REBUILT BEAM LINE SECTION BETWEEN THE TARGETS M AND E

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During the last shutdown (2001) the old and non-radiation resistant components (designed for 100 µA beam current only) of the beam line section between the targets M and E have been replaced with newly engineered and carefully pre-assembled components, so that later replacement or repair can be made without exposure of personnel to high dose rates [1]. The whole beam line was pre-assembled and tested outside the proton channel well in advance of the shutdown. This operation was considered to be mandatory for the successful replacing and testing of a beam line section during a shutdown of four months duration in a radioactive zone. Although there were still some time-consuming unforeseen problems to be solved during the shutdown period, the pre-assembly was decisive in reducing them to an absolute minimum.

During the following commissioning phase, which had to take place simultaneously with the first beam onto the targets M and E after a long shutdown, no problems were seen with the newly built-in components; 2 pairs of horizontal and vertical steering magnets, 4 pairs of profile and beam position monitors (BPMs) with their protection collimators (the 4th one had to be placed inside the quadrupole lens QHTC18, which was relatively easy to achieve after cleaning out the old components and pushing it through the common vacuum chamber of the 2nd quadrupole triplet), 1 current monitor and 3 ionisation chambers). It should also be noted here, that no disturbing side effects from the 4 protection collimators in front of the new profile monitor plug-in units have been observed with the proton beam so far.

Figure 1 shows a top view of the new beam line region after finishing all work and just before covering the whole section with the needed top layers of concrete shielding blocks. Figure 3 shows the same in a side view drawing.

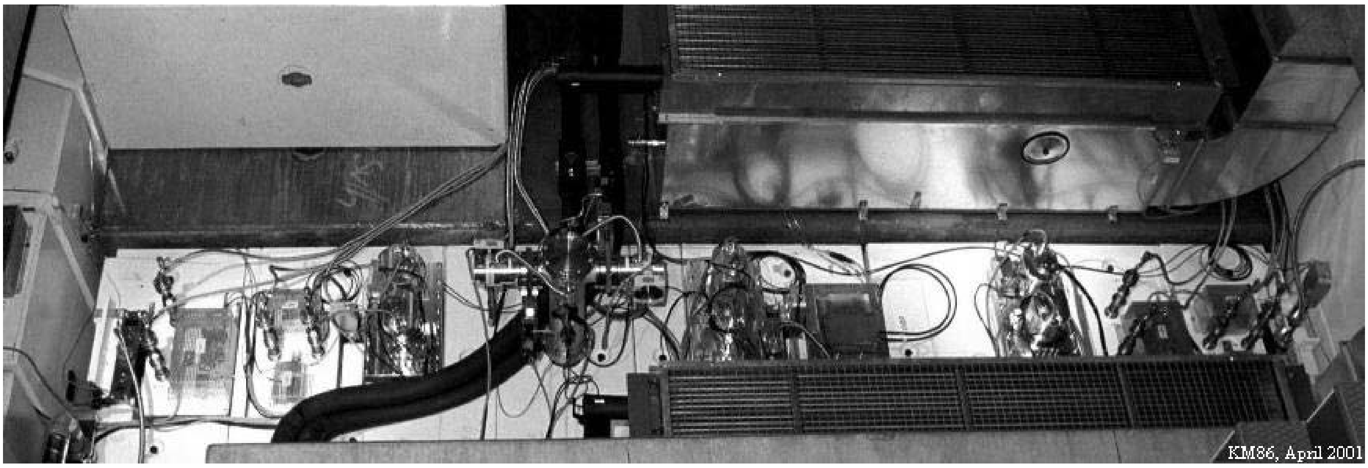

Figure 1: Top view of the new beam line section between the quadrupole triplet after Target M (left) and the one before Target E (right). The white surfaces are the top faces of the newly added local shielding blocks. Well visible are also the 3 pairs of motor drives for the profile monitors, the water- and current-connections of the 2 pairs of steering magnets, the dual turbo molecular vacuum pumping aggregate and part of the air-cooling ventilation system for the region behind the target E.

