PAC09 Vancouver

Beam commissioning of the J-PARC Main RING

H. Kobayashi for the J-PARC MR group

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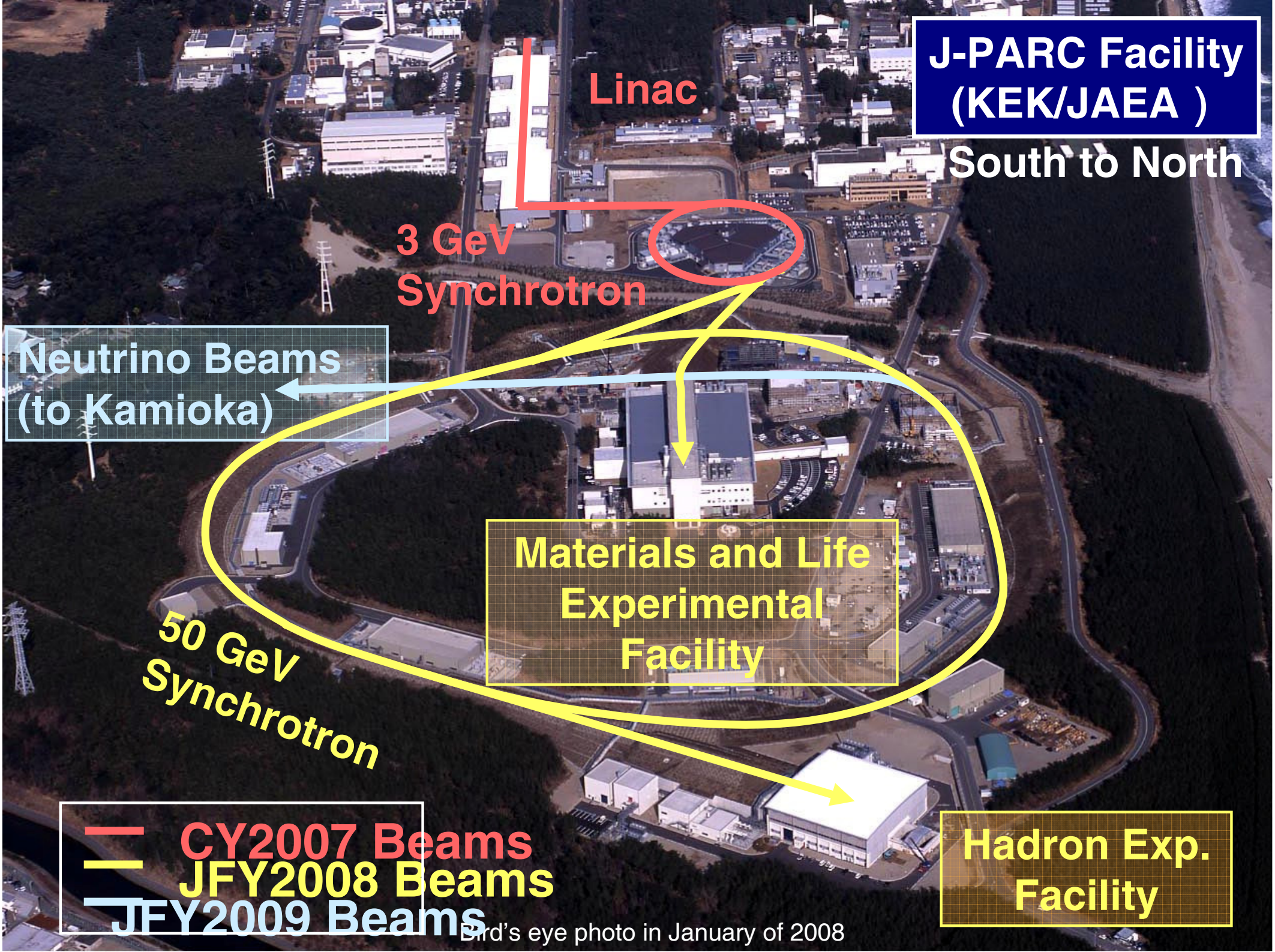
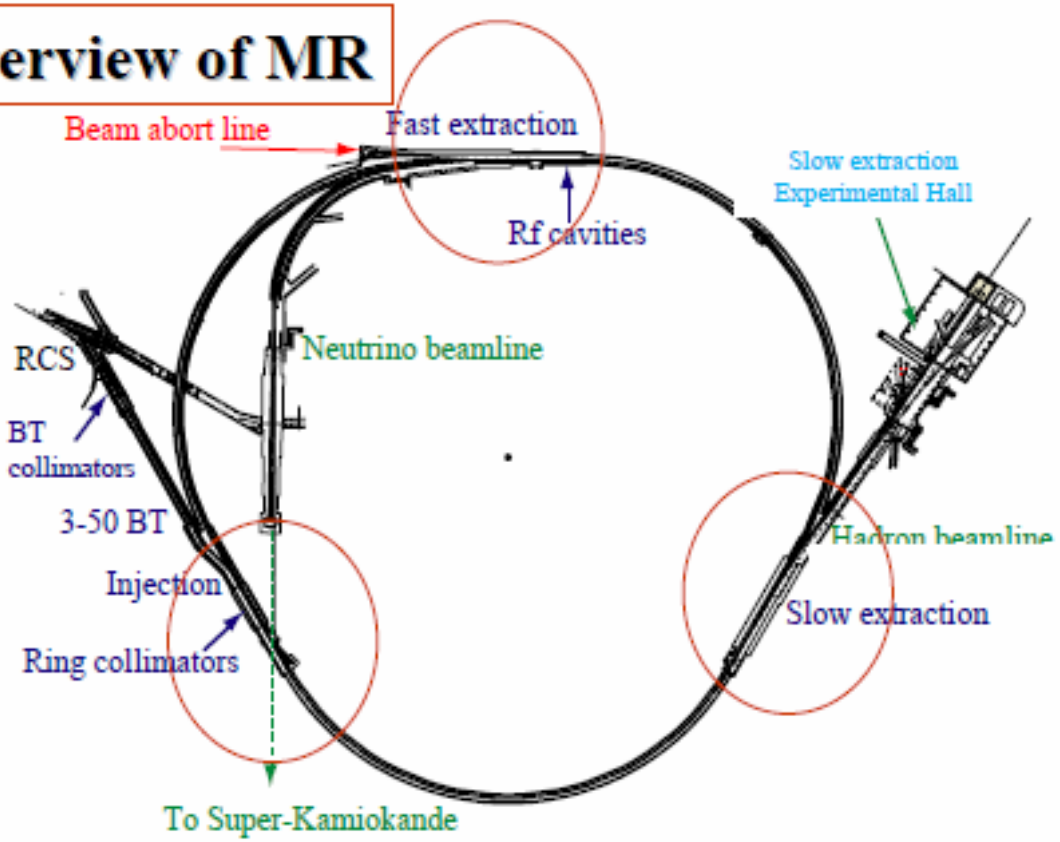
- Introduction
- Cable re-configuration
- Results of the first stage
- Toward high power acceleration


