Japan side update

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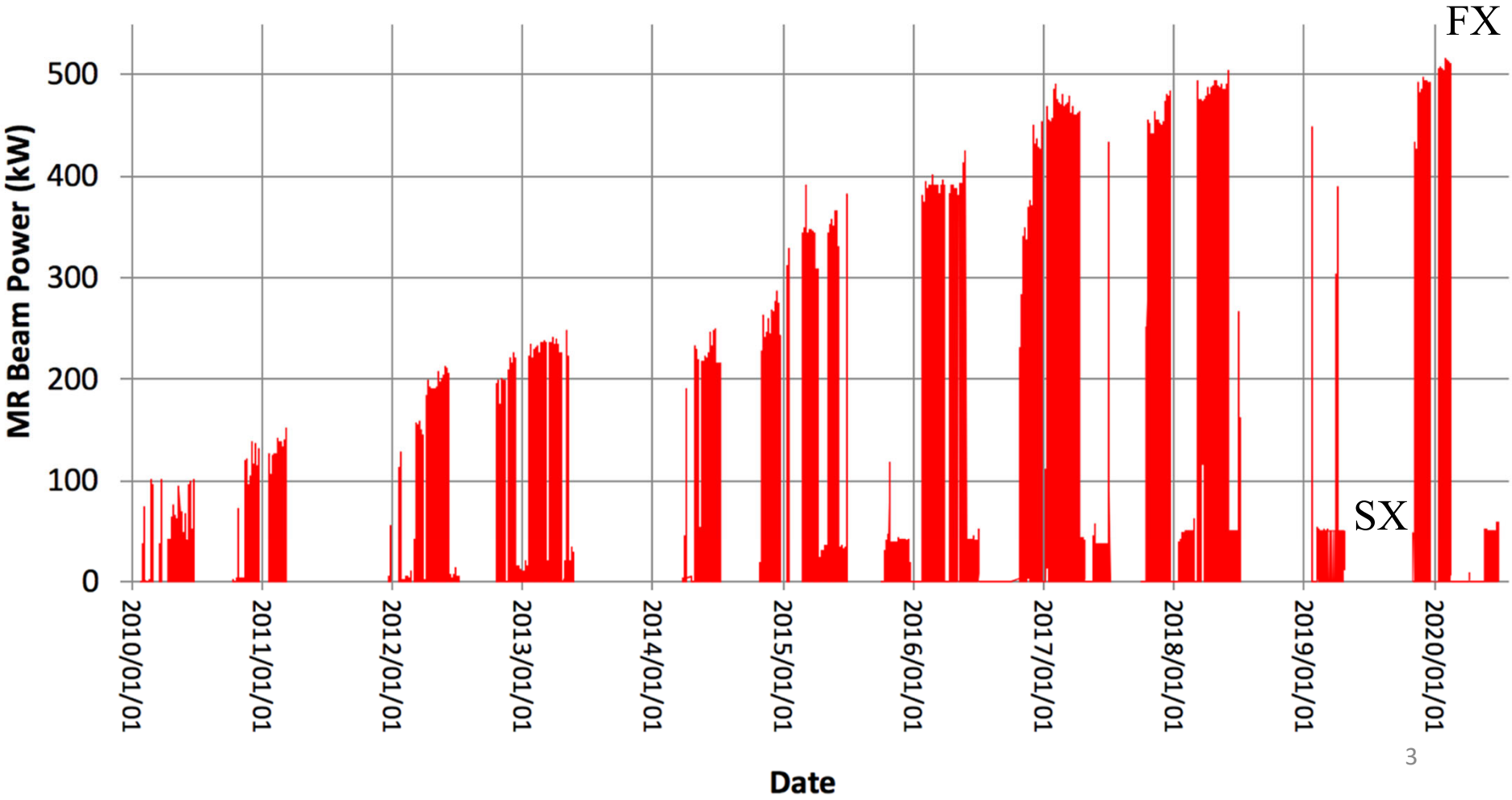
J-PARC, KEK and JAEA

