Status of T2K

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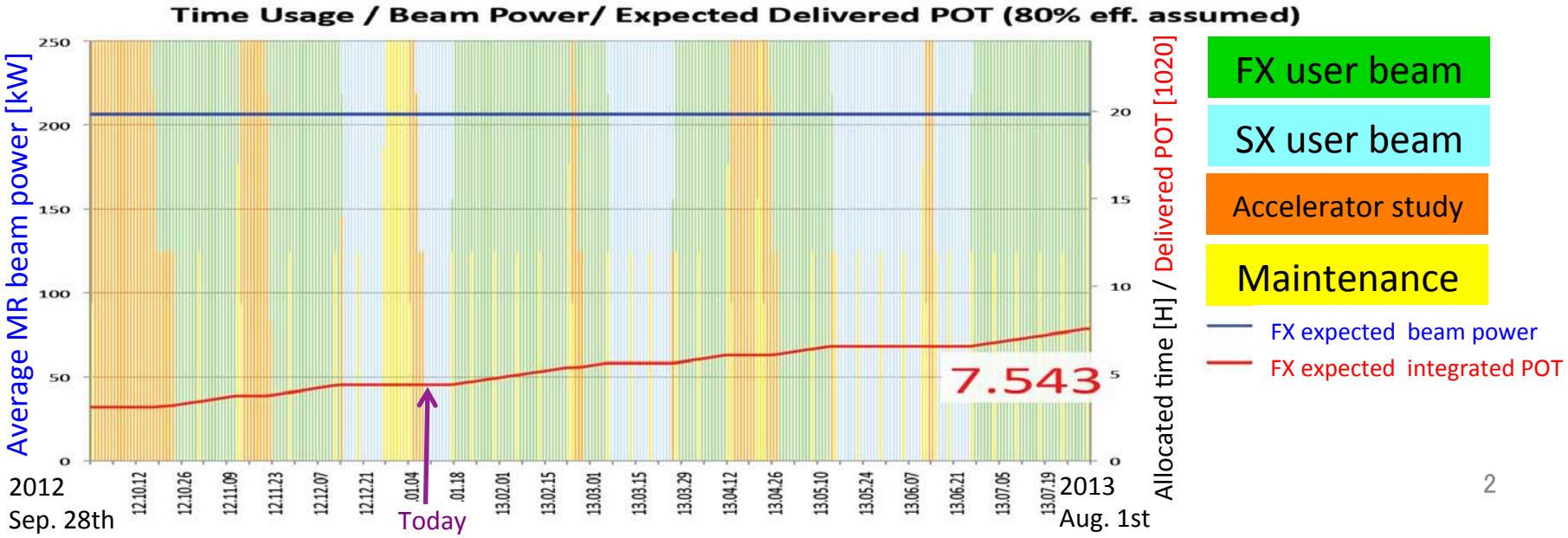
for

T2K collaboration

- Allocated beam time
- Data taking status
- Trouble happened in the neutrino beam line and the countermeasures
- Horn operation status
- Summary of running status

