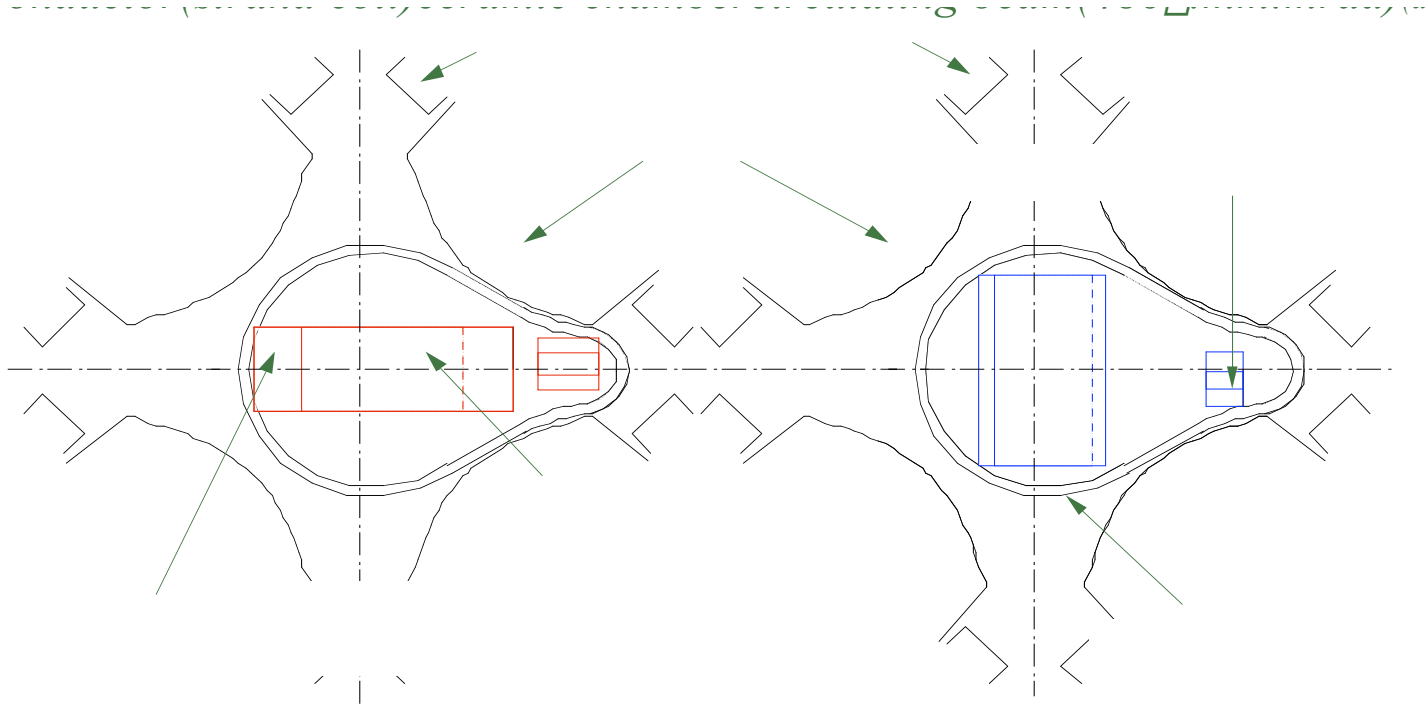


# Aperture Requirement for the *F* and *D* Quadrupoles

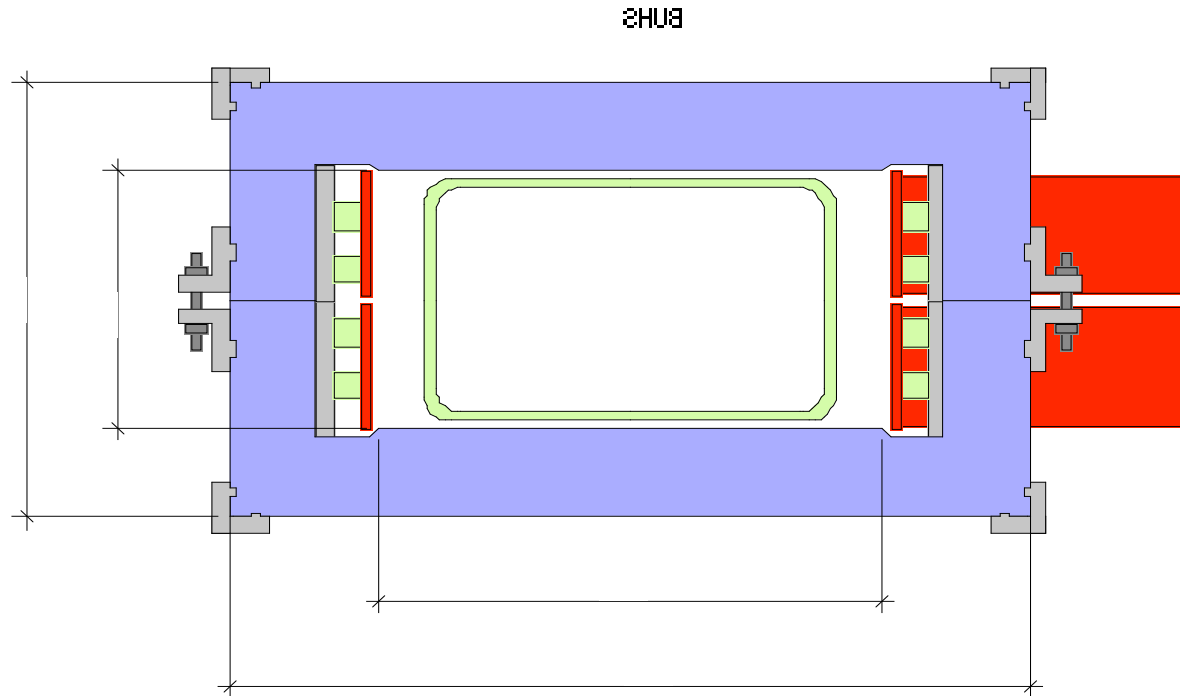


- The beam needs to be injected vertically off-center for vertical painting.
- The corner of the F and D quadrupole magnets are thus required to have additional aperture for the injection/disposal beam lines

## ***Separation of $H^0$ & $H^-$ disposal beam from $H^+$ circulating beam on the bump orbit***

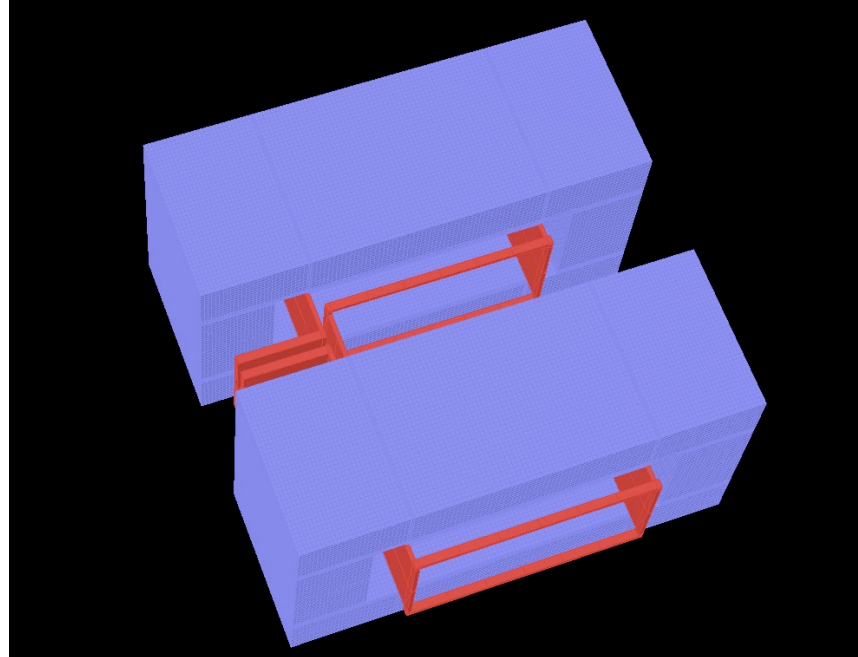
- In the FODO structure, the beam envelope at the down-stream of F quadrupole, tilts down stream.
- The injection beam line for horizontal painting must be tilted accordingly.
- The separation angle of the  $H^0$  beams and circulating  $H^+$  beam envelope of the bump orbit become tight.
  
- The  $H^0$  beams, which are estimated to be 0.3% of the incoming beams, must be converted to  $H^+$  by a second foil to divert to the beam dump.
- To solve this problem the split-type bump magnet has been investigated.
- The second foil "A" is inserted in the middle of the fourth bump magnet, by a split at the center of the core.
  
- $H^-$  beams, which are estimated to be  $3 \times 10^{-4}$  % of the incoming beams, are also converted to  $H^+$  by another second foil, "B", set at the entrance of the D quadrupole magnet, "ODK"

## ***Fixed Closed-Orbit Bump Magnets ” SB-I~SB-IV”***



- Four dipole bump magnets named ” SB-I~SB-IV” are identical in construction and are powered in series to give a symmetrical beam bump.
- The dipoles are out of vacuum and ceramic vacuum chamber is included in the magnet gap.
- The structure of the magnet is composed of two-turn coils and window frame core made by laminated silicon steel cores of which thickness is 0.1 mm.