J-PARC Facility
(KEK/JAEA)
South to North
Linac
3 GeV
Synchrotron
Neutrino Beams
(to Kamioka)
Materials and Life
Experimental
Facility
50 GeV
Synchrotron
Hadron Exp.
Facility
CY2007 Beams
JFY2008 Beams
JFY2009 Beams
Bird's eye photo in January of 2008

Overview of MR

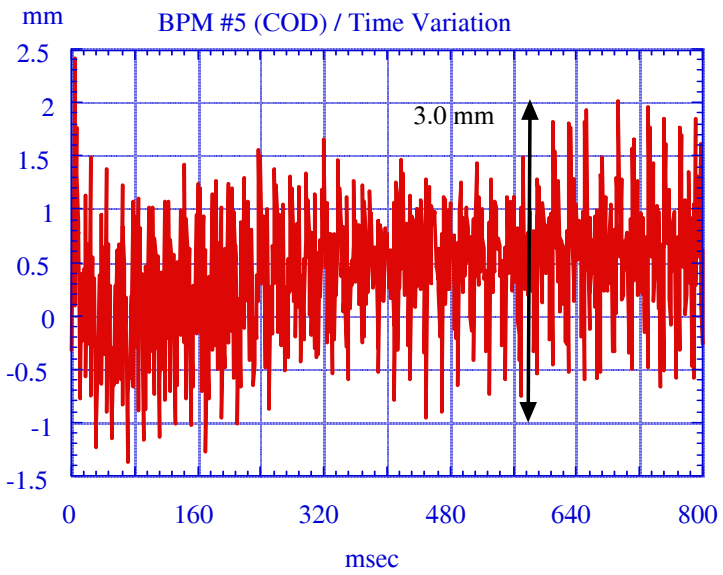
Main parameters:	
Circumference	1567.5 m
Repetition rate	0.17 Hz (Start up)
	0.28 Hz (Design)
	0.5Hz (Ultimate goal)
Injection energy	3 GeV
Extraction energy	30 GeV
Superperiodicity	3
Harmonic number	9
No. of bunches	8 (6 in day-1)
Transition γ	31.7(imaginary)
Typical tune	22.4, 20.8
Transverse emittance	
At injection	~54 πmm-mrad
At extraction	~10 πmm-mrad
Beam power	0.75MW



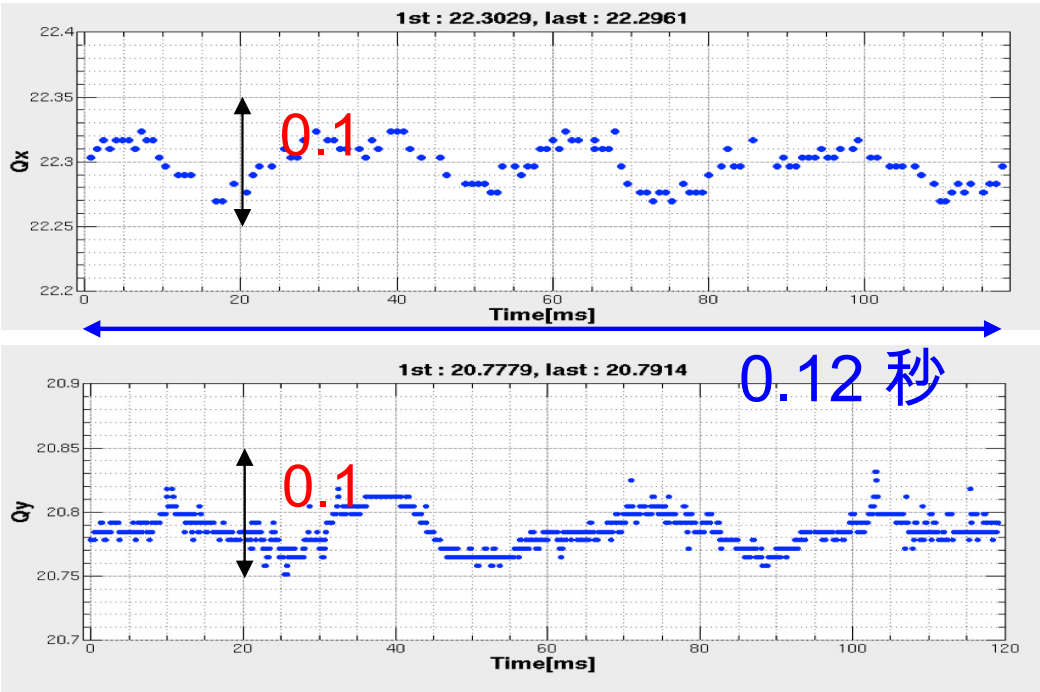
Three dispersion free straight sections of 116-m long:

- Injection and collimator systems
- Fast extraction (beam is extracted inside/outside of the ring) and RF cavities
  - inside: Neutrino Beam line (intense ν beam to SK located 295 km west)
  - outside: Beam abort line (when hardware failure occurs)
- Slow extraction
  - to Slow extraction Experimental Hall (K Rare decay, hyper nucleus..)

Big issue found during May, June 2008 beam commissioning

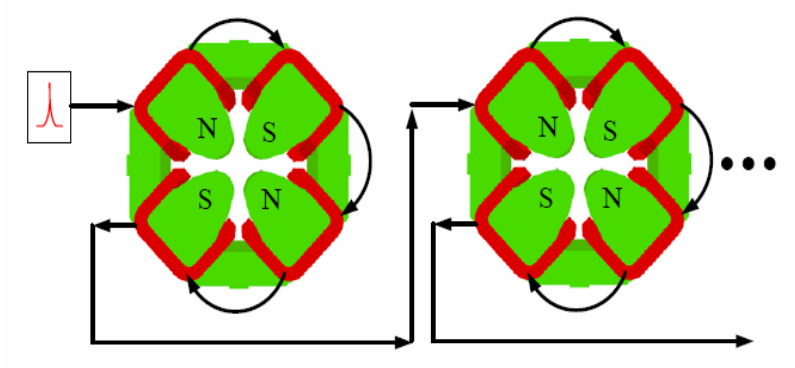


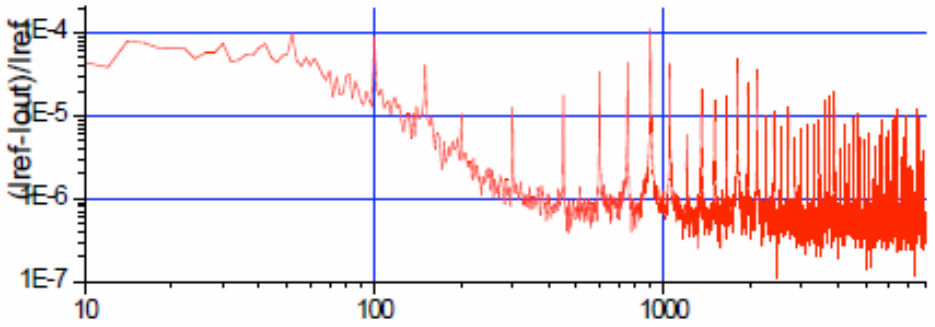
Orbit fluctuation due to B-mag. Power supply.