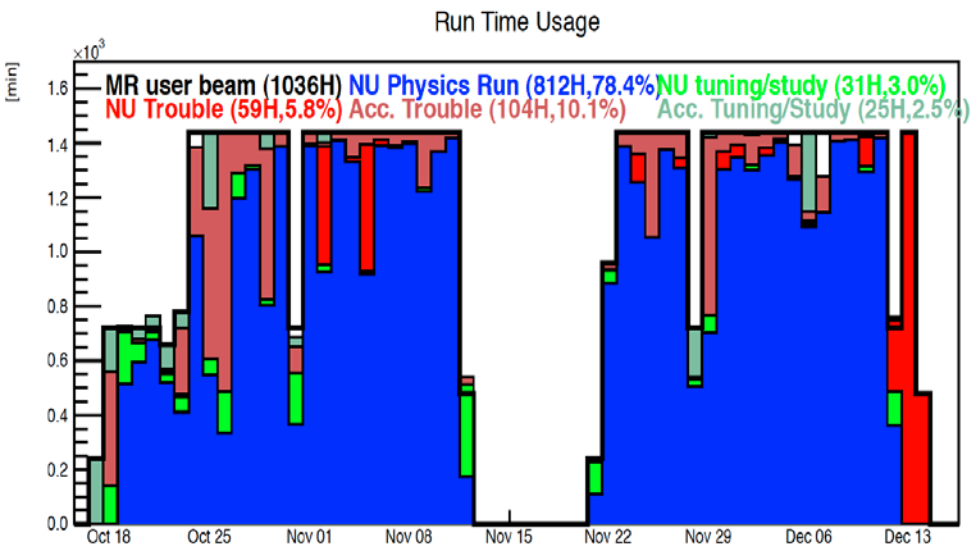
Beam time allocation to FX

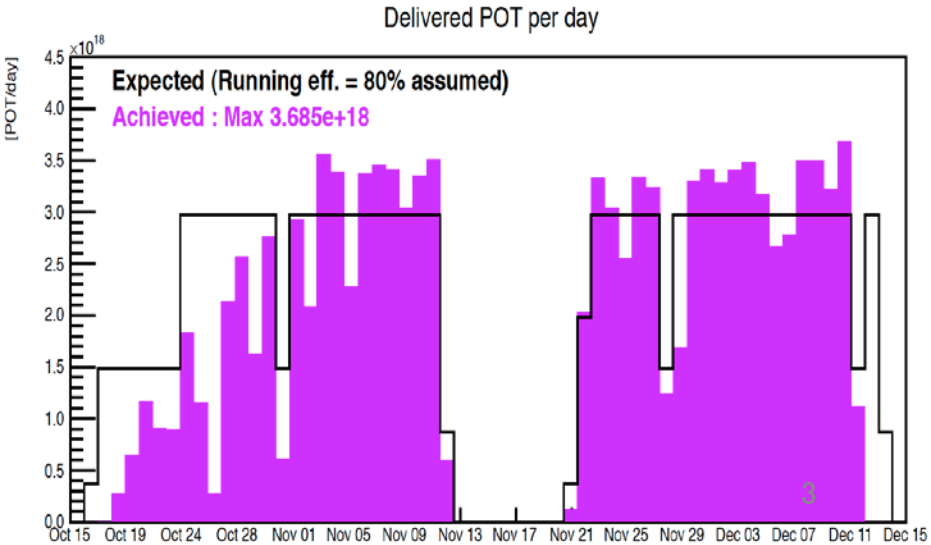
- Requested POT before LINAC upgrade @ previous PAC meeting
  - We requested to accumulate >8×10^{20} POT (increasing >5×10^{20})
    (Previous physics results is based on 3.01 × 10^{20} POT)
- Beam time allocation determined at JPNC.
  - FX user time: 3624Hours (151days) from Oct. 2012 ~ to Aug. 1st 2013.
    - 1036Hours (43 days) are already used.
      new data set: J-PARC Run #44 (Oct. 17th, 2012 ~ Nov. 12th, 2012),
      #45 (Nov. 21th,2012 ~ Dec. 14th, 2012)
- Expected delivered POT at Aug. 1st , 2013 is 7.54×10^{20} .
  - Assuming 206kW beam power with 80% running efficiency.



Running status of Oct. ~ Dec. 2012

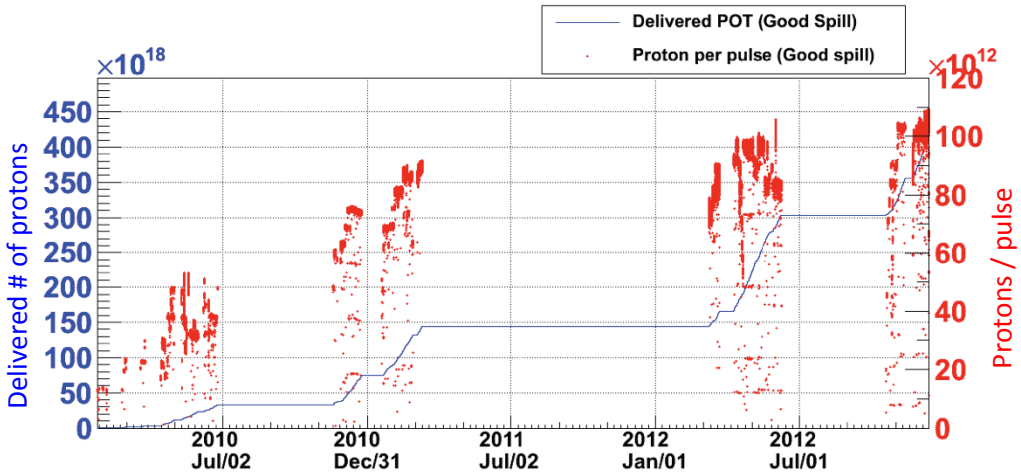
- Physics runtime fraction was 78.4 % = 812H / 1036H.
  - NU beam-line tuning (3.0%=31H)
  - NU trouble (5.8%=59Hours) … Vacuum leak due to beam hit, etc.
  - Accelerator trouble (10.1%=104H)
  - Additional accelerator study (2.5%=25H)
- At the beginning (Oct.), MR beam power was lower than the expectation due to "large beam loss @ MR", but it reached to 210kW in December.
  - 3.68×10^{18} POT/day is recorded.
- Total delivered POT at this moment is 4.19×10^{20}.
  - Increase in this period is 1.13×10^{20} POT (86.5% of expectation= 1.31×10^{20})





