1. Introduction

This report describes a kicker magnet and driver hardware for fast extraction by "beam shaving" from the 300 GeV machine. In addition to the kicker magnets which provide the "bumps" this scheme makes use of an electrostatic thin wire septum, together with a conventional magnetic septum.

The "slow" kicker system consists of two, independently triggered closed orbit deflection magnets which move the beam across the wire septum, and producing an ejected beam during one or two main ring revolutions.

The second magnet will be triggered 400 nsec after the first one, to take into account the propagation time of the particles.

It is advantageous to construct air magnets around a ceramic vacuum chamber instead of magnets enclosed in vacuum. Each magnet consists of a lumped L-C line with 8 modules, 7 full and 2 half-capacitors, all 8 modules being connected in cascade.
2. Basic parameters for a possible lay-out

Beam aperture
60 · 60 mm

Ceramic chamber
Ø 90/100 mm

Magnet window
100 · 100 mm

Kick strength (for 400 GeV)
3500 Gm

Rise time (linear)
11.5 µsec

Flat top
23 µsec

Fall time
(15...25 µsec)
(not specified, because ring empty after ejection)

3. Lay-out of magnets and drivers

Occupied length of straight section
3 m

Total ferrite length
2.40 m

Number of modules per magnet
8

Ferrite length of module
300 mm

Average field
1170 G

Field in module centre
1500 G

Flux of total magnet
Ø = 35 mVs

Excitation
N·I = 12000 A

Number of turns per module
N = 4

Current
I = 3000 A

Inductivity of total magnet
L = \( \frac{N\Phi}{I} \) = 47 µH

Propagation time (design value)
9 µs
(required rise time 11.5 µs)

Storage line charge voltage
U = 16 kV

Characteristic impedance
\( Z_0 = \frac{16 kV}{3 kA} = 5.3 \Omega \)

Total magnetic energy in one magnet
220 joule

Installed pulse power of one system
50 MW
Driver circuit

One or two tubes (in parallel)  CX 1140 EEV
Lumped capacity per module  210 nF/16 kV
Total capacity per magnet  1.7 μF
(to be placed near the magnet)

PFN

Characteristic impedance  5.3 Ω
Nominal voltage  16 kV
Propagation time  17.5 μs
(Pulse time)  (35 μs)
Total capacity in PPN  3.6 μF/17 kV
(for one magnet)
Stored energy at nominal voltage  680 joule

Termination circuit  5.3 Ω + Diode

either: self-triggering series spark gap (as used
for PSB ejection kickers) with 5.3 Ω constantan
band resistors,

OR  : thyratron CX 1140 with cathode up
at 16 kV and anode grounded, with dc current
biased grids.

Power supply

Nominal recharge energy per system  680 joule

either: Resonant charging pulsed power
supply (for low erratic break-down
ratio of thyratrons, such as used
for PSB injection or PS injection)

OR  : dc controlled supply,  16 kV/100 mA
4. Cost estimate

<table>
<thead>
<tr>
<th>Component</th>
<th>Price per system</th>
<th>Total for both systems</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>A. Driver, electrical parts</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Main switch device, based on 2 x CX 1140</td>
<td>10 kFr.</td>
<td>20 kFr.</td>
</tr>
<tr>
<td>Cables</td>
<td></td>
<td>5 kFr.</td>
</tr>
<tr>
<td>Capacitors 5.3 µF/16 kV</td>
<td>7 kFr.</td>
<td>14 kFr.</td>
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<tr>
<td>(10 Fr. per joule = high reliability)</td>
<td></td>
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<tr>
<td>Resonant charging power supply</td>
<td>12 kFr.</td>
<td>24 kFr.</td>
</tr>
<tr>
<td>Terminating circuit, based on 1 x CX 1140</td>
<td>6 kFr.</td>
<td>12 kFr.</td>
</tr>
<tr>
<td>Trigger circuits</td>
<td>3 kFr.</td>
<td>6 kFr.</td>
</tr>
<tr>
<td>Metal mountings</td>
<td></td>
<td>30 kFr.</td>
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<tr>
<td>Timing</td>
<td></td>
<td>30 kFr.</td>
</tr>
<tr>
<td>Controls</td>
<td></td>
<td>10 kFr.</td>
</tr>
<tr>
<td>Total of electrical parts</td>
<td></td>
<td>151 kFr.</td>
</tr>
<tr>
<td><strong>B. Development and tests</strong></td>
<td></td>
<td>150 kFr.</td>
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<tr>
<td><strong>C. Magnet and vacuum chamber</strong></td>
<td></td>
<td></td>
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<tr>
<td>Ferrites for 2 x 8 modules</td>
<td>80 kFr.</td>
<td></td>
</tr>
<tr>
<td>Mechanical mounting for magnets</td>
<td>60 kFr.</td>
<td>120 kFr.</td>
</tr>
<tr>
<td>Ceramic vacuum chamber, total 6 m</td>
<td>40 kFr.</td>
<td></td>
</tr>
<tr>
<td>Total magnetic part</td>
<td></td>
<td>240 kFr.</td>
</tr>
</tbody>
</table>
Recapitulation:

A. Electrical parts
B. Development
C. Magnetic part

D. Total cost (staff salaries excluded) 540 kFr.

E. Staff requirements: 2 men, 2 1/2 years.

5. Possible modifications of requirements and their consequences for the total cost

5.1 Change of performance:
- Rise time 23 μs instead of 11.5 μs: same price 540 kFr.
- Rise time 5 μs instead of 11.5 μs: +100 % for A, B 840 kFr.
- Design for controlled rise and fall time: +100 % on A, B 840 kFr.
- Limitation of kick strength to half of initial value (200 GeV): -30 % on D 380 kFr.

5.2 Change of aperture and magnet construction
- Using a kicker immersed in vacuum with 60 · 60 mm aperture:
  - 40 % on A, B +150 kFr. for vacuum tanks and supplementary pumps 570 kFr.
- Aperture 60 · 100 mm ceramic tube Ø 100/110:
  + 20 % on D 650 kFr.
- Aperture Ø 110, ceramic tube Ø 110/120:
  + 45 % on D 790 kFr.

Distribution:
300 GeV Machine Committee
300 GeV Ejection Study Group
J.B. Adams
A. Ašner
G. Brianti
R. Gouiran
6. Electrical Scheme for 1 magnet

- H.V. Supply
- +16 kV
- 10 parallel cables 50 Ohm
- L L L L L L L L L
- C/2 C/2 C/2 C/2 C/2 C/2 C/2 C/2 C/2 C/2
- 2 x CX1140
- CX1140
- 53 Ohm
- DC DC
- PFN 53 Ohm / 35 μs