	5432.54	25.0	25.0	20.0	20.0				

Lattice elements							Loss			
No	Name	Length meters	Distance	Apertures, mm full hor.	full ver.	small hor.	small ver.	prot/(m*lhp) coll. off full	small	prot/lhp coll. on full	small
500		1.00	5433.54	25.0	25.0	20.0	20.0				
501	VM	12.64	5446.18	25.0	25.0	20.0	20.0				
502		4.96	5451.14	25.0	25.0	20.0	20.0				
503	QVF	14.25	5465.39	25.0	25.0	20.0	20.0				
504		.80	5466.19	25.0	25.0	20.0	20.0				
505	QVD	14.25	5480.44	25.0	25.0	20.0	20.0				
506		4.20	5484.64	25.0	25.0	20.0	20.0				
507	QVD	14.25	5498.89	25.0	25.0	20.0	20.0				
508		.80	5499.69	25.0	25.0	20.0	20.0				
509	QVF	14.25	5513.94	25.0	25.0	20.0	20.0				
510		4.20	5518.14	25.0	25.0	20.0	20.0				
511	QVF	14.25	5532.39	25.0	25.0	20.0	20.0				
512		.80	5533.19	25.0	25.0	20.0	20.0				
513	QVD	14.25	5547.44	25.0	25.0	20.0	20.0				
514		4.20	5551.64	25.0	25.0	20.0	20.0				
515	QVD	14.25	5565.89	25.0	25.0	20.0	20.0				
516		.80	5566.69	25.0	25.0	20.0	20.0				
517	QVF	14.25	5580.94	25.0	25.0	20.0	20.0				
518		13.07	5594.02	33.0	33.0	33.0	33.0				
519	SVM	5.00	5599.02	33.0	33.0	33.0	33.0				
520		1.00	5600.02	33.0	33.0	33.0	33.0				
521	SVM	5.00	5605.02	33.0	33.0	33.0	33.0				
522		1.00	5606.52	33.0	33.0	33.0	33.0				
523	SVM	5.00	5611.02	33.0	33.0	33.0	33.0				
524		90.00	5701.02	33.0	33.0	33.0	33.0				
525	C9	4.00	5705.02	20.0	6.5	16.5	5.0	*	**	*	
526		90.00	5795.02	33.0	33.0	33.0	33.0				
527		.80	5795.81	33.0	33.0	33.0	33.0				
528	SVM	5.00	5800.81	33.0	33.0	33.0	33.0				
529		1.00	5801.81	33.0	33.0	33.0	33.0				
530	SVM	5.00	5806.81	33.0	33.0	33.0	33.0				
531		1.00	5807.81	33.0	33.0	33.0	33.0				
532	SVM	5.00	5812.81	33.0	33.0	33.0	33.0				
533		7.00	5819.81	33.0	33.0	33.0	33.0				
534	QL3	12.96	5832.77	20.0	20.0	16.5	16.5				
535		.80	5833.57	20.0	20.0	16.5	16.5				
536	QL2	11.22	5844.79	20.0	20.0	16.5	16.5				
537		1.00	5845.79	20.0	20.0	16.5	16.5				
538	QL2	11.22	5857.01	20.0	20.0	16.5	16.5				
539		.80	5857.81	20.0	20.0	16.5	16.5				
540	QL1	15.14	5872.95	20.0	20.0	16.5	16.5				
541		20.00	5892.95	20.0	20.0	16.5	16.5				
542		20.00	5912.95	20.0	20.0	16.5	16.5				
543	QL1	15.14	5928.09	20.0	20.0	16.5	16.5				
544		.80	5928.89	20.0	20.0	16.5	16.5				
545	QL2	11.22	5940.11	20.0	20.0	16.5	16.5				
546		1.00	5941.11	20.0	20.0	16.5	16.5				
547	QL2	11.22	5952.33	20.0	20.0	16.5	16.5				
548		.80	5953.13	20.0	20.0	16.5	16.5				
549	QL3	12.96	5966.59	20.0	20.0	16.5	16.5				

No	Name	Length	Distance	Apertures, mm full hor.	full ver.	small hor.	small ver.	Loss density prot/(m*lhp) coll. off full	coll. off small	prot/lhp coll. on full	coll. on small
		Lattice elements meters									