Data taking status

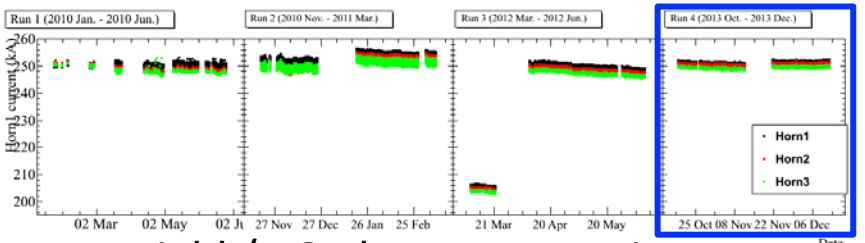
- Beam quality is kept as well as before the summer shutdown.
  - We are tuning the neutrino beam continually when the beam power is increased.



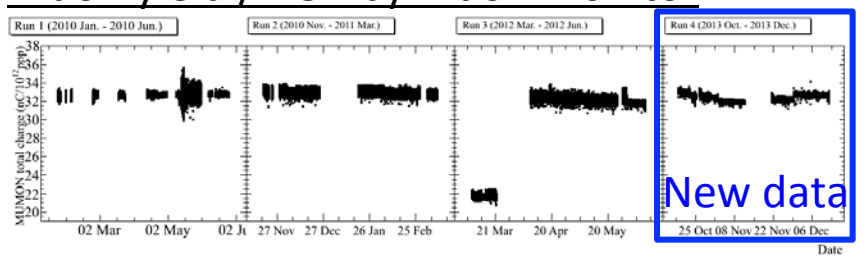
Total Integrated POT (physics run) = 4.148×10^{20}

