ATF2

ILC Final Focus Test Beam Line at KEK-ATF

T. Tauchi, IN2P3-KEK collaboration meeting on ATF2, Annecy, 15-17 October 2007

References :

ATF2 Proposal, KEK Report 2005-2

ATF2 Proposal Vol.2, KEK Report 2005-9

Home page : http://atf.kek.jp/collab/ap/projects/ATF2/index.php

ATF2 Final Goal

Ensure collisions between nanometer beams; i.e. luminosity for ILC experiment

Reduction of Risk at ILC

Optics and bean tuning
Stabilization

FACILITY construction, first result	ATF2/KEK; 1.3GeV 2005-07-08?	FFTB/SLAC; 47GeV 1991-93-94
Optics	Local chromaticity correction scheme; very short and longer L* (β^*_y=100μm, L_{FF}=30m)	Conventional (separate) scheme; non-local and dedicated CCS at upstream; high symmetry in x, y ; i.e. orthogonal tuning (β^*_y=100μm, L_{FF}=185m)
Design beam size	2.3μm / 34nm, aspect=82 ($\gamma\varepsilon_y$=3 x 10^{-8} m)	1.92μm /52nm, aspect=37 ($\gamma\varepsilon_y$=2 x 10^{-6} m)
Achieved	?	70nm (beam jitter remains !)

Mode-I

A. Achievement of 34nm beam size

A1) Demonstration of a new compact final focus system; proposed by P.Raimondi and A.Seryi in 2000,

A2) Maintenance of the small beam size (several hours at the FFTB/SLAC)

Mode-II

B. Control of the beam position

B1) Demonstration of beam orbit stabilization with nano-meter precision at IP. (The beam jitter at FFTB/SLAC was about 40nm.)

B2) Establishment of beam jitter controlling technique at nano-meter level with ILC-like beam (2008 -?)

Requirements

Mode	ATF-EXT	ATF2
I	Jitter < 30% of σ_y $\gamma\varepsilon_y$=(4.5 → 3)x10^{-8}m	BSM (laser in higher mode) BPMs with 100nm res. at Qs Power supplies of < 10^{-5} Rigid support of Final Q ,BSM
II	Jitter < 5% of σ_y (2nm jitter at FP)	BPM with < 2nm res. at FP Intra-bunch feedback for ILC style beam

Future prospects

ILC beam; 30(60) bunches s_b=300(150)nsec

- Fast extraction kicker R&D in 2007-
- intra-pulse feedback (FONT, Oxford university)

Final focus Q magnet test ; 2012 - 2014

- super conductiong magnet (BNL)
- permanent magnet (Kyoto university)

Optional Photon facility ; 2016 - 2019

- laser and optical cavities for photon linear collider
- generation of photon beam

"Strong QED" experiments ; LEI2007, Hiroshima

- Non-linear QED with Laser intensity of > 10^{19} W/cm^2

Schedule of Installation (Tentative)

Japanese Fiscal year					JFY2007												JFY2008											
		2007												2008												2009		
Activity	12	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
ATF Beam operation																							ATF2 Commissionin					
Reconfiguration of extraction line		preparatior					partial recons												New ext. line									
Conventional Facilities																												
detailed floor planning					bid						New floor constructed																	
re-location/ site preparation		X-band, Crab																										
floor refurbishment							Floor																					
construction of extended area											side wall and roof																	
utilities; water, AC power													cable, pipe															
construction at ATF-EXT		clean-u		partial constrruction															reconfiguratio									
laser huts for BSM and LW													BSM				LW											
Installation																												
beam dump																DMP												
magnets & supports & vacuum pipes								magne					magne							magnets								
cooling pipes													cooling															
cable tray installation											c. tray										c.tray							
large DC cable installation												power cables									p.cable							
small cable installation														cables							cables							
power supply system															PS													
new stable FD system															FD?			FD?										
Shintake monitor with IPBPM															ship			BSM										
Laser wire															light path				1 LW , detector									
wire scanners, screen mon. etc.															wire scanners, screen monit													

We will discuss
in this afternoon

Magnet Installation

R.Sugahara, 23 May 2007

Magnet installation schedule in 2007 (outside of ATF ring)

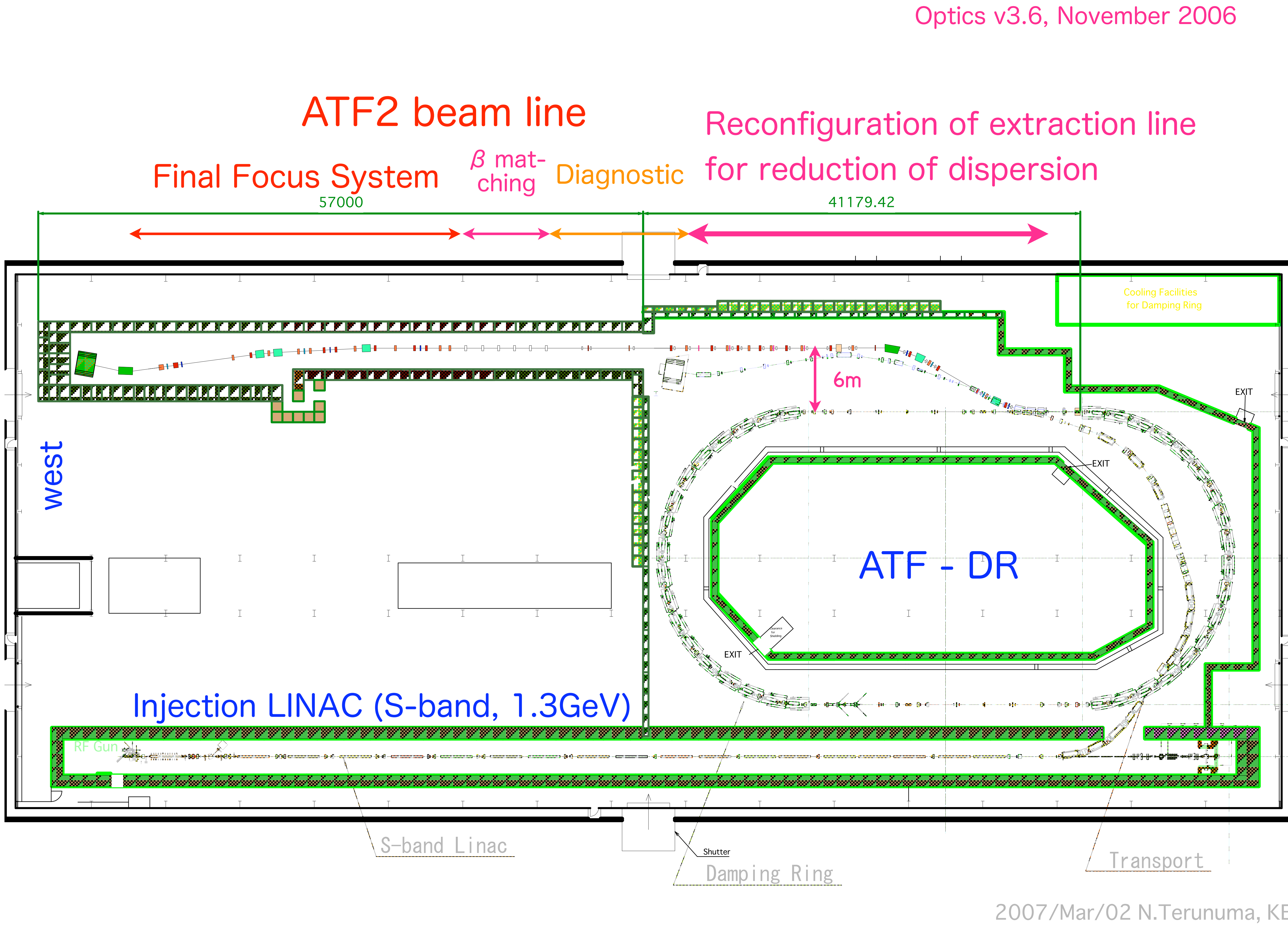
R.S. May 23, 2

1 October 2007

2007	August	September					October				November	
	20/26	27/2	3/9	10/16	17/23	24/30	1/7	8/14	15/21	22/28	29/4	5/11
Install & survey beam line markers												
Concrete shields installation								9	16			
Draw beam line & mark mag. position												
Install concrete blocks												
Install movers, stands, magnets												
First alignment												
	For 4 magnets in the ATF ring											
Floor painting												
11/12-18												
ATF2 floor refurbishment							Start observation of the floor displacement					
Close ATF ring and start beam OP												

		December					January, 2008				February	
	19/25	26/2	3/9	10/16	17/23	24/30	31/6	7/13	14/20	21/27	28/3	4/10
Magnet installation												
Install concrete blocks												
						New Year's holiday						
Install movers, stands, magnets												
First alignment												
Open magnets and install BPM												
Connect beam pipes												
Beam opeartion												

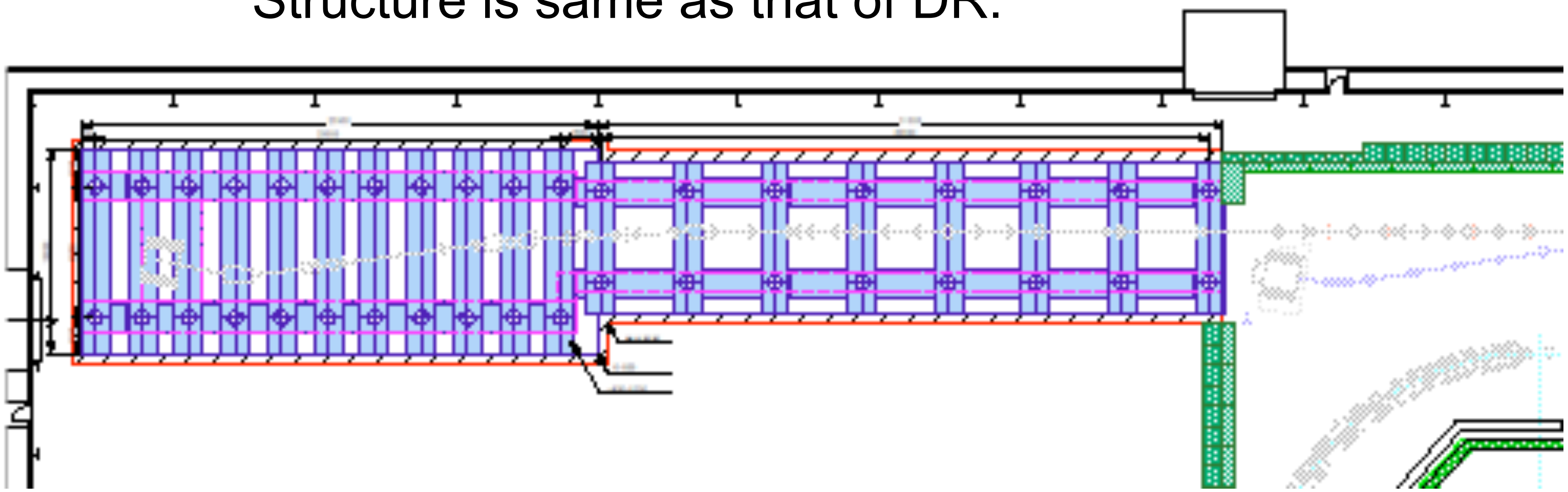
* Second alignment will be carried out just before the ATF2 beam commissioning. When?


Optics v3.6, November 2006
ATF2 beam line
Final Focus System
β mat-ching
Diagnostic
Reconfiguration of extraction line
for reduction of dispersion
57000
41179.42
Cooling Facilities
for Damping Ring
6m
EXIT
EXIT
EXIT
west
ATF - DR
Injection LINAC (S-band, 1.3GeV)
RF Gun
S-band Linac
Shutter
Damping Ring
Transport
2007/Mar/02 N.Terunuma, KE

Floor structure for ATF2 beam line

Refurbishment from Jun to Sep 2007

Structure is same as that of DR.

