S1-Global study plan (HLRF/LLRF)

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GDE meeting Beijing (Mar.29, 2010)

Schedule

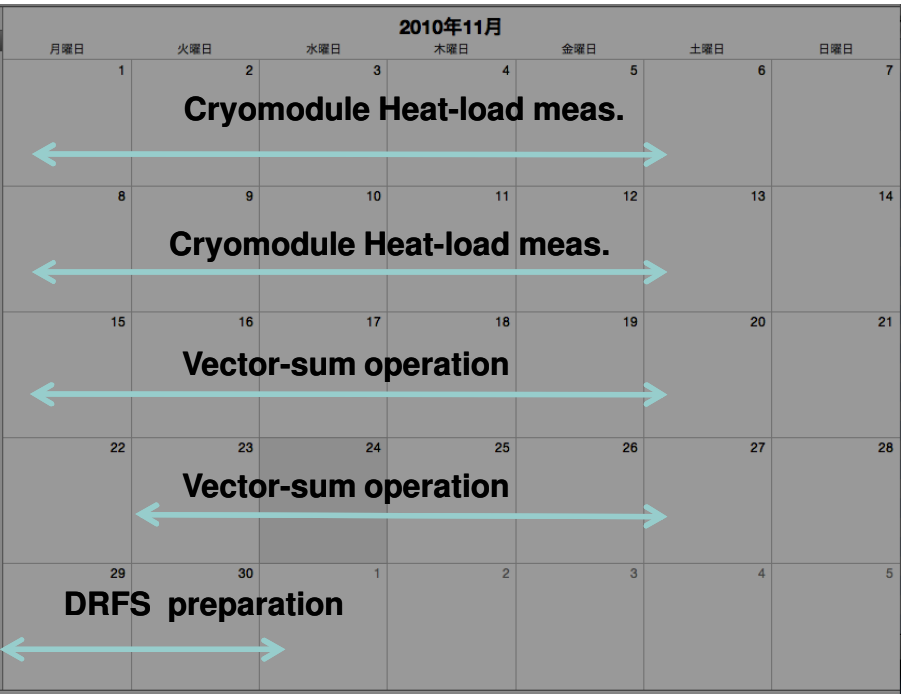
- Total 5 weeks for LLRF/HLRF

- Two weeks for 8 cavity rf control
  - Replacement and calibration
  - Fast interlock system using loaded-Q monitor
  - Vector sum FB control 8cav. under piezo compensation
  - Vector sum FB control IF-Mix
  - Feedback instability

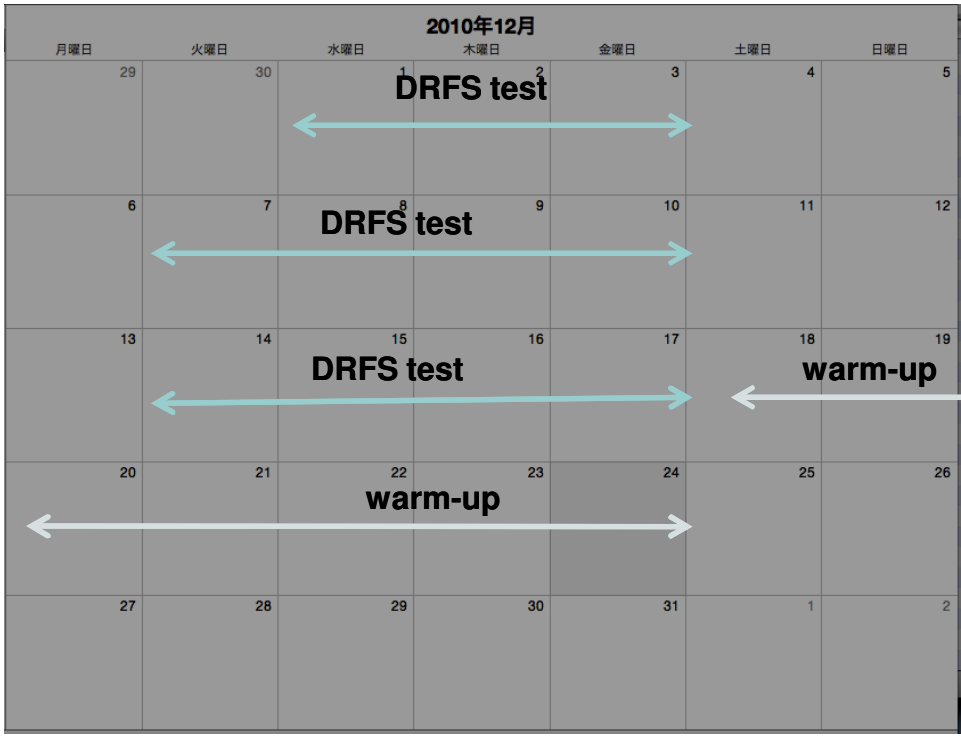
- Three weeks for DRFS system evaluation
  - Replacement and calibration
  - Fast interlock performance
  - Field regulation
  - Sag compensation
  - Cavity filling procedure
  - Forward & reflection monitor without circulators
  - Klystron output characteristics under rf reflection