Horn current

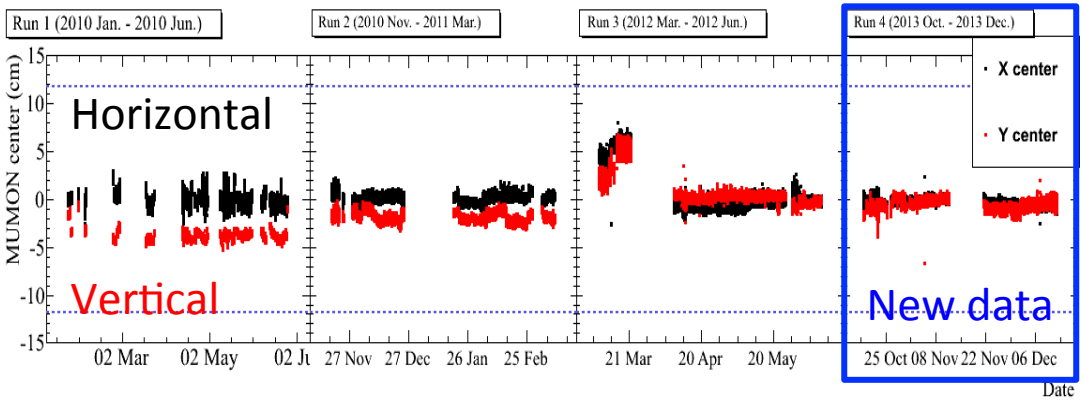
New data



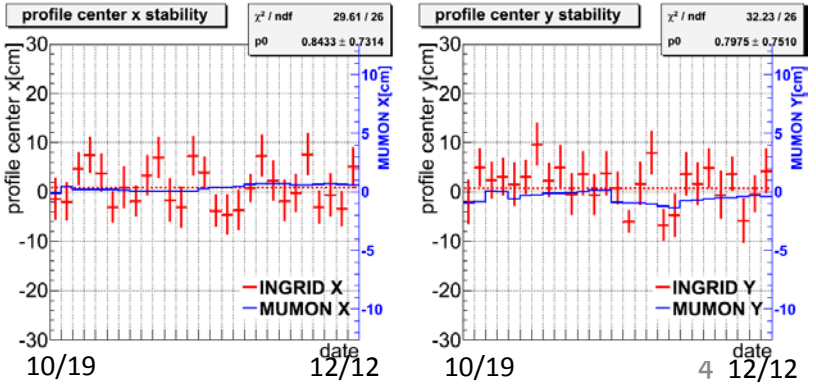
Muon yield / POT by muon monitor



Beam direction by muon monitor



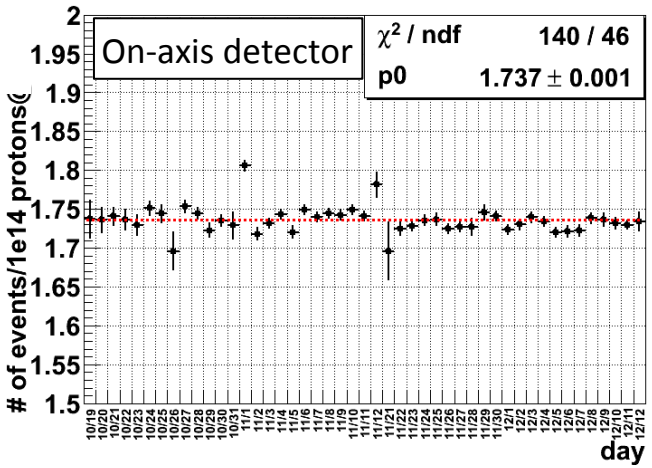
Beam direction of new data set by on-axis near detector

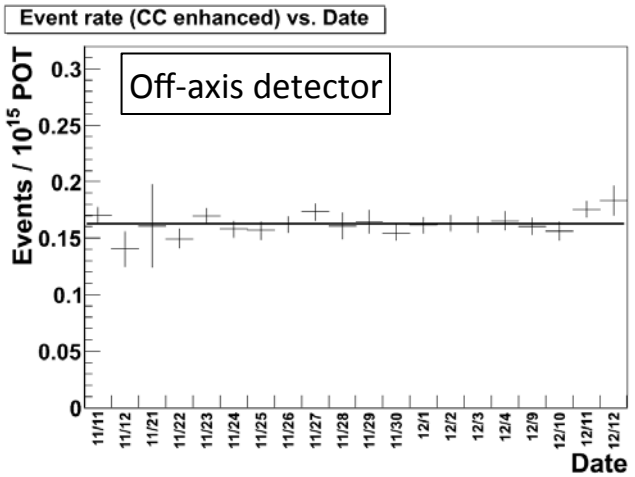


Data taking status

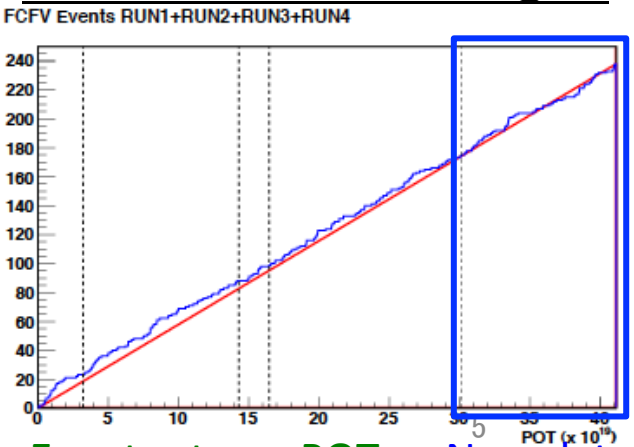
- Near detector and Far detector is running stably with good running efficiency.
  - Near detector (ND280) : 96.6%
  - Far detector (SK) : 99.2%