Status

- MLF
  - -May. 18 : 500 kW
  - May. 18-Jun. 24 600 kW
  - Jun. 25-27 : 1 MW
  - Jun. 27 -: Summer Shutdown
- MR/HD
  - FX: 510 kW operation
  - HD User run: -Jun. 26 : 51 kW (63 kW demonsration)
  - Jun. 26 Stop, Summer Shutdown

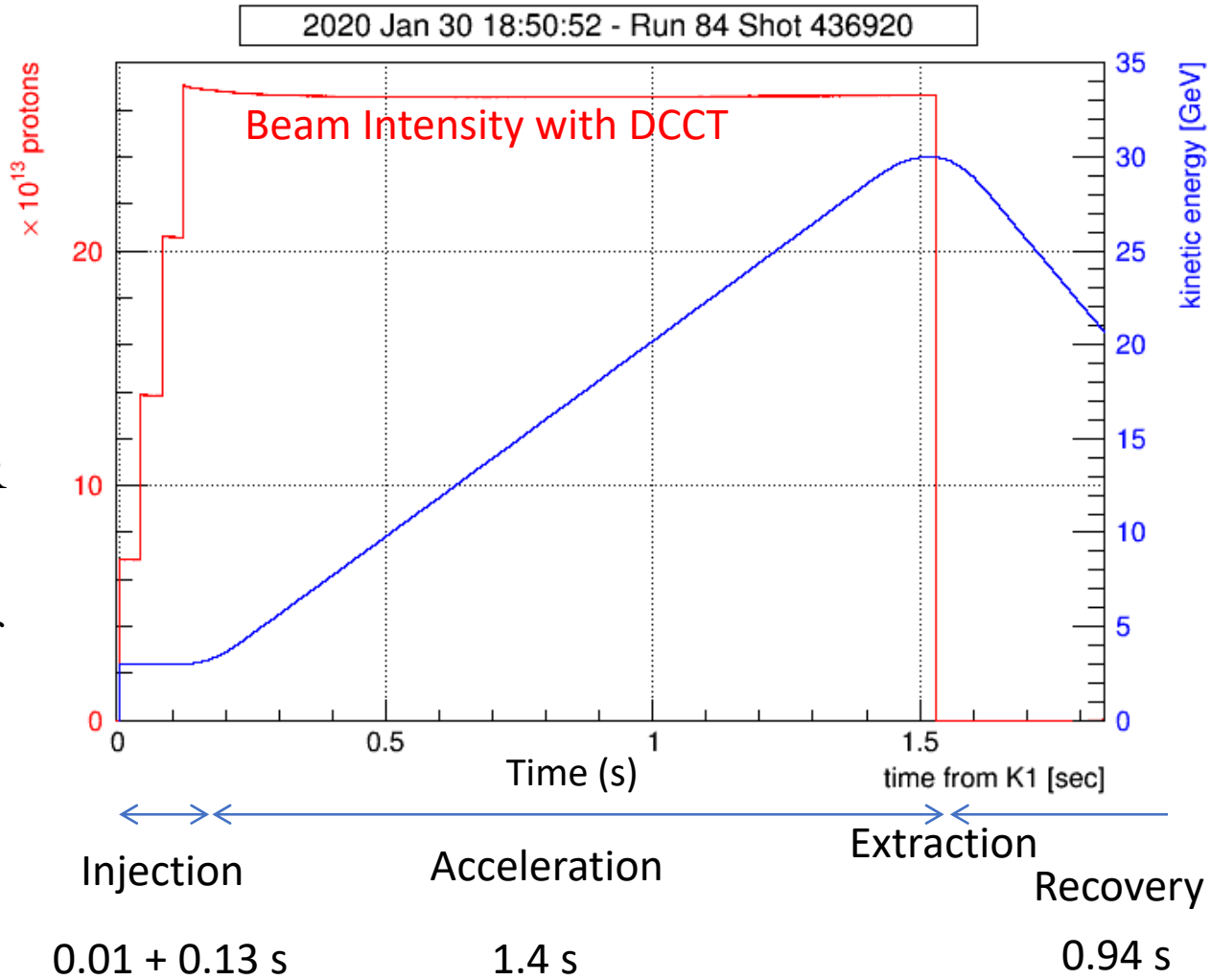
MR Beam Power History

- The beam power is ~ 510 kW for the recent FX operation.
- The beam power of ~ 50 kW for the recent SX operation and 63 kW was demonstrated. The target capacity limited the SX operation beam power. During the last shutdown, it was upgraded from 57 kW to 95 kW.



