# Mid-long term plan at the injector linac

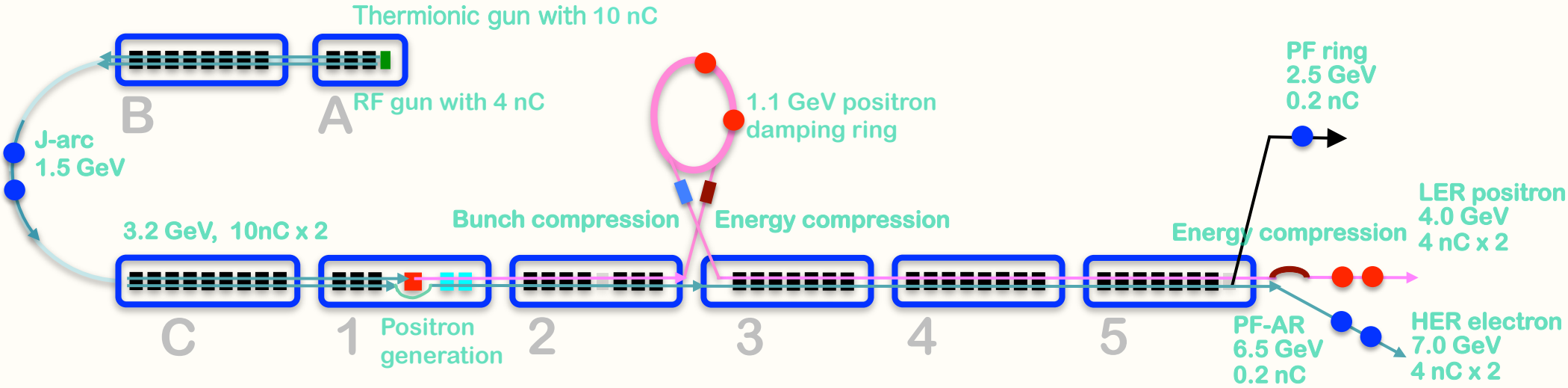
Supplement to Masanori Satoh's injector presentation

**Kazuro Furukawa**

for Injector Linac Group

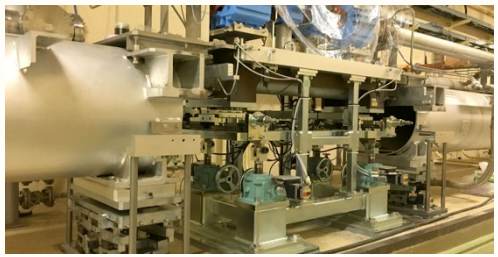
<http://www-linac.kek.jp/linac-paper/general/>
< kazuro.furukawa @ kek.jp >

