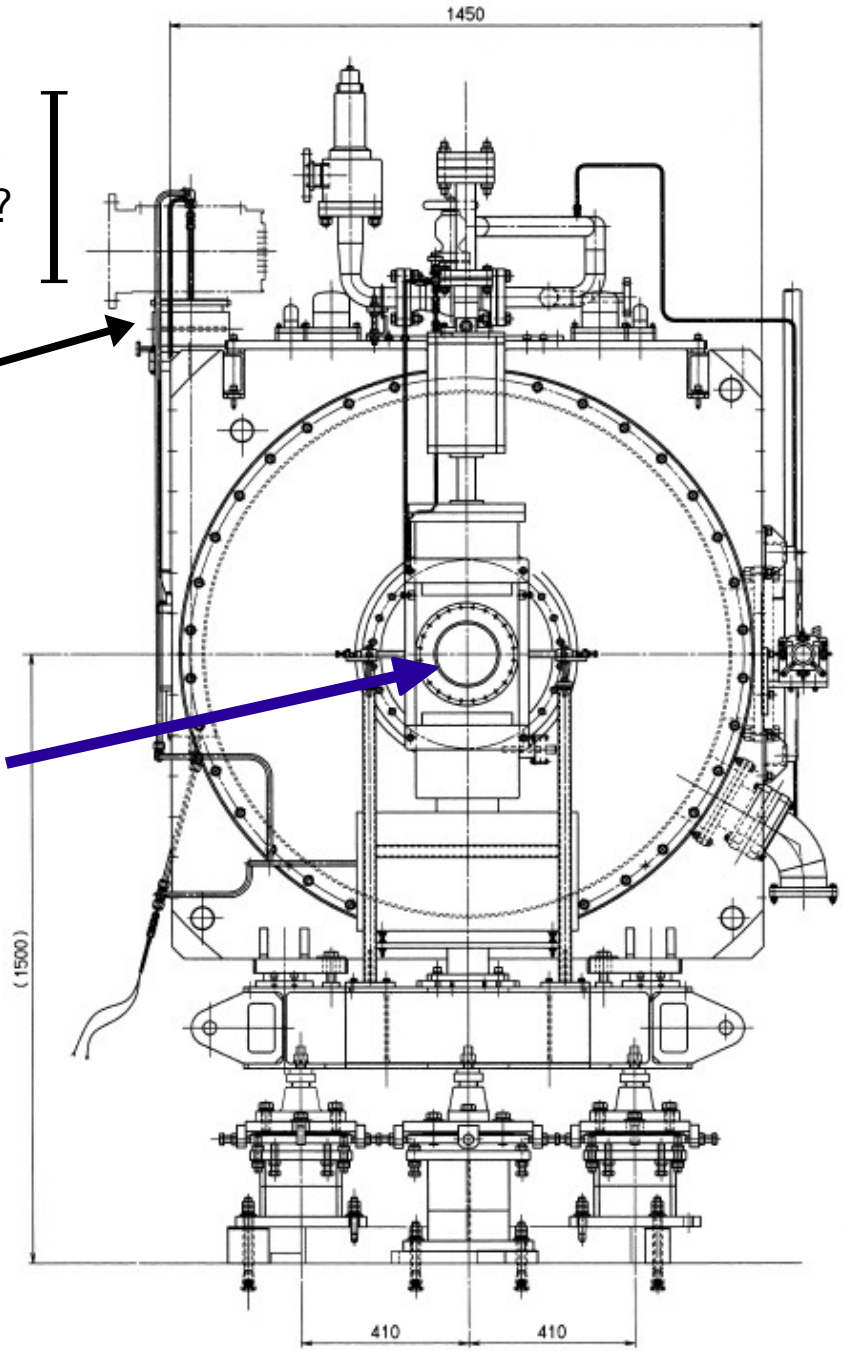
Cryostat Cross Section



Weight: 5830.5 kg

0.35 m ?