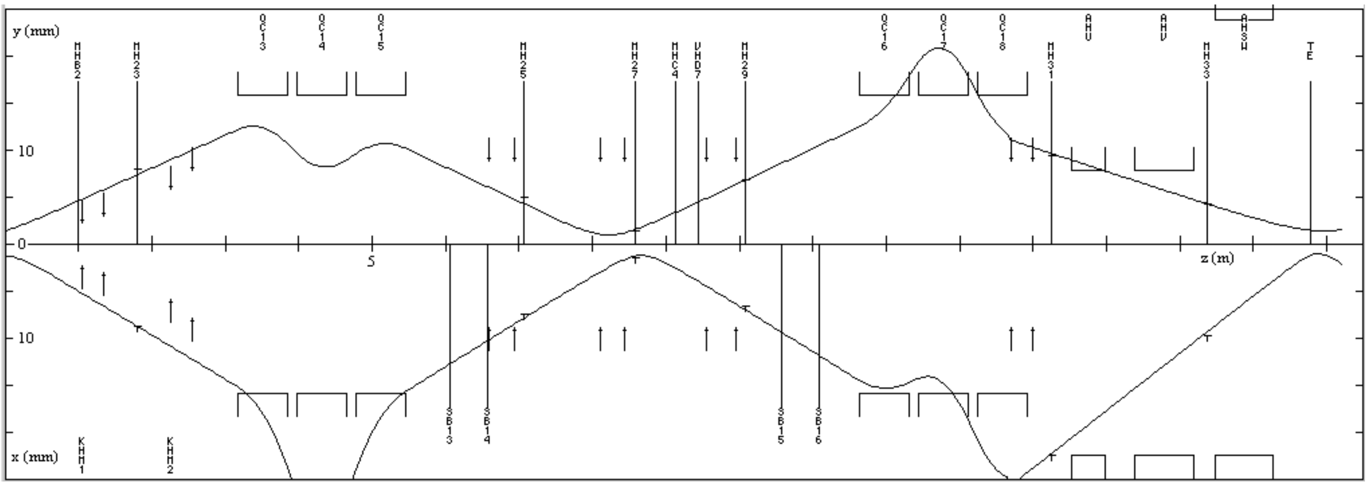

Figure 2: Transport Envelope Fit of the 1.8 mA proton beam between the targets M and E. The profile data used were taken with the new profile monitor devices after a short commissioning period. Also included in the plot are the diverse aperture constraints (old and newly added collimators (symbolized with arrows), quadrupoles and bending magnets). The scaling of the aperture extent compared with that of the beam envelopes is reduced by a factor of five.