# Injector Linac Upgrade Items 2022 - 2026





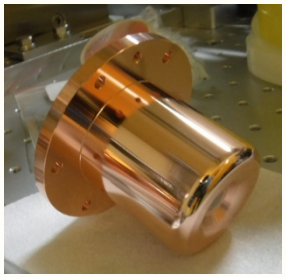
Pulsed magnets/kickers



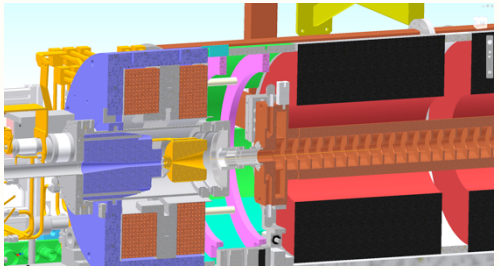
High precision movers

PCB capacitor renewal

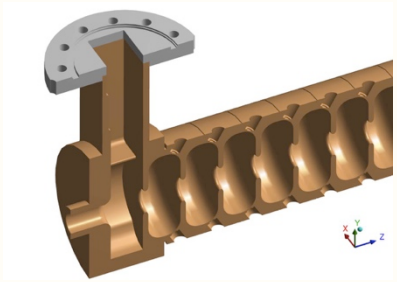
New energy compressor



RF gun



Positron capture section



Accelerating structure

# Linac Beam Parameters for KEKB/SuperKEKB

| Stage | KEKB (final) | | Phase-I (achieved) | | Phase-II (achieved) | | Phase-III (interim) | | Phase-III (final) | |
|---|---|---|---|---|---|---|---|---|---|---|
| Beam | e+ | e– | e+ | e– | e+ | e– | e+ | e– | e+ | e– |
| Energy | 3.5 GeV | 8.0 GeV | 4.0 GeV | 7.0 GeV | 4.0 GeV | 7.0 GeV | 4.0 GeV | 7.0 GeV | 4.0 GeV | 7.0 GeV |
| Stored current | 1.6 A | 1.1 A | 1.0 A | 1.0 A | – | – | 1.8 A | 1.3 A | 3.6 A | 2.6 A |
| Life time (min.) | 150 | 200 | 100 | 100 | – | – | – | – | 6 | 6 |
| Bunch charge (nC) | primary e- 10 → 1 | 1 | primary e- 8 → 0.4 | 1 | 0.5 | 1 | 2 | 2 | primary e- 10 → 4 | 4 |
| Norm. Emittance (γβε) (mrad) | 1400 | 310 | 1000 | 130 | 200/40 (Hor./Ver.) | 150 | 150/30 (Hor./Ver.) | 100/40 (Hor./Ver.) | 100/15 (Hor./Ver.) | 40/20 (Hor./Ver.) |
| Energy spread | 0.13% | 0.13% | 0.50% | 0.50% | 0.16% | 0.10% | 0.16% | 0.10% | 0.16% | 0.07% |
| Bunch / Pulse | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| Repetition rate | 50 Hz | | 25 Hz | | 25 Hz | | 50 Hz | | 50 Hz | |
| Simultaneous top-up injection (PPM) | 3 rings (LER, HER, PF) | | No top-up | | Partially | | 4+1 rings (LER, HER, DR, PF, PF-AR) | | 4+1 rings (LER, HER, DR, PF, PF-AR) | |

**Gradual improvements**

# Challenges in Linac upgrade

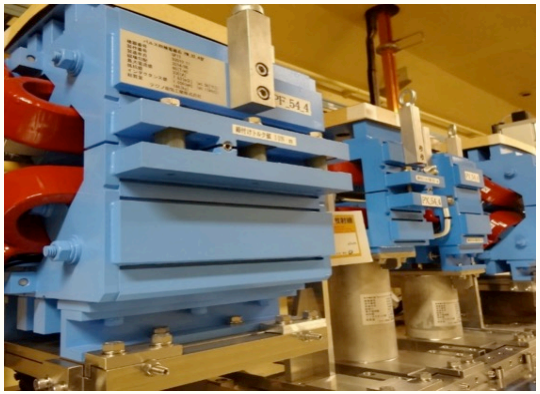
- Achieving the both of higher injection beam charge and lower transverse/longitudinal emittance
- Maintaining higher availability and stability
- Establishing injection energy for higher resonances
- Solutions with upgraded hardware
  - Precise pulsed magnets and kickers
  - Movable girders for quads and structures
  - Energy compression system (ECS)
  - Accelerating structures to replace aged ones
  - Low emittance and high charge RF gun
  - High efficiency positron capturing
  - Replacement of capacitors including PCB at power converters
- Polarized electron beam design for the future