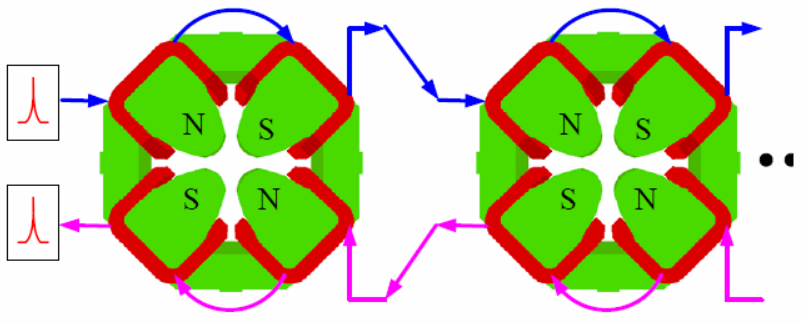
Tune fluctuation due to Q-mag power supply

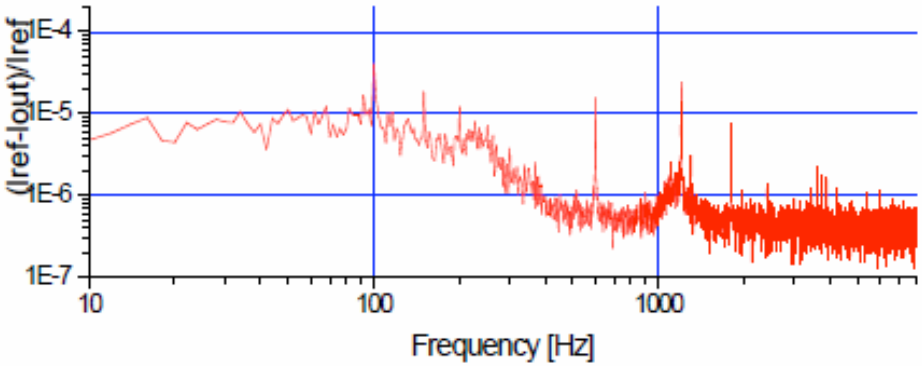
Difference between two networks





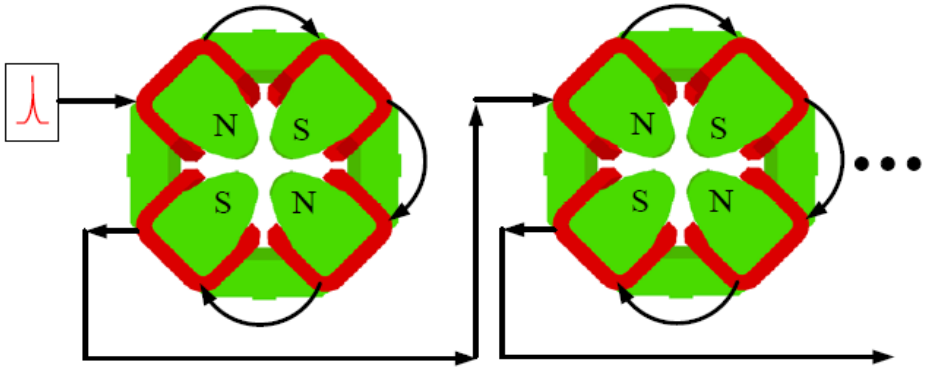
Original connection

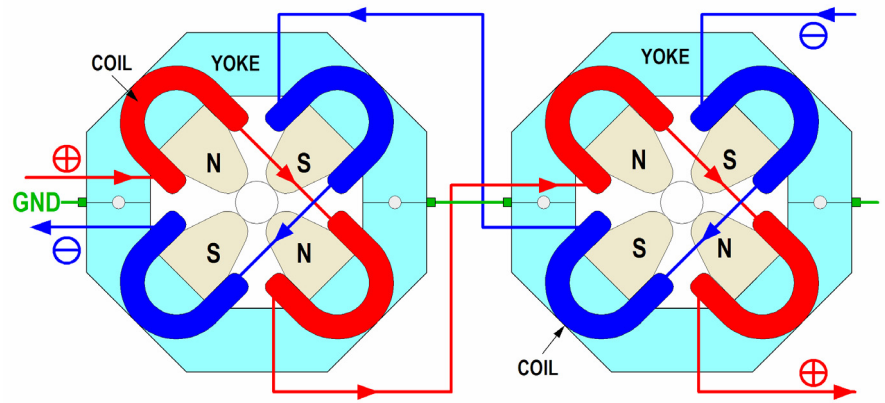


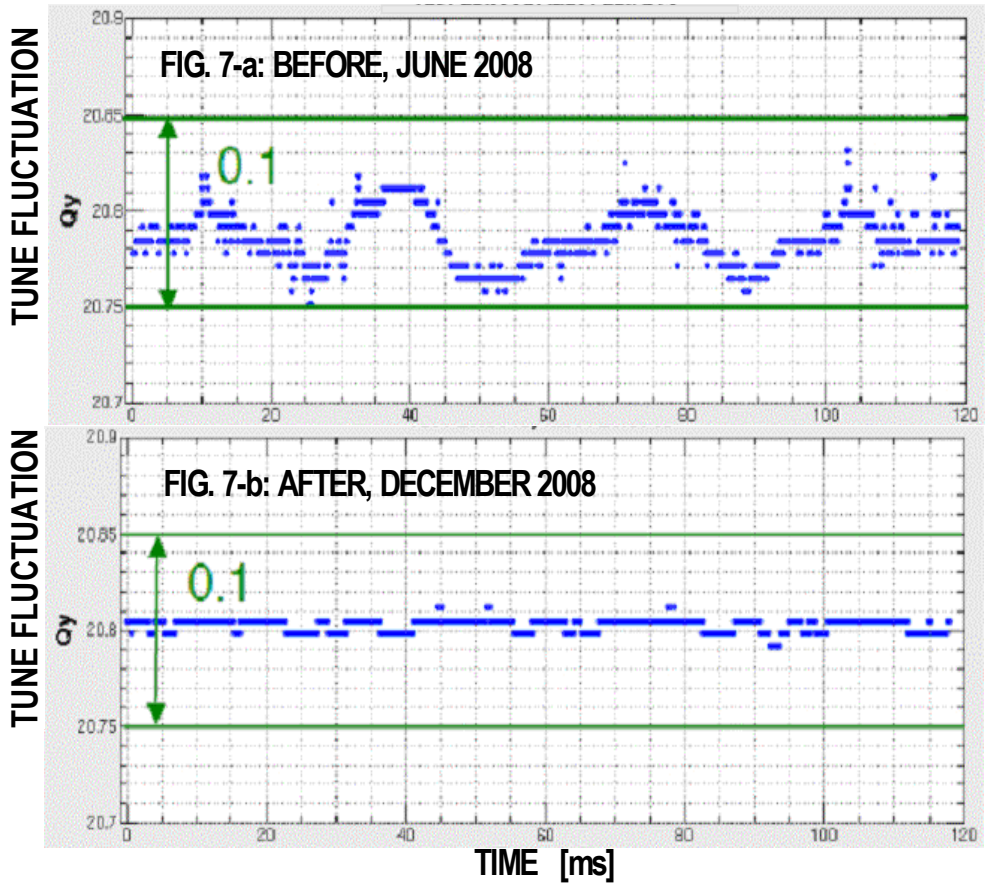


Symmetrical connection

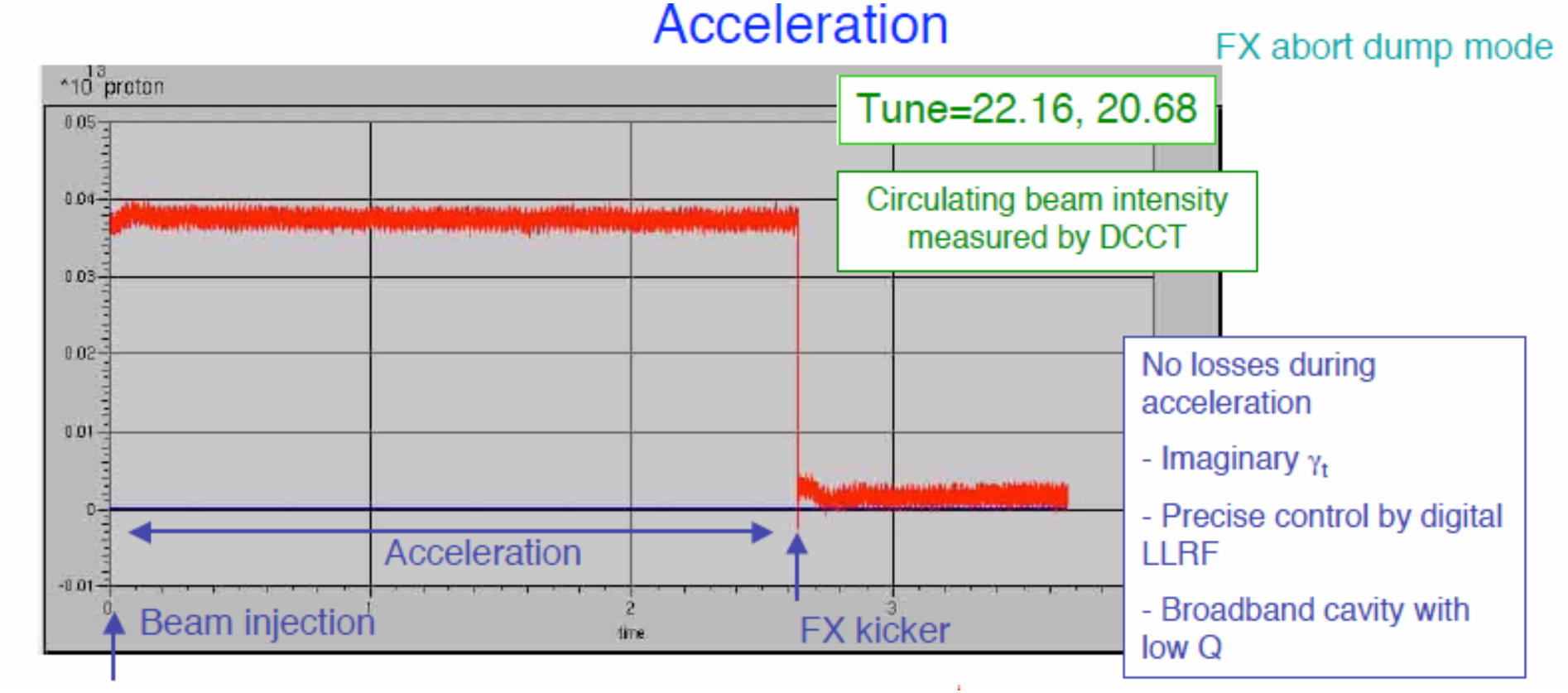
