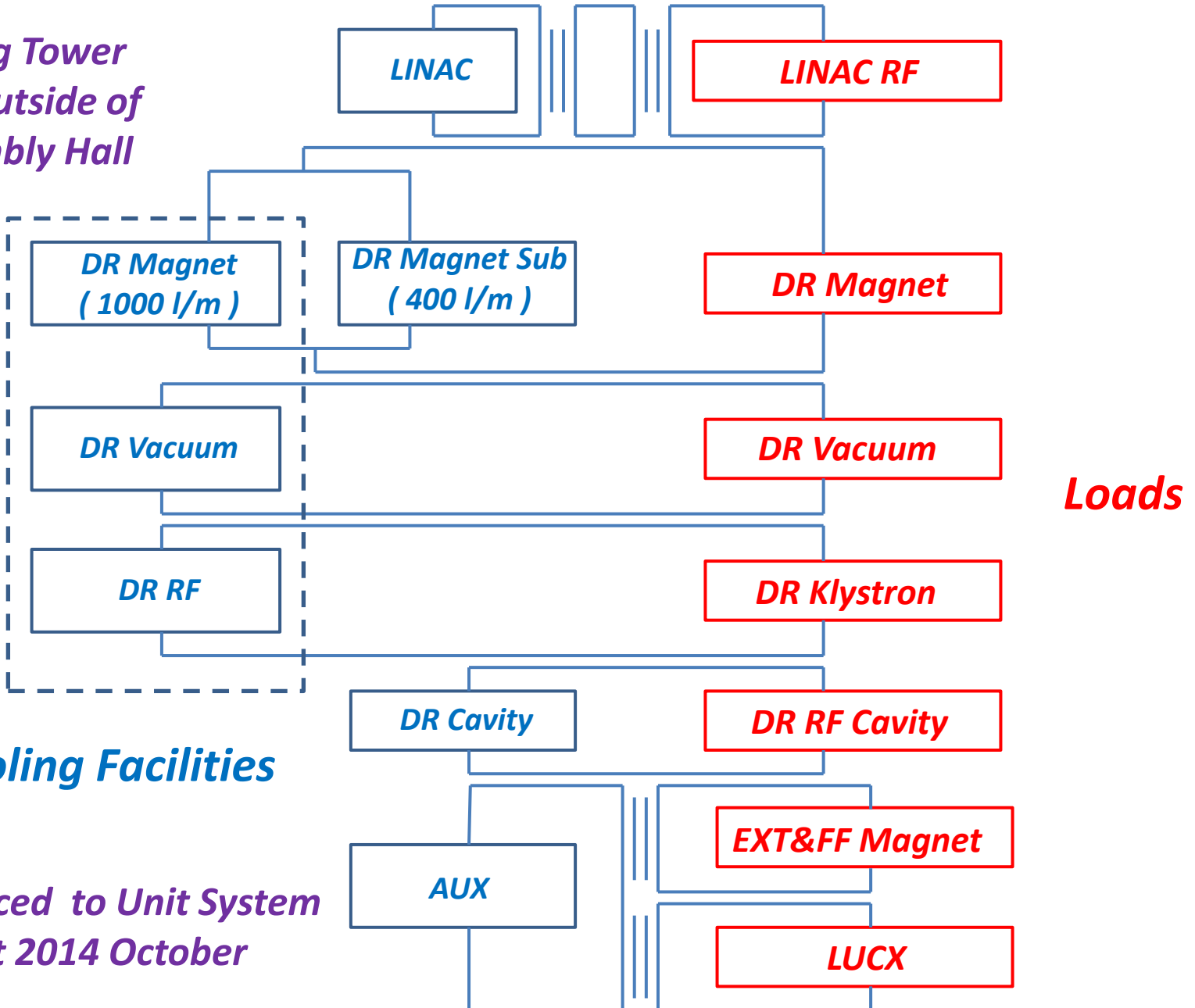


# ***ATF Cooling Water System***

*Toshiyuki OKUGI, KEK  
2015/ 2/ 24  
ATF2 Project Meeting  
LAPP (Annecy, France)*

# Schematic Figures of ATF Cooling Water System

Cooling Tower  
was outside of  
Assembly Hall



Cooling Facilities

Replaced to Unit System  
at 2014 October

# Linac Cooling Water System

Outside temperature was increased.



The floor of Assembly hall was expanded.



The frequency of RF system was changed to match the circumference of DR.



The frequency of RF system was mismatched to the resonant frequencies of Linac cavity.



The injection energy to DR was reduced.