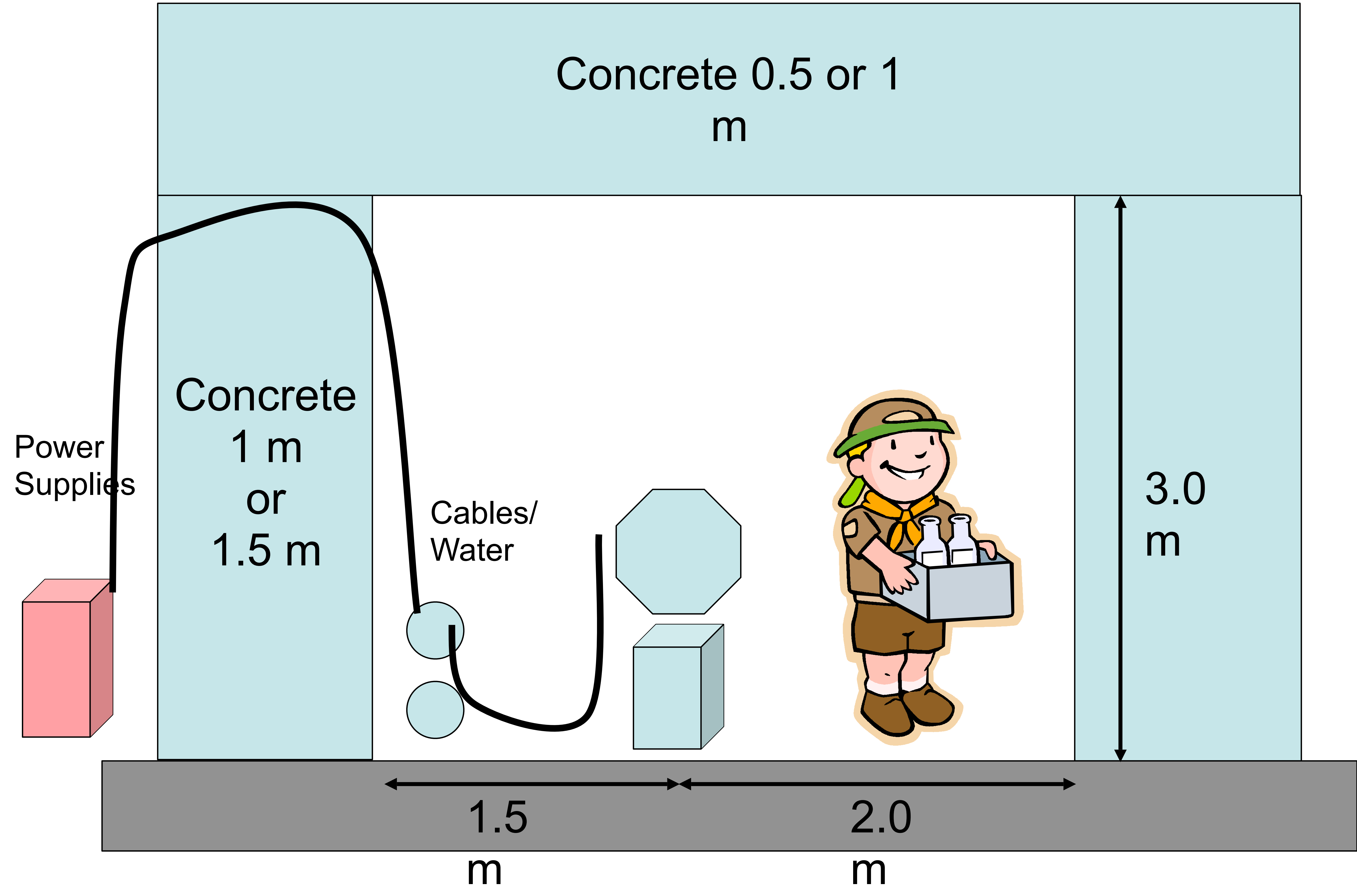



concrete of about 1,000t
14th September 2007


19th September 2007


Shintake Monitor Group aroud the dump
26th September 2007

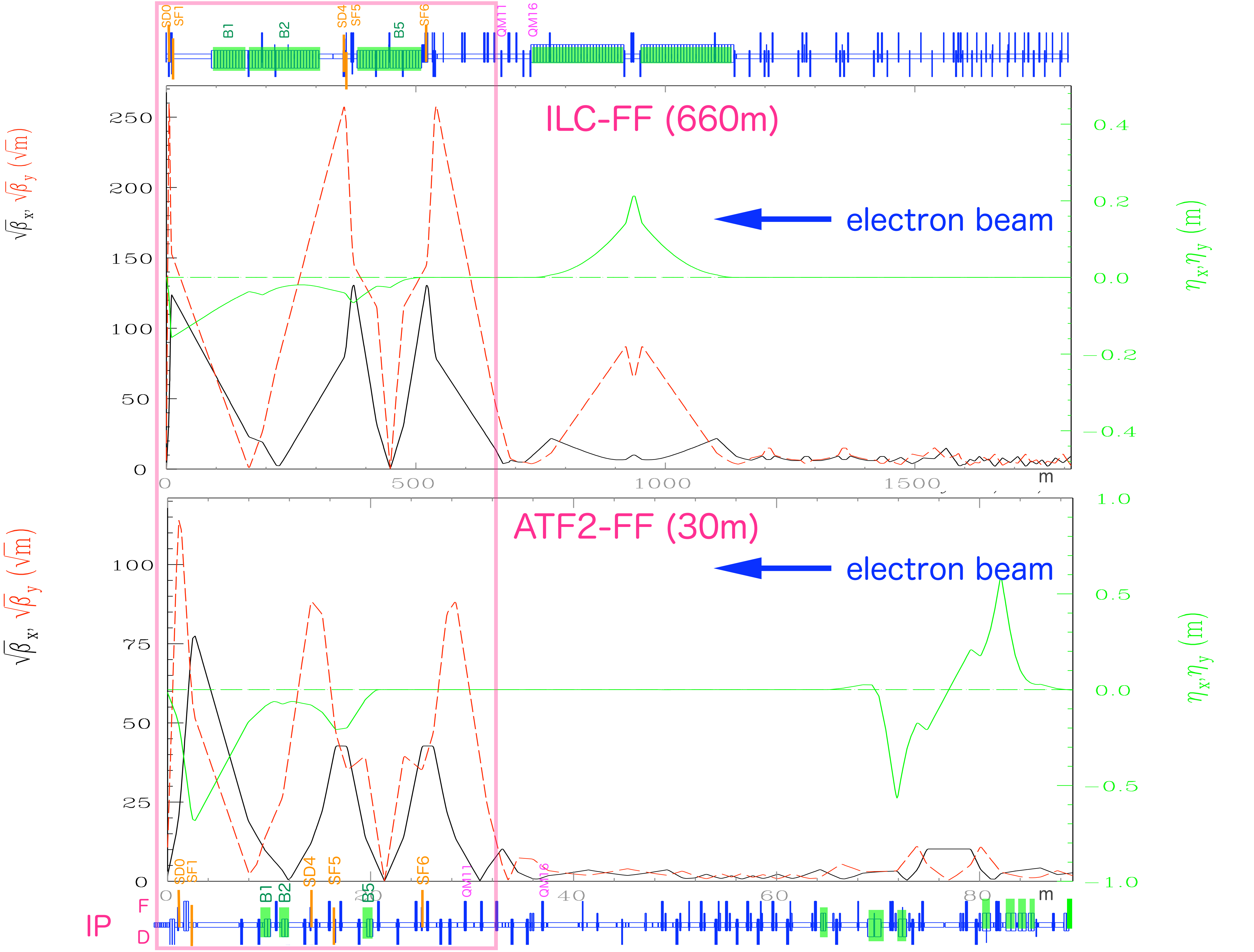

12th October 2007


Concrete 0.5 or 1 m
Power Supplies
Concrete 1 m or 1.5 m
Cables/ Water
3.0 m
1.5 m
2.0 m


ATF
022
T-2B

params	ATF2	ILC
Beam Energy [GeV]	1.3	250
L^* [m] (f*)	1	3.5 – 4.2
$\gamma\,\epsilon_x$ [m-rad]	5e-6	1e-5
$\gamma\,\epsilon_y$ [m-rad]	3e-8	4e-8
β_x^* [mm]	4.0	21
β_y^* [mm]	0.1	0.4
η' (DDX) [rad]	0.14	0.094
σ_E [%]	$\sim$0.1	$\sim$0.1
Chromaticity W_y	$\sim 10^4$	$\sim 10^4$
$\sigma_x(\mu\mathrm{m})$	2.8	0.655
$\sigma_y(\mathrm{nm})$	34	5.7
σ_x/σ_y	82	115

$\sim \mathbf{L}^*/\beta^*_{\mathbf{y}}$

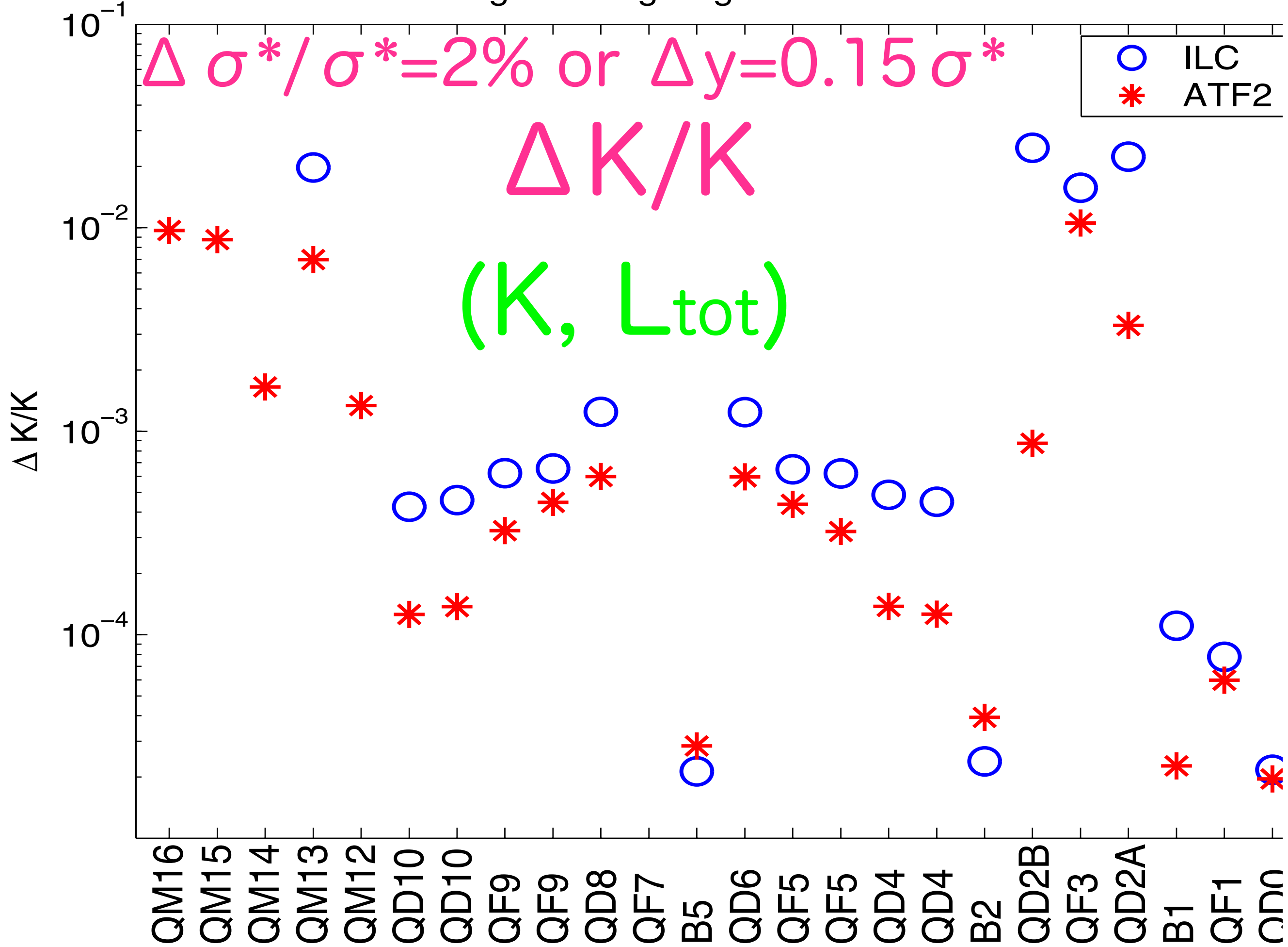


ILC-FF (660m)
electron beam
ATF2-FF (30m)
electron beam
SD0
SF1
B1
B2
SD4
SF5
B5
SF6
QM11
QM16
IP
F
D
m