Cabling Network improvements







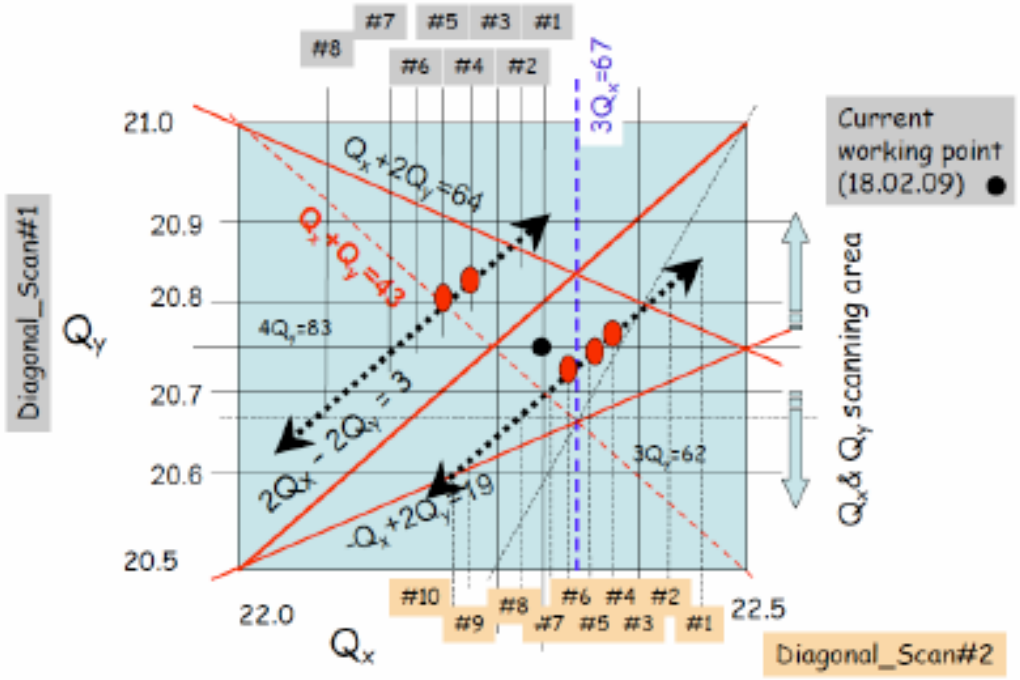
First beam acceleration 23rd Dec. 2008



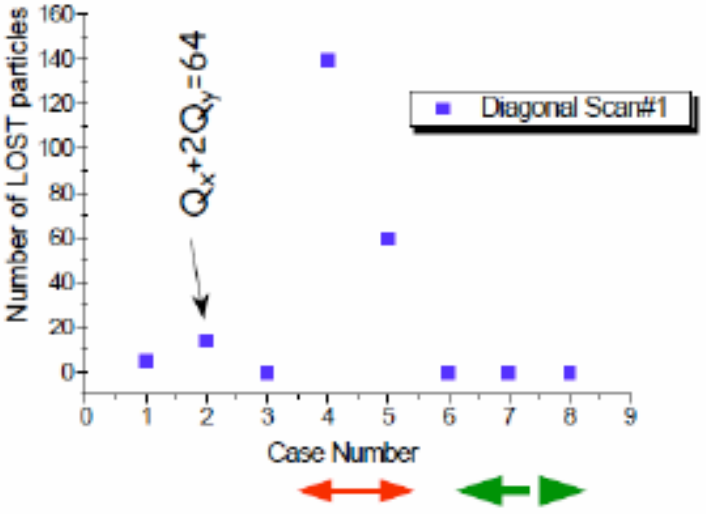
Tune survey

-Simulation for 1.8 kW/bunch-

A. Molodozhentsev

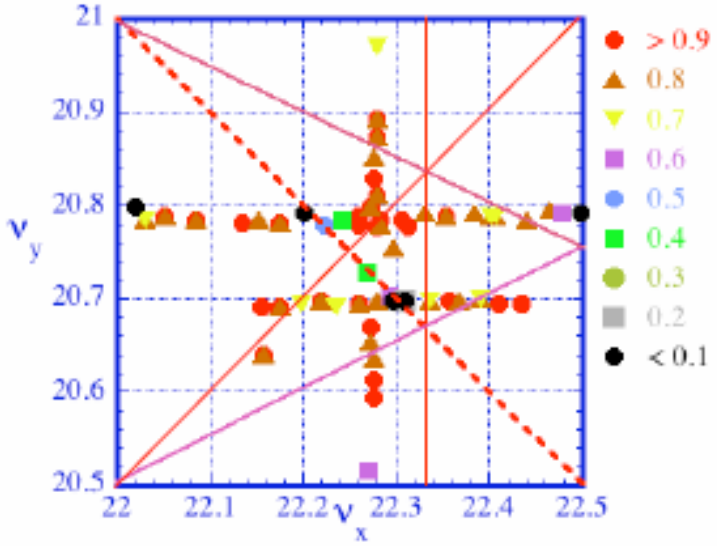


#1: Q_x=22.30 / Q_y=20.90
#2: Qx=22.275 / Qy=20.875
#3: Qx=22.25 / Qy=20.85
#4: Qx=22.225 / Qy=20.825