RF Coupler

0.725 m, Cryostat Rad

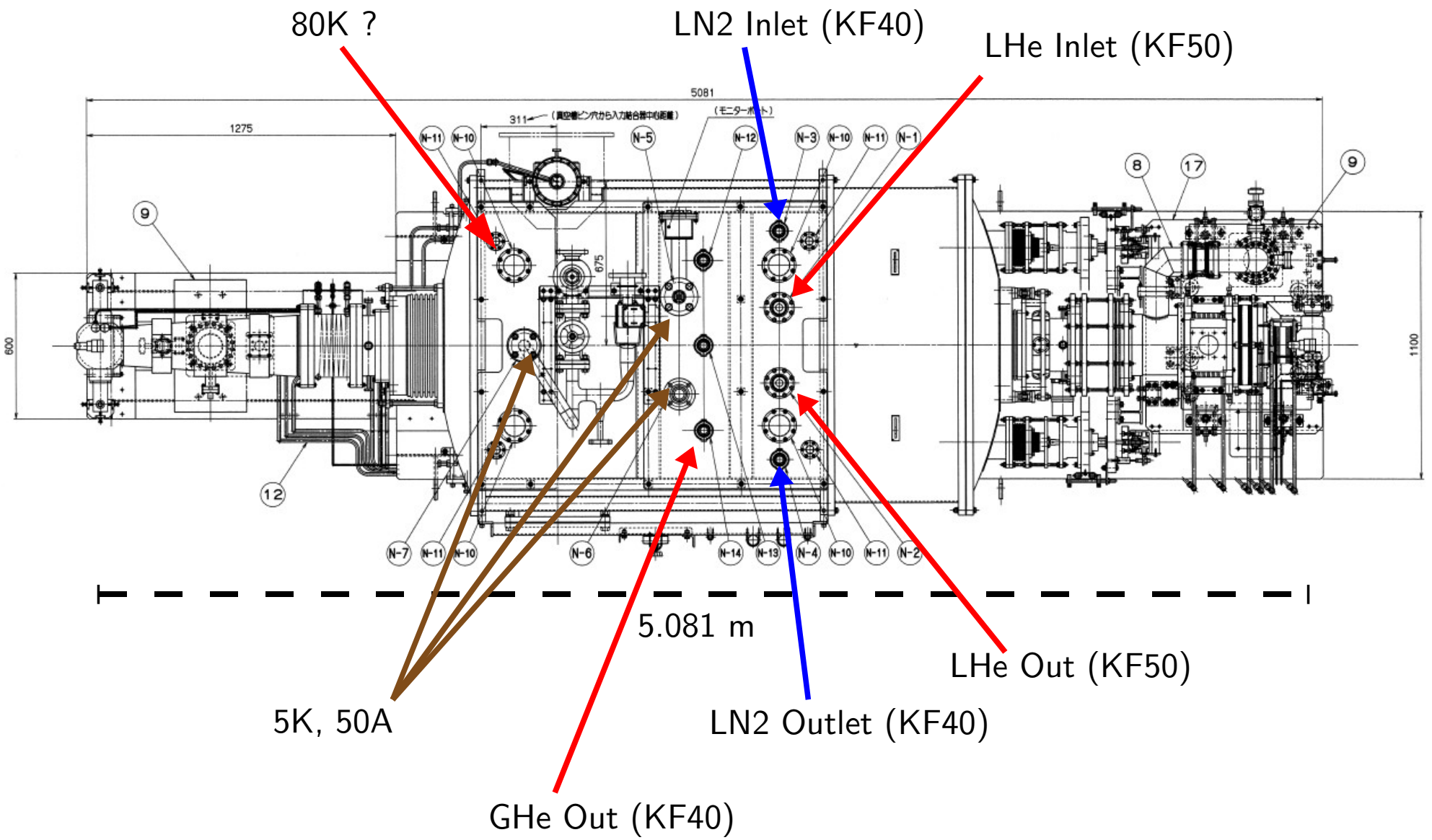
Aperture: 150 mm, 94 mm
(Left, Right)

1.5 m

0.48 m

Courtesy KEK-B

Cryostat Top View



Courtesy KEK-B

Prelim RF & Cryo Specs

Heat load

- Static: 15 W (He), 110 W (LN2)
- Dynamic: 50 W (He) corresponds to 1.5 MV kick

Volume of the Helium vessel: 400 L

- Both liquid and gas volumes are connected
- Cryogenic interfaces (Byonet drawings on web - .igs, .dwg)

Frequency tuning

- Static: 2 MHz possible for SPS 100ns bunch spacing
- Dynamic: 1 kHz/s, maximum range: 200 kHz (operations – 100 kHz)

RF power (Cavity $Q_0 > 1e9$)