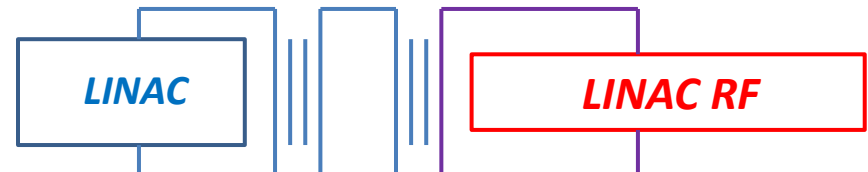


Before 2014, we stopped the beam,  
or operated with mismatched DR circumference.

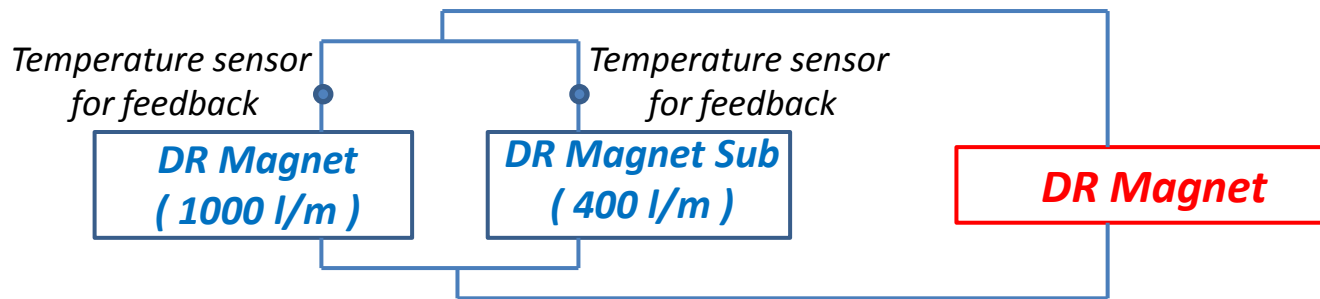
From 2014,  
the temperature of linac RF system  
was changed to match the appropriate frequency  
by Naito-san.

We could operate in June 2014.  
(We achieved the minimum beam size.)

**June and July Operation**



# DR Magnet Cooling Water System



*Operate with 2 Cooling water system to increase the water flow.*

*When we operate with single water cooling system,  
we sometimes have a water flow interlock for individual magnets.*

*The temperature of each cooling system is stabilized within each system.*

*Since the cooling tower for main cooling water system was located  
outside of assembly hall, the cooling power was very strong in winter.*

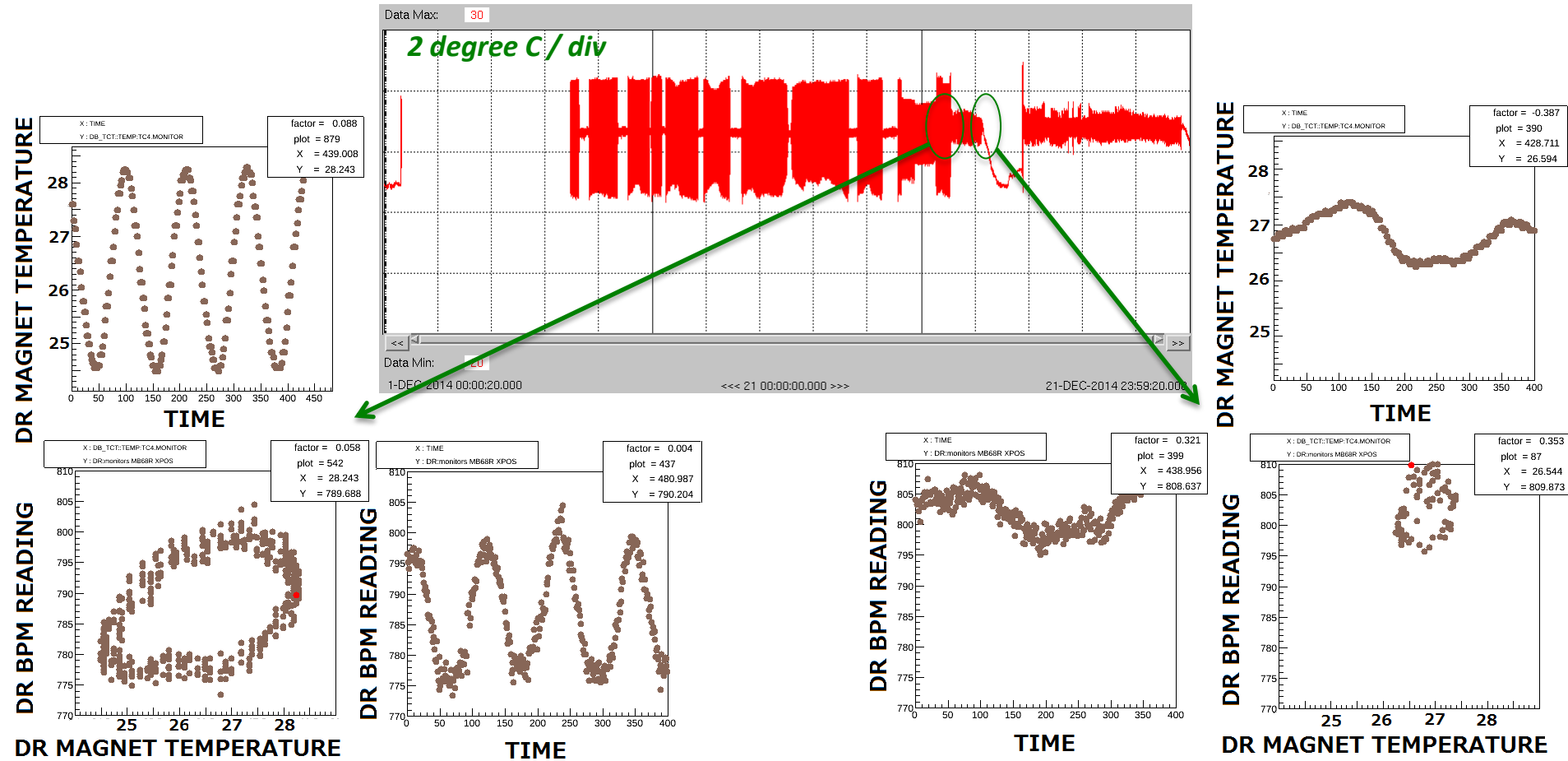
# DR Cooling Water Temperature (2014/12/01 – 2014/12/21)