# Pulsed Magnet, Kicker and Mover

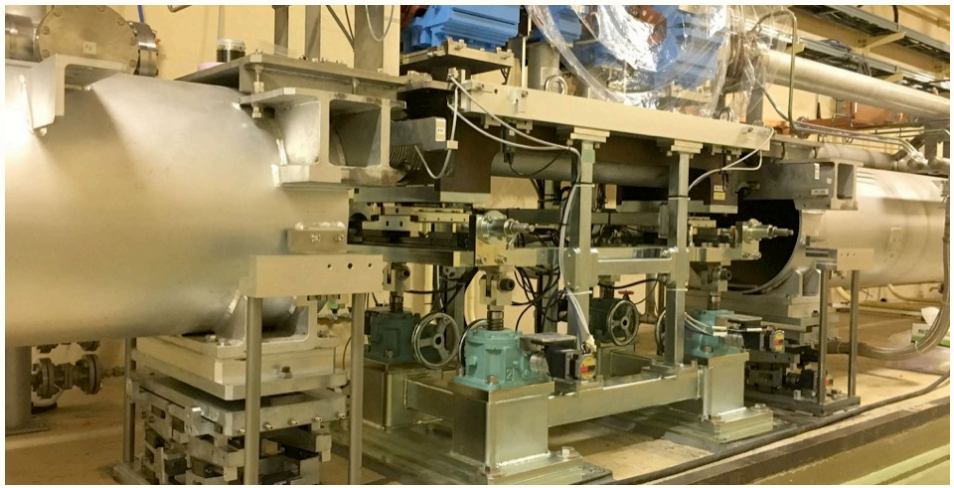
Injector linac injects beams into SuperKEKB HER, LER as well as light sources PF, PF-AR with adequate beam properties at 50 Hz maximum in simultaneous top-up injection scheme. Pulsed magnets, kicker magnets and girder movers will be installed in order to suppress emittance blow-up caused by wakefield in accelerator structure with 4 nC per bunch. Kicker magnets may correct beam orbits separated by only 96 ns. Girders may adjust girders at less than 10 microns.

Ceramics chamber integrated kicker development


Pulsed magnets and power supplies



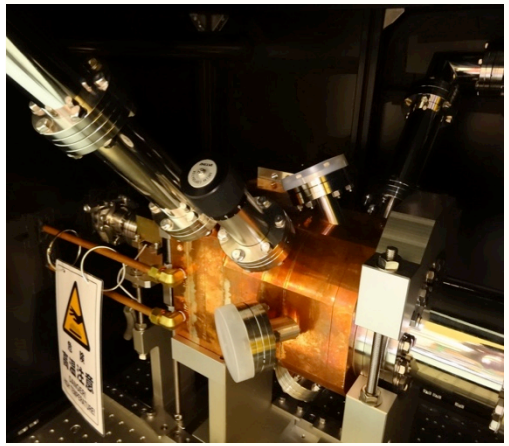
High-precision girder movers

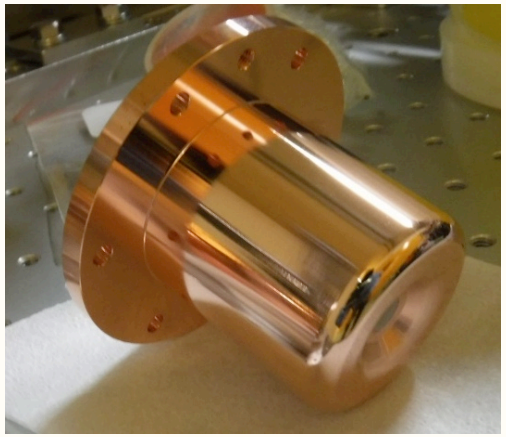


# RF gun and positron capture section

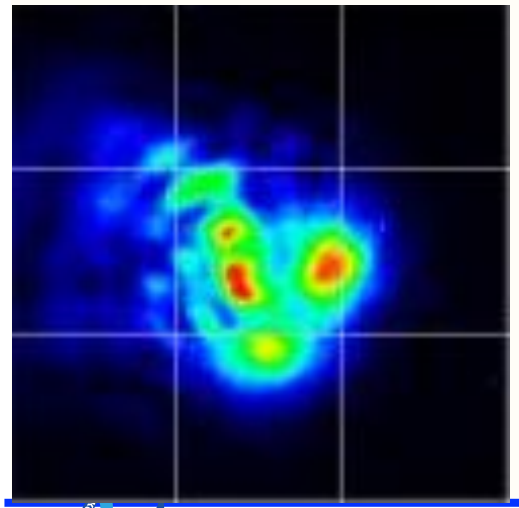
Further improvements at the high-charge low-emittance RF gun and high-efficiency positron capture section are planned.