- Presently using: 1.3-2 x $1x10^5$ (55-120 kW)
- Alt Available: 1-1.3 x $1x10^6$ (20 kW)

Feedback

- Orbit feedback (slow, 1 sec)

Coldex Location, Optics

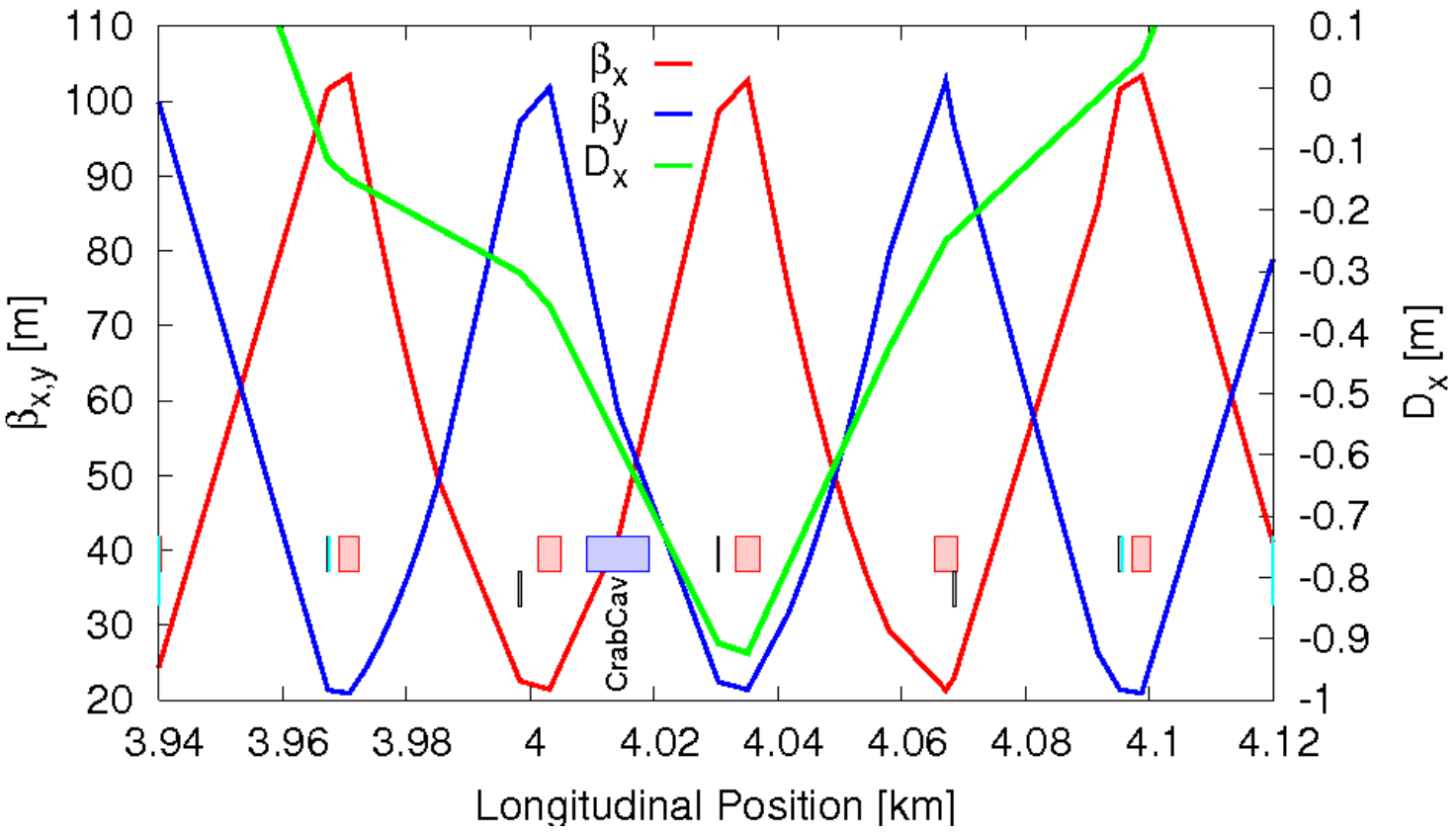
Longitudinal Position: 4020 m +/- 5m

Total length (in MAD): 10.72 m

βx, βy: 41.559m, 58.604m

muX, muY: 15.19652, 15.188

Dx: -0.58 m