The DR horizontal orbit was oscillated with the DR cooling water temperature.

The FF vertical orbit was also oscillated with DR cooling water temperature.

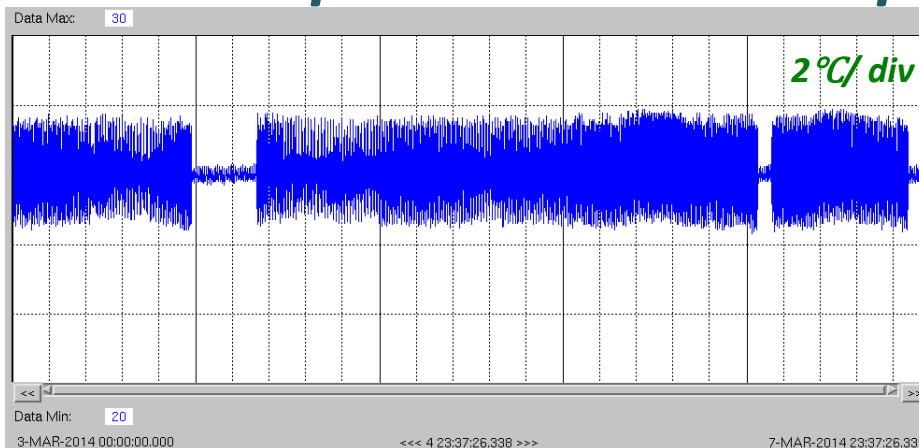
- Since we operated with ultra-low beta optics at December 2014, we could clearly observed the oscillation in FF beamline.
- Since the frequency of FF orbit oscillation was twice as DR cooling water temperature, DR horizontal orbit oscillation was converted to FF oscillation through skew sextupole field at septum.

Naito-san adjusted the feedback parameters of the cooling water.



# Cooling Water Temperature in 2014 Spring Operation

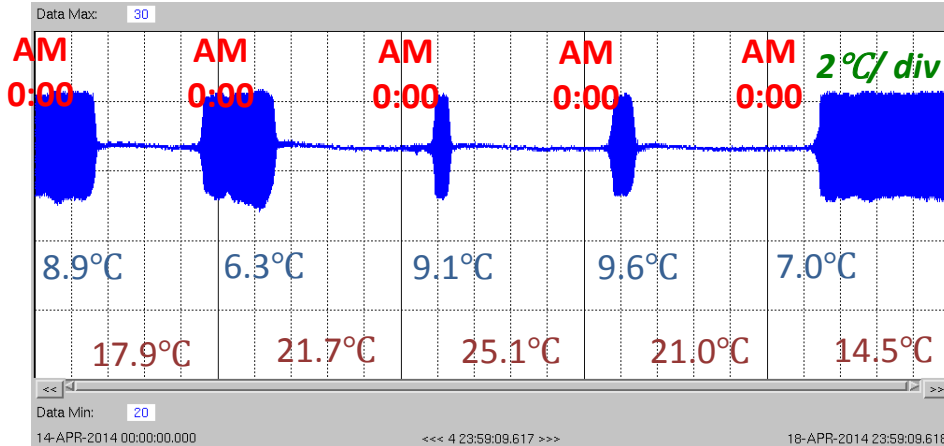
2014 March  
(03/03-03/07)