S1G schedule LLRF/HLRF

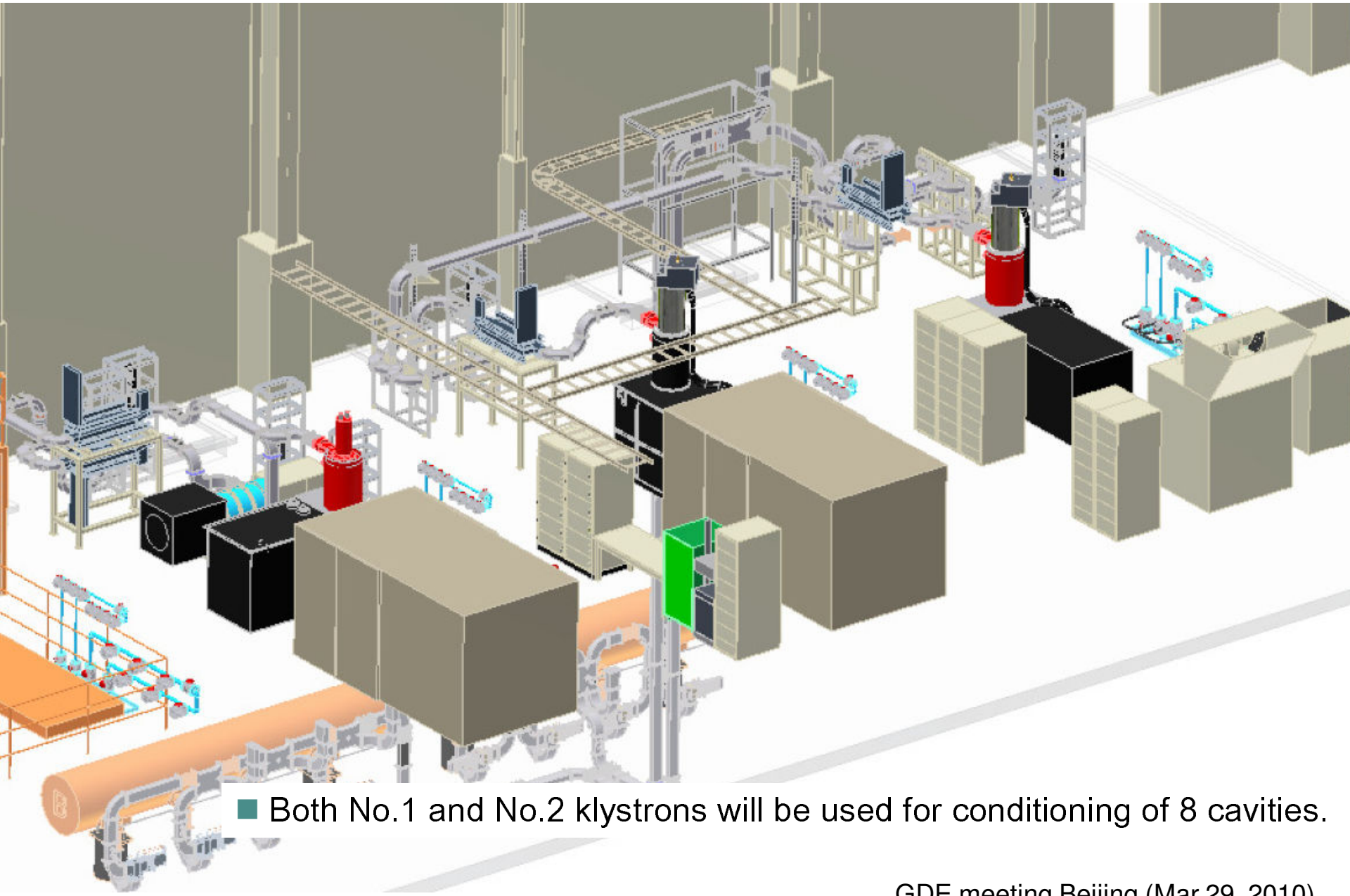
Nov. 2010



Dec. 2010



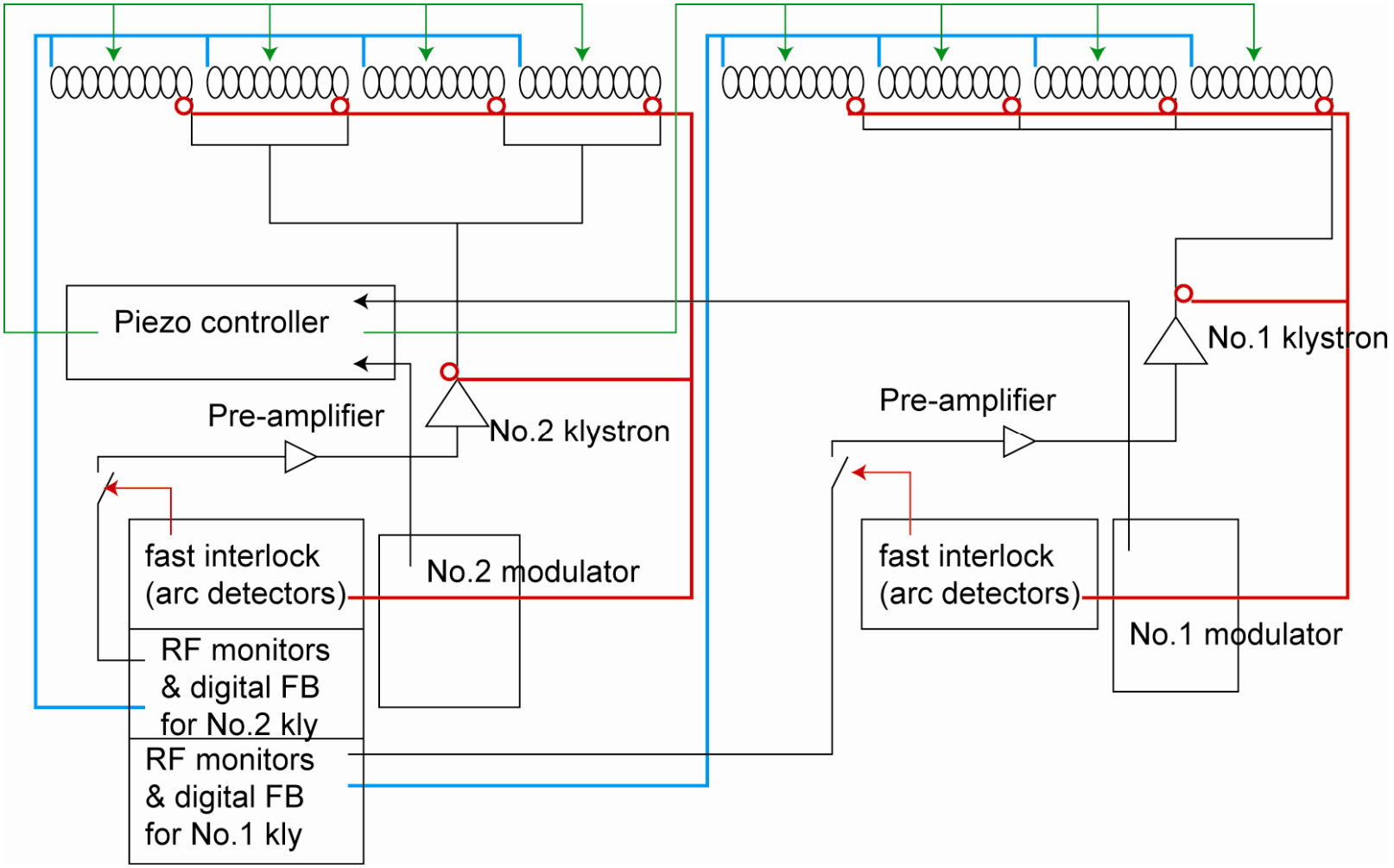
S1 Global



- Both No.1 and No.2 klystrons will be used for conditioning of 8 cavities.