Event rate / POT for new data at near detectors



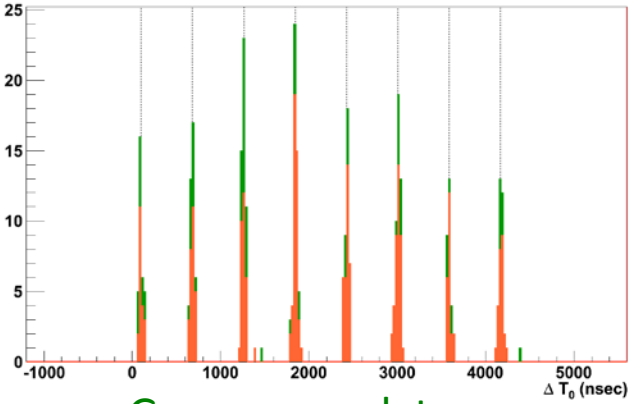


# of FCFV Events vs. POT @ SK



Event rate ∝ POT New data

Event timing @ SK



Green: new data

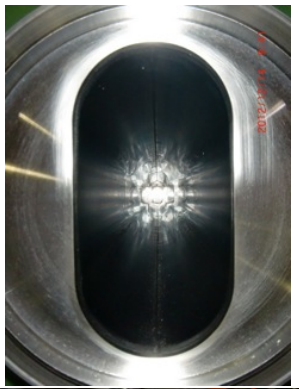
Troubles and Counter measure

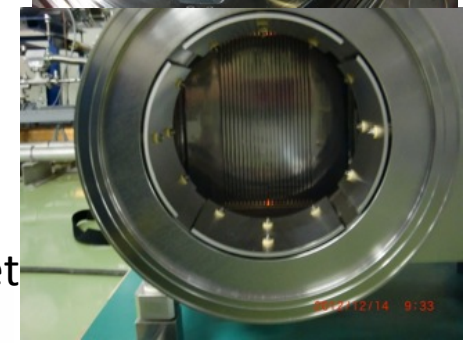
List of the troubles which stop the operation more than 4H (0.5shift)

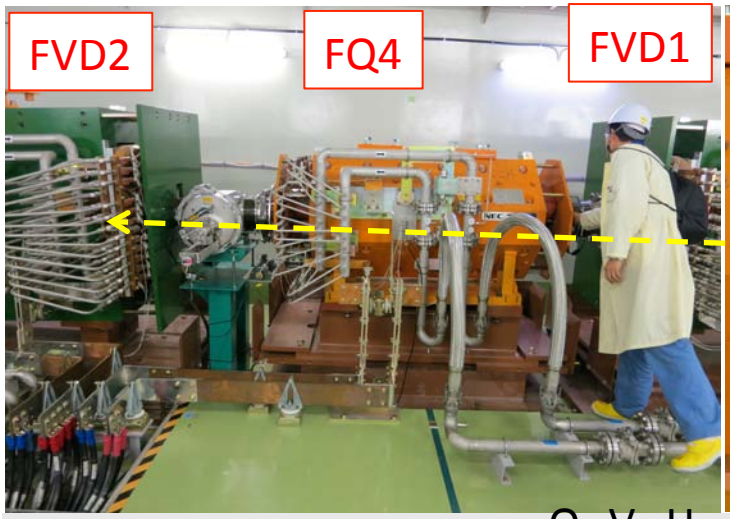
- Accelerator troubles
  - Initial troubles after summer shutdown (10/17: ~12H)
  - MR vacuum trouble @ SX septum (10/25: ~24H)
    - Beam power was limited another 1day.
  - RCS RF1 amp. trouble (10/29: ~9H)
  - MR RF8 Cooling water (11/29: ~8H)
- NU beam-line troubles
  - TS cooling water anomaly (11/2, 11/5 ~8H × 2 times)
    - Clogging up of the filters for oxygen reduction equipment
      → Fixing work is in progress during winter shutdown.
  - FF vacuum leak due to beam-hit (12/12: ~36H)
    - Detail is described in next page.