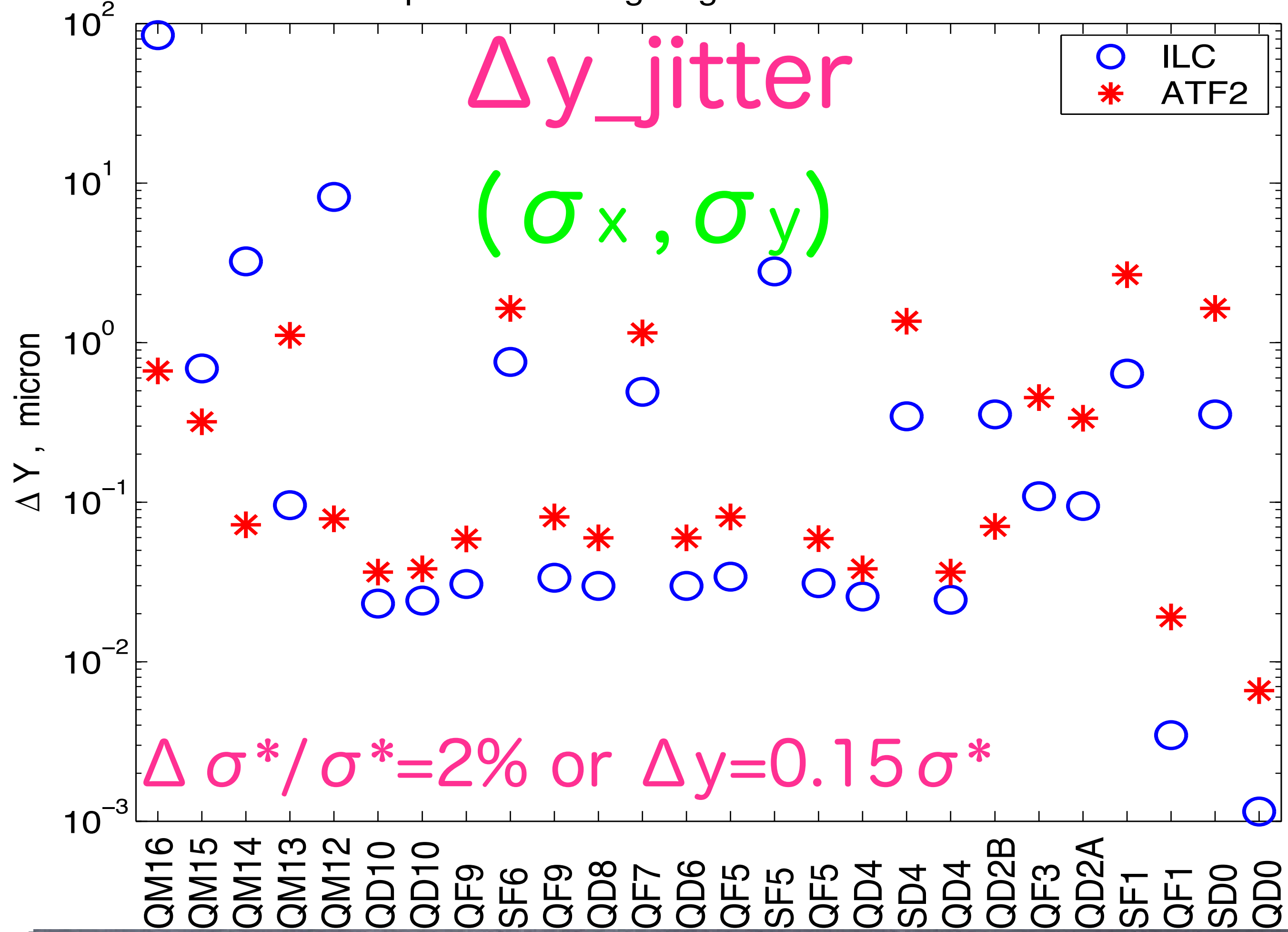
ATF2 Features

- The same number of magnets as the ILC-FF.
- The tuning knob, methods are the same,too.
- Beam instrumentation has been developed with the ILC specifications; BPMs, BSMs, movers, magnet support, laserwires, HA power supplies, FONT-feedback system etc. .
- International participation in the commissioning and operation

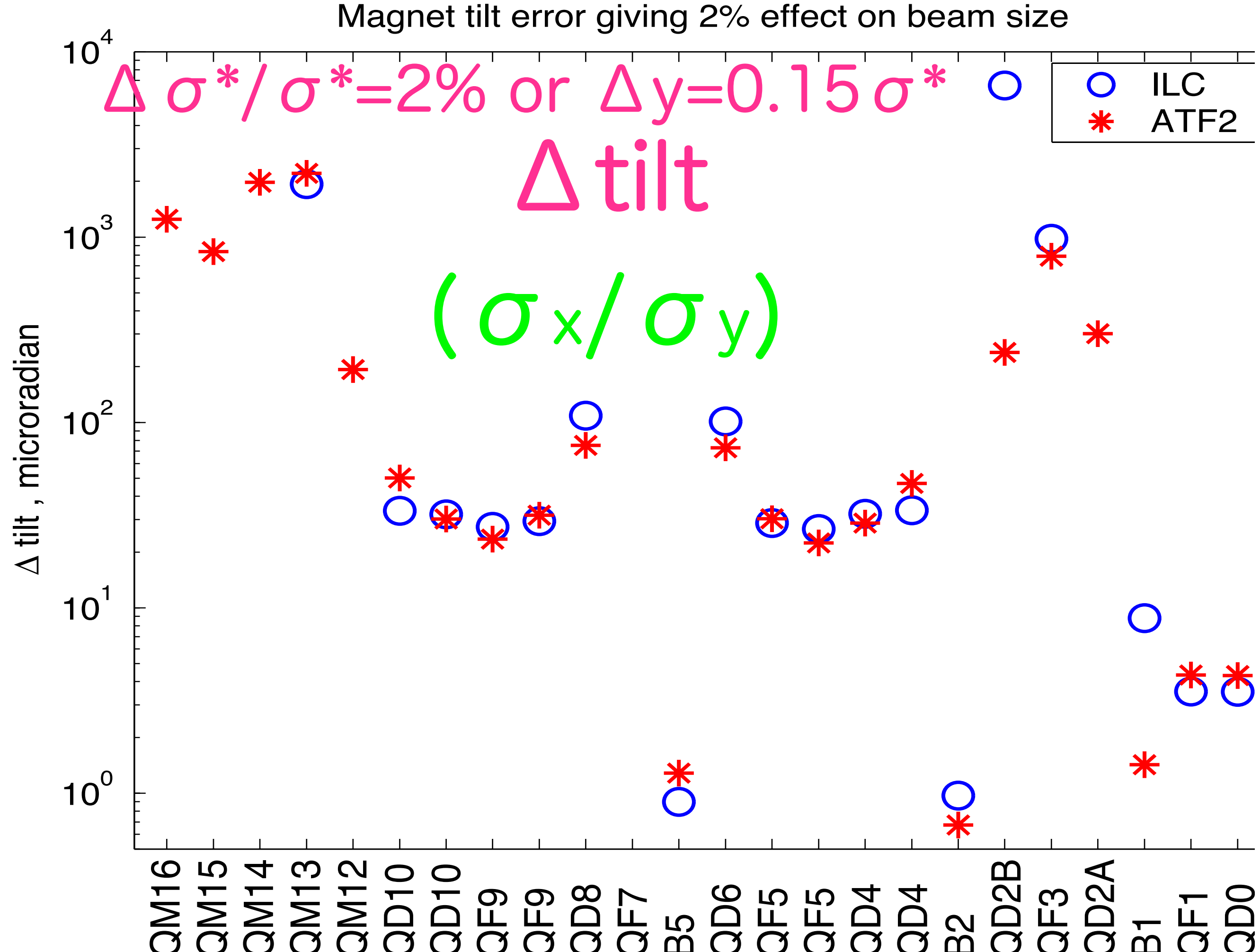
Field strength error giving 2% effect on beam size



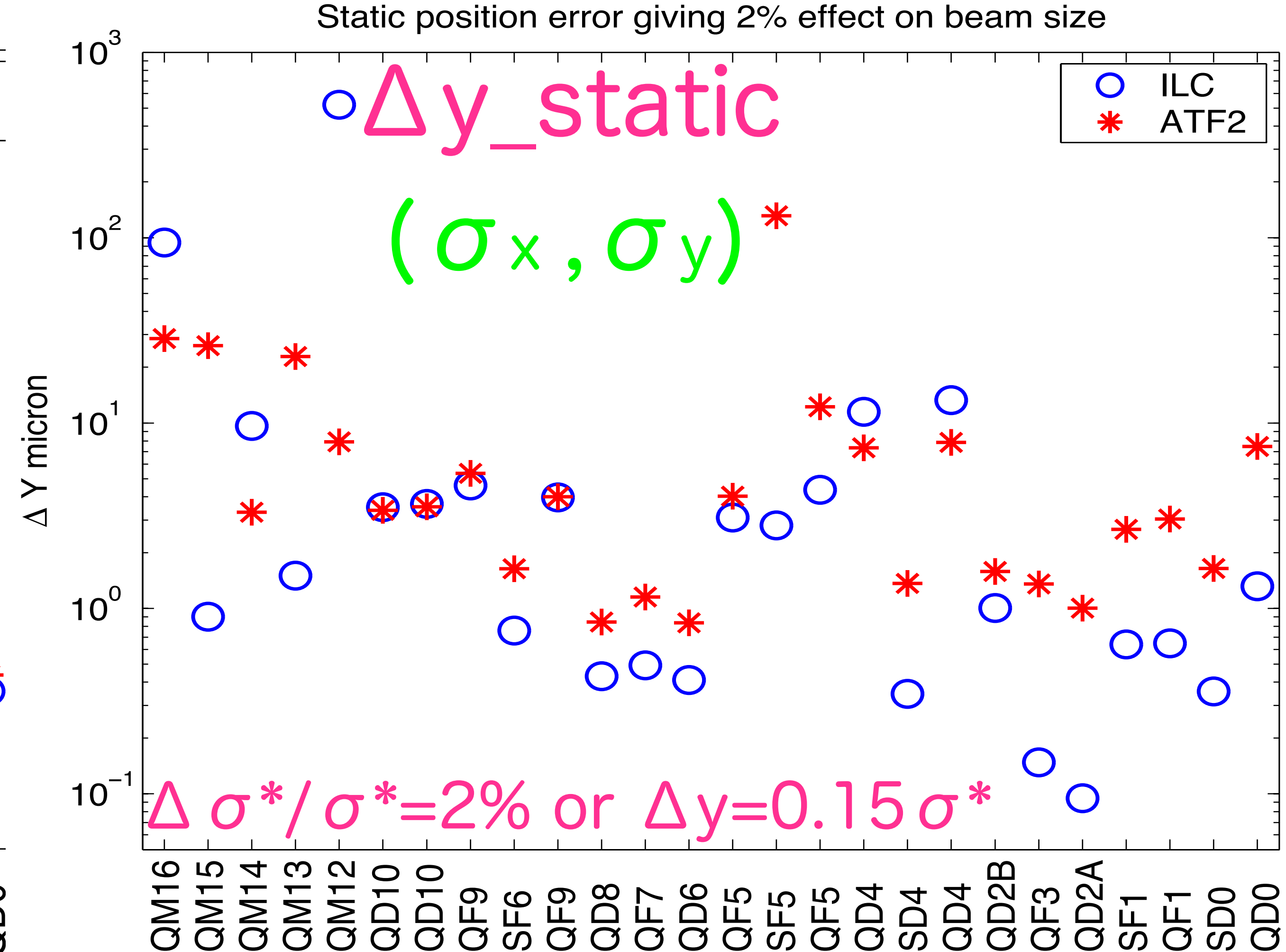
Jitter position error giving 2% effect on beam size



Magnet tilt error giving 2% effect on beam size



Static position error giving 2% effect on beam size



Magnets and Instrumentation at ATF2

22 Quadrupoles(Q), 5 Sextupoles(S), 3 Bends(B) in downstream of QM16

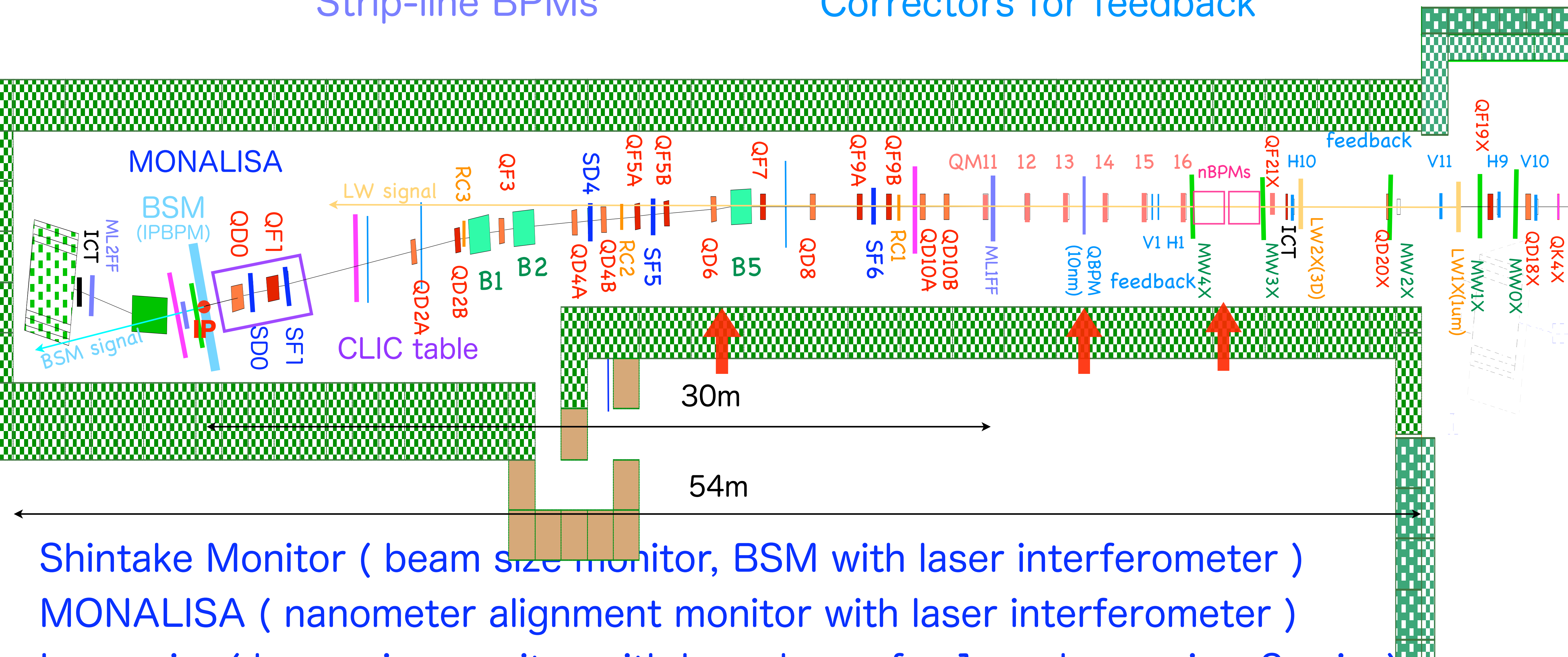
All Q- and S-magnets have cavity-type beam position monitors(QBPM, 100nm).

