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Linac 2 Performance Optimizer
Conversion for operation on other machines

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Foreword

The Beam Optimizer program, developed by Andre Ster (*CERN/PS 97-05 (HP)*), required the modifications detailed in this document to enable it to perform on Linac 3, and other machines if required. This document is intended to be read in conjunction with the above referenced note, although similarities now only exist in the optimization procedure itself, as many of the functions and subroutines have been modified or re-written. The aim of the modification was to remove the "Hard Coded" nature of the parameters used by the program enabling the optimization process to be carried out along any part of either Linac 2 or Linac 3, or indeed on any other suitable machine.

Geneva, Switzerland
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General Changes

Files referenced by the original are prefixed by L2 (i.e.: l2optim.in). Those referenced by the modified version are prefixed by L3 (i.e.: l3optim.in). The terminal output from the program was modified to refresh during the process, and now displays additional information to allow monitoring during optimization.

Input file

The file "l3optim.in" has been modified and takes the following format. An instance of each card is compulsory for the successful operation of the optimizer.

```
TITLE
LINAC 2 OPTIM

COMMAND
SIM 200 0.000002

INPUT
LA1.QFN48S
0.0        5.0    -5.0   5.0

INPUT
LA1.QFN50S
0.0        5.0    -5.0   5.0

INPUT
LA1.QFN52
0.0        5.0    -5.0   5.0

INPUT
LA1.QDN53
0.0        5.0    -5.0   5.0

OUTPUT
ABS
LI.TRA06
STA

OUTPUT
REL
LA.TRA07
LI.TRA06

INITIAL
LI.TRA06
100

EVAL
2
STOP
```

TITLE Sets a title for the optimization procedure, referenced only in the output from the Minuit function minimizer ("l3optim.mnt")

COMMAND The command line to be sent to Minuit, SIM being the Minuit optimization method. 200 the approximate number of optimization steps, and 0.000002 the maximum tolerable distance to the function minimum.

INPUT The first 10 characters of the PS standard equipment name. This equipment will be modified during the optimization procedure. The first parameter is the initial value of the equipment, if zero the original value will be retained. The second value is the step size, or maximum deviation during one cycle of the process. The third value and fourth values are the parameter lower and upper limits. Parameters 2,3 and 4 should be expressed as an absolute value if the first parameter is an initial value, or a percentage if the first parameter is zero.

OUTPUT The output to be read and stored as results in the "l3optim.out" file. Prefixing the entry with ABS indicates an absolute value will be used for the optimization process, and the prefix REL indicates that a relative value will the used based on the following two equipment entries. The equipment entries are the first ten characters of the standard PS equipment name.

The **first** output parameter in the file can be either static or variable. The last entry in the OUTPUT card can be STA indicating a static value that is calculated and used in the optimization process after the first cycle whereas VAR indicates a value, which will vary during the process depending on the output of the equipment.

A limit of six output cards can be used.

INITIAL The value taken during the optimization process to indicate whether the beam is good enough to take measurements for optimization. The first entry is the equipment name. The second entry is the minimum value at which the beam is considered good enough for measurements. Should the beam fall below this value, then the current optimization cycle will suspend pending the measurement increase above the minimum.

EVAL The parameter taken by the optimization process and passed to the function minimizer for evaluation. An integer between 1 and *n* where n is the number of output parameters defined.

STOP Indicates the end of the input file.

Output files

"l3optim.ccv" the contains the current control calues for the equipments defined in the INPUT section of the input file. These are written after each cycle of the optimizer.

"l3optim.out" contains the corresponding readings from the equipment defined in the OUTPUT section of the input file.

Each file is indexed with the number of the optimizer cycle they were taken from for cross referencing.

Testing - Premlinary Results

During the first week of December 1997, the optimizer was tested on Linac 2. A better transmission through the LEBT and the MEBT was found resulting in a proton current of 190mA in LI.TRA06 and a lower radiation level as measured. This was achieved by optimizing the LEBT solenoids and the MEBT quads, the source remaining untouched and delivering 270 mA according to LI.TRA02. With the above setting so far no more than 174mA have been found in LA.TRA07 despite trying to optimize the quads of Tank 1. This should be compared to the linac setting of October 9, 1997. That setting was the standard operational setting except for changed source parameters. The readings for the transformers were LI.TRA02 310mA, LI.TRA06 197mA and LA.TRA07 190mA. Clearly a much higher transmission rate through Tank 1, but a lower one from the source to the MEBT. More investigation will be needed to explain this difference.