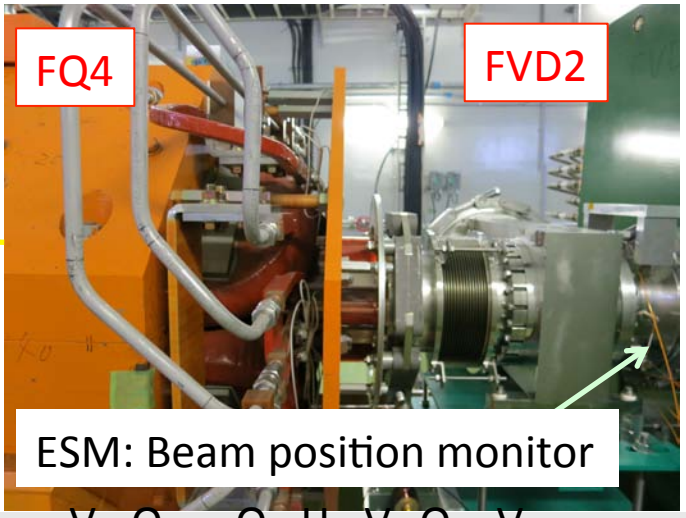
FF Vacuum leak trouble in 12/12

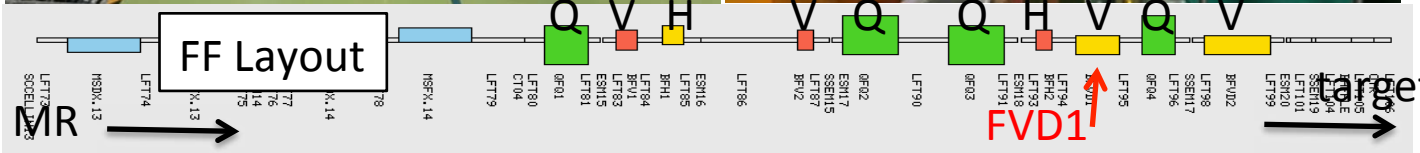
- Trouble happened during the beam tuning for beam power increase(210kW→217kW)
  - When the beam power changes, 4 Q-magnets and FF bending magnets should be adjusted to keep the targeting condition and beam direction towards SK.
  - Unexpected turning-off of 1 bending magnet (FVD1, 25mrad bend) without alarm was happened.
    → Beam hit the beam duct and beam monitors (SSEM: profile monitor, ESM: position monitor).
  - The vacuum leak was happened at ESM.
- Fixing work was done already.
  - Replacement of the broken ESM by spare.
    → Now pressure in beam duct is low enough for beam operation.
  - Visual inspection of other beam pipes and SSEM → No damage was found.
  - Check the functionarity of SSEM.
- Countermeasure to avoid same trouble
  - Improve the machine protection interlock (MPS) during the beam tuning.