3 Screen Monitors

5 Wire Scanners, Laserwires

Strip-line BPMs

Correctors for feedback



Shintake Monitor (beam size monitor, BSM with laser interferometer)

MONALISA (nanometer alignment monitor with laser interferometer)

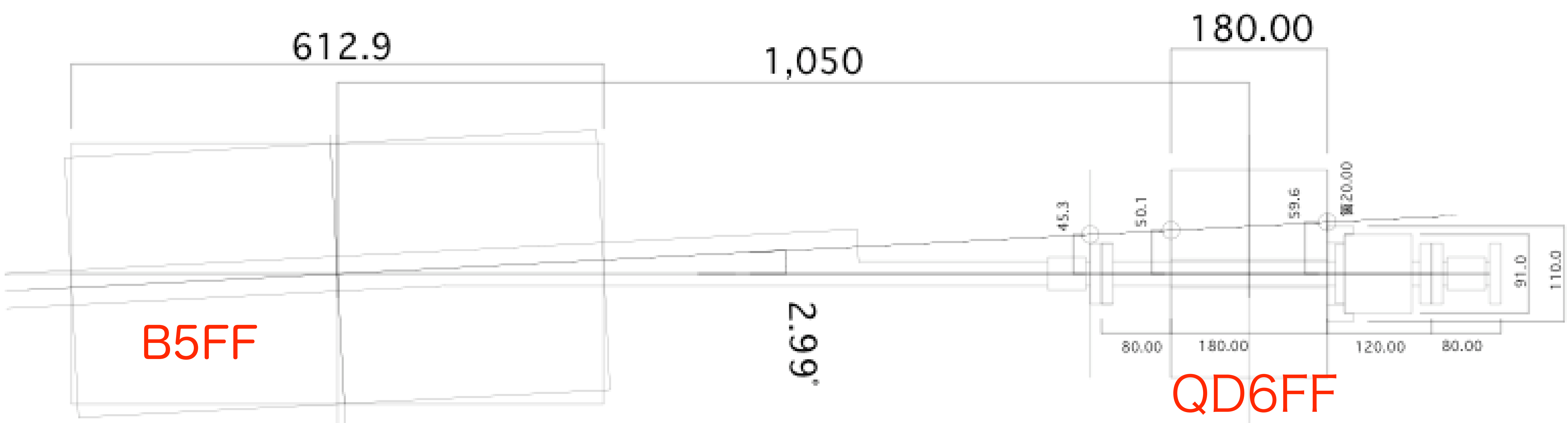
Laserwire (beam size monitor with laser beam for 1μm beam size, 3 axies)

IP intra-train feedback system with latency of less than 150ns (FONT)

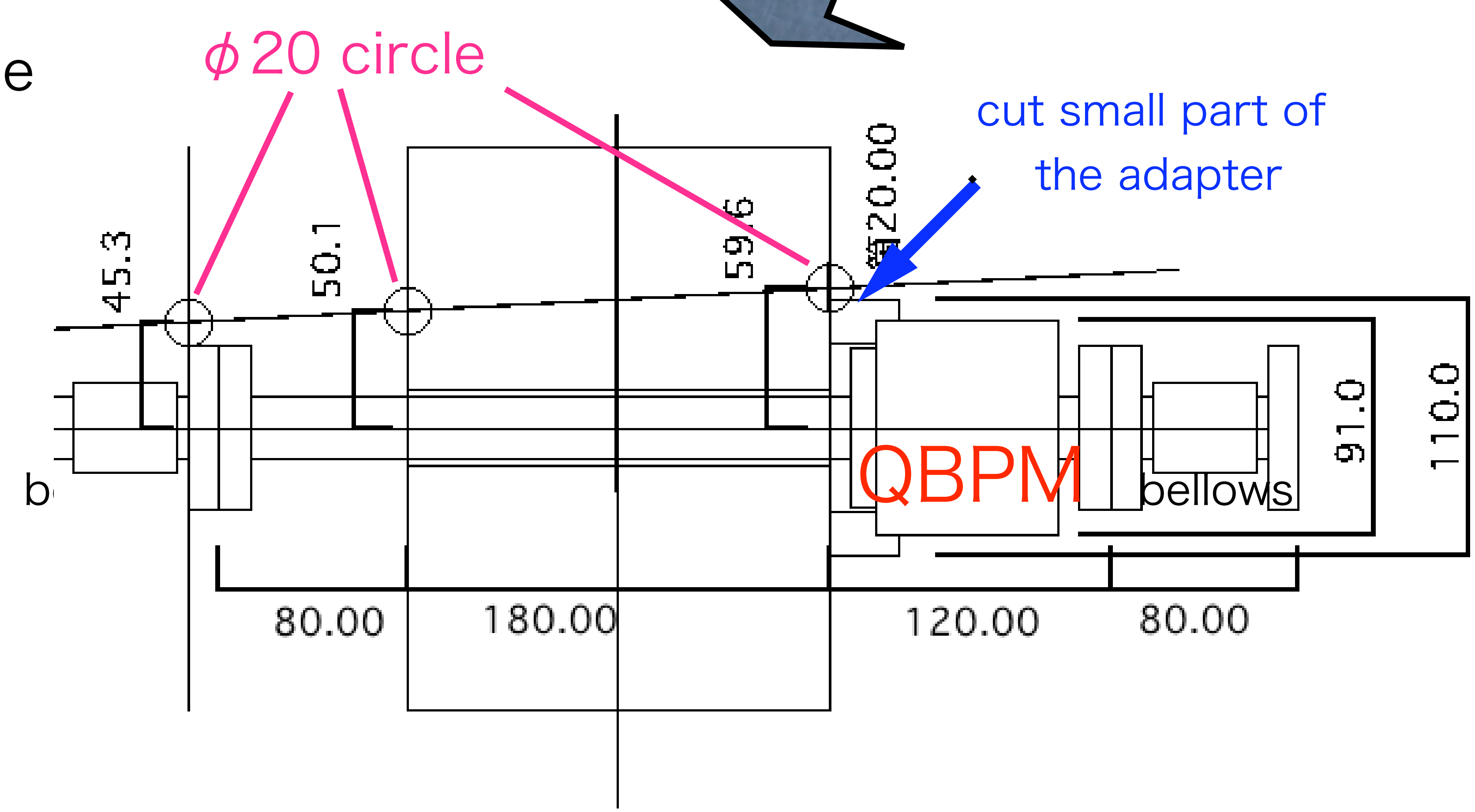
Magnet movers for Beam Based Alignment (BBA)

High Available Power Supply (HA-PS) system for magnets

LW exit port area

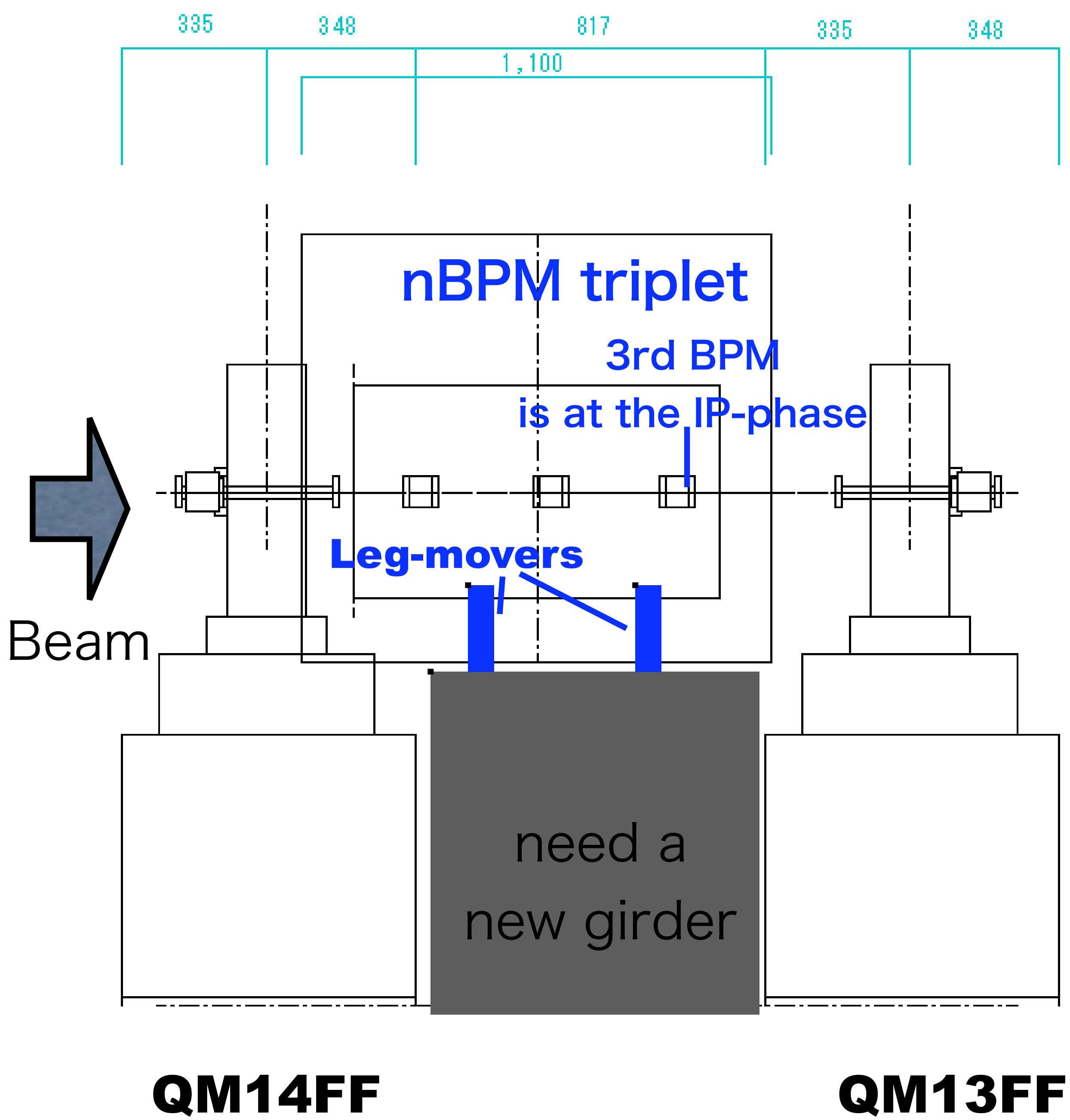


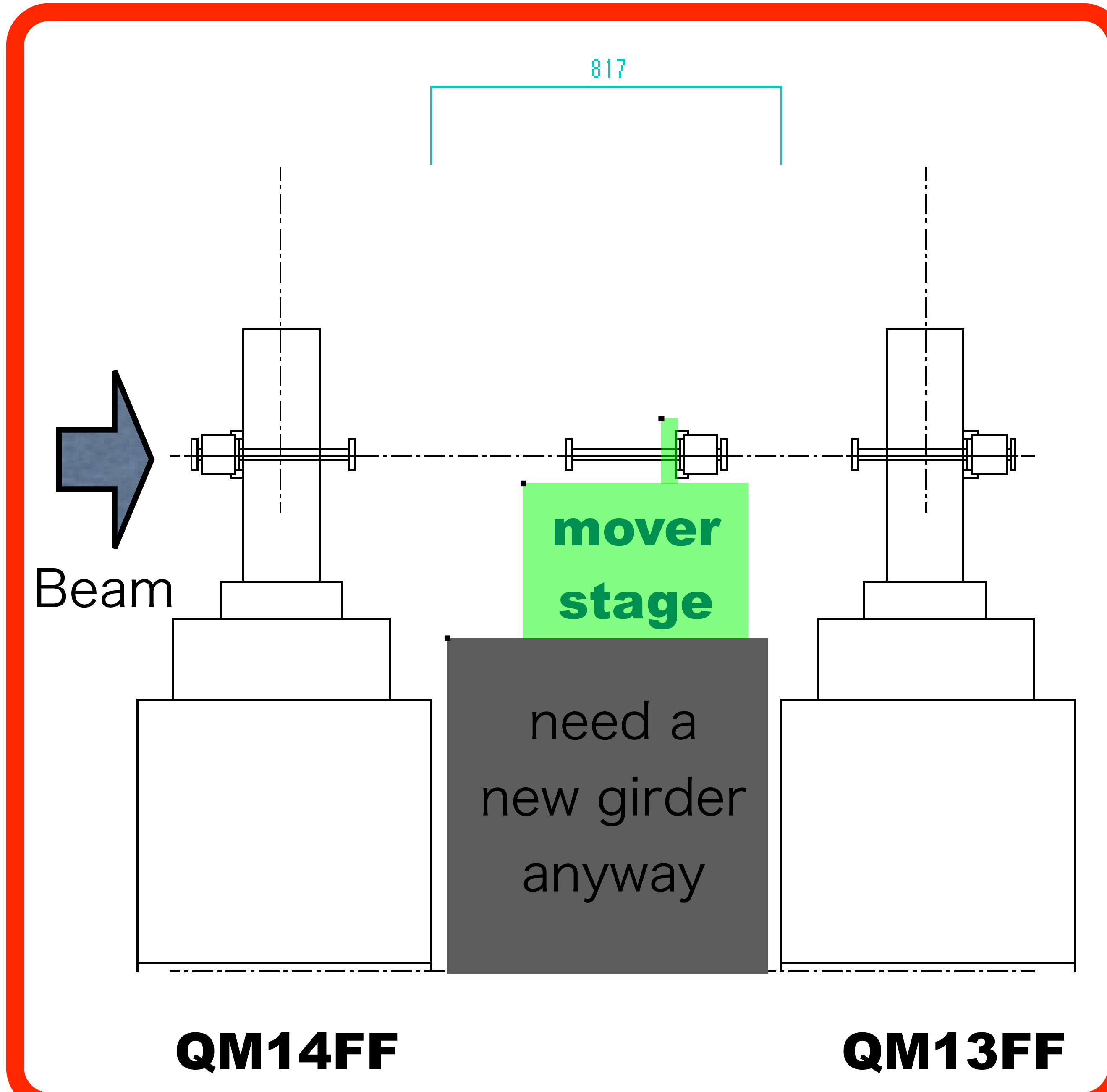
- Flange at the other end of the BPM is the smallest aperture if a part of the BPM is cut.
- There can be the 20mm diameter aperture which is the request of LW group
- Conclusion is “special short-pipe QBPM is not necessary”