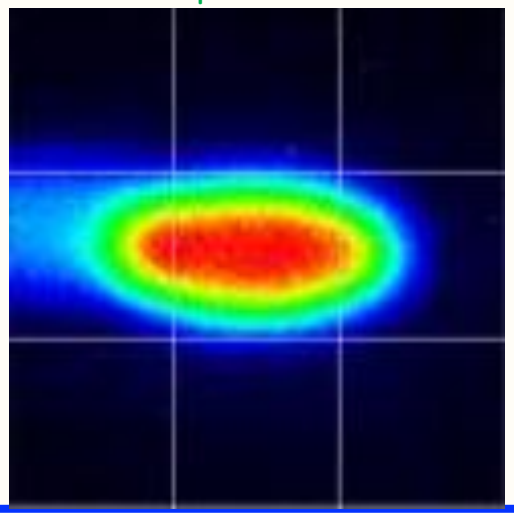
Cavities and photo cathode

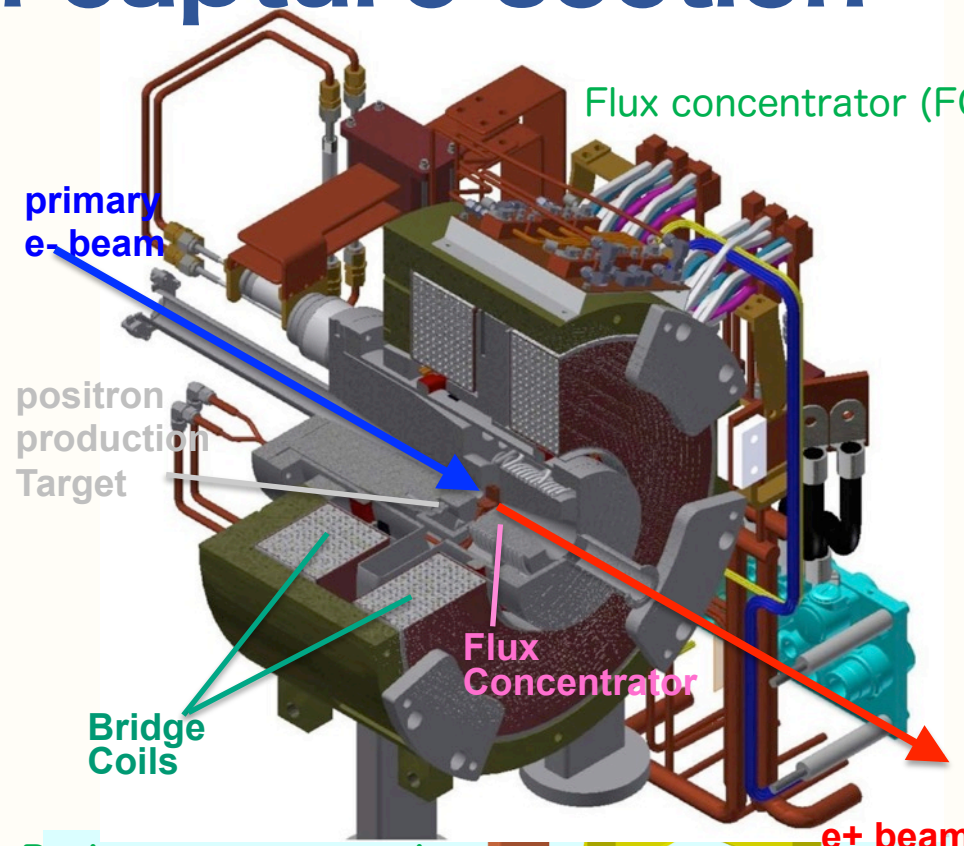




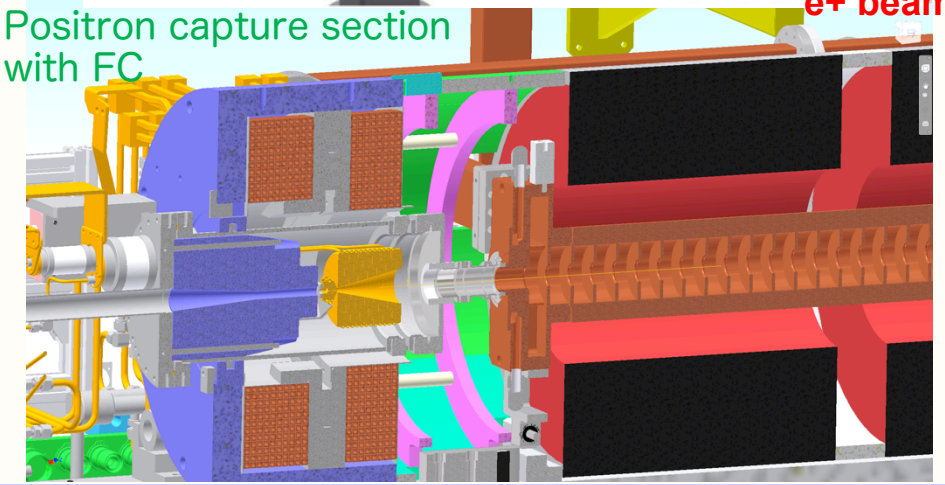
Laser shaping and stabilization with DOE optical element