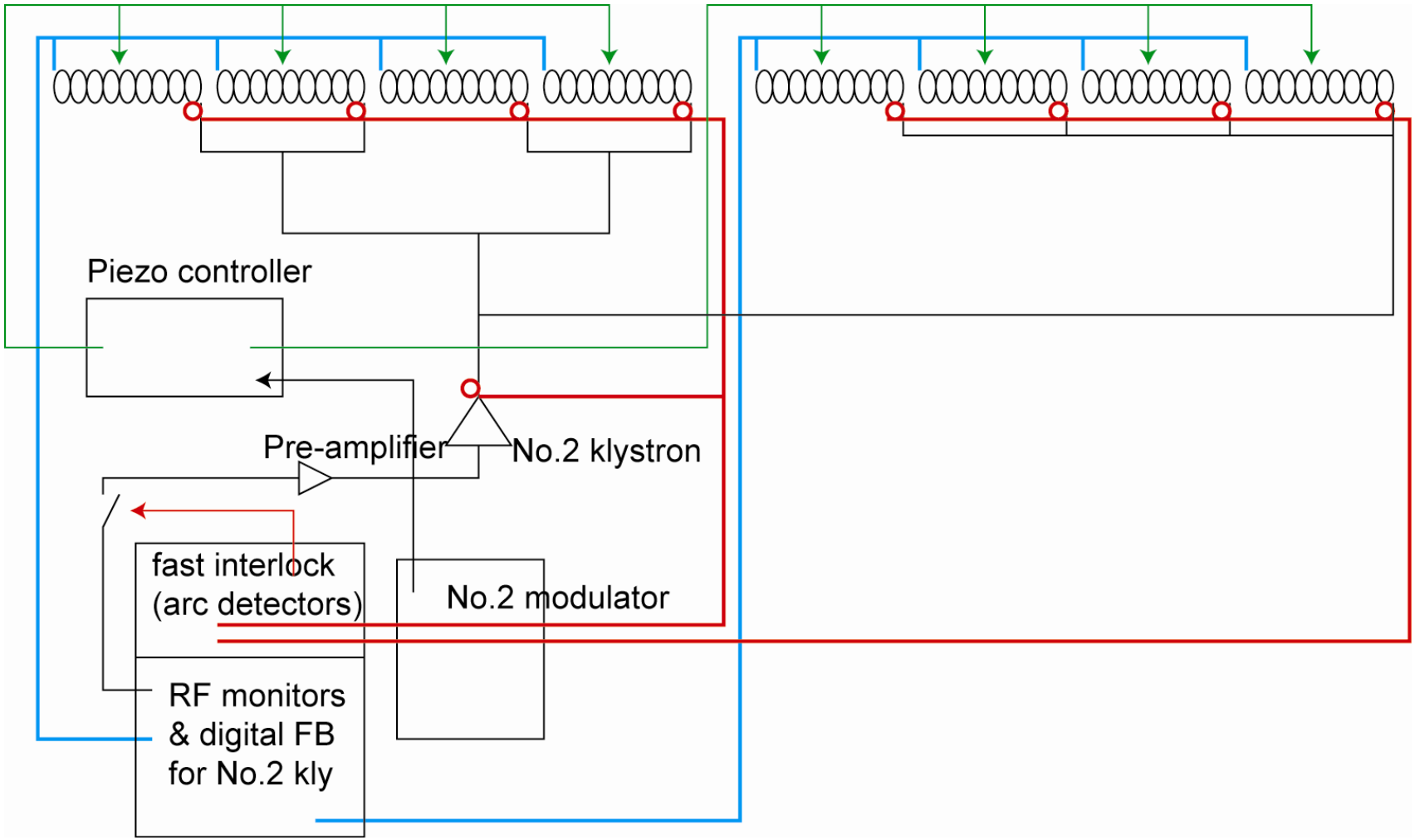
S1 Global 1st stage

- Each 4-cavities is driven by a klystron (in order to reduce the conditioning time).
- Digital llrf controls are located near No.2 klystron.
- Only fast interlock (MPS) system will be located at No.1 klystron.



S1 Global 2nd stage

- All the cavities are driven by No.2 klystron.



loaded-Q monitor

- Loaded Qs of the cavities can be calculated using a decay curve of the cavity field.
- Real-time loaded-Q monitor is under development.

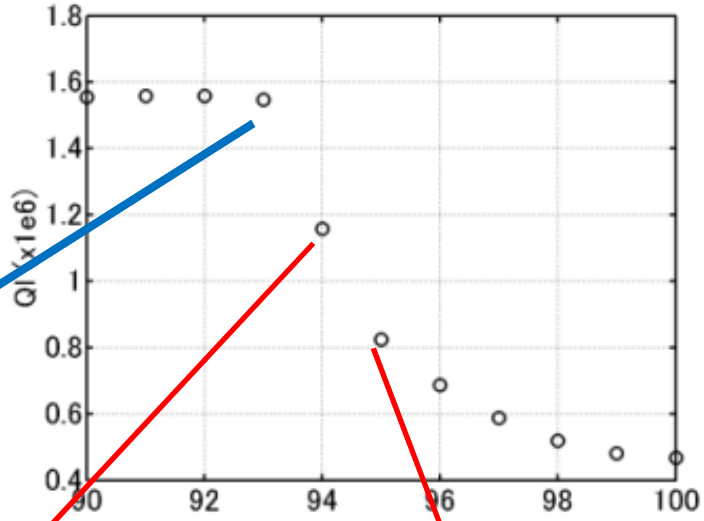
Study goal

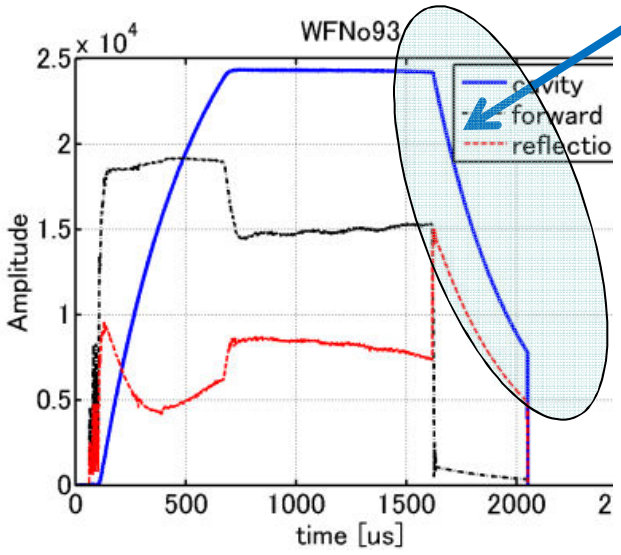
- Performance evaluation:

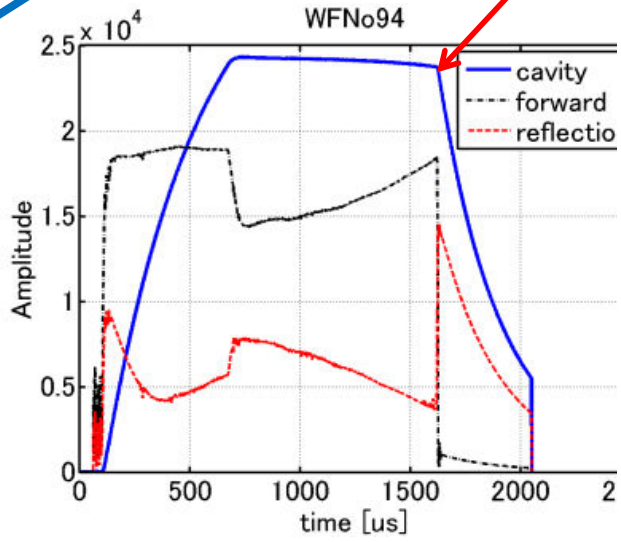
Calculated Q values will be used for the quench detection.