*In 2014 January to March, the temperature of DR magnet cooling water was also fluctuated.*

*Maximum IP-BSM modulation was limited around 30%.*

2014 April  
(04/14-04/18)

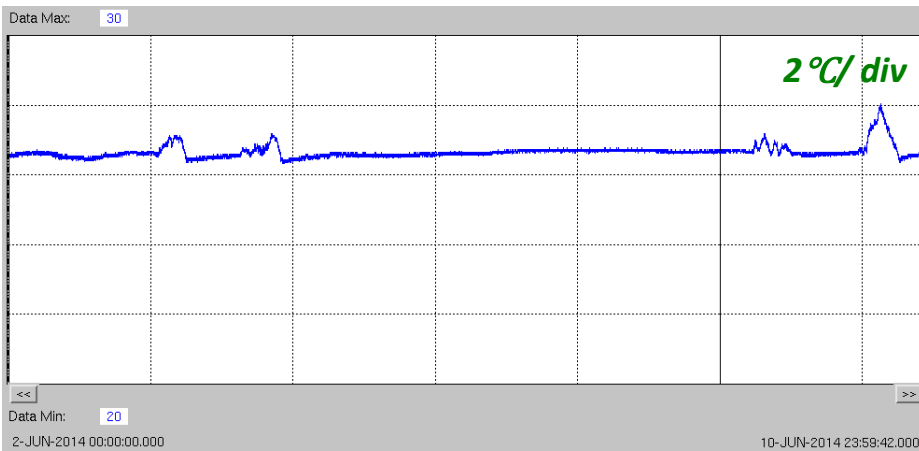


*Minimum temperature at Tsuchiura city*

*Maximum temperature at Tsuchiura city*

*by Japan Meteorological Agency*

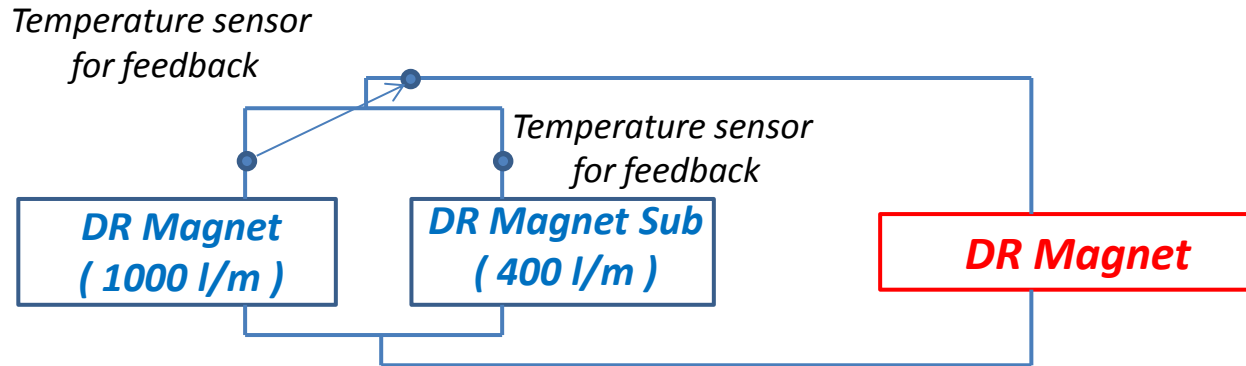
2014 June  
(06/02-06/10)



*In 2014 June, the temperature of DR magnet cooling water was stable.*

*Maximum IP-BSM modulation was more than 50%.*

# *Plan to be stable DR Magnet Cooling Water System*



*The temperature sensor of main cooling water system will be moved to be after combined to that of sub-system.*