Typical Operation Status for FX

- Power : 515 kW
- Repetition : 2.48 sec
- 4 batch (8 bunch) injection during the period of 0.13 s
- 3.4e13 protons per bunch (ppb) × 8 @ Injection
- 2.66e14 ppp @ P3 (end of acceleration)
- Beam Loss : 800 W
- Loss power is within the MR collimator limit of 2 kW
- Loss at 3-50BT : 100 W, < 3-50BT collimator limit of 2 kW

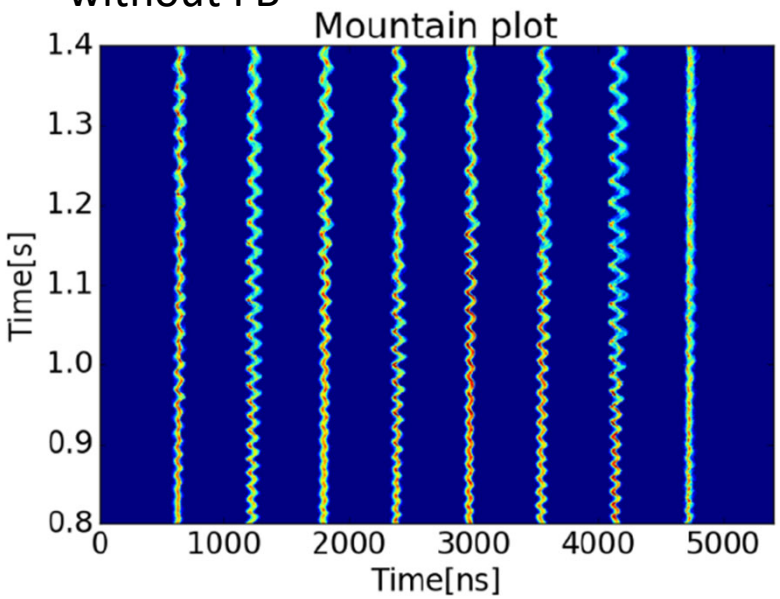


Suppression of the Coupled Bunch Instability with New RF Feedback System

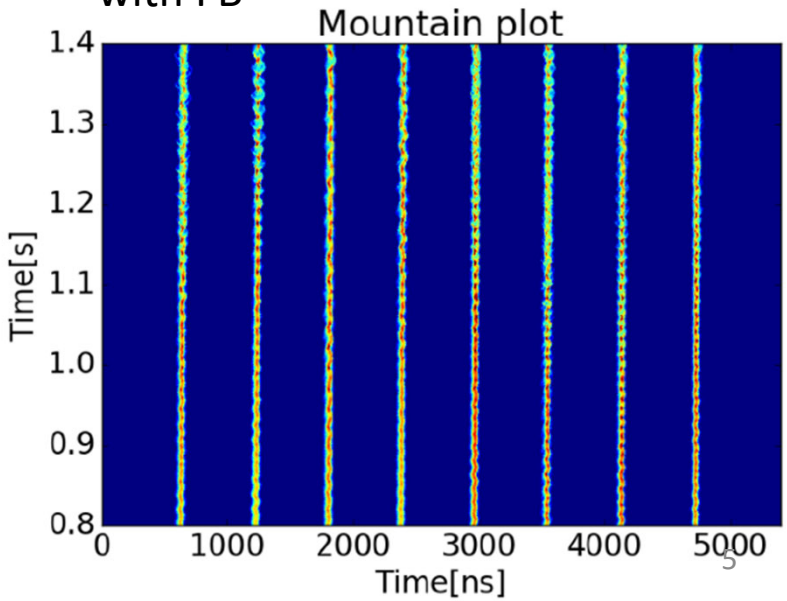
- Wake fields of undesired h=8 and 10 induced by the high intensity beam caused the coupled bunch instability.
- It resulted in the beam losses during acceleration in the worst cases.
- With the new RF feedback system, we were able to suppress the wake voltages of harmonics of h=8 and 10.