Situation at QM14FF-QM13FF area

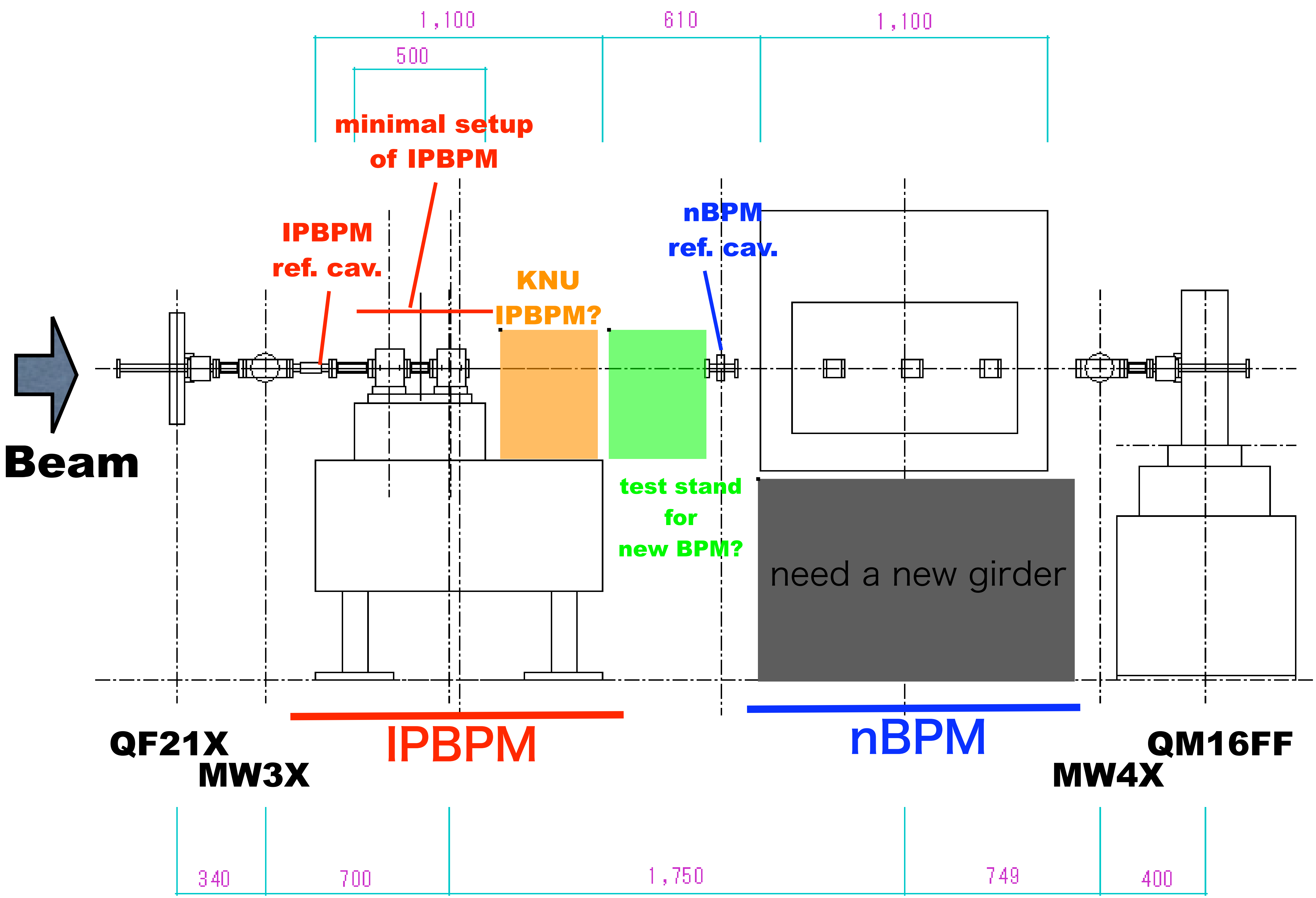
- Its true that there is a 1120mm length space (flange to flange) between QM13FF and QM14FF.
- But subtracting the foot prints of concrete pillers, 817mm is left for installing a device.
- The cylinder-flame of nBPM is ~850mm, plastic covering is 1100mm length. Not impossible but ...
- There will be 5 Q-BPM spares left, it can be used for pulse-to-pulse BPM if a high sensitivity electronics is available. Rigid girder and a mover stage will be needed also.





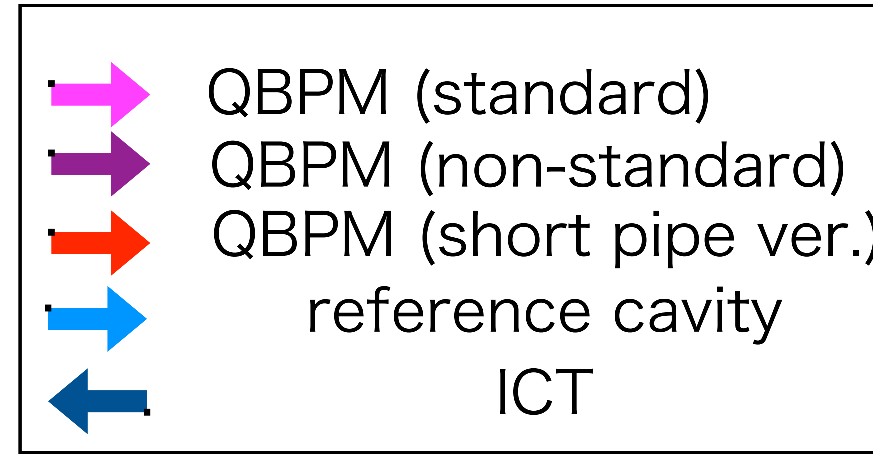
Idea for QF21X-QM16FF area

- This largest free space can contain both “IPBPM test setup” and “nBPM triplet”.
- It will be possible to install other R&D BPMs such as KNU group’s BPM.



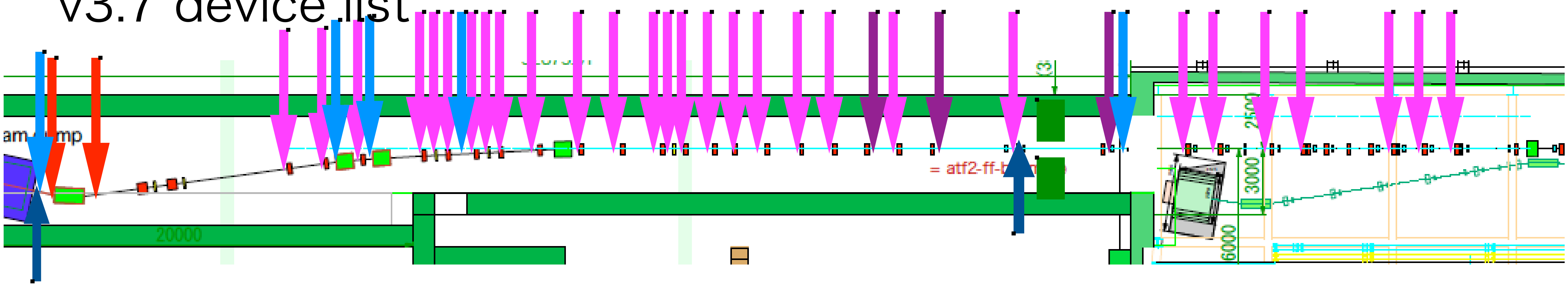
Q-BPM/Ref.cav. layout

- prefer to spread reference cavities with equally distance (temp. variation on cable, etc.)
- specified which QBPM belongs which ref.cav.
- removed the one at d/s of BDMP, may be strip-line is good eough.
- the one at LW photon port has to be short pipe version.