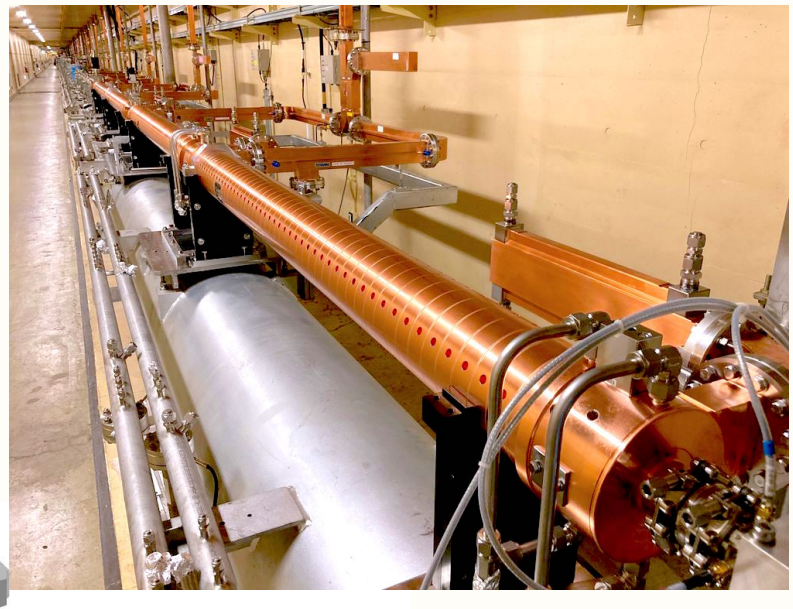


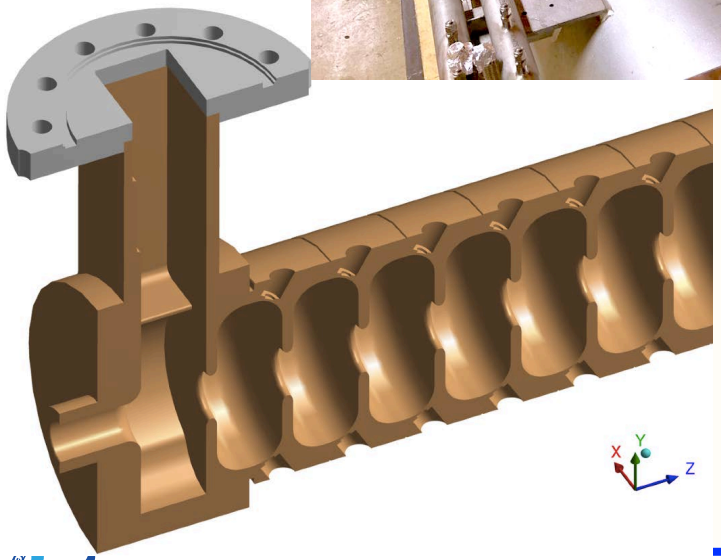

Positron capture section with FC



# New accelerating structures and ECS for electron beam

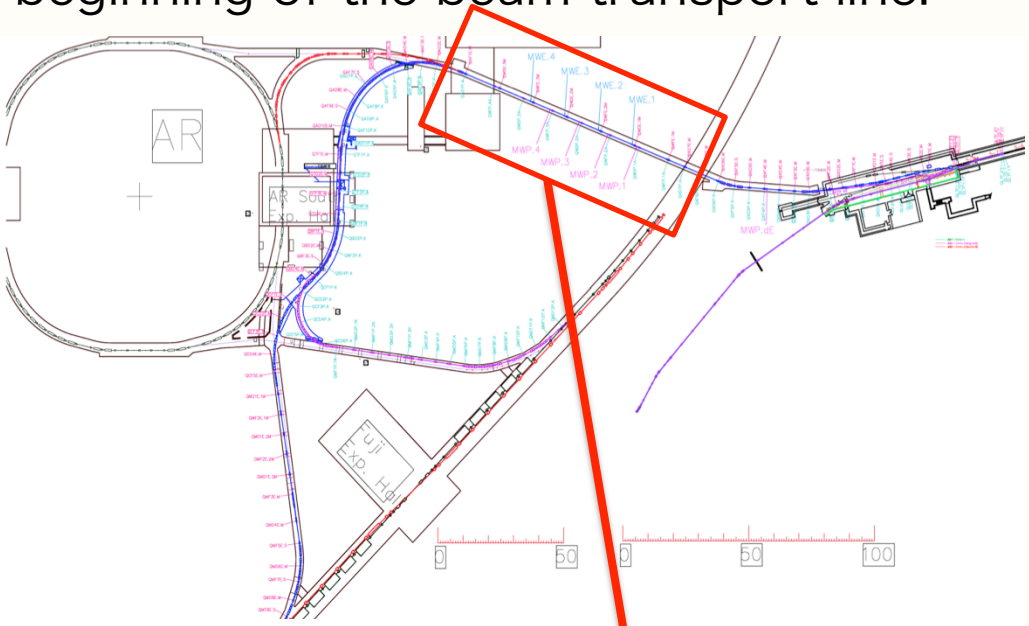
7% of 230 accelerating structures will be replaced for mitigation of 40-years of degradation by discharges and water leaks.

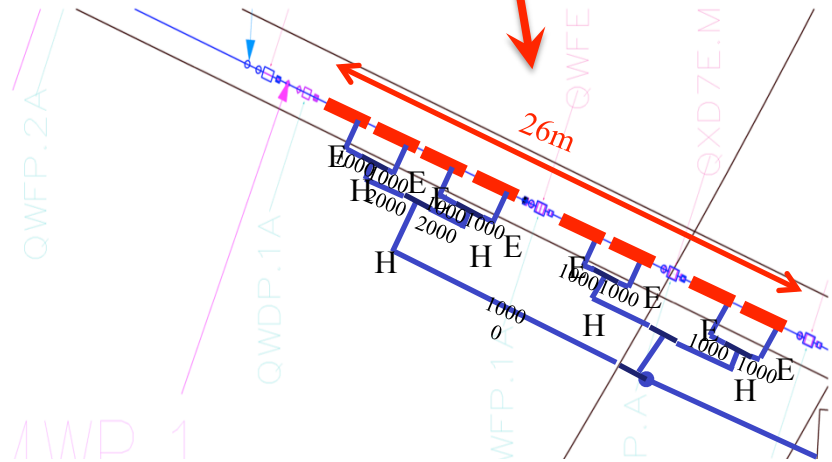




Additional replace-ment will be necessary in near future.