Coldex Location, MADX

$$V_{crab} = \frac{cE_0 \tan(\theta/2)}{\omega \sqrt{\beta_{cc}\beta(s)}}$$

Assuming pi/2 phase advance between the CC & Observation point

$\beta x = 41.559$ m, $\beta(s) = 100$ m, Freq $= 510$ MHz, E=120 GeV

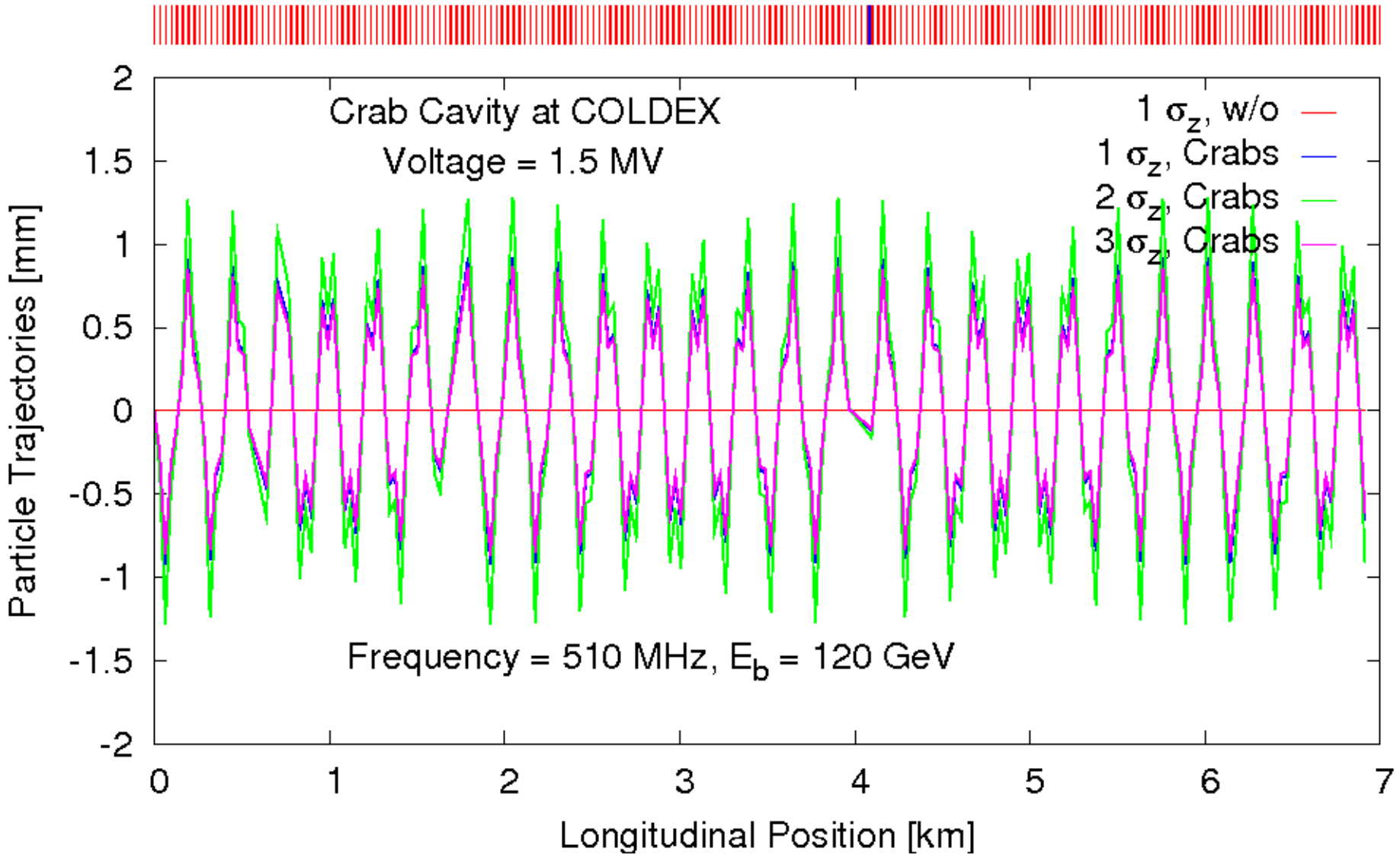
Assuming 1.5 MV: $\theta/2 = 8.6$ mrad ($\lambda_{rf} >> \sigma_z$)