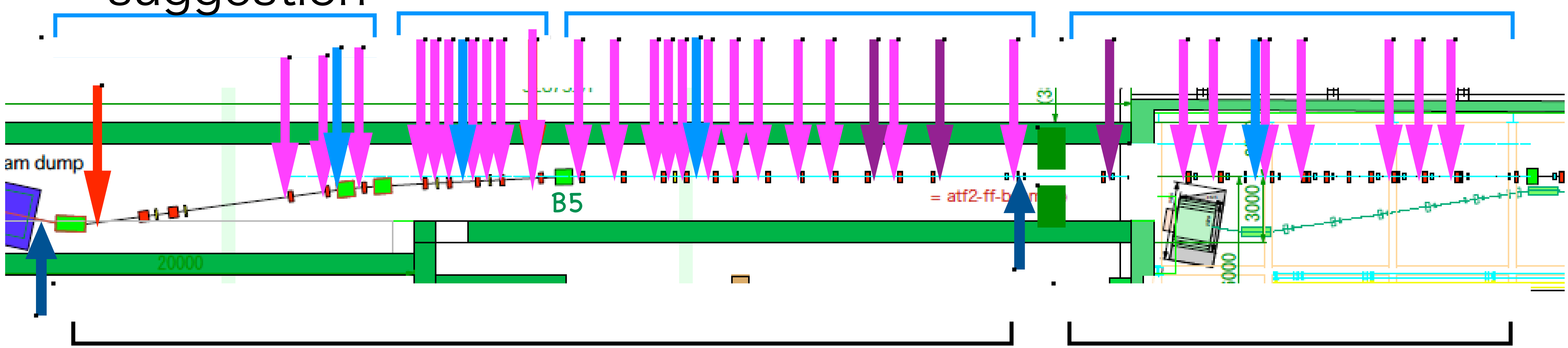


non-standard = QBPM at upstream of Q

v3.7 device list

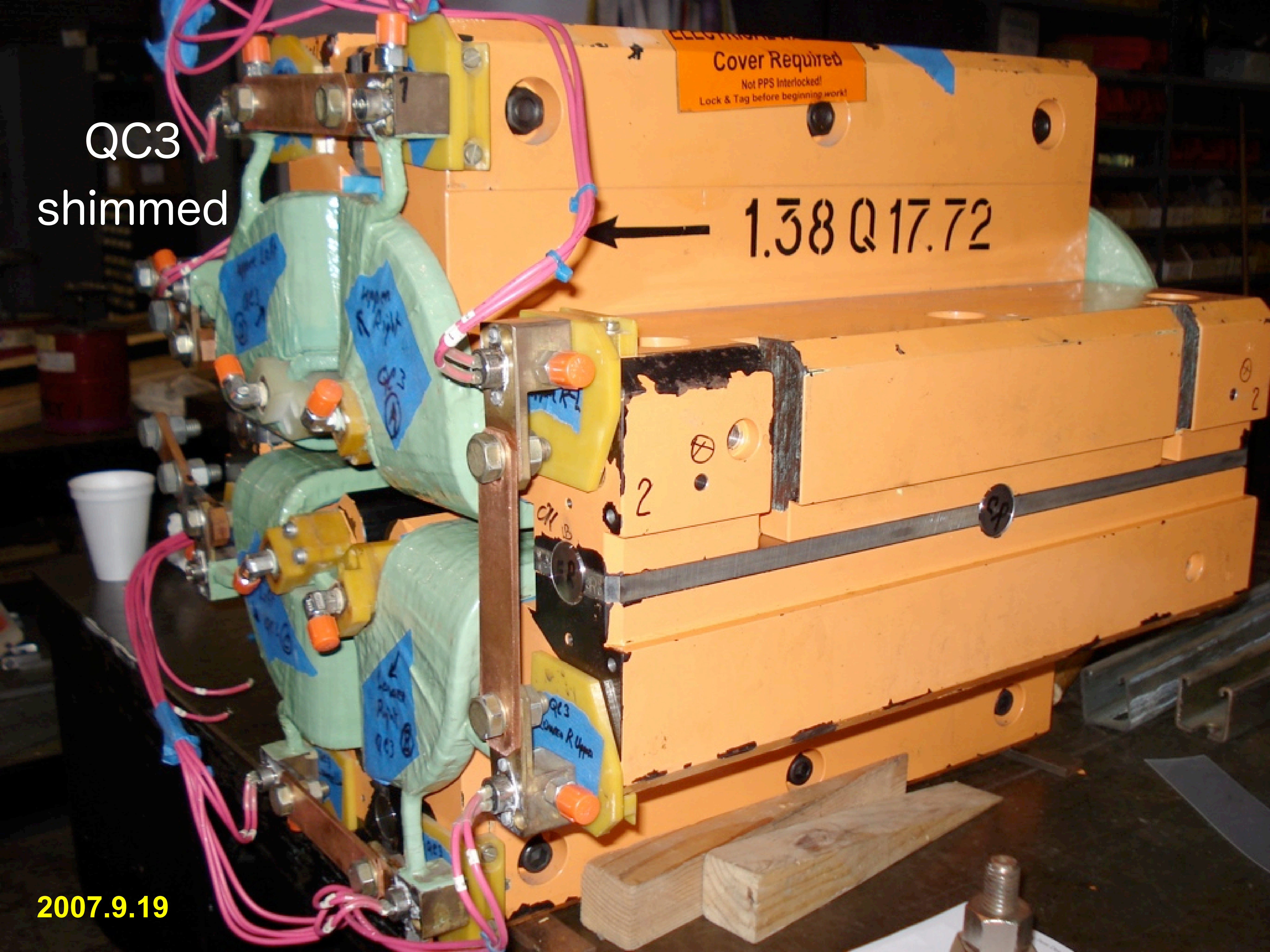


suggestion

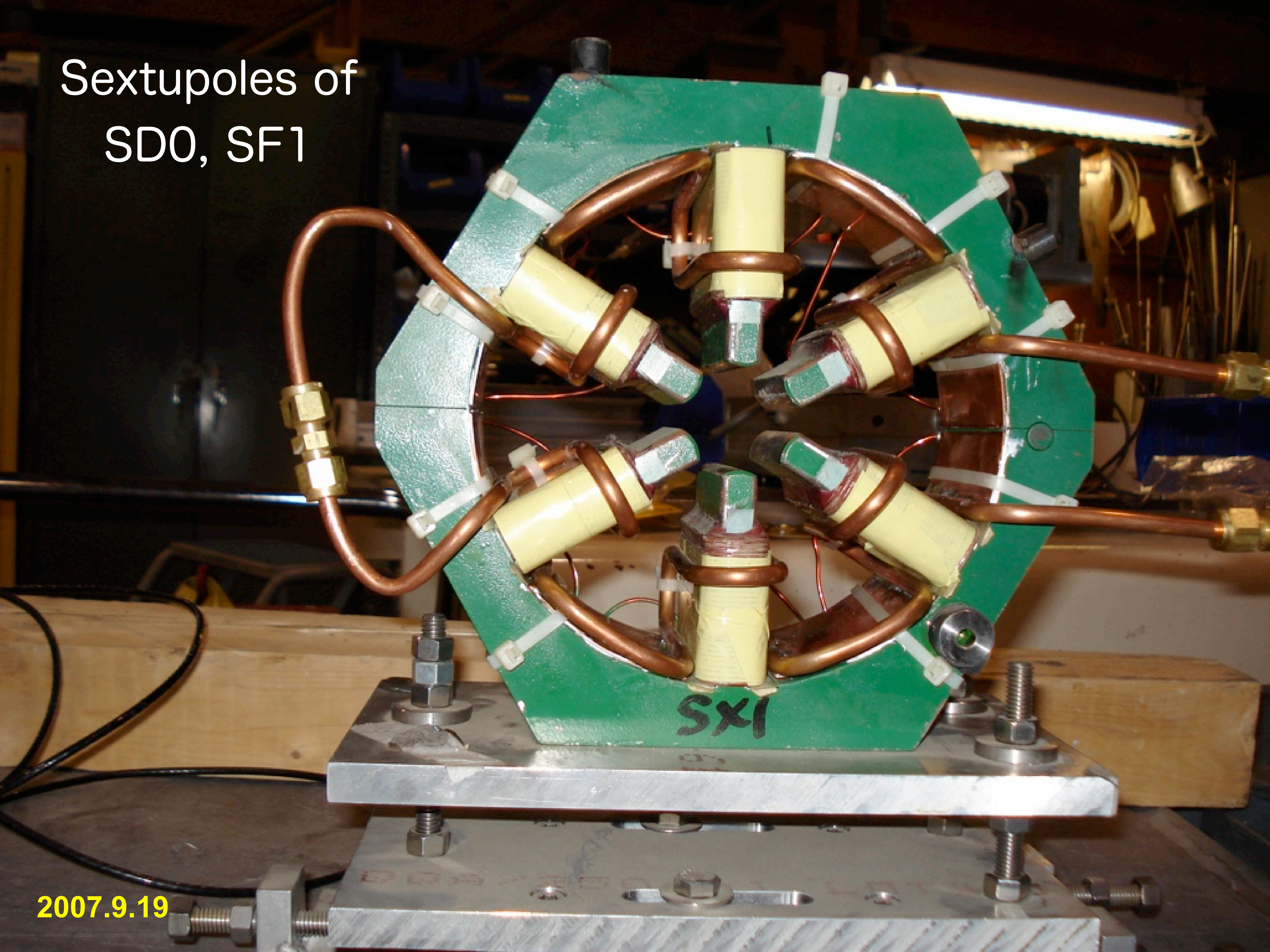


2007 model (24)
2005 model (1)
IP-BPM has its own ref.cav.

2006 model (8)
ref.cav. optimized for the freq.

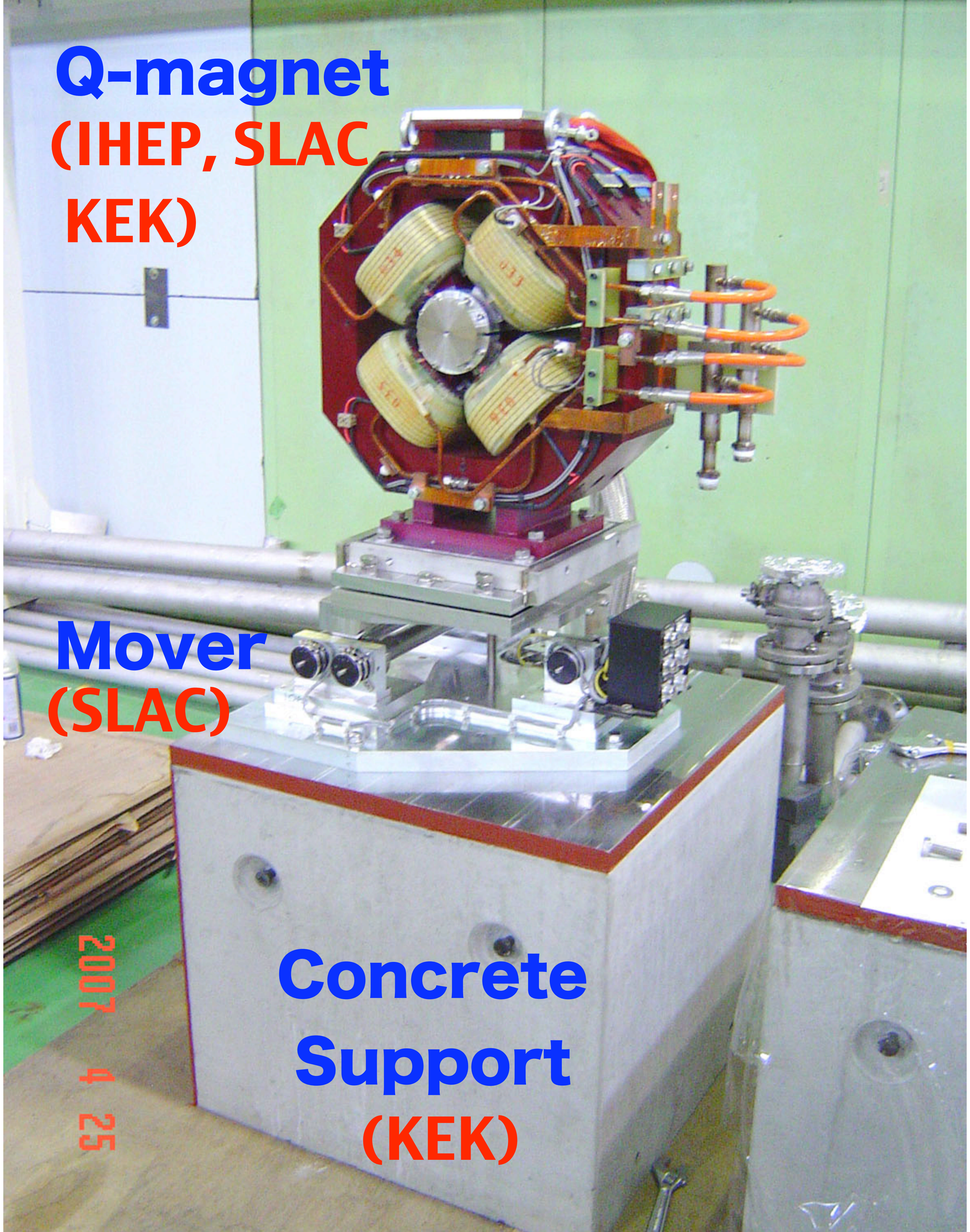

QC3
shimmed
Cover Required
Not PPS Interlocked!
Lock & Tag before beginning work!
1.38 Q 17.72
2007.9.19