RF Harmonics: 9, Number of Bunches: 8

Bunch Oscillation of 480 kW beam without FB

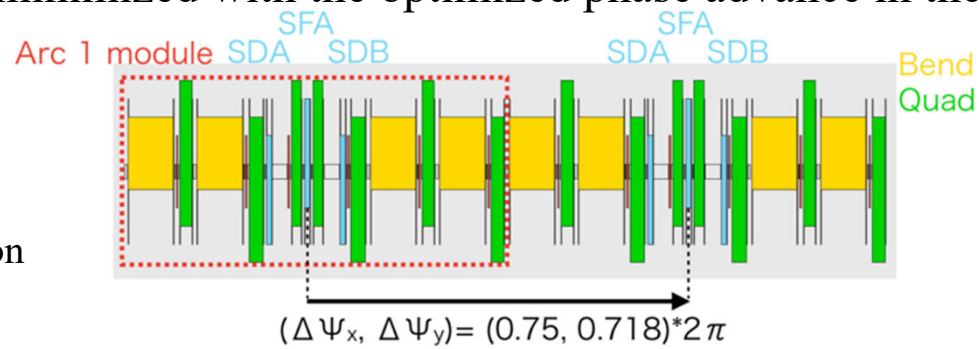


Bunch Oscillation of 480 kW beam with FB



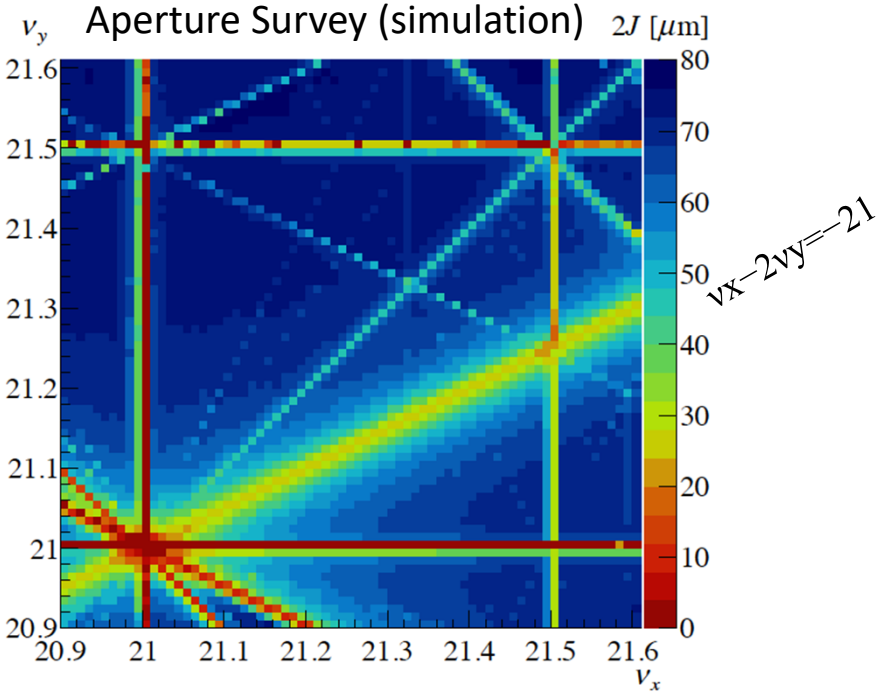
νx−2νy = −21 Resonance Correction

- To achieve higher-intensity acceleration, further reduction of the beam loss is required.
- The resonance amplitude $G_{1,-2}$ can be minimized with the optimized phase advance in the arc modules.
- The beam study has been done.
  - x − y coupling
  - tune scan for the beam loss
  - frequency analysis of betatron oscillation