Orbit excursion ($\sigma_z = 7.5$, 15.0, 22.5 cm) $= 0.6$, 1.3 1.9 mm

Coldex Location, MADX

Crab Voltage = 1.5 MV (E_b = 120 GeV)

$\theta/2 \sim$? mrad, $1\sigma_z$ = 7.5 cm



More Items

Impedance spectra (Morita-san calculating)

Detailed beam dynamics (perhaps for after)

RF-loops (waiting for Akai-san)

Autocad-CATIA files for the cryostat (not available)

LER -or- HER cavity (should we pick high voltage -or- low trip rate)

Dog-leg -or- movable -or- install/uninstall ?

Approximate schedule

- KEK-B runs till June 2010, earliest availability ~summer 2011
- LHC compact cavities ~ summer 2013 (assuming 2 yr construction, $$)

Beam Step I: Commissioning

Feasibility of crab cavities in a hadron machine (circulate & beam survival)

- Injection (26 GeV), Ramp (26-120 GeV), Coast (120 GeV, 270 GeV)
- 1-12 bunches, 3-5 x 10^{10}/bunch
- εn: 3.75 μm, Tunes: 26.125, 26.18

Cavity performance

- Static & dynamic frequency tuning (510-511 MHz)
- Phase tuning (zero crossing from minimum orbit)
- Cavity ramping (0-1.5 MV)
- Reliability & trip rate (with & w/o beam)

Machine protection, interlocks and worst case scenarios

- example: one turn failure (voltage or phase)
- Long term orbit, tune stability

Instrumentation & Specs

SPS BPMs (single plane, 100?)

Closed orbit +/- 3 mm, resolution $\sim$? microns

LHC BPMs (double plane, 4? possibly more):

Resolution $<$ 0.3 microns (closed orbit, turn-by-turn)

Bunch-to-bunch variations (for example 50 ns spacing)

Tune Measurement (Qmeter, BBQ): 10^{-3}, 10^{-4}

Emittance (scanners, BTVs):

Measure 1% emittance growth/hr (induced noise maybe produce more)

Headtail monitor, Wide band pickup

Intra-bunch characteristics

BCT, Fast-BCT

eCloud monitor (some effect was proposed by L. Wang a while ago)

KEK-B Experiments, Electrons

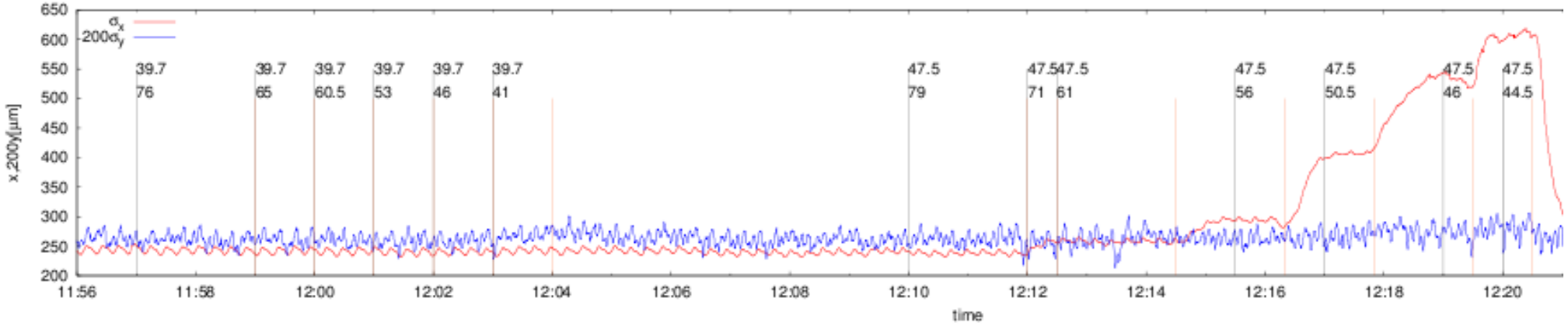
What has been done

- Noise studies and emittance growth $\rightarrow$ RF phase noise specifications
- Instability driven by beam-beam between sigma-pi mode
- Crab dispersion measurements

Future experiments

- Accumulation of beam with crab-on
- Crab cavity ramping and effect on the beams
- Detailed study of RF parameters due to a trip
- Beam survival after RF trip (currently aborted for safety)

