Highly Efficient New Energy Kicker
Originally Designed and Developed Kicker in SPring-8
High Kick Efficiency per Length
→ Three Times Higher than Conventional WOC type

Kicker Cell
Cavity Length 96 mm, Electrode Gap 40 mm
Driving RF Frequency
\((3+1/4) f = 1.65 \text{ GHz}\) RF reference frequency \(f_{\text{ref}} = 508.58 \text{ MHz}\)
Beam is kicked by a Single Resonant Mode excited at the driving frequency.

Low Q-factor
The resonant mode is required to have low Q-factor, i.e. fast damping time of several nanoseconds.

Longitudinal Wake Impedance (Calculation)
Assuming bunch length of 6 mm (r.m.s.)
Estimated Q-factor by Lorentzian fitting
\(Q \approx 4.2\)

Driving RF Power
Input from symmetrically attached two I-ports at the same timing
Removal of Unwanted Higher Order Modes
Removed from two pairs of ports (H-ports, V-ports) attached symmetrically

Kicker body made of Copper with high thermal conductivity
Water-cooled copper body and high power feed-through ports (I-port)

Beam Kick Test & Kick Performance
Kicker Driving Circuit

Electron bunches are kicked by using resonance of the synchrotron oscillation. Kick voltage was amplitude-modulated with \(f_{\text{rev}} + f_s\).
Bunch Fill Pattern : 84 bunches equal spacing (57 ns interval)
Mod. Freq. : \(f_{\text{rev}} (208.8 \text{ kHz} @\text{Revolution}) + f_s (2.14 \text{ kHz} @\text{Synch. Osc.})\)

Beam Kick Test: 84 bunches equal spacing (57 ns interval)

Spectrum of Excited Synchrotron Oscillation

Resonance Curve

\[ \tau = \frac{\alpha \cdot e V_{\text{kick}}}{T_0} \frac{E_0}{E} \frac{(\omega^2 - \omega_{\text{env}}^2)^2}{4 \omega^2} \]

\[ \tau_{\text{max}} = 0.64 \text{ ps} \]

Input Power per each kicker cell
\(P_s = 2^s (V_{\text{kick}}^2/50/2) \sim 44 \text{ (W/kicker)}\)

Shunt Impedance per one cell
\(R_s = (V_{\text{kick}}/3)^2/P_s/2 = (920/3)^2/44/2 = 1.1 \text{ (k} \Omega)\)

Shunt impedance per unit length is three times larger than that of waveguide overloaded cavity (WOC) type kicker.

Response to a Single Bunch Beam
Beam signals observed at each port (I-port, H-port and V-port)
Observed signal waveforms have similar shapes to simulated results.