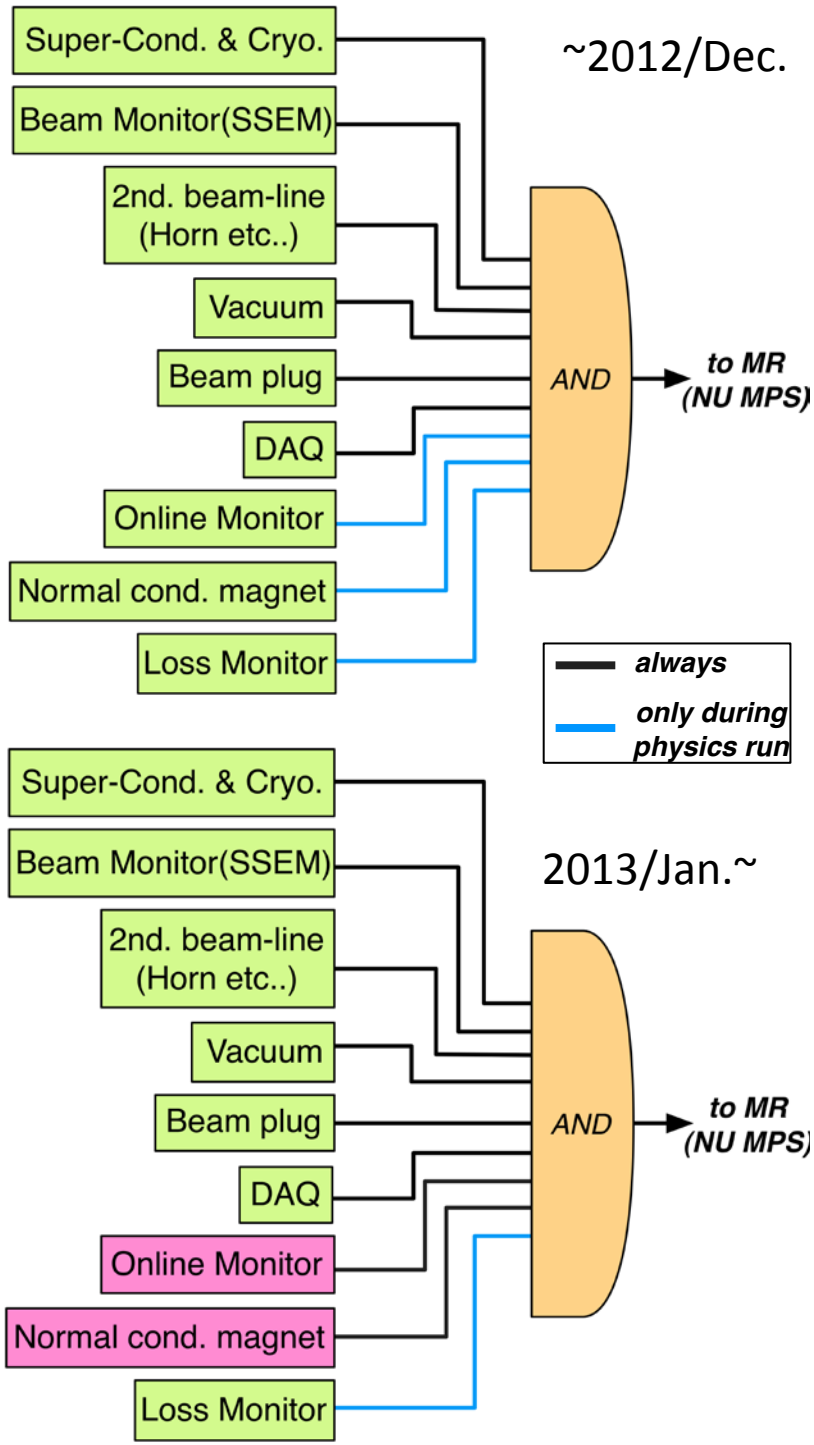






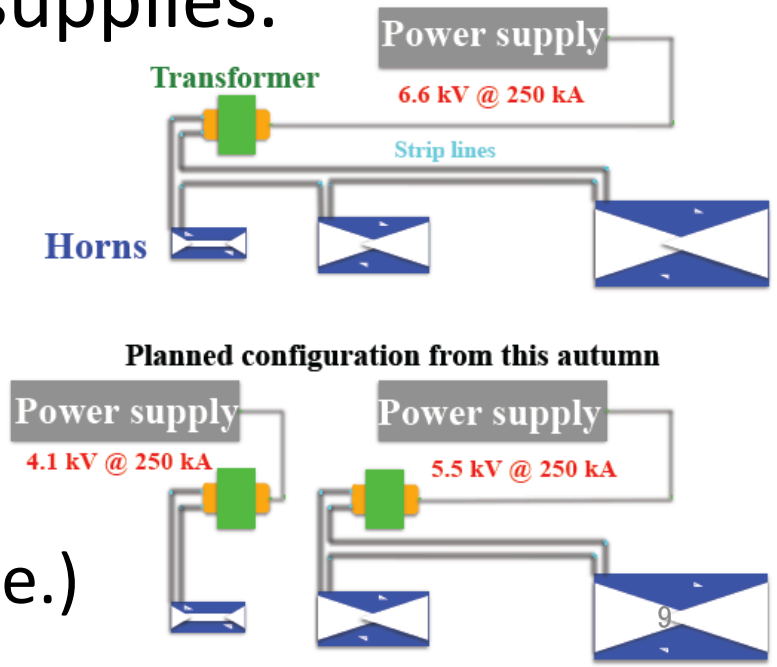
Neutrino MPS issues & improvement

- There are 2 interlock conditions
  - Physics run (continuous operation)
  - Beam tuning (Changing magnet current, using profile monitors)
- Until 2012/Dec., Some interlocks components are not included in "beam tuning" condition.
  - It was not a fail-safe
- Modification to make a fail-safe system from Jan. run.
  - Changing the interlock condition to include all the interlocks except for the beam loss monitor.
  - Adding redundant interlocks for the normal cond. magnet (require a range of absolute current for the bending magnets) in the both hardware and software (online monitor.)
- Further improvement in near future is under discussion.
  - Include the beam loss monitor to the interlock condition for beam tuning.
  - Reduce the excessive MPS in cooperation with the accelerator interlock system.
  - Implement the interlock condition which can be also used for the beam study with low intensity beam .