KEK-B Experiments, RF Noise



Systematic noise experiments performed at KEK-B with & w/o beam-beam

First effects of noise observed at 0.03 deg phase noise

Effect on emittance observed close the the betatron spectrum

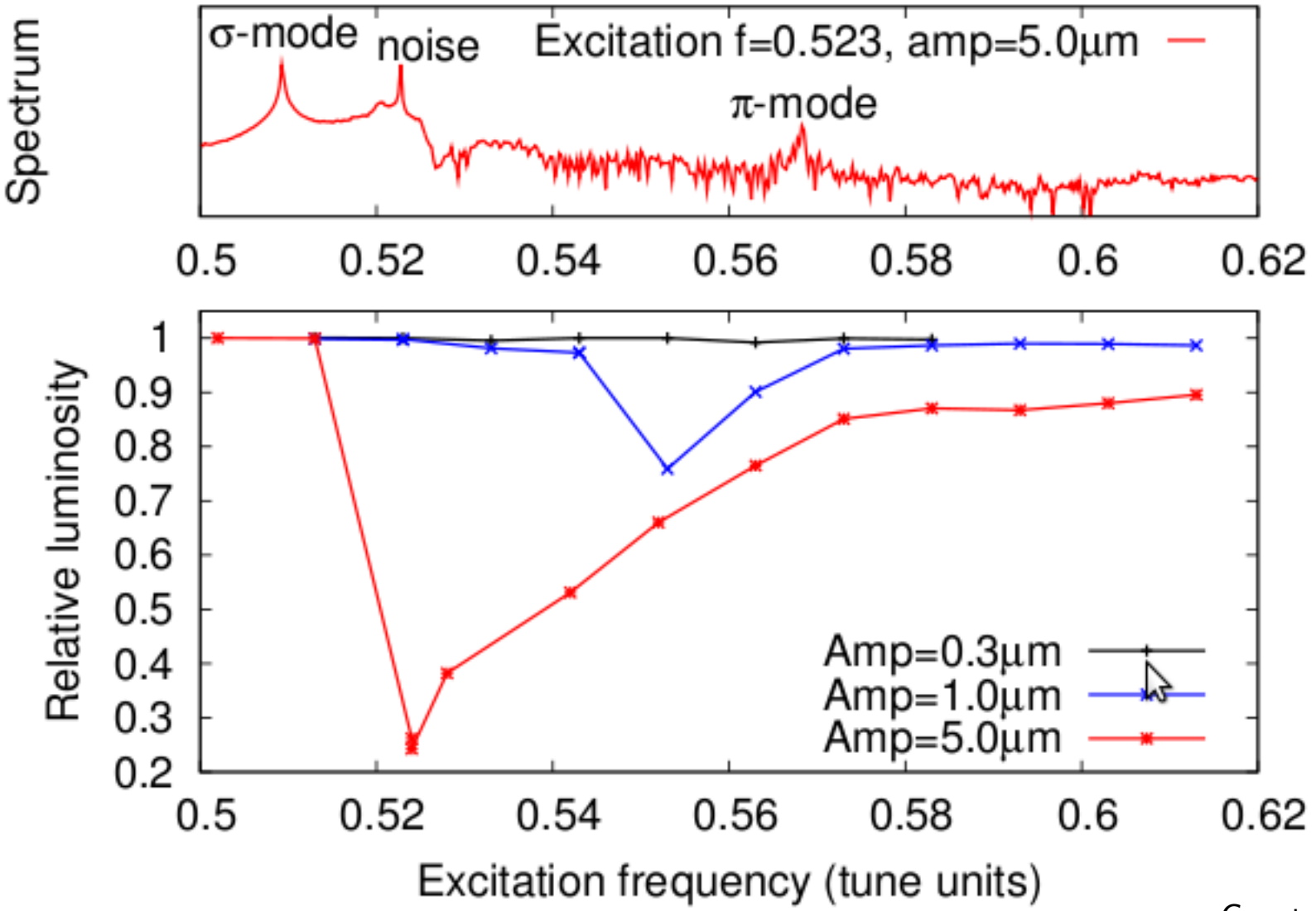
Effect is observed at lower noise levels in the presence of beam-beam