Sextupoles of SD0, SF1

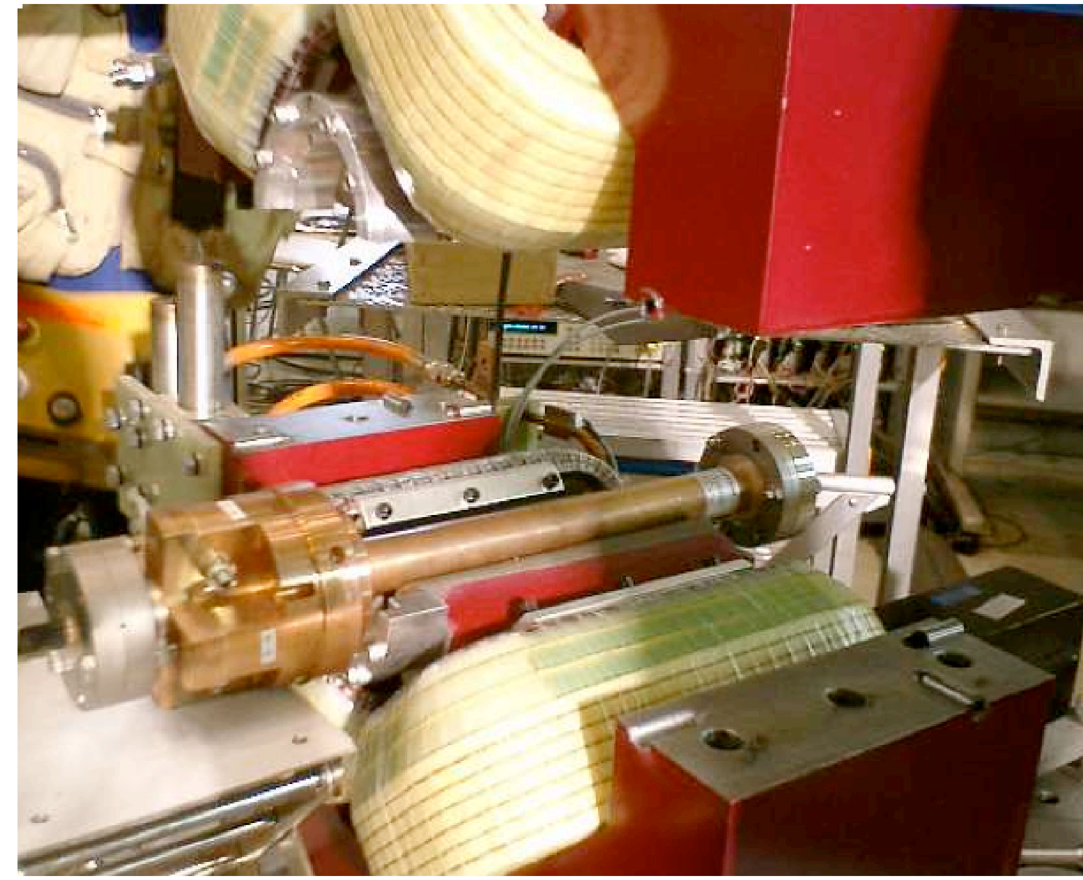


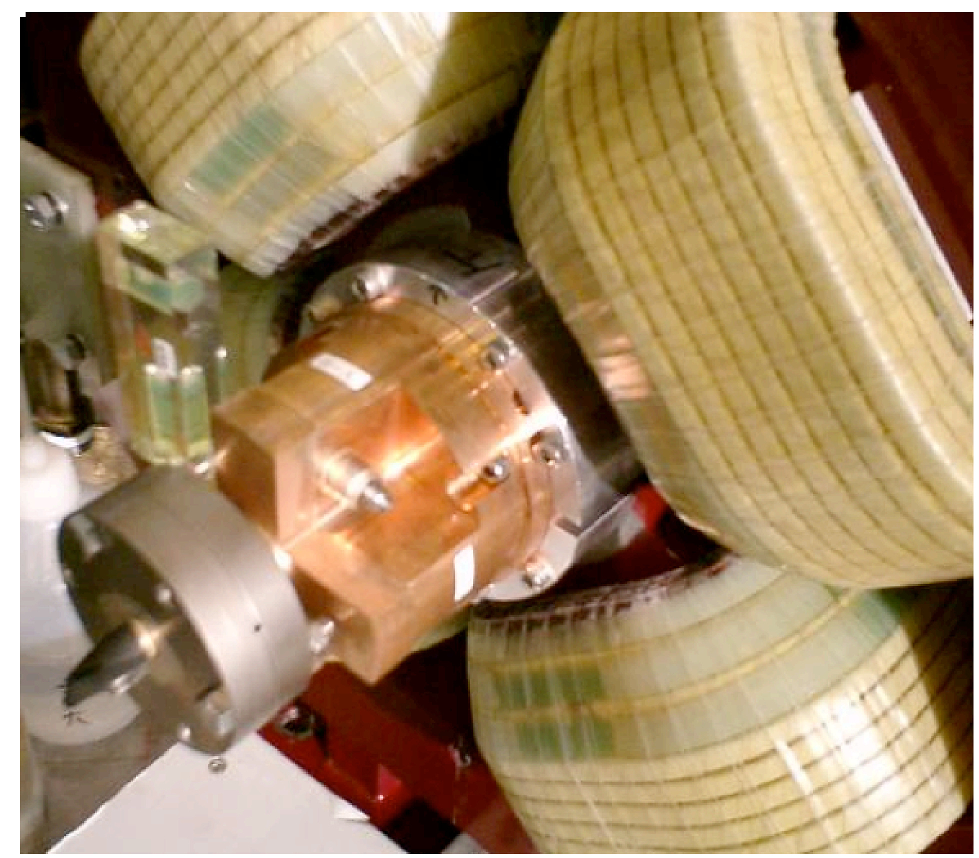
HA-Power Supply System for ATF2, at SLAC

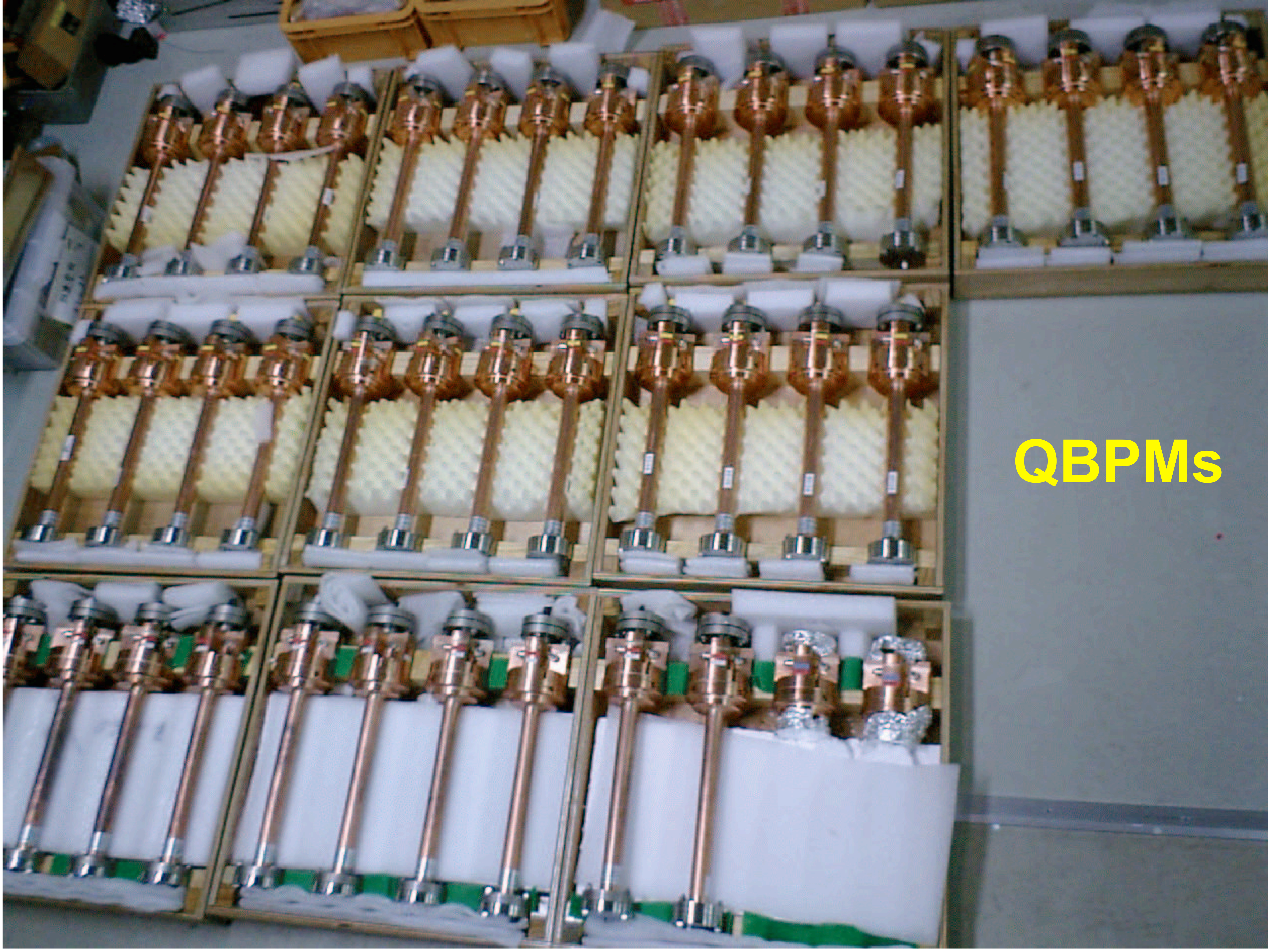
2007.9.14



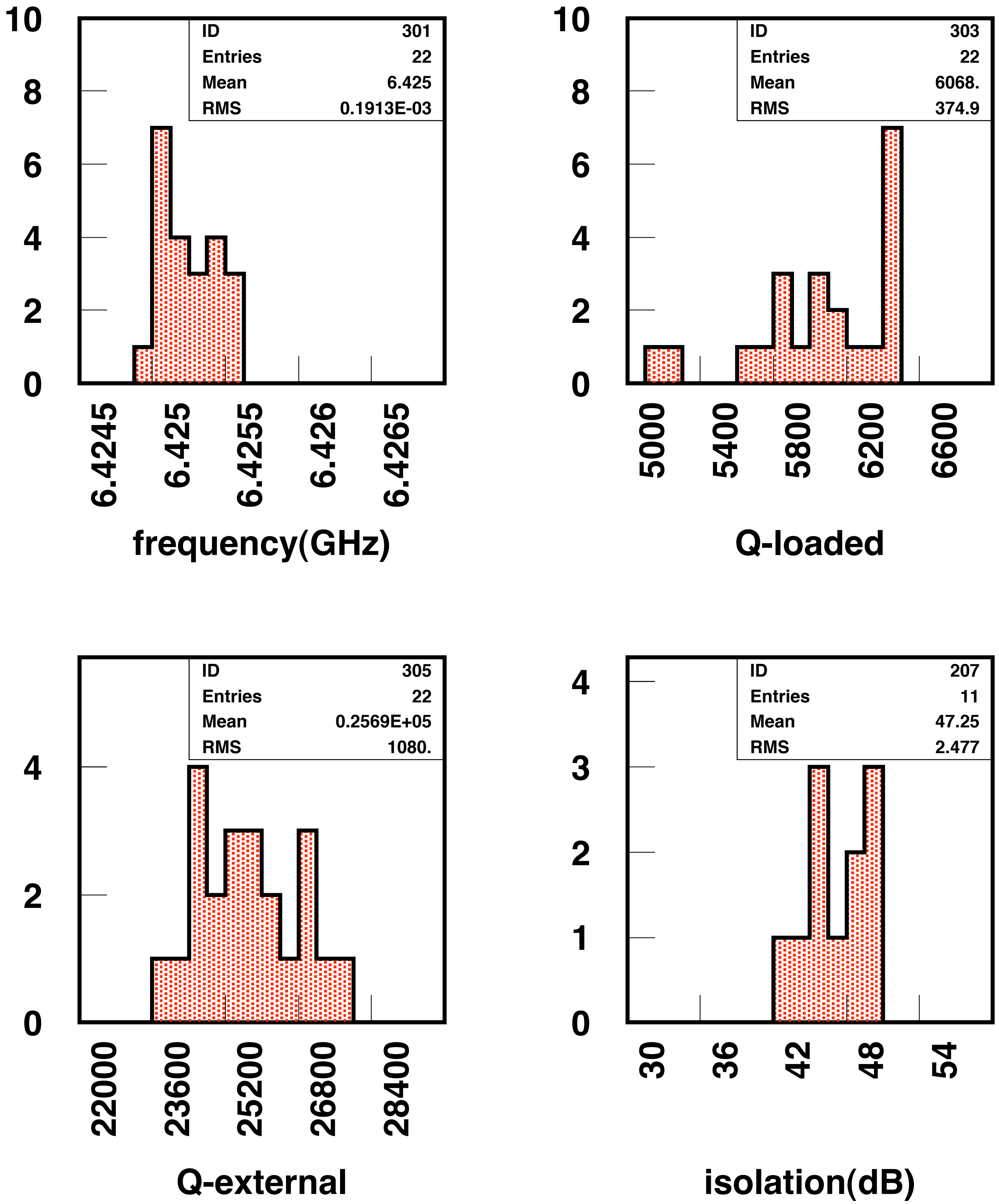
QBPM in a Q-magnet
(KEK, PAL, SLAC)