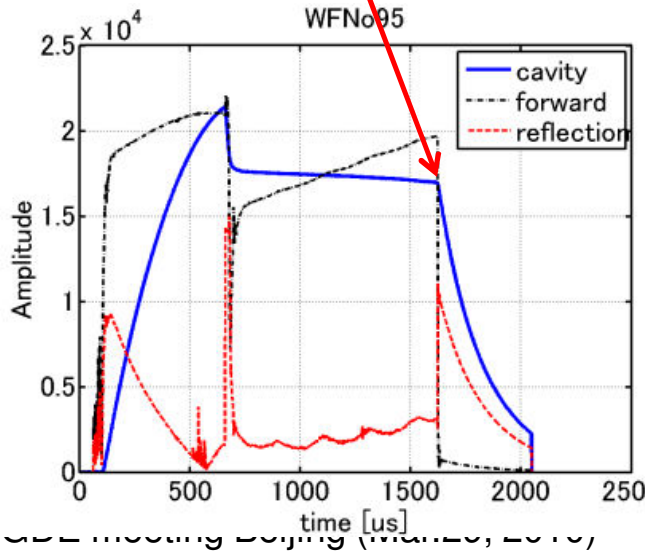
- Functionality as a fast interlock:

RF output will be stopped simultaneously.









Vector sum FB control

- Vector sum FB control 8cav. under piezo compensation..

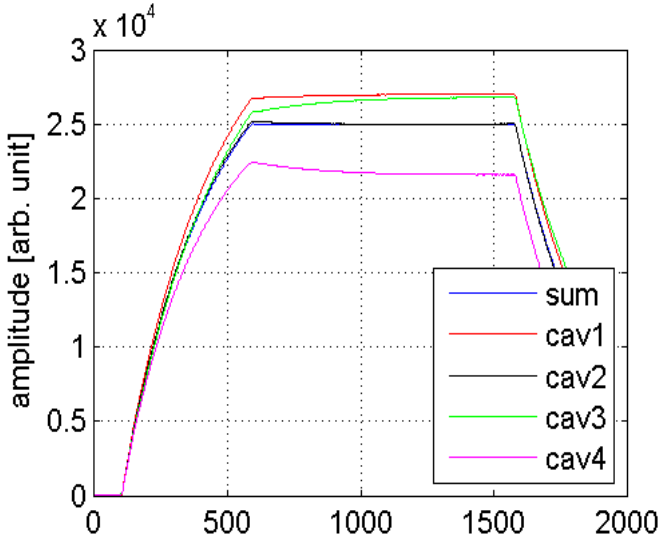
Study goal

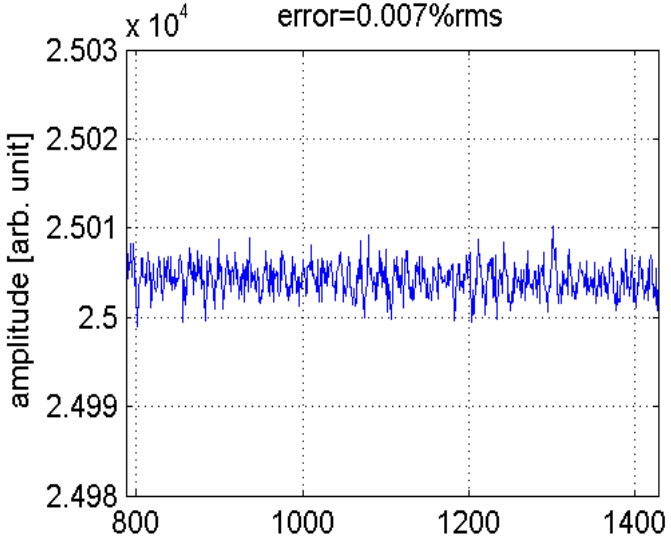
- Performance evaluation:

Amplitude and phase stabilities during rf pulse
These number will be compared with the stabilities obtained at STF-0.5.

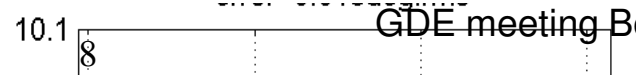
- half day (~5hours max.) stability

Effects of microphonics, pieze compensation





4 vector sum control 0.007%rms 0.018deg. r ms at STF-1



Feedback with IF-Mix scheme

- Vector sum FB control 8cav. under piezo compensation using IF-Mix.

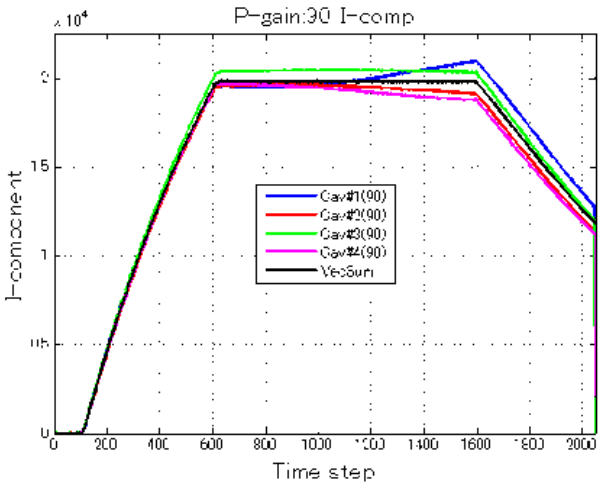
Study goal

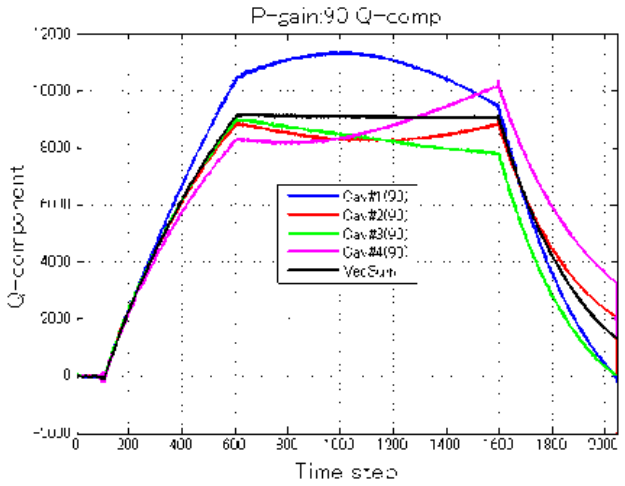
- System demonstration

Eight ADCs will be used for 8 cav. Pick-up, forward, reflection signals.
First feedback demonstration using the IF-Mix scheme.
(Four-cavity vector sum was demonstrated at STF-0.5 with IF-Mix)

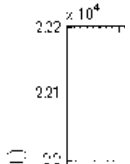
- Performance evaluation:

Amplitude and phase stabilities during rf pulse.