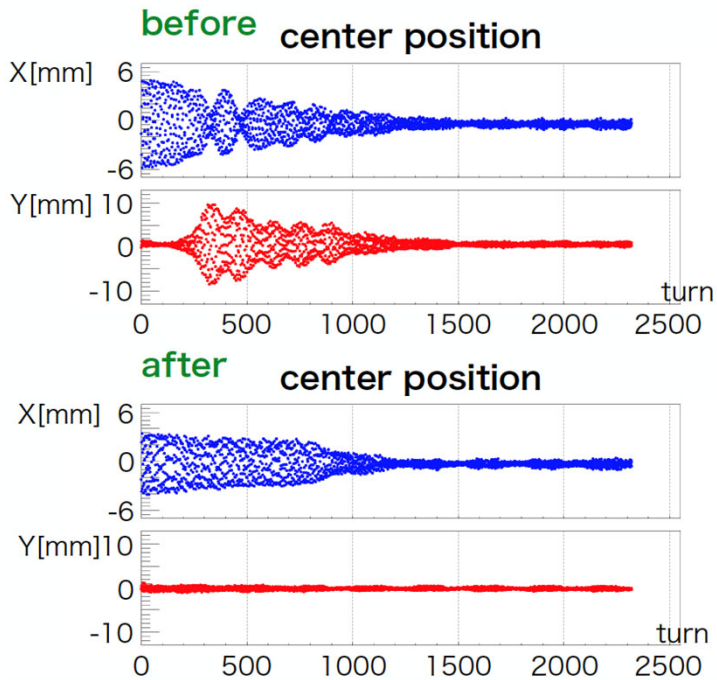


$$G_{1,-2,-21} = \frac{\sqrt{2}}{8\pi}\sum \beta_x^{1/2}\beta_y K_2 \exp[i(\phi_x - 2\phi_y)]$$

Aperture Survey (simulation)



x − y coupling (measurement)



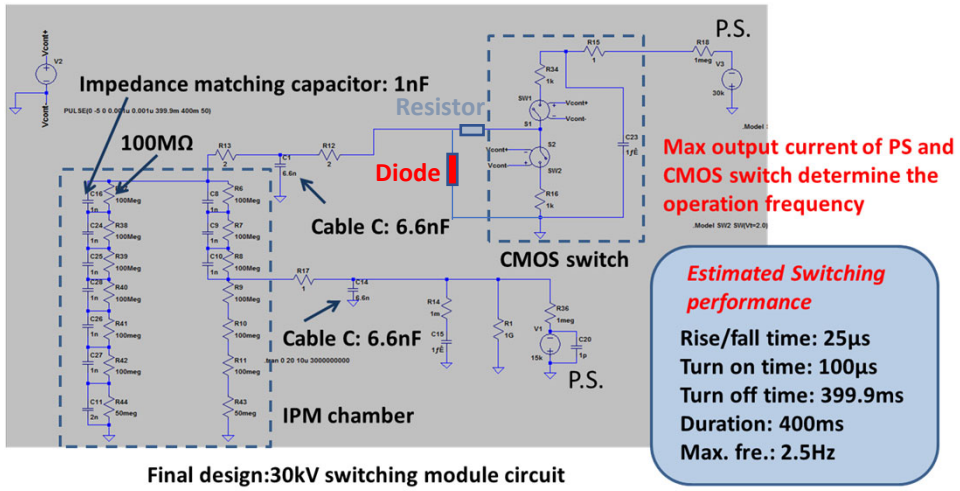
Gated IPM (Ionization Profile Monitor)

Switching of operational HV of 30kV : DC to Pulse-mode

- ***Trouble in JFY2020***
  - ***MOSFET switch trouble***
    - ***DC-HV on off-state during a beam operation, a DC power supply (+30kV) was tripped due to overcurrent***
    - ***Off-state impedance was dropped down to 2.3MΩ -> Broken!!***
    - ***The module was sent to the*** **manufacturer(BEHLKE) -> Under inspection**
- ***Plans in JFY2020***
  - A spare switch was mounted
  - A new switch was already procured and delivered soon
  - Countermeasure against the trouble
    - Add protection circuit : a **back-to-back diode** and a **resistor** at the output terminal
  - A beam test -> after this summer maintenance (in Dec.?)