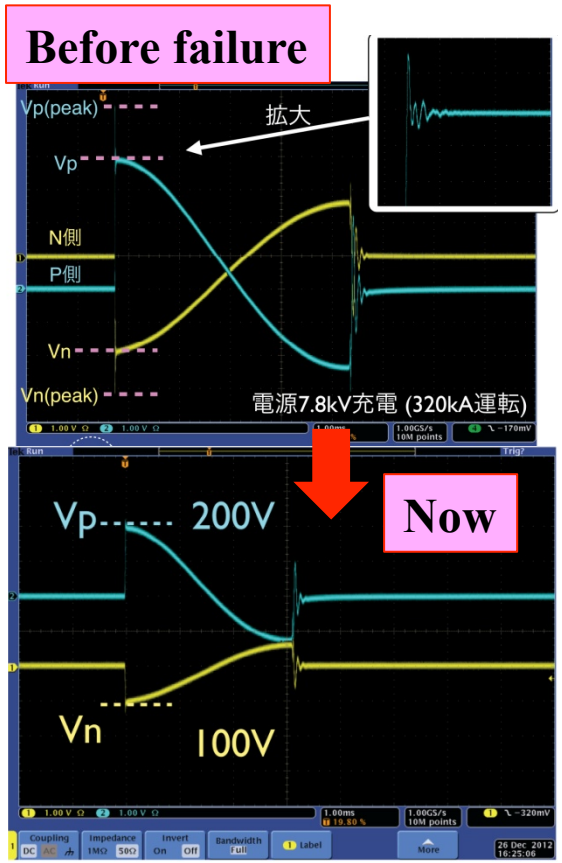
Status of horns (power supply)

- We met the trouble of “new Power Supply (PS)” in Dec. 2011, and used “old PS”.
- At previous PAC meeting, we reported the plan to repair “new PS” in summer 2012 and to operate horns with 2 power supplies.
  - The repair of “new PS” was not finished by Oct. 2012
  - We operated the horns with only old PS in Oct. ~ Dec. (Same condition as Dec. 2011 ~ 2012 June.)



New Power Supply Status

- New PS repair was finished in Dec. 2012 and test operation is in progress.
- 250kA test operation of horn1 using new PS is successfully done!
  - **The operation voltage is reduced as expected (6.2kV→4.0kV).**
    → This is the major countermeasure against the previous failure.
  - Other countermeasures are also installed.
    - RC filters and modified ground lines to suppress the spike voltages.
    - IGBT(*) gate monitor to identify fake trigger signal.
      * IGBT is a semiconductor switching device.
    - Rapid fuses to avoid large current flow to chargers.
- Now, we are testing the horn operation with 2 power supplies.
  - Checking the noise interference between new PS and old PS.
- We plan to use 2 PSs from next run if it is OK. (Jan. 2013~)



Summary so far

- We have requested >8×10^{20} POT before LINAC upgrade.
  - Allocated beam time is 151 days.
  - Expected POT is 7.5×10^{20} POT @ Aug. 1st 2013
    assuming 206kW beam power and 80% running efficiency.
- Data taking status from Oct. ~ Dec. 2012
  - FX user beam time in this period is 43 days
  - Delivered POT become 4.19×10^{20} POT at this moment.
  - Stable run with 210kW MR power is achieved in Dec.
  - Physics runtime fraction was 78.4%.
  - Near and Far detectors are working with high efficiency.
    And the neutrino beam quality is also well controlled.
  - We met the vacuum leak trouble at the end of Dec. run.
    - Vacuum leak is already fixed. The improvement of the interlock to avoid the same trouble was done.
  - The horn power supply recovery is in progress during winter beam-off.
    We plan to operate horns with two Power supply from next run.
- Neutrino beam-line is ready for the beam operation from Jan. 17th as scheduled. We need to run until the end of July 2013 to reach the requested POT.