## ***Structure of the Split-type Bump Magnet***



- The excitation current is supplied in the middle of the core through the split to form a symmetrical distribution of magnetic field along the longitudinal direction.
- To insert the second foil
- Symmetrical power supply for a symmetrical field distribution along the longitudinal axis

# The Waveform of Magnetic Field

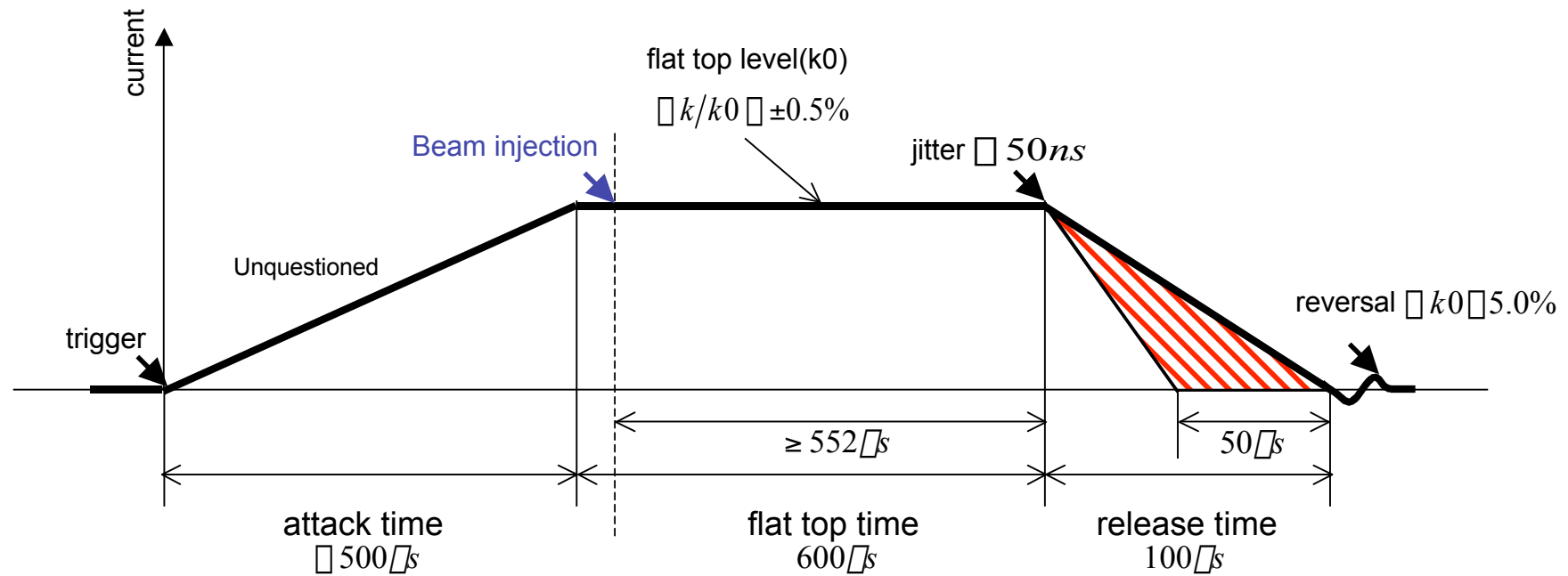
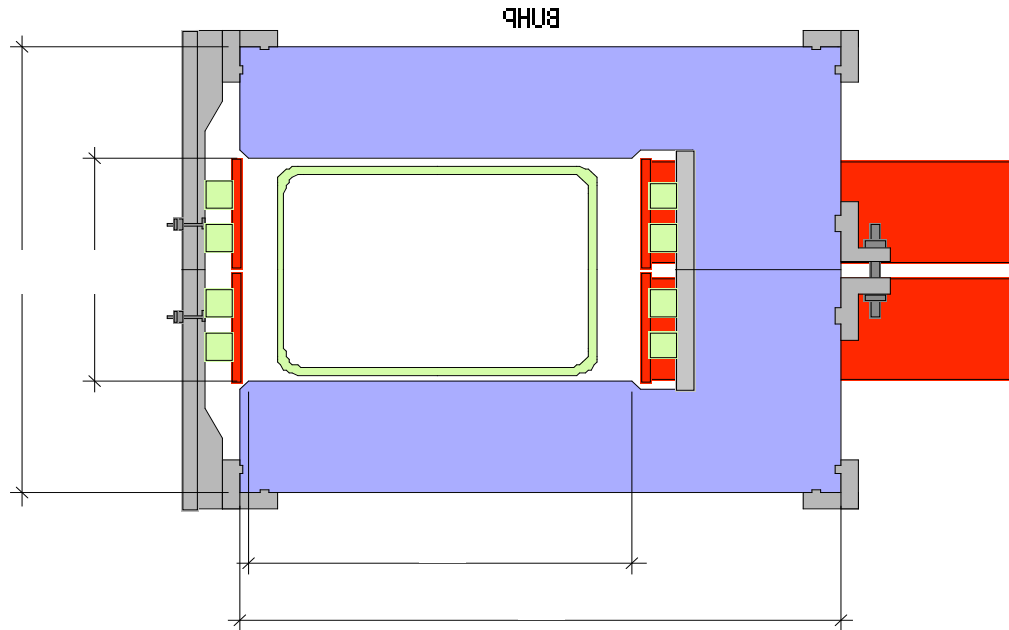