Courtesy R. Tomas

KEK-B Experiments, RF Noise

Beam-beam driven Coherent peak observed between the sigma-pi mode

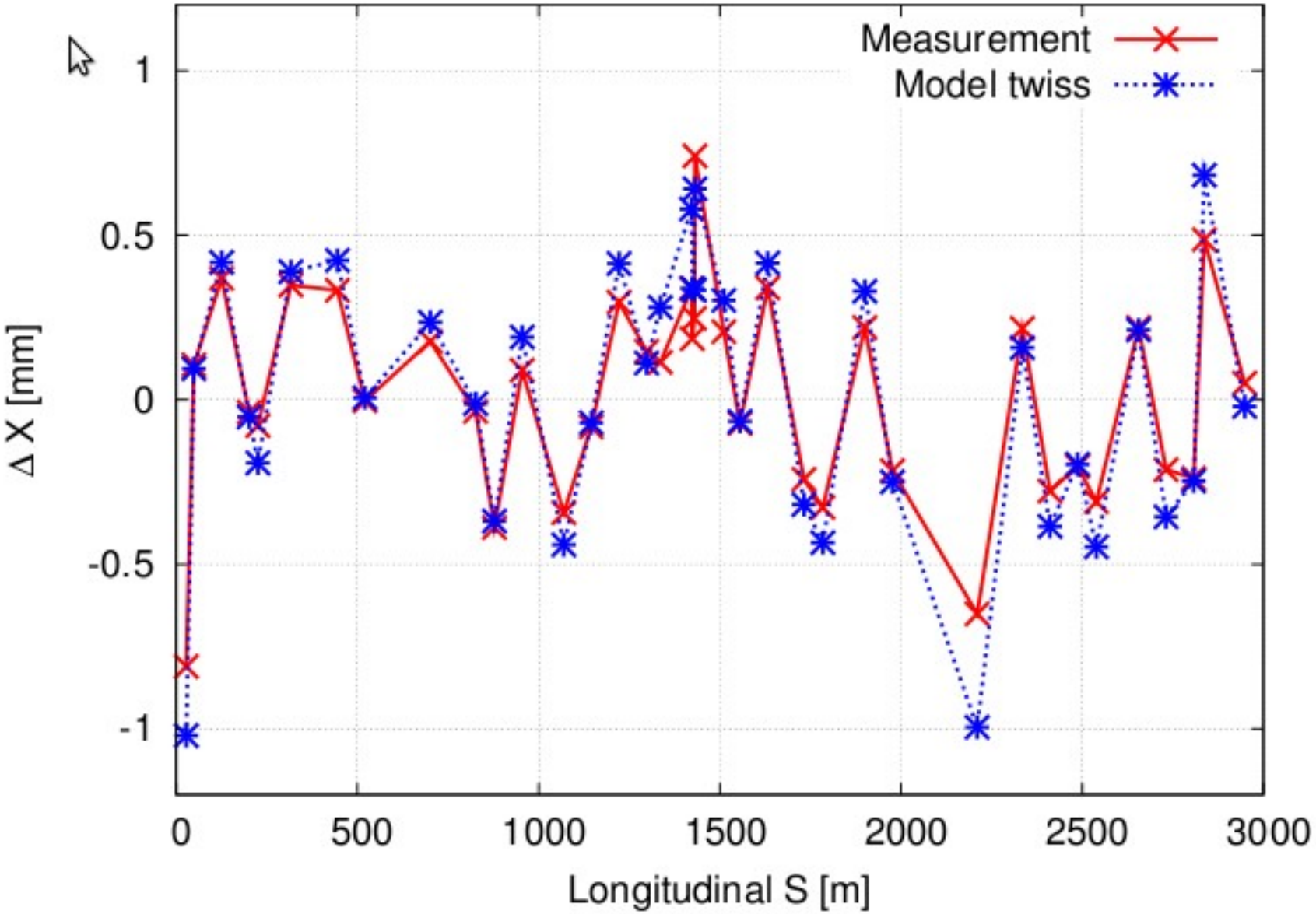
Leads to rapid emittance growth and luminosity degradation



Courtesy R. Tomas

KEK-B Experiments, Crab Dispersion

Very good agreement with the model



Courtesy R. Tomas

SPS Test Objectives, Protons

Safe beam operation (low intensity) & reliability

- Tests, measurements (orbits, tunes emittances, optics, noise)