550		7.00	5973.09	33.0	33.0	33.0	33.0				
551	SVM	5.00	5978.09	33.0	33.0	33.0	33.0				
552		1.00	5979.09	33.0	33.0	33.0	33.0				
553	SVM	5.00	5984.09	33.0	33.0	33.0	33.0				
554		1.00	5985.09	33.0	33.0	33.0	33.0				
555	SVM	5.00	5990.09	33.0	33.0	33.0	33.0				
556		184.00	6174.09	33.0	33.0	33.0	33.0				
557		.80	6174.88	33.0	33.0	33.0	33.0				
558	SVM	5.00	6179.88	33.0	33.0	33.0	33.0				
559		1.00	6180.88	33.0	33.0	33.0	33.0				
560	SVM	5.00	6185.88	33.0	33.0	33.0	33.0				
561		1.00	6186.88	33.0	33.0	33.0	33.0				
562	SVM	5.00	6191.88	33.0	33.0	33.0	33.0				
563		13.07	6204.96	33.0	33.0	33.0	33.0				
564	QVD	14.25	6219.21	25.0	25.0	20.0	20.0				
565		.80	6220.01	25.0	25.0	20.0	20.0				
566	QVF	14.25	6234.26	25.0	25.0	20.0	20.0				
567		4.20	6238.46	25.0	25.0	20.0	20.0				
568	QVF	14.25	6252.71	25.0	25.0	20.0	20.0				
569		.80	6253.51	25.0	25.0	20.0	20.0				
570	QVD	14.25	6267.76	25.0	25.0	20.0	20.0				
571		4.20	6271.96	25.0	25.0	20.0	20.0				
572	QVD	14.25	6286.21	25.0	25.0	20.0	20.0				
573		.80	6287.01	25.0	25.0	20.0	20.0				
574	QVF	14.25	6301.26	25.0	25.0	20.0	20.0				
575		4.20	6305.46	25.0	25.0	20.0	20.0				
576	QVF	14.25	6319.71	25.0	25.0	20.0	20.0				
577		.80	6320.51	25.0	25.0	20.0	20.0				
578	QVD	14.25	6334.76	25.0	25.0	20.0	20.0				
579		4.96	6339.72	25.0	25.0	20.0	20.0				
580	VM	12.64	6352.36	25.0	25.0	20.0	20.0				
581		1.00	6353.36	25.0	25.0	20.0	20.0				
582	VM	12.64	6366.50	25.0	25.0	20.0	20.0				
583		1.00	6367.00	25.0	25.0	20.0	20.0				
584	VM	12.64	6379.63	25.0	25.0	20.0	20.0				
585		13.41	6393.04	25.0	25.0	20.0	20.0				
586	VM	12.64	6405.68	25.0	25.0	20.0	20.0				
587		1.00	6406.68	25.0	25.0	20.0	20.0				
588	VM	12.64	6419.32	25.0	25.0	20.0	20.0				
589		1.00	6420.32	25.0	25.0	20.0	20.0				
590	VM	12.64	6432.96	25.0	25.0	20.0	20.0				
591		.80	6433.76	25.0	25.0	20.0	20.0				
592	QL4	10.63	6444.38	20.0	20.0	16.5	16.5				
593		.80	6445.18	25.0	25.0	20.0	20.0				
594	QL5	14.08	6459.27	25.0	25.0	20.0	20.0				
595		104.00	6563.27	25.0	25.0	20.0	20.0				
596	QL6	4.68	6567.95	25.0	25.0	20.0	20.0				
597		87.40	6655.35	25.0	25.0	20.0	20.0				
598	QF	5.20	6660.55	20.0	20.0	16.5	16.5				
599		84.80	6745.35	20.0	20.0	16.5	16.5				

Lattice elements								Loss			
No	Name	Length	Distance	Apertures, mm				prot/(m*1hp)		prot/1hp	
		meters		full		small		coll. off		coll. on	
				hor.	ver.	hor.	ver.	full	small	full	small
600	QD	5.20	6750.55	20.0	20.0	16.5	16.5				
601		84.80	6835.35	20.0	20.0	16.5	16.5				
602	QF	5.20	6840.55	20.0	20.0	16.5	16.5				
603		84.80	6925.35	20.0	20.0	16.5	16.5				
604	QD	5.20	6930.55	20.0	20.0	16.5	16.5				