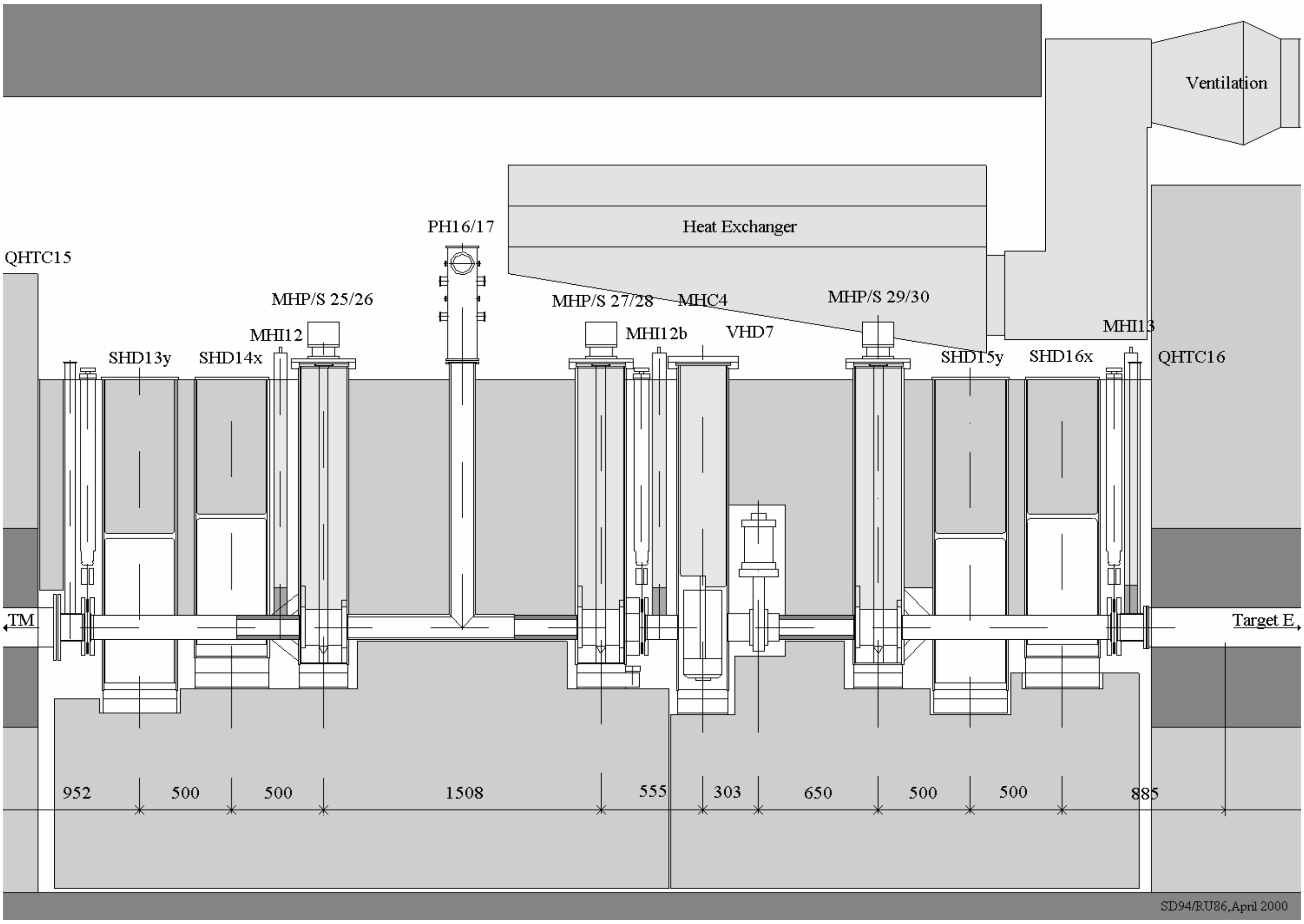

Figure 3: Side view drawing (simplified construction layout). The shown elements from left to right are: Vacuum gasket, a pair of steering magnets (SHD13y and SHD14x), ionization chamber (MHI12), profile/BPM-monitor pair (MHP/S25/26), 2 vacuum pumps (PH16/17), profile/BPM-monitor pair (MHP/S27/28), vacuum gasket, ionization chamber (MHI12b), beam current monitor (MHC4), vacuum valve (VHD7), profile/BPM-monitor pair (MHP/S29/30), a second pair of steering magnets (SHD15y and SHD16x), vacuum gasket, ionization chamber (MHI13). All devices are placed on 2 specially shaped concrete blocks and integrated into a local shielding environment consisting of concrete or steel blocks. On top of the local shielding, the heat exchanger and the ventilator for the air-cooling system are also visible.

Figure 2 shows a graphical output of a TRANSPORT (computer code) envelope fit with the measured profile widths as input constraints (represented with ⊥ at locations marked with MHxx). The data are well interpolated with the drawn curves (86%-beam envelopes), which therefore represent quite well the actual proton beam of this section.

Table 1: Emittance data at the Target-E gained from the TRANSPORT envelope fit shown in Figure 2.

σx	0.65	mm
σx’	3.0	mrad
r12	0.0	
σy	0.8	mm
σy’	1.3	mrad
r34	0.0	

The beam emittance data gained with this fit have proven to be very useful for extrapolating the size of the beam spot and the slope of the beam at the target E location (see Table 1). A small horizontal spot size at the location of Target E is important in order to allow horizontal play of at least ±1 mm over the target width of 6 mm, which is crucial for avoiding frequent transmission-interlocks produced by some beam missing the Target E [2]. These computed emittance data also play an important role in safety considerations for the planned MEGAPIE target at the SINQ [3] for the case where a substantial portion (≥10 %) of the proton beam misses the Target E because the possibility of a failure in the beam transmission interlock has to be taken into account.

REFERENCES

[1] R. Reckermann, H.R. Vetterli, Shutdown Scheduling for the Accelerator, PSI Scientific and Technical Report 2000, Volume VI, page 93

[2] K. Deiters, F. Foroughi, G. Heidenreich, U. Rohrer, Reduction of Target-E Length from 60 mm to 40 mm, PSI Scientific and Technical Report 1999, Volume VI, page 26.

[3] U. Rohrer, A Novel Method to Improve the Safety of the Planned Megapie Target at SINQ, PSI Scientific and Technical Report 2001, Volume VI, page 34.