Energy compression system (ECS) for electron beam will be installed at the beginning of the beam transport line.

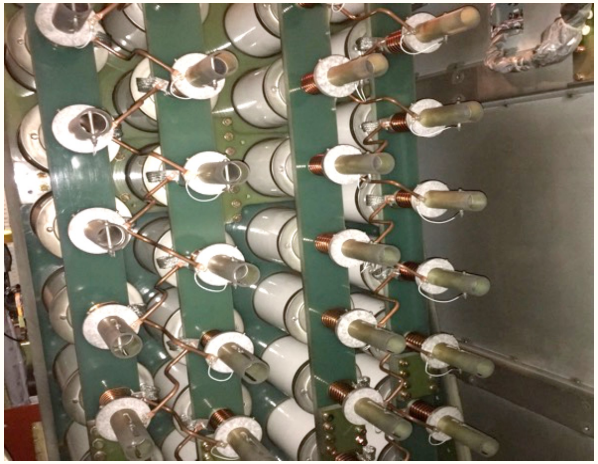


# Capacitors with PCB contamination

Capacitors (up to 1200) in power modulators with low-level PCB produced before 1991 will be replaced following the law.

Capacitors in high-power klystron modulators

Summary:

Injector linac continues to improve with hardware upgrade in above 7 category regions from 2022 to 2026.