- Flat-top (650 ~ 1550us) Stabilities at STF-0.5



⊿A/A : 7×10^-4(rms)

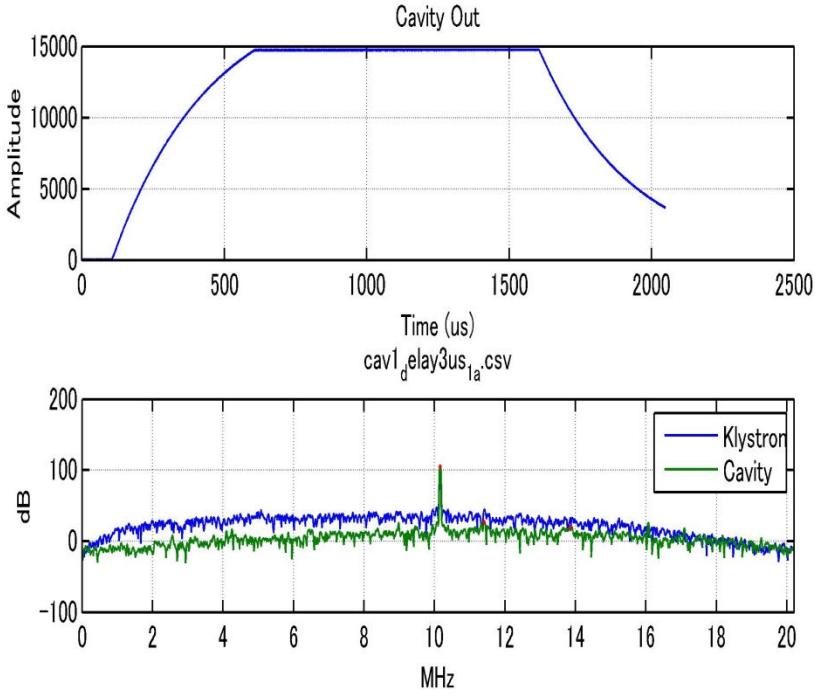
⊿φ : 0.06deg.(rms) (@ P gain = 104)

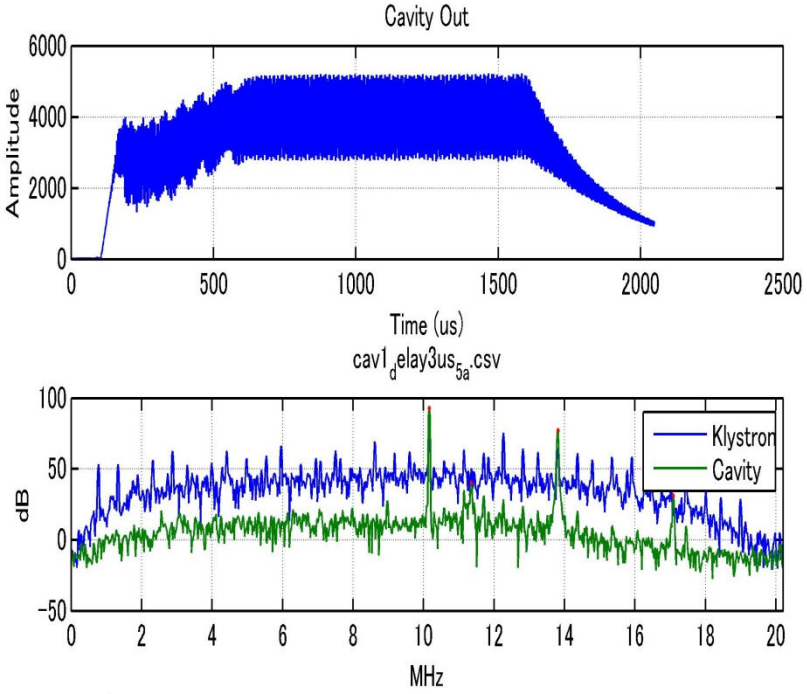
Feedback instability

- Instability suppression using analog/digital filters

Study goal

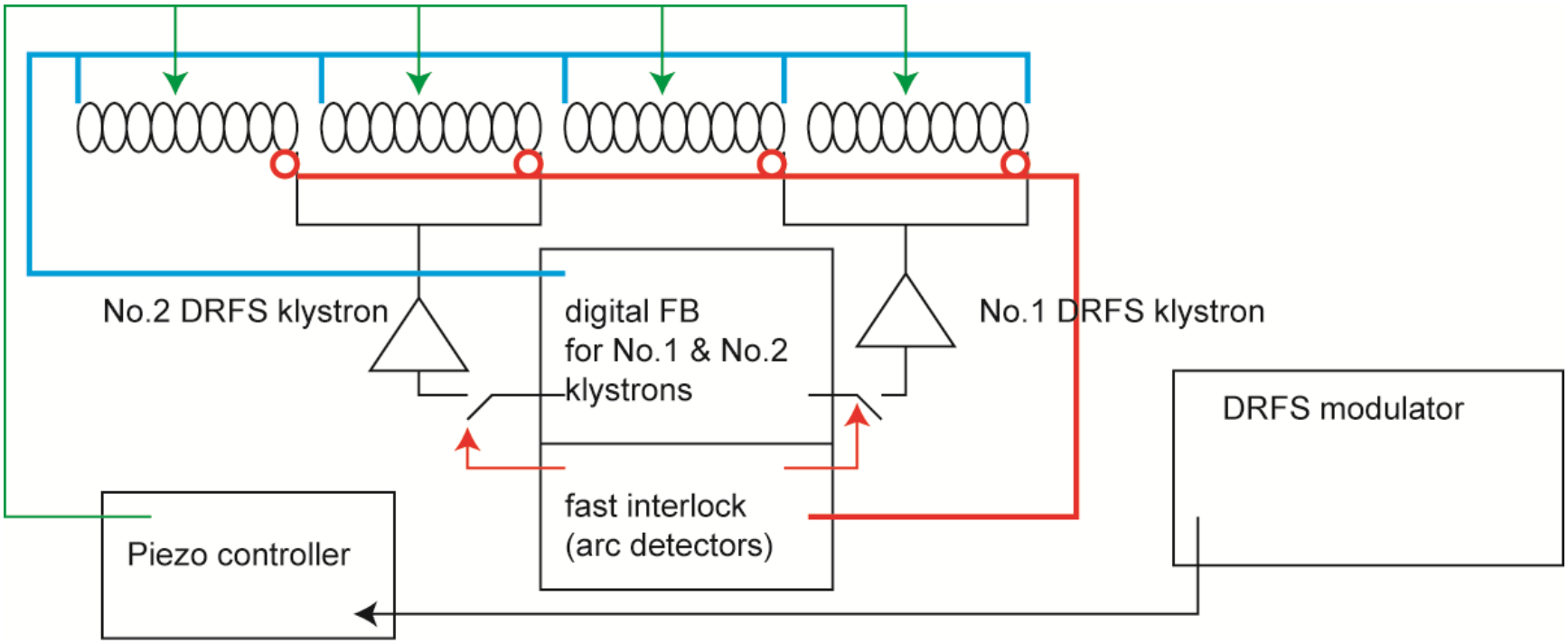
- Performance using digital or analog filters to eliminate the instablilities
- Comparison between these filters and latency optimization





S1 Global 3rd stage (DRFS)

- New digital LLRF systems (uTCA) will be installed to the tunnel.
- Fast interlock will be also located at the tunnel.
- Piezo compensation from the ground level