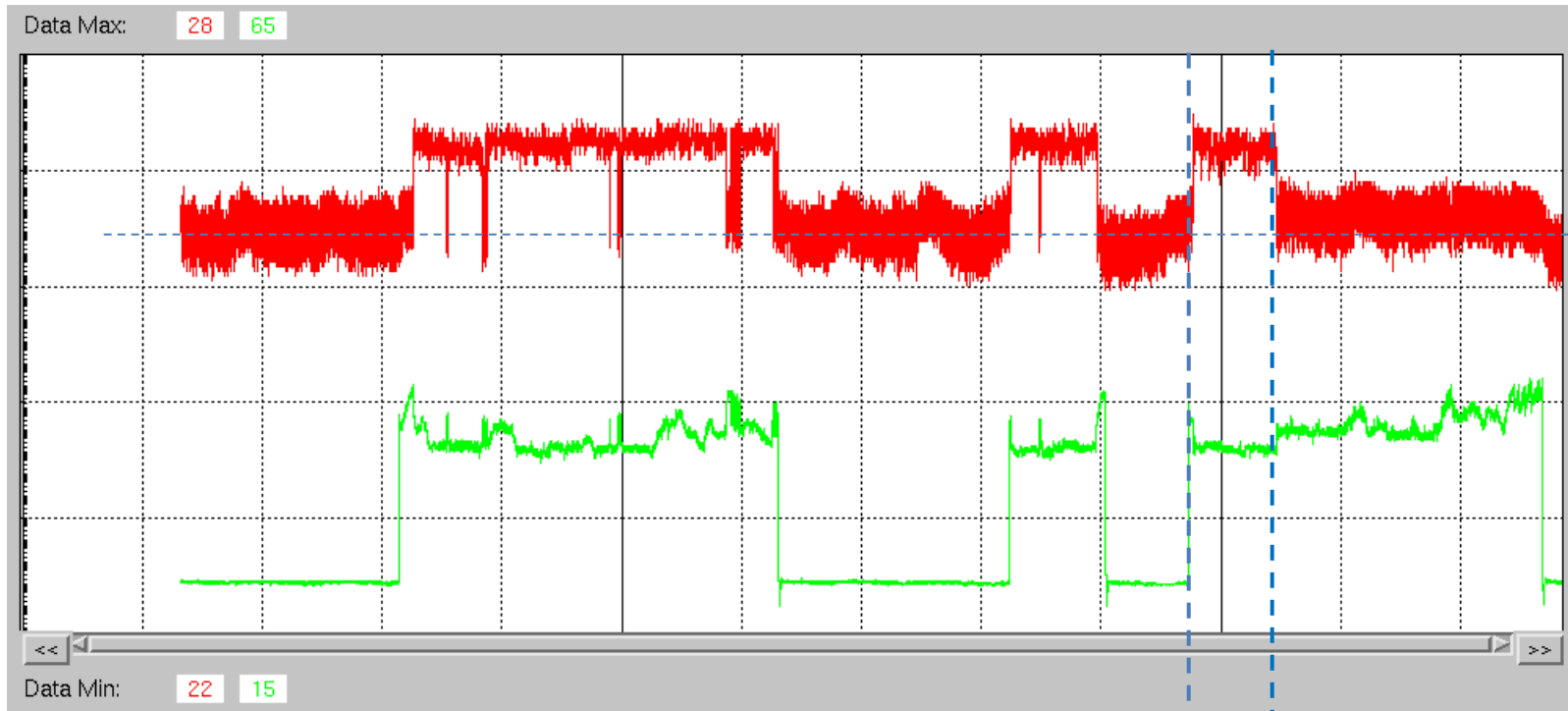
*The sensor of sub-cooling water system will be kept to be same location.*

*The water temperature within cooling water system will be changed for summer and winter season.*

# DR RF Cooling Water System (2014 December)

Temperature variation of DR RF cooling water

RED; DR RF cavity  
GREEN; DR RF klystron



*Kicker trouble was cured.*

**The temperature of DR RF cavity was decreased.**

**On the other hands, the temperature of DR klystron was a little bit increased.**

Was the most of RF power reflected at cavity ?

- Tuner ?
- Temperature ?