Fig.1 Current pattern of the power supply of the shift bump magnet in horizontal

## *Horizontal painting bump magnets*



- Two sets of bump magnet pairs in the upstream of the F quadrupole magnet and the downstream of the D quadrupole magnet.
- These four painting bump magnets will be excited individually.
- To form a local closed orbit include the F and D quadrupole magnets

# Waveform of Horizontal Painting Bump Field

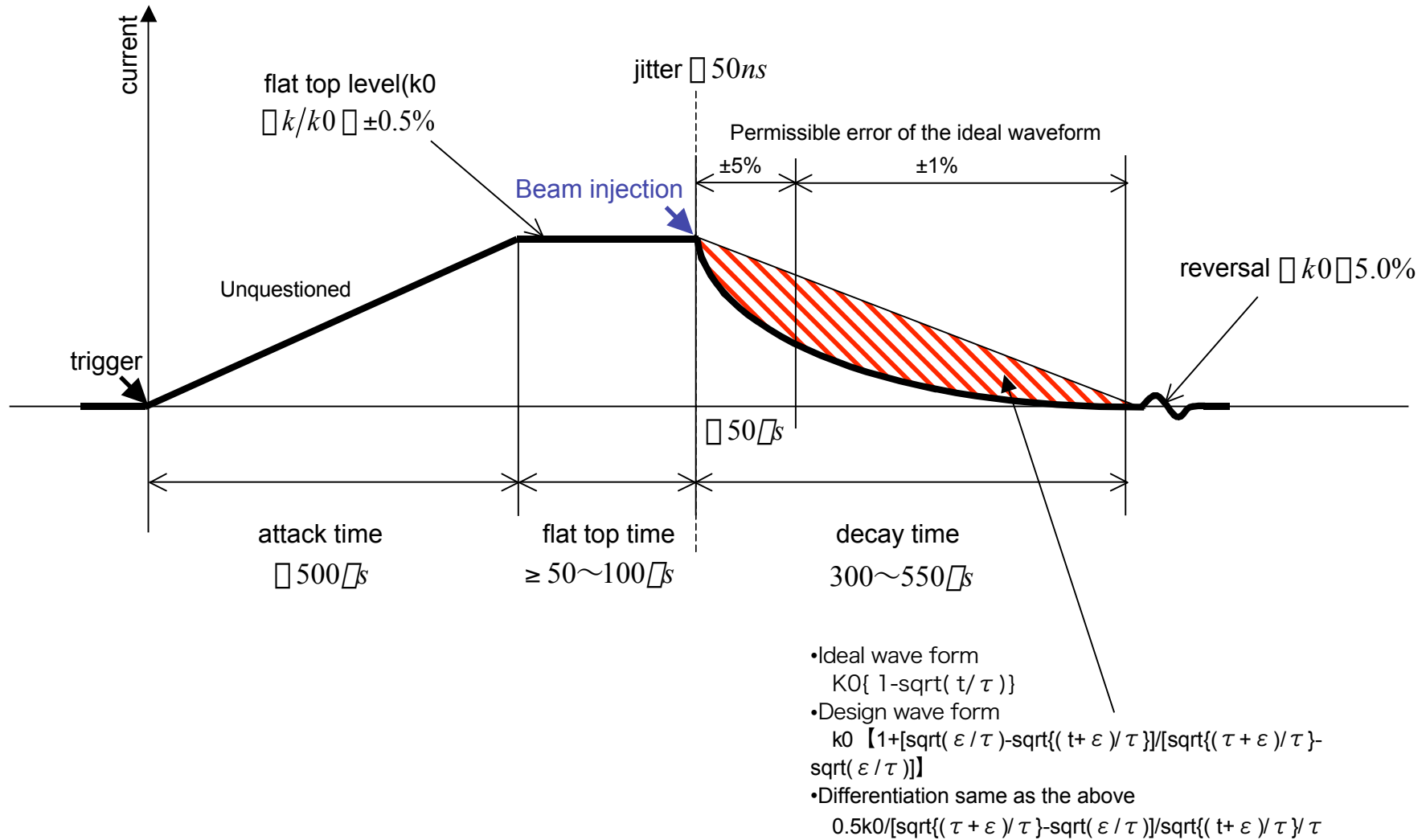


Fig.2 Current pattern of the power supply of the painting bump magnet in horizontal