HALF INTEGER RESONANT EXTRACTION FROM KEK-PS

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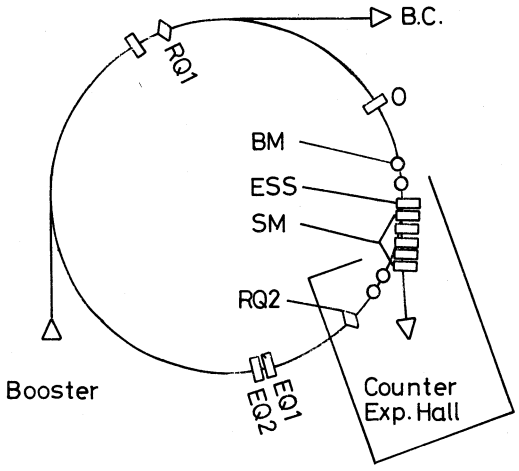
In order to obtain the slow beam spill from the main ring of KEK-PS, a half integral resonance is utilized. The basis of the method is that the horizontal betatron motion becomes unstable and the oscillation amplitude of a circulating particle grows rapidly when the tune is moved close to the stapband of $\nu_H = 7.5$ and non-linear perturbing magnetic field (octupole) is applied.

The layout of elements including septa used for the extraction is given in Fig.1.

In shifting the horizontal tune close to the stopband, at first the tracking ratio of the lattice quadrupole field to the bending field is changed at flat-top from the normal ratio as shown in Fig.2, and next the extraction quadrupole (EQ2) is excited to such a level that particles are about to go into the resonance. Then, if the ramped quadrupole field (EQ1) is applied, the circulating particles become unstable successively and spill along the outgoing separatrix in the phase plane (Fig.3). Due to the negative machine chromaticity ($\Delta\nu \simeq -10(\Delta p/p)$), extraction begins with particles of lower momenta with larger emittance. However, if the chromaticity is compensated with the correction sextupole magnets, extraction becomes independent of momentum. Both cases are shown in Fig.4 and 5.

Servo-spill control system is incorporated into the power supply of the extraction quadrupole (EQ1) so as to remove the low frequency structure in the slow beam spill. This system is similar to that of the internal target. High frequency structure ($\gtrsim$ 50 Hz) will be supressed with the air core quadrupoles (RQ1 and RQ2) excited by the signal which is obtained from analysis of the spill. They will be tested on the next run. Operating the dynamic filters in the power supplies of the lattice magnets also reduces the high frequency structure remarkably (Fig.6).

Since last November, the slow extraction has been tested at 8 GeV. The beam spill was monitored upstream of the extraction beam channel with the insulated aluminium plate. After a few trials, the extraction efficiency became almost 90 % and the spill duration was ~400 msec.



EQ ext. quad. SM septum mag.
O octupole BM bump mag.
RQ ripple quad.
ESS electrostatic septum

FIG.1

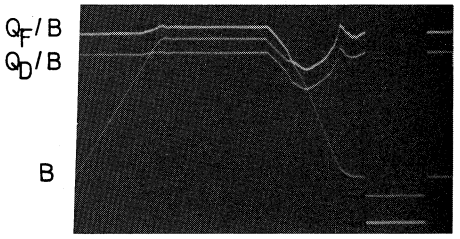


FIG.2

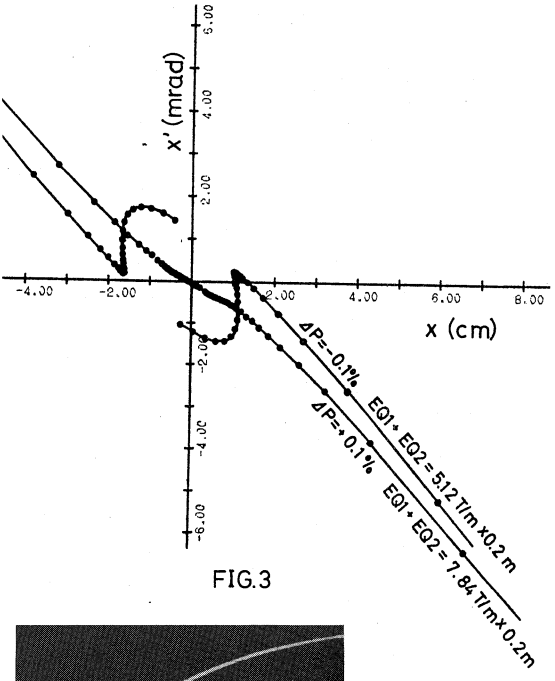


FIG.3

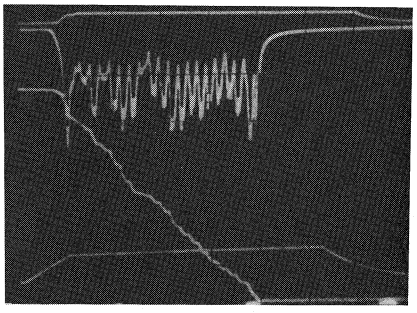


FIG.4
(sextupole on)

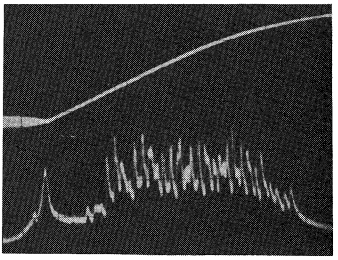
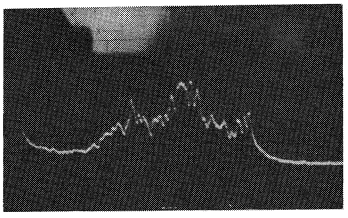
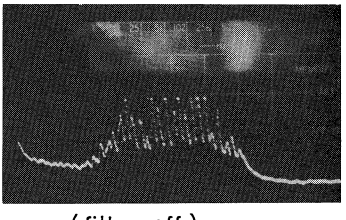


FIG 5
(sextupole off)



(filter on)



(filter off)

FIG.6