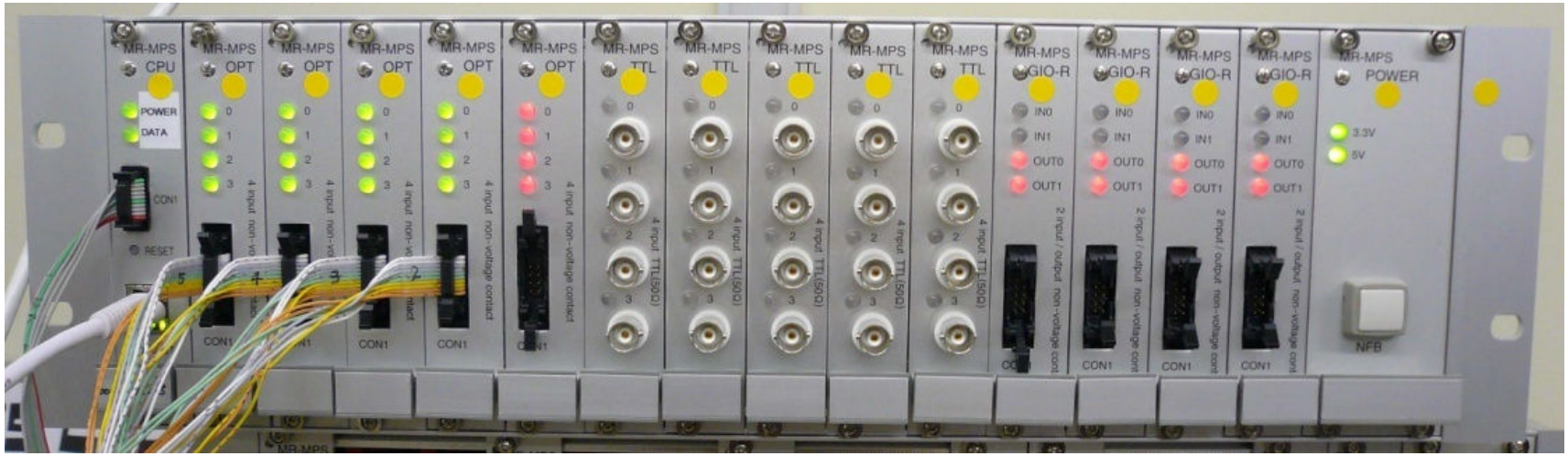


Fastinterlock performance

- ILC-aimed compact fast-interlock system will be installed to DRFS units.
- This was developed for J-PARC and was also installed to cERL rf test stand.

Study goal

- Performance evaluation

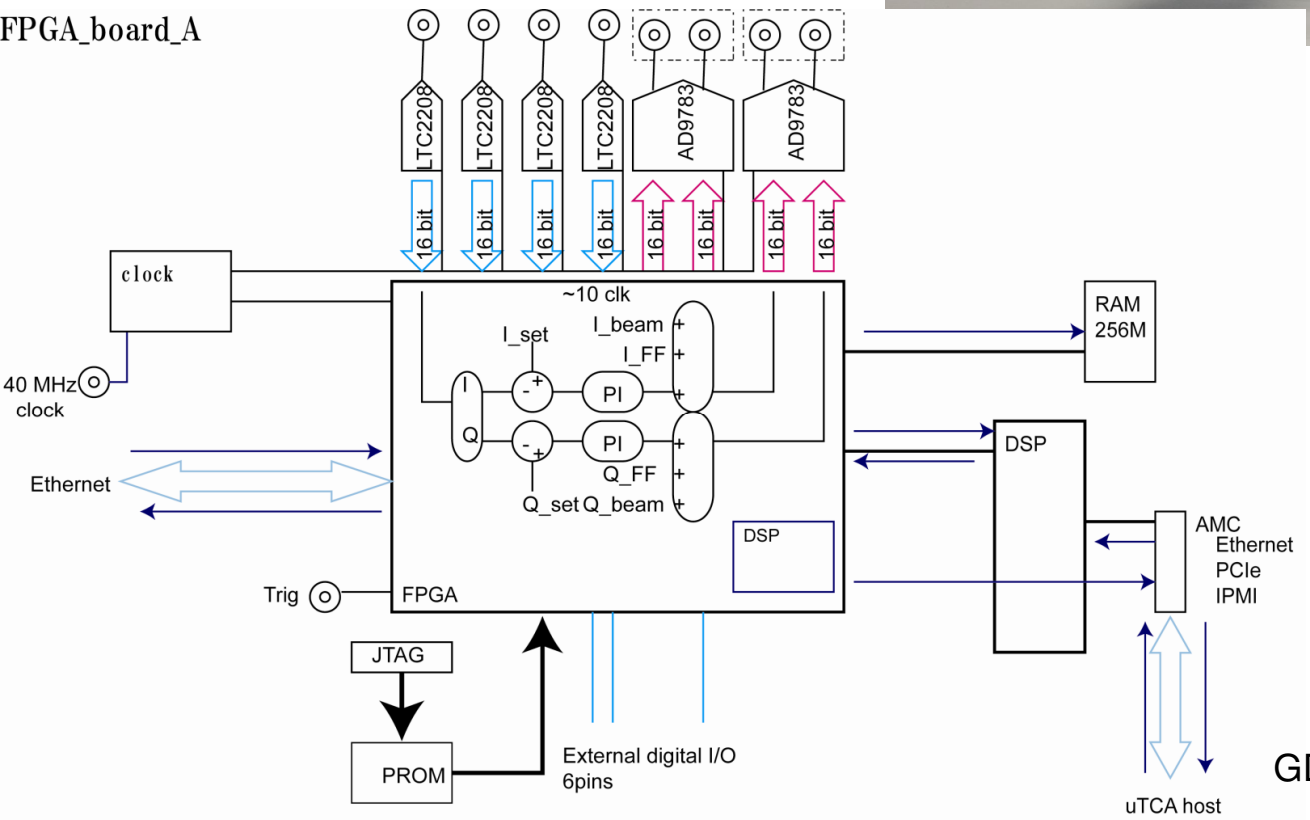


Field regulationField regulation

- cERL like uTCA FPGA system will be installed.