#5: Qx=22.21 / Qy=20.81
#6: Qx=22.175 / Qy=20.775
#7: Qx=22.15 / Qy=20.75
#8: Qx=22.10 / Qy=20.70



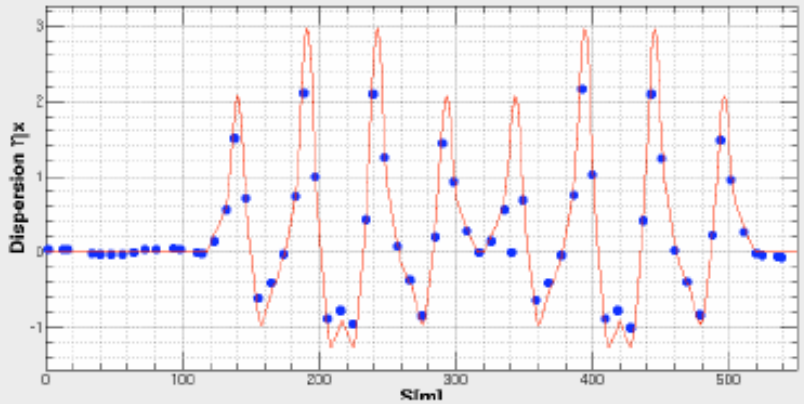
Q_x+Q_y=43

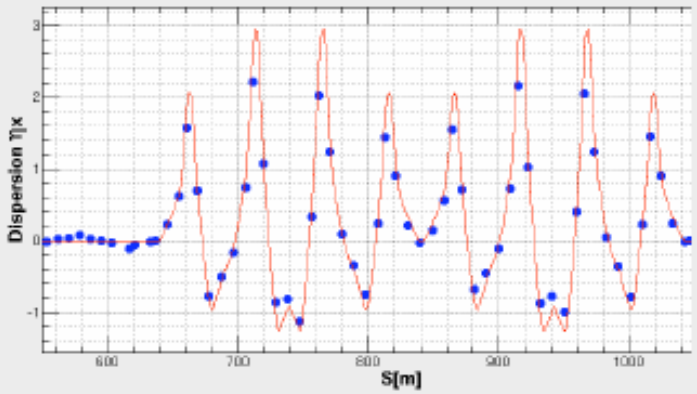
Safe area

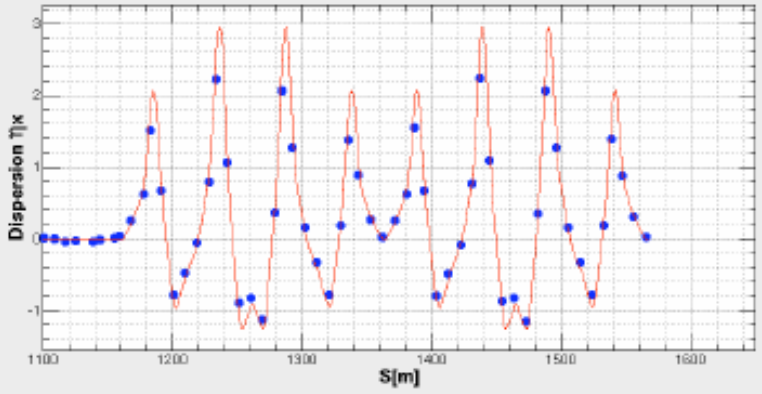


Measurement of dispersion function at 3 GeV

The dp/p dependence of the closed orbit is measured by changing rf frequency.