605		84.80	7015.35	20.0	20.0	16.5	16.5				
606	QF	2.60	7017.95	20.0	20.0	16.5	16.5				
607	QSF	3.52	7021.47	20.0	20.0	16.5	16.5				
608		2.31	7023.79	20.0	20.0	16.5	16.5				
609	SM	12.64	7036.42	20.0	20.0	16.5	16.5				
610		.65	7037.07	20.0	20.0	16.5	16.5				
611	SM	12.64	7049.71	20.0	20.0	16.5	16.5				
612		.65	7050.36	20.0	20.0	16.5	16.5				
613	SM	12.64	7063.00	20.0	20.0	16.5	16.5				
614		.65	7063.65	20.0	20.0	16.5	16.5				
615	SM	12.64	7076.29	20.0	20.0	16.5	16.5				
616		5.64	7081.93	20.0	20.0	16.5	16.5				
617	QSD	7.05	7088.97	20.0	20.0	16.5	16.5				
618		2.91	7091.89	20.0	20.0	16.5	16.5				
619	SM	12.64	7104.53	20.0	20.0	16.5	16.5				
620		.65	7105.18	20.0	20.0	16.5	16.5				
621	SM	12.64	7117.81	20.0	20.0	16.5	16.5				
622		.65	7118.46	20.0	20.0	16.5	16.5				
623	SM	12.64	7131.10	20.0	20.0	16.5	16.5				
624		.65	7131.75	20.0	20.0	16.5	16.5				
625	SM	12.64	7144.39	20.0	20.0	16.5	16.5				
626		5.04	7149.43	20.0	20.0	16.5	16.5				
627	QSF	7.05	7156.47	20.0	20.0	16.5	16.5				
628		2.41	7158.88	20.0	20.0	16.5	16.5				
629	SM	12.64	7171.52	20.0	20.0	16.5	16.5				
630		.65	7172.17	20.0	20.0	16.5	16.5				
631	SM	12.64	7184.81	20.0	20.0	16.5	16.5				
632		.65	7185.46	20.0	20.0	16.5	16.5				
633	SM	12.64	7198.10	20.0	20.0	16.5	16.5				
634		.65	7198.75	20.0	20.0	16.5	16.5				
635	SM	12.64	7211.38	20.0	20.0	16.5	16.5				
636		5.54	7216.93	20.0	20.0	16.5	16.5				
637	QSD	7.05	7223.97	20.0	20.0	16.5	16.5				
638		3.04	7227.02	20.0	20.0	16.5	16.5				
639	SM	12.64	7239.65	20.0	20.0	16.5	16.5				
640		.65	7240.30	20.0	20.0	16.5	16.5				
641	SM	12.64	7252.94	20.0	20.0	16.5	16.5				
642		.65	7253.59	20.0	20.0	16.5	16.5				
643	SM	12.64	7266.23	20.0	20.0	16.5	16.5				
644		.65	7266.88	20.0	20.0	16.5	16.5				
645	SM	12.64	7279.52	20.0	20.0	16.5	16.5				
646		4.91	7284.43	20.0	20.0	16.5	16.5				
647	QSF	3.52	7287.95	20.0	20.0	16.5	16.5				
648	QF	2.60	7290.55	20.0	20.0	16.5	16.5				
649		.65	7291.20	20.0	20.0	16.5	16.5				

Lattice elements								Loss density			
No	Name	Length	Distance	Apertures, mm				prot/(m*lho)		prot/lho	
		meters		full		small		coil. off		coil. on	
				hor.	ver.	hor.	ver.	full	small	full	small
650	M	15.16	7306.37	20.0	20.0	16.5	16.5				
651		.65	7307.02	20.0	20.0	16.5	16.5				
652	M	15.16	7322.18	20.0	20.0	16.5	16.5				
653		.65	7322.83	20.0	20.0	16.5	16.5				
654	M	15.16	7338.00	20.0	20.0	16.5	16.5				
655		1.15	7339.15	20.0	20.0	16.5	16.5				
656	M	15.16	7354.31	20.0	20.0	16.5	16.5				
657		.65	7354.96	20.0	20.0	16.5	16.5				
658	M	15.16	7370.13	20.0	20.0	16.5	16.5				
659		5.22	7375.35	20.0	20.0	16.5	16.5				
660	QD	2.60	7377.95	20.0	20.0	16.5	16.5				