Study goal

- Performance evaluation

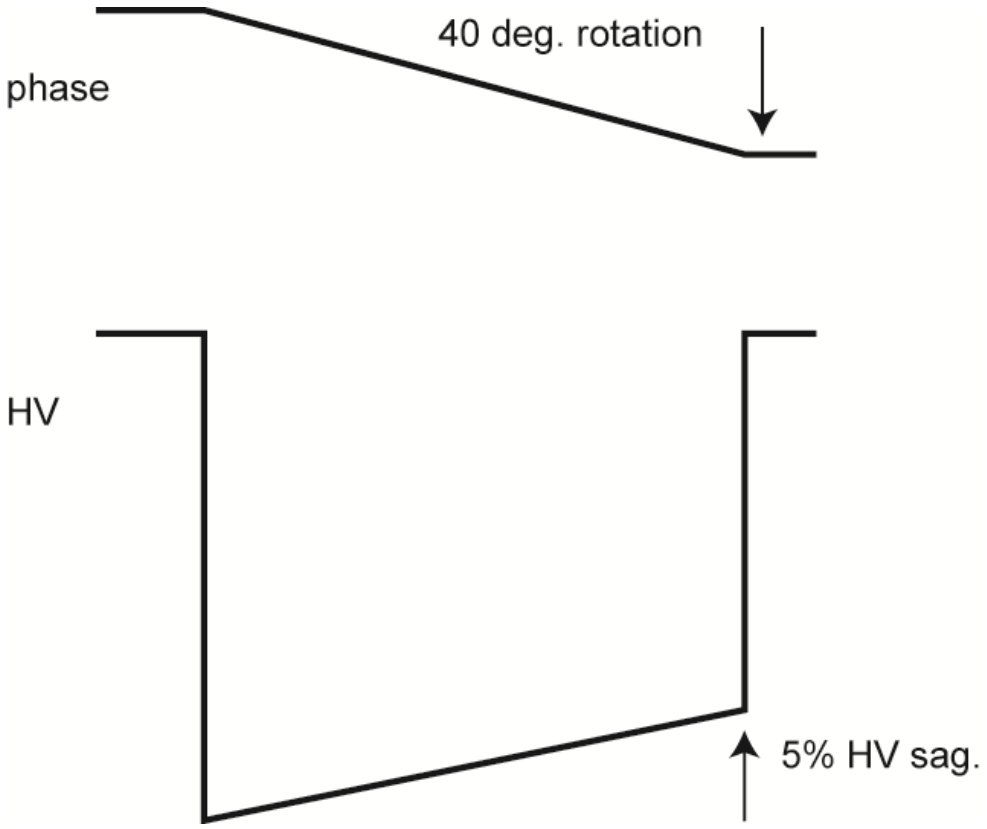


Sag compensation

- HV sag (~5%) will cause 40deg. Rotation. (8deg./%)
- This will degenerate the feedback stability and compensation is the essential for high feedback gain.

Study goal

- Proof of sag compensation

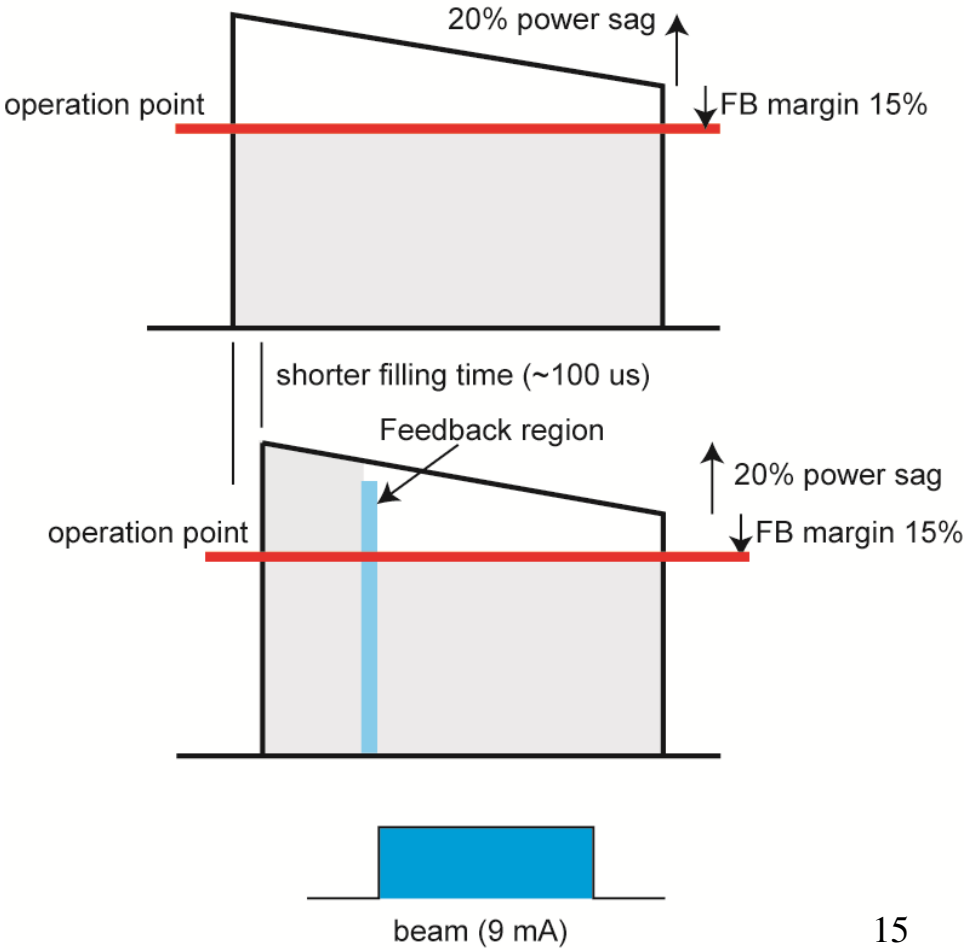


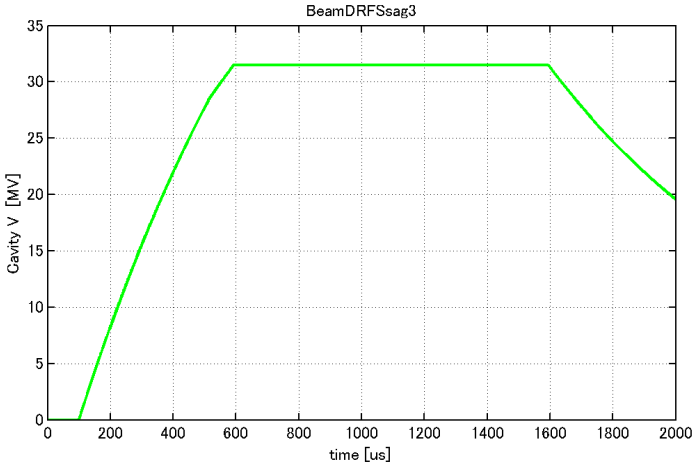
Full power filling scheme

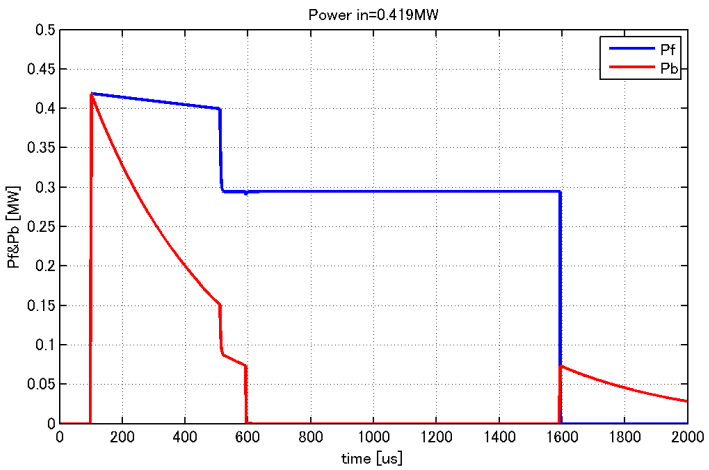
- In order to use the rf power under sag efficiently, full-power filling scheme is proposed.
- By using the full-power filling, shorter rf pulse will be enabled.