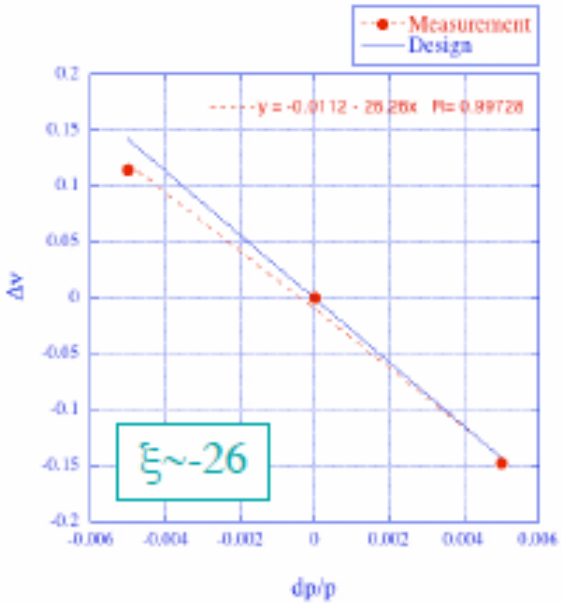


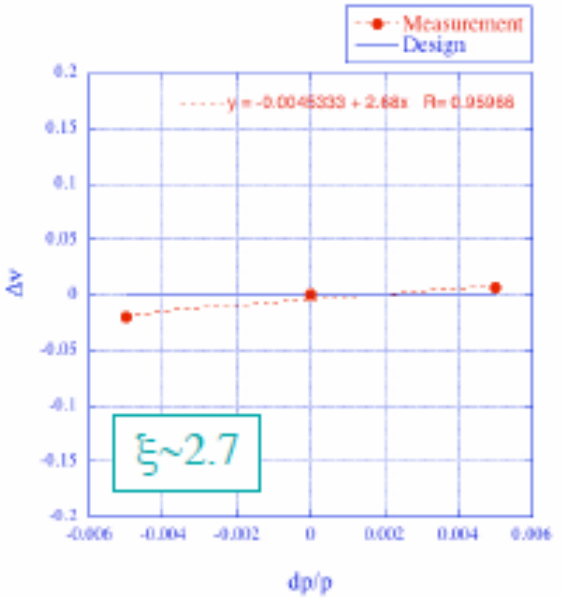
Measured results agree well with design.

Chromaticity measurement and correction at 3 GeV

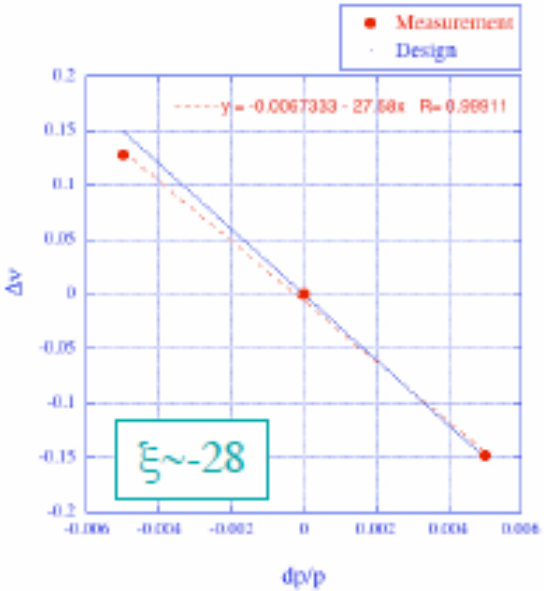
Chromaticity is measured by changing rf freqeency adiabatically.

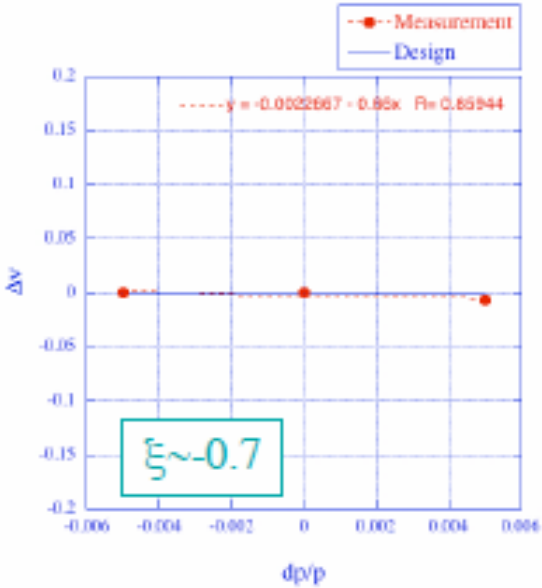
Horizontal





Vertical

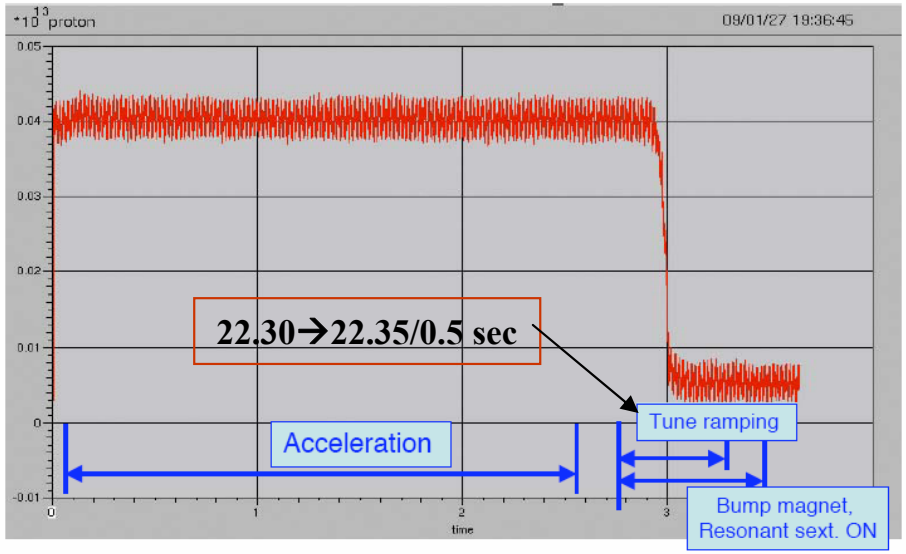




- Measured ξ agrees with design and ξ is corrected well by the sextupole strengths estimated from design optics.

Slow extraction operation

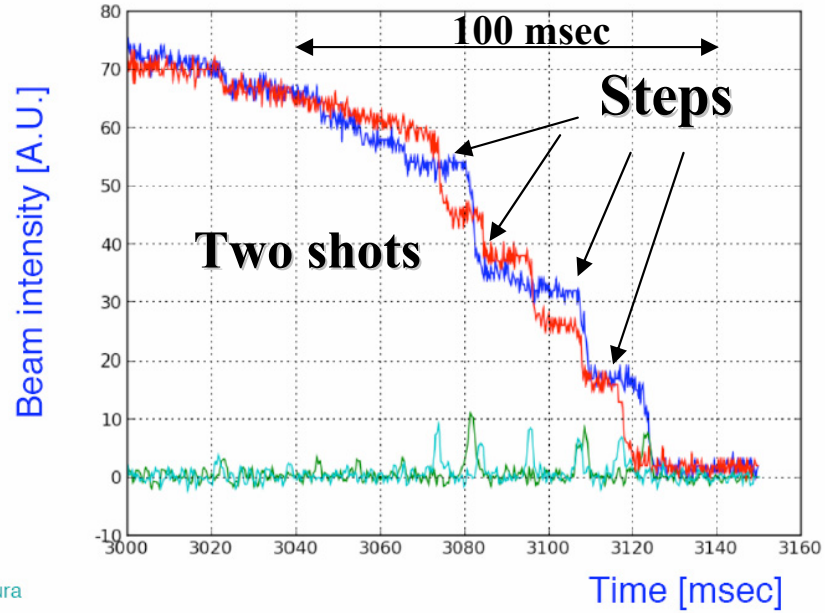
Slow extraction: Bump magnets ON
Resonant sextupoles ON
Tune ramp pattern for QFN: (22.30, 20.78) -> (22.35, 20.78)



Slow extraction tuning and beam loss

It's a "Ripple extraction" using SX system
We need;
→further improvement of magnet power supply
→installation of feedback system

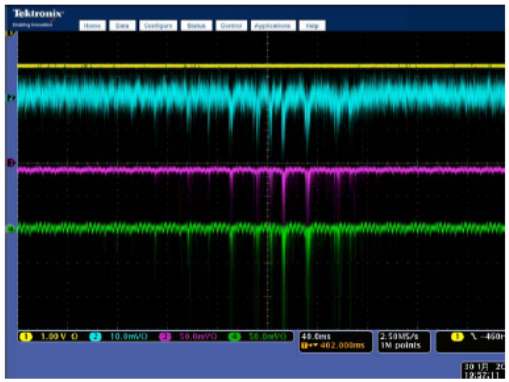
Beam intensity during extraction



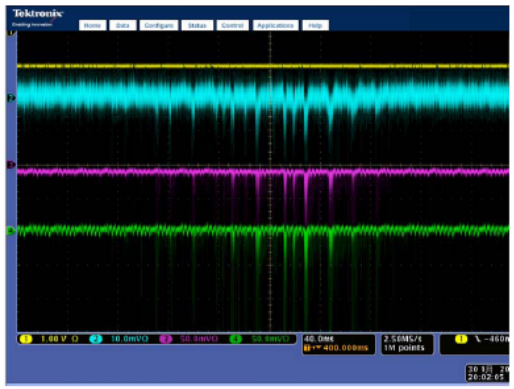
F. Tamura

Spill measurement in HD beamline

RF off, ξ~0

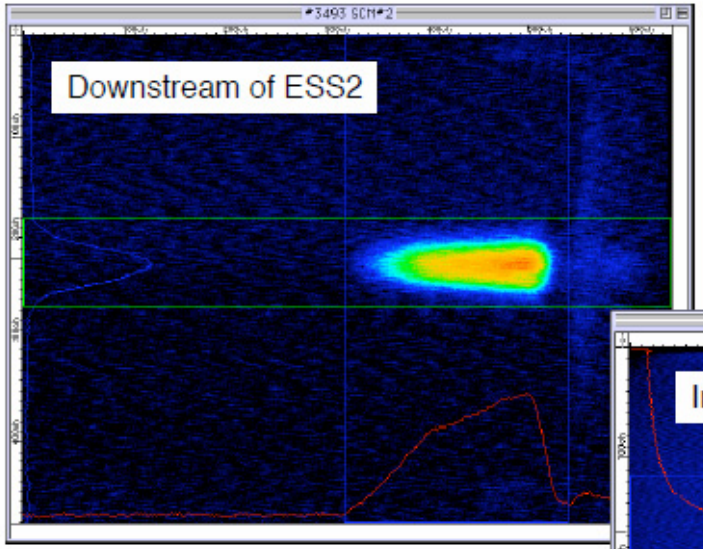


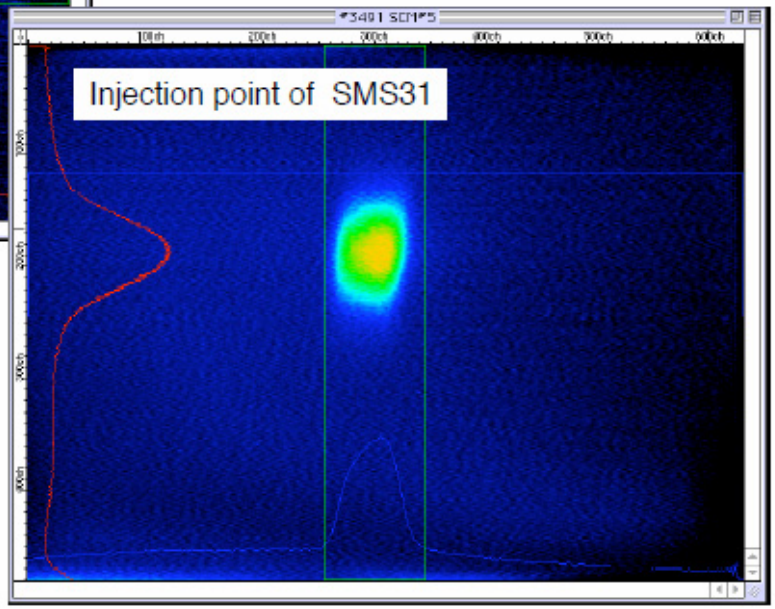
RF off, ξ~-2



Slow Extraction (beam profile)