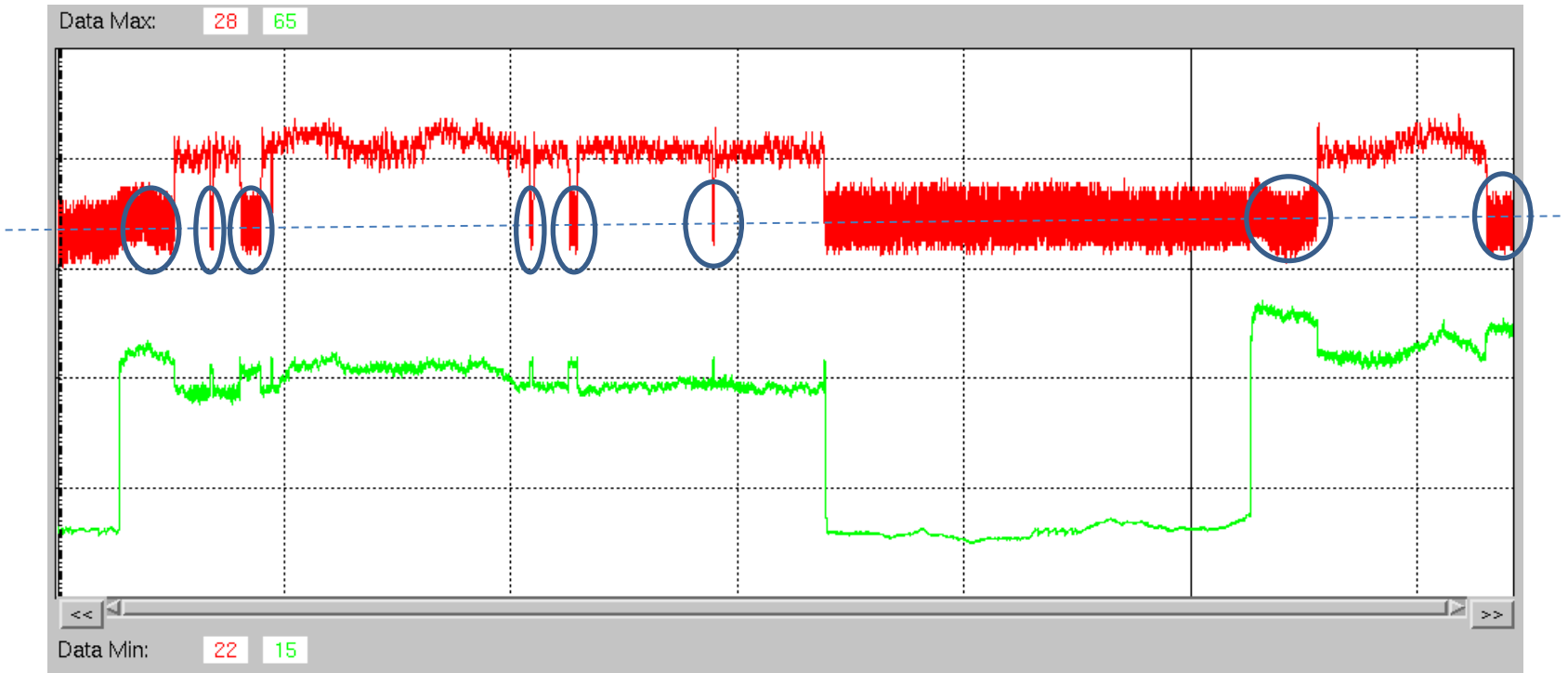
Was the low power RF off ?



# DR RF Cooling Water System (2014 June)

Temperature variation of DR RF cooling water

RED; DR RF cavity  
GREEN; DR RF klystron



We observed same situation in other season too.

# DR Vacuum Cooling Water System (2014 May)

The IP beam size was increased.

And we found that the cooling water system of DR vacuum was stopped.

Therefore, the cooling water system was restarted.

After the cooling water system was restarted,

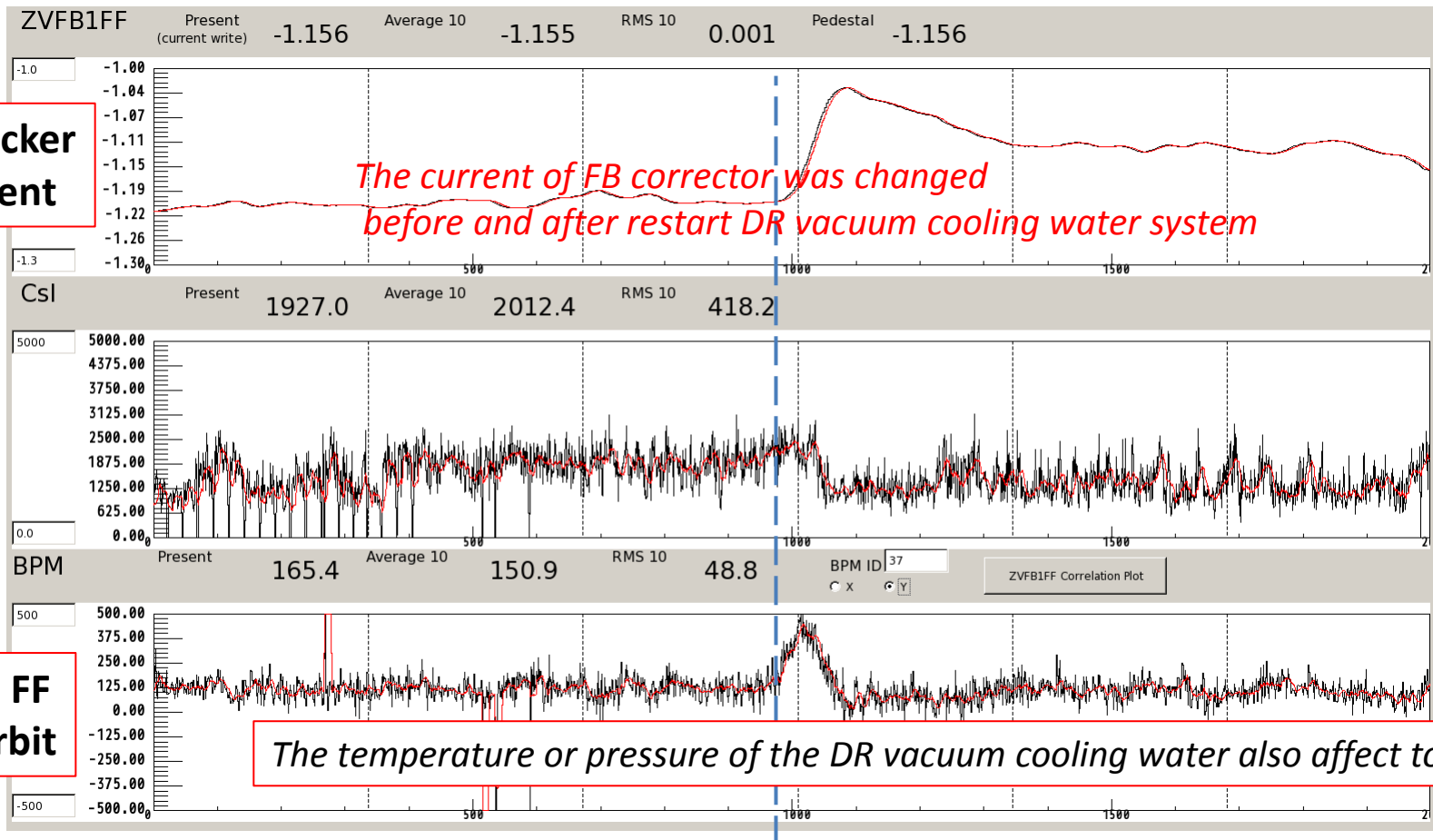
the FF orbit was changed, and the IP beam size was recovered.