Photo of IPM

The Final design of gated system

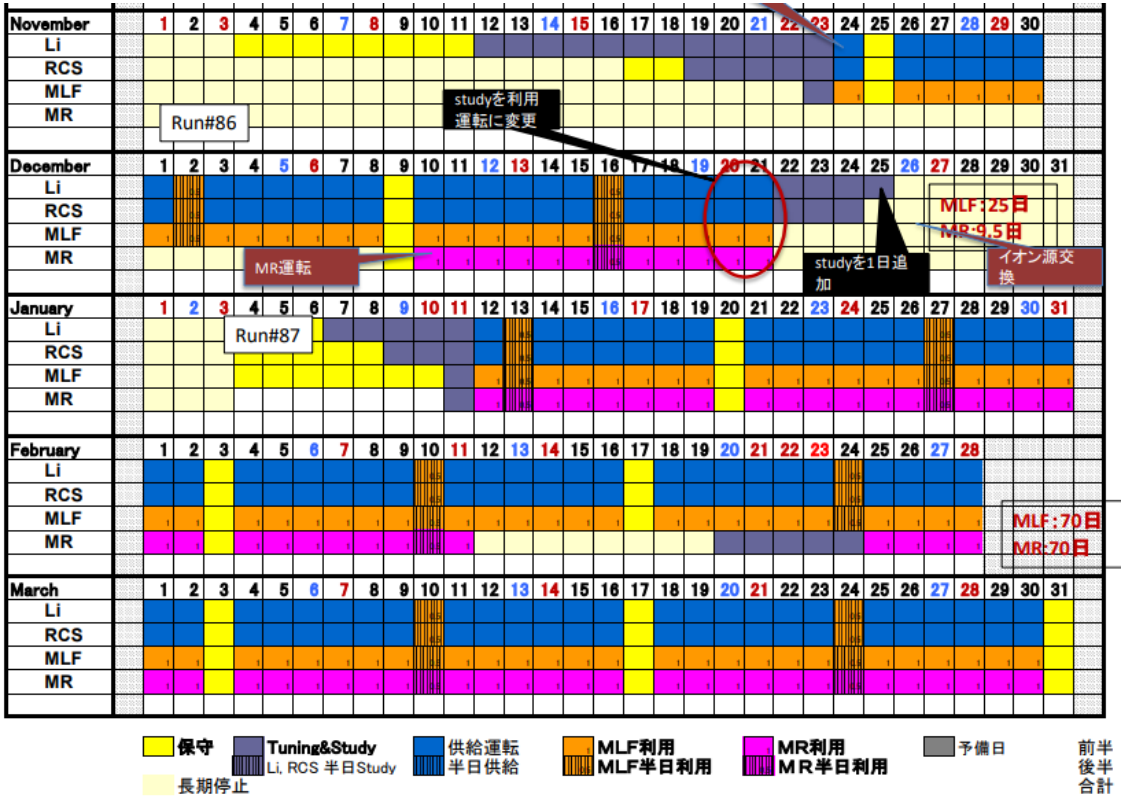


Final design:30kV switching module circuit

Linac

- J-PARC Bunch length detector(Bunch shape monitor, BSM):
  - Beam study of BSM@MEBT1 (W=3MeV) undergoing.
  - **Bunch shape at Test bench agreed with simulation by parameter optimizations.**
  - BSMs@ACS(W~181MeV).....running
  - BSM@L3BT(W=400MeV) study scheduled in Nov.

J-PARC Plan



Schedule may be changed.
MR will start operation on Dec. 10.
User Run #86 includes several days for HD. User Run #87 will start Jan. 12, 2021.
T2K run will start after 1 week stop & beam comisioning in Feb.