Study goal

- Proof of the scheme







Circulator effects

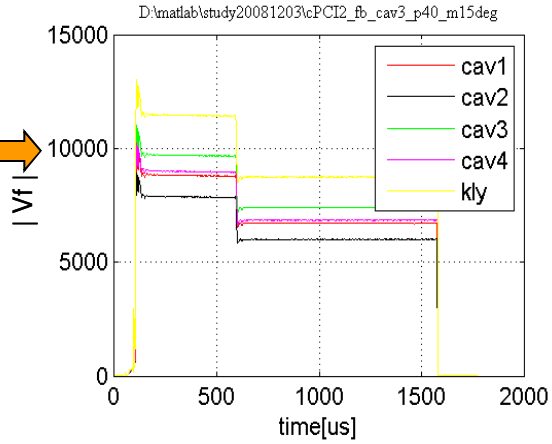
- The previous study (STF-1) indicate high isolation will be required at hybrid in order to estimate the cavity parameters (such as Ql and detuning).

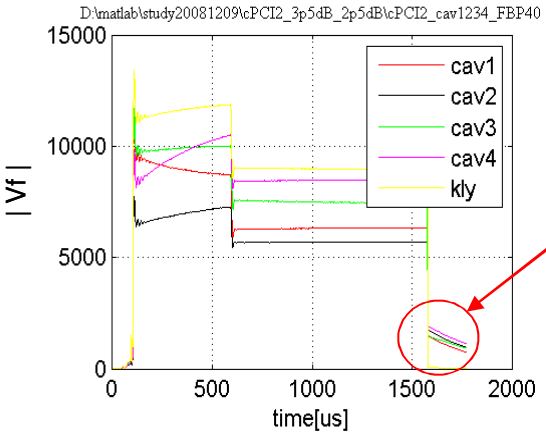
Study goal

- Study of the rf isolation with new hybrid system suitable for DRFS

With circulators ***Without circulators***

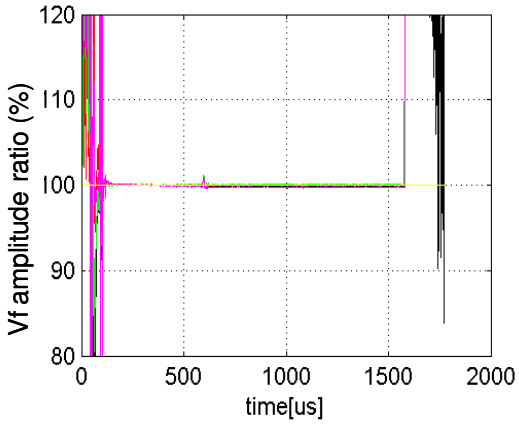
Cavity input

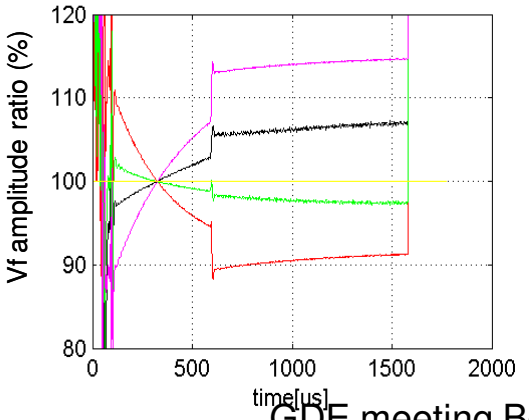




Cavity input exis
even after RF off

Normalized by klystron output

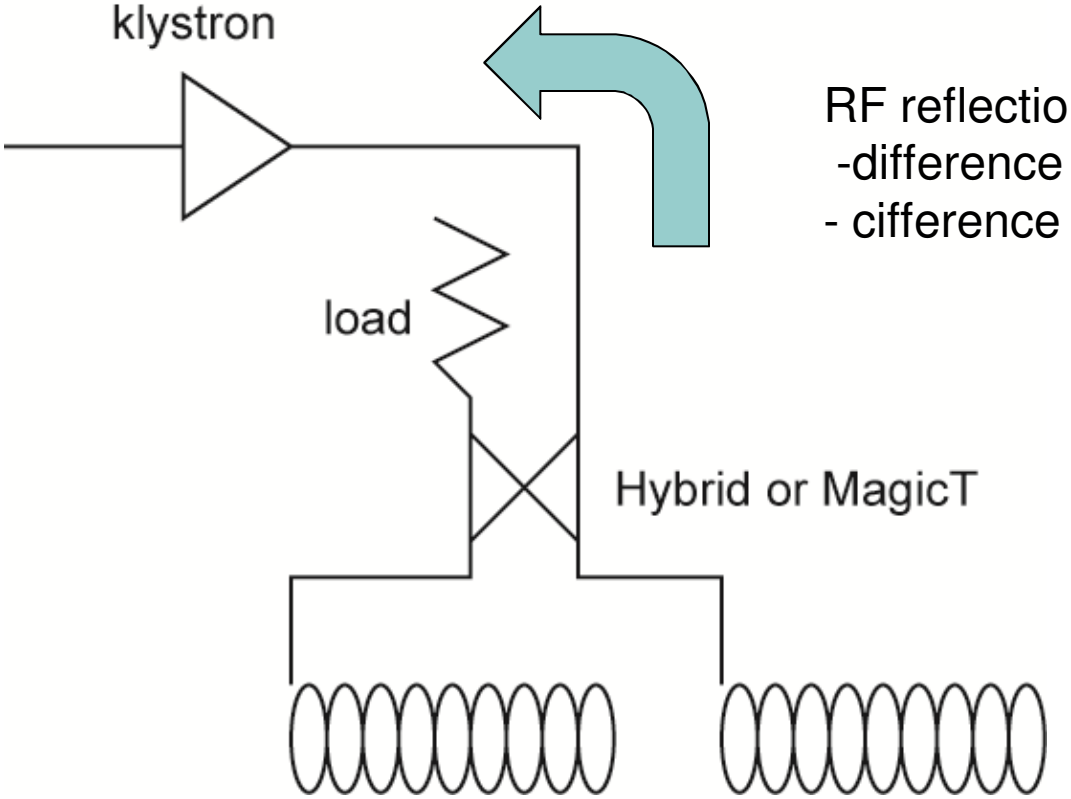




Circulator effects (2)

- Klystron output depends on the reflection to the klystron itself.
- In case of the unbalanced operation (or different cavity detuning each other), the refections cannot be canceled.

- Study goal: Evaluation of the effect of the reflection signal to the klystron



RF reflection goes back to klystron in case of
-difference in cavity detunings
- cifference in input power