**FB kicker  
current**

*The current of FB corrector was changed  
before and after restart DR vacuum cooling water system*

**ATF FF  
Y orbit**

*The temperature or pressure of the DR vacuum cooling water also affect to beam.*



**Restart the DR vacuum cooling water system**

# Summary

*The stability of cooling water temperature is very important.*

## **LINAC RF Cooling Water System**

*We can store the beam to DR in June from 2014, because Naito-san prepared the LINAC cooling water temperature control system in order to adjust the resonant frequencies of LINAC RF cavities.*

*Before 2014, the beam energy was reduced in LINAC after June, when we adjusted the LINAC frequency to adjust the DR circumference.*

## **DR Magnet Cooling Water System**

*Stability of DR MAG cooling water temperature strongly depends on the outside temperature, especially the summer season was stable. ( We measured smaller IP beam size in June 2014.)*

## **DR RF Cooling Water System**

*We observed the temperature of DR cavity cooling water was dropped down. We should check the stored power in DR cavity (not yet).*

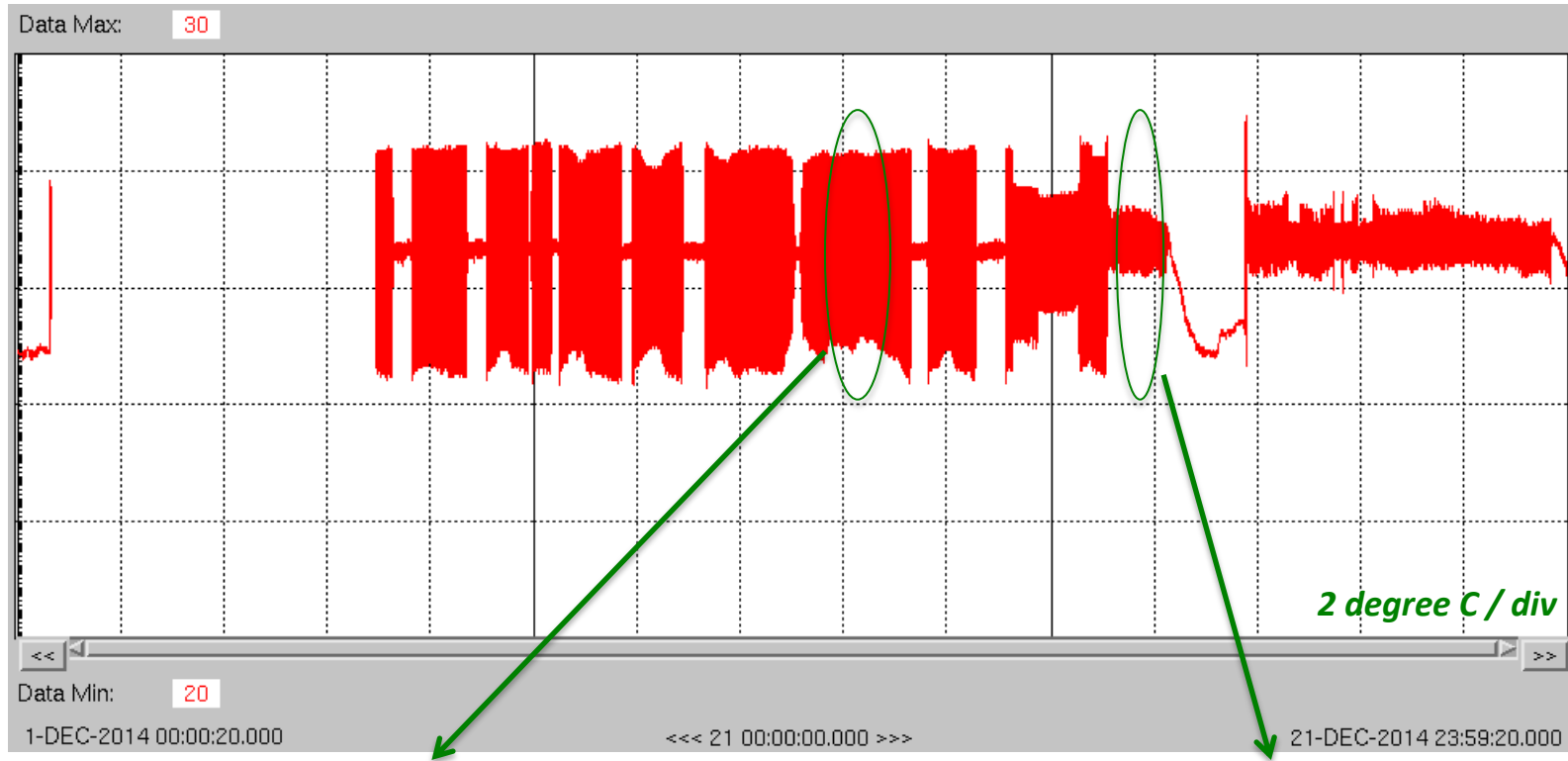
## **DR Vacuum Cooling Water System**

*The temperature of DR vacuum system affect to the beam orbit.*

## **EXT&FF Magnet Cooling Water System**

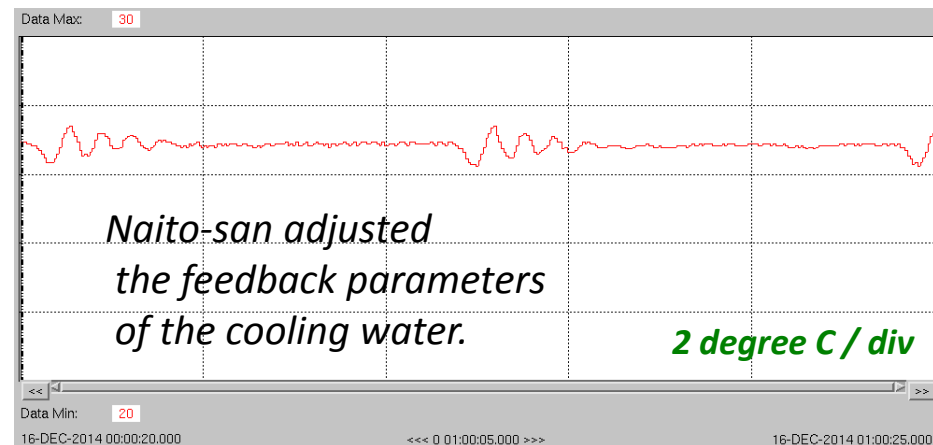
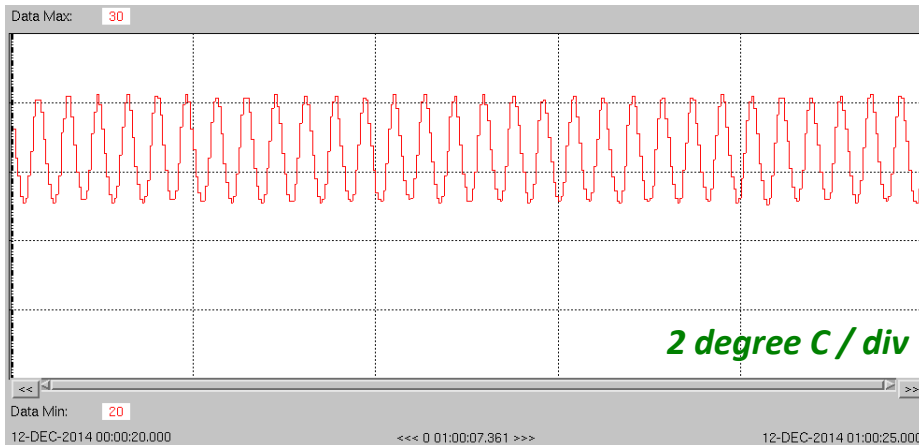
*The cooling water system was very old, and sometimes had troubles. Therefore, the system was replaced to new unit system at 2014 October.*

# DR Cooling Water Temperature (2014/12/01 – 2014/12/21)



2014/12/12 (1 hour)

2014/12/16 (1 hour)



*Maximum IP-BSM modulation was around 30%.*