Extraction beam position and profile

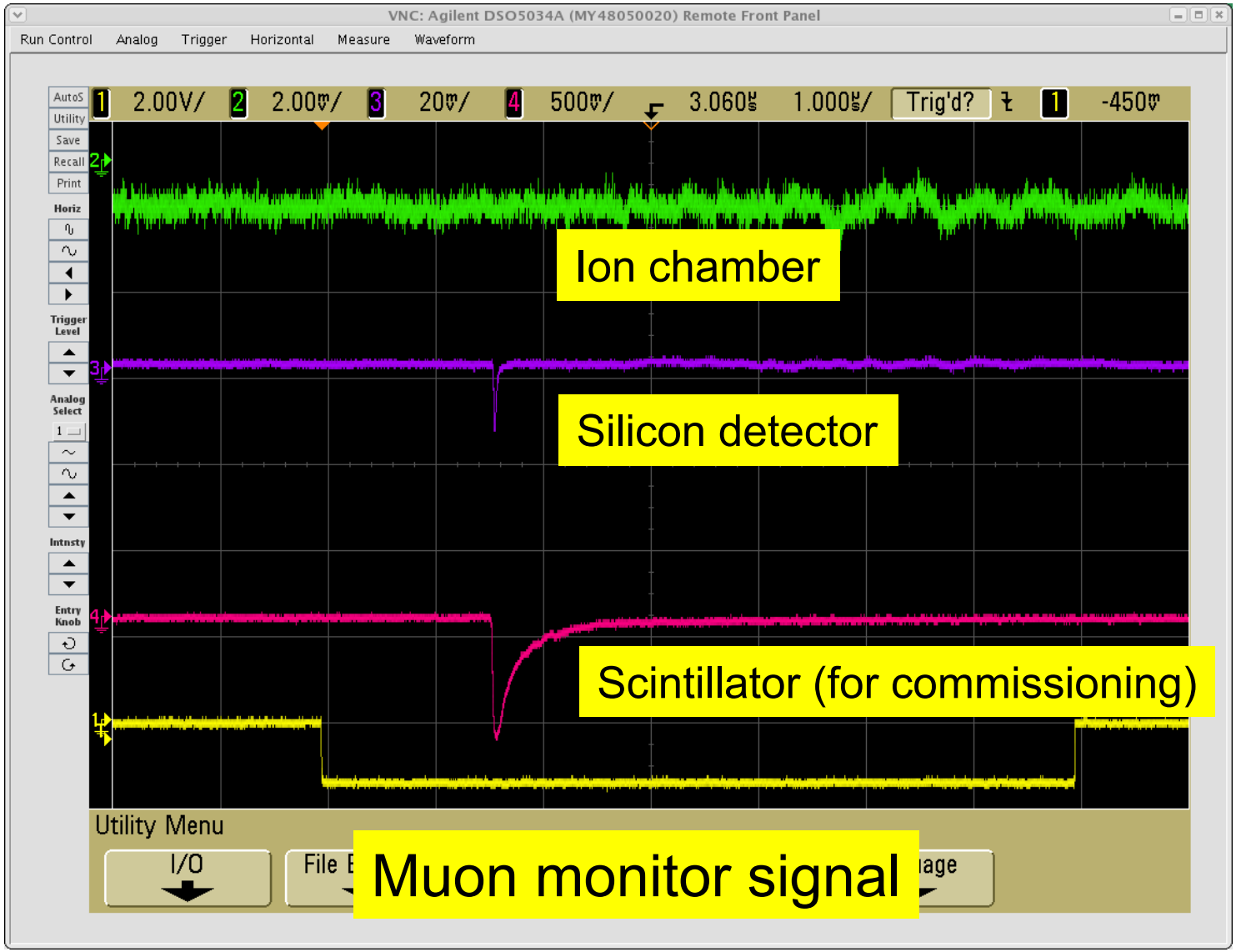




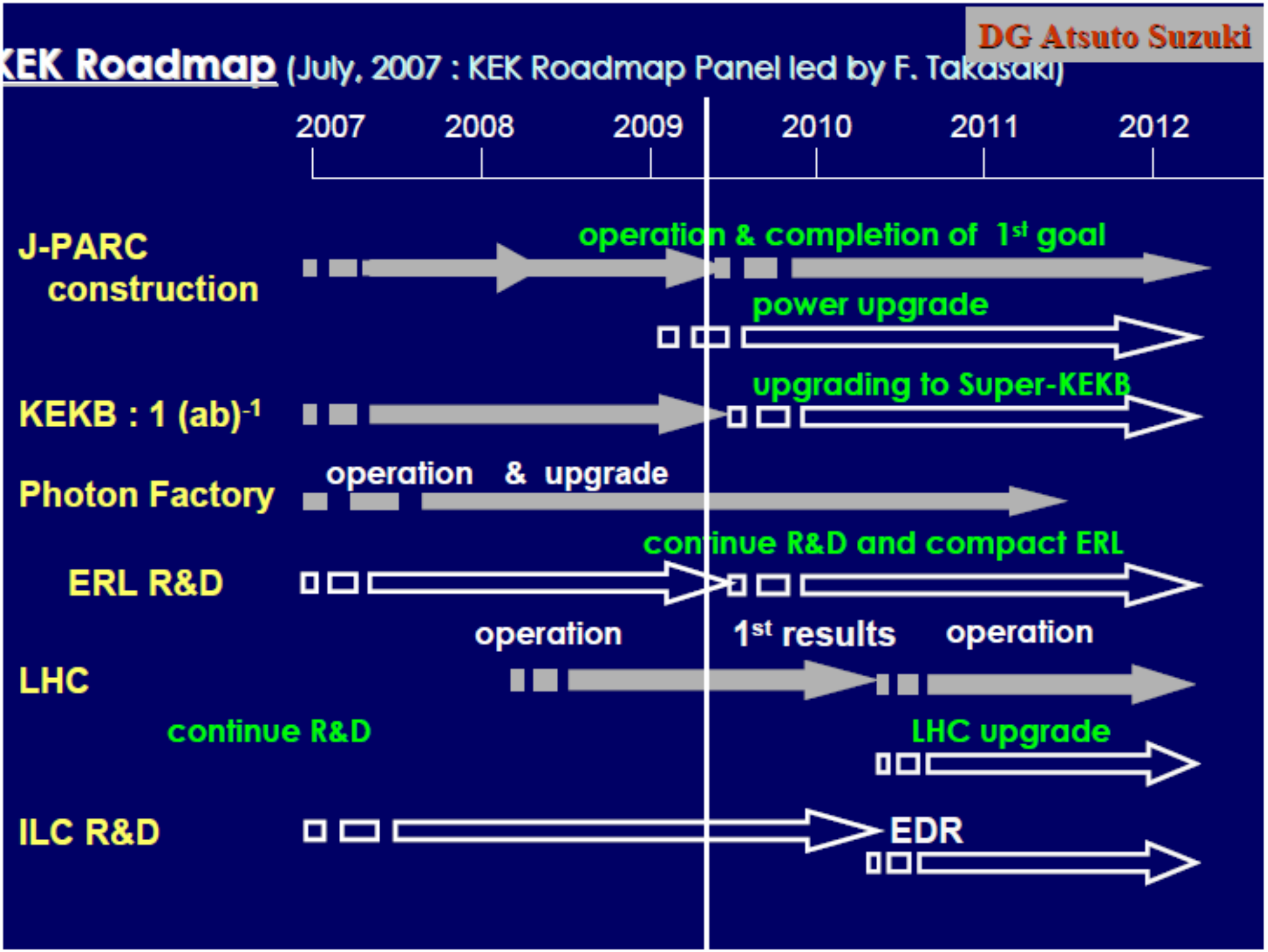
SCM	Design [mm]	Measurement [mm]
Inj. SMS1	41	44.2
Inj. SMS2	66	63.3
Inj. SMS31	90	86

T2K beamline started operation!

First shot after turning on SC magnets at 19:09, Apr.23, 2009



First observation of muons produced in neutrino beamline


DG Atsuto Suzuki
KEK Roadmap (July, 2007 : KEK Roadmap Panel led by F. Takasaki)
2007
2008
2009
2010
2011
2012
J-PARC construction
operation & completion of 1st goal
power upgrade
KEKB : 1 (ab)-1
upgrading to Super-KEKB
Photon Factory
operation & upgrade
ERL R&D
continue R&D and compact ERL
operation
1st results
operation
LHC
continue R&D
LHC upgrade
ILC R&D
EDR

Summary

Neutrino

1. **Early achievement of 100kW run (for 10^7 sec, in 2010)**
2. **Create strong team to consider and work for the power upgrade scenario from 100 to 750kW.**
3. **The above second step should be the base of the MW-class power frontier machine.**

Hadron

1. **Early realization of spill control by;**
    1. **improving magnet power supplies, and**
    2. **applying feedback system.**
2. **Early achievement of 10kW-class power by;**
    1. **understanding and suppressing and/or localizing the beam loss.**
3. **In order to realize 100kW-class slow beam extraction, we have to develop;**
    1. **excellent extraction efficiency,**
    2. **more beam loss control, and**
    3. **radiation maintenance technology.**