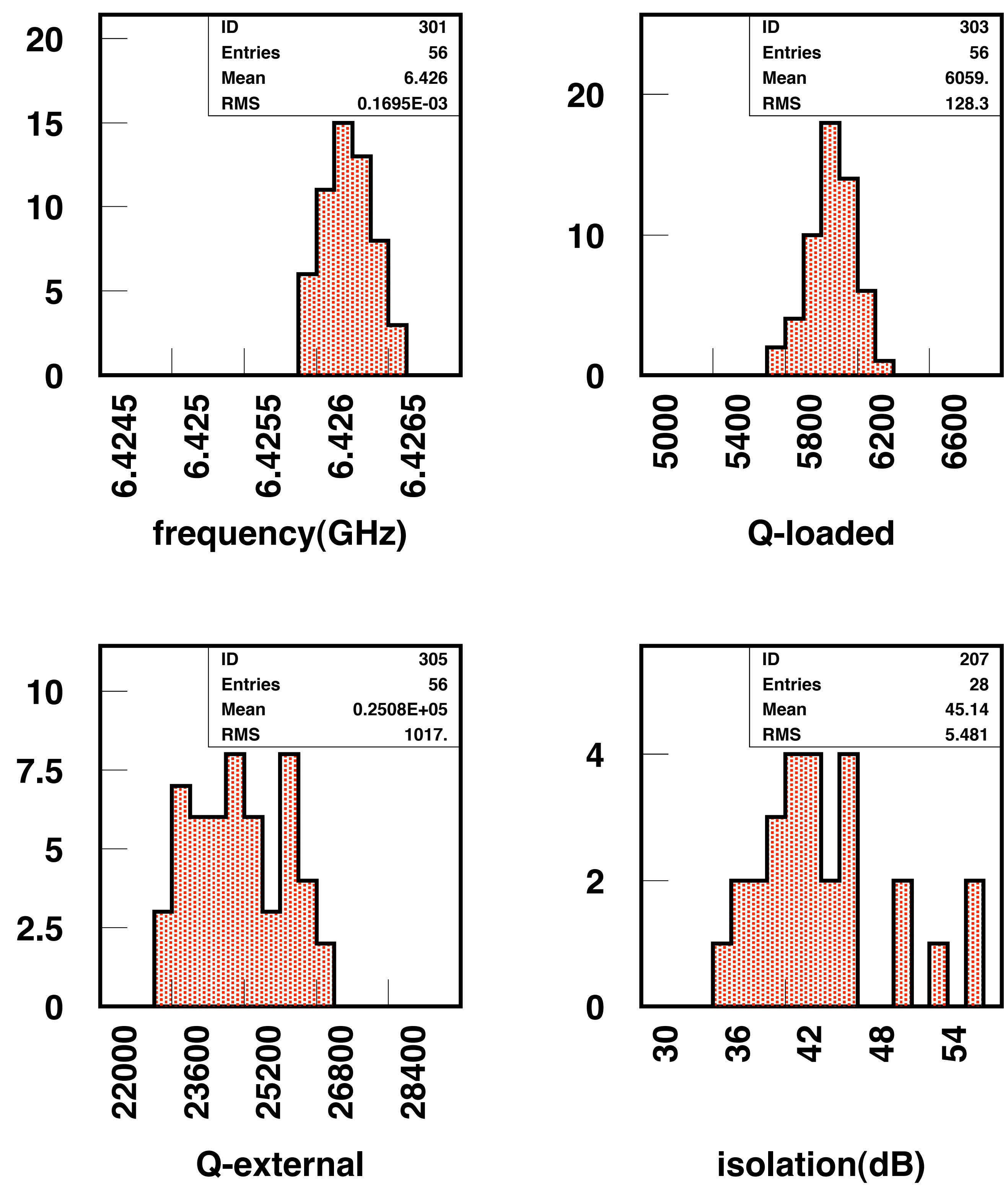



QBPMs

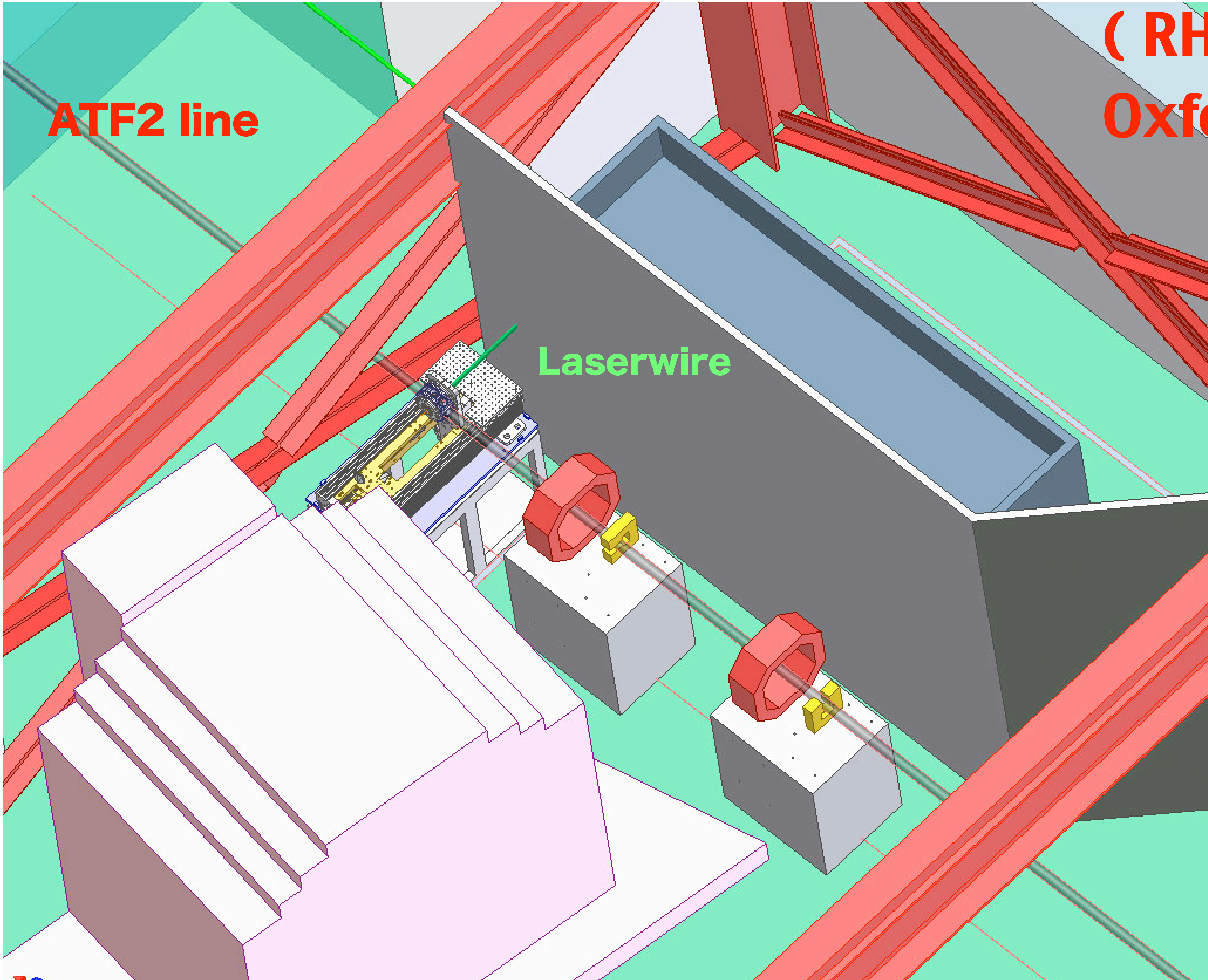
11 QBPMs in 2006



28 QBPMs in 2007



Stage 1 (continued) - 3D View of proposed new 'Laser-wire' region



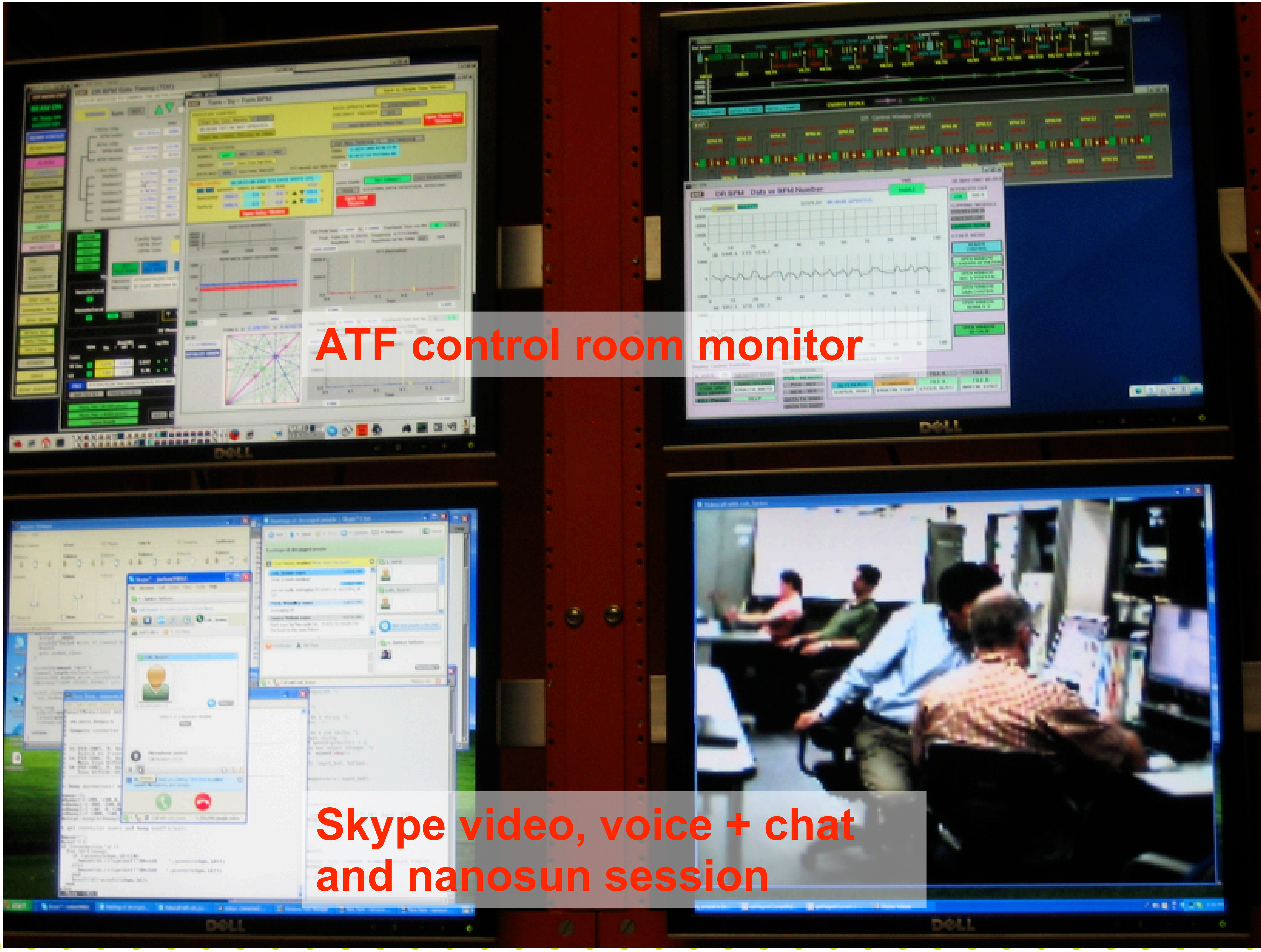
Remote Participation

- Principle
  - Participation to be focused on the work (e.g. data analysis) which does not involve remote control, to respect the ATF safety rules
- Desired capabilities
  - possibility to see the monitors of ATF control room
  - have audio & video connection with ATF control room
  - have access to a computer where data analysis can be done, but not the control
- Present realization:
  - Use Webex with desktop sharing to transmit ATF monitors+ Skype for audio and video
  - Use VPN to nanosun.kek.jp for data analysis

Shifts 2-3, Preparation of BBA

Dual monitors on 1st PC to display ATF control room monitor

Skype (voice+video+chat) & unix session on nanosun on 2nd PC


ATF control room monitor
Skype video, voice + chat
and nanosun session

Recent Status of ATF-EXT (Mar.2007)

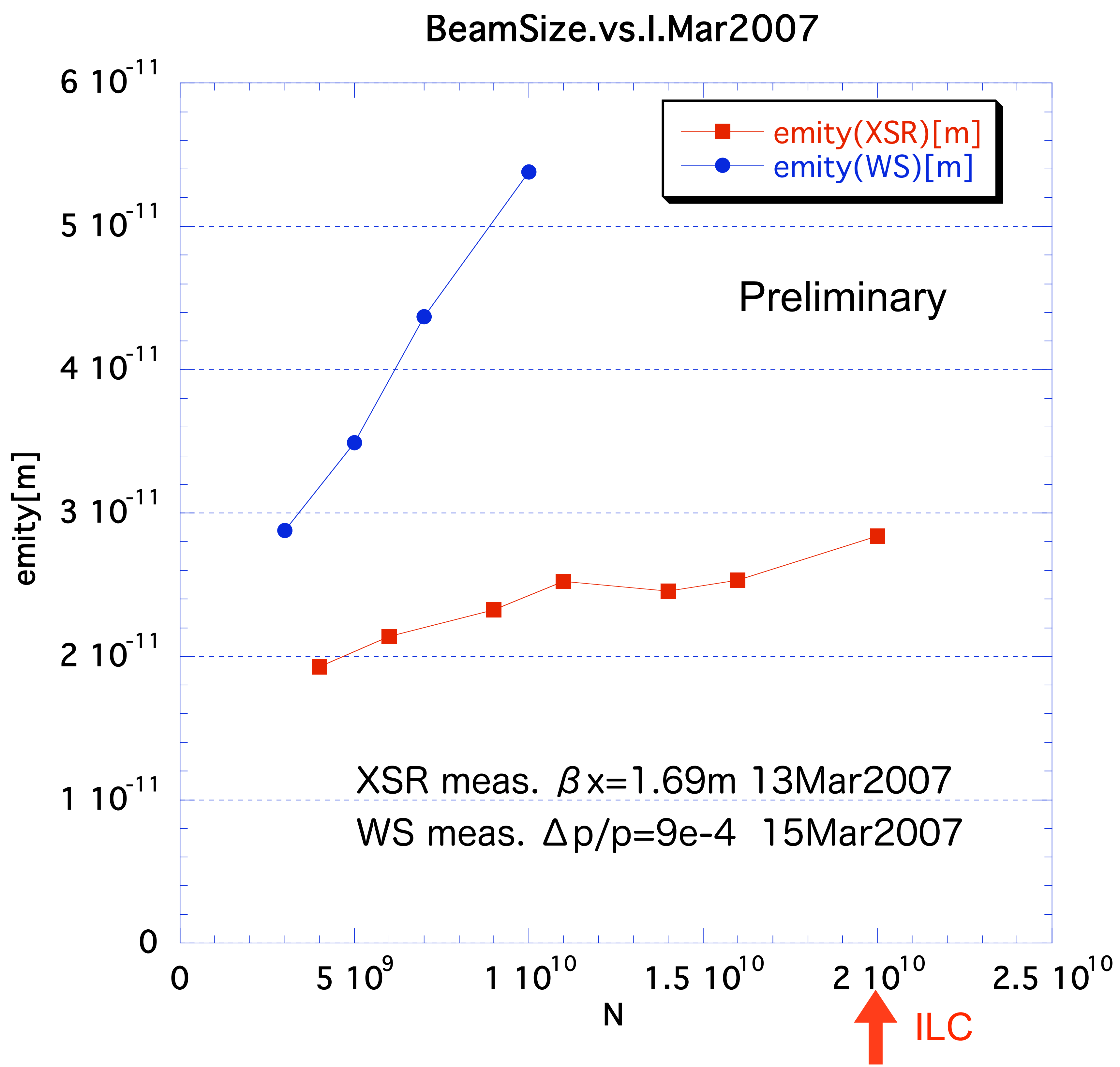
S.Kuroda(KEK)

Still observed emittance growth at EXT line

→Issue for study

(So long no study since 2000)

ε measurement usually suffers from limited strength of skew Q for η correction. No coupling correction.



Major Discussion Issues

1. Full test of the FD system with magnets at LAPP
2. Installtion plan of the FD system

   shipment of QC3s, 6-poles from SLAC to LAPP

3. Beam test plan for studies on the emittance growth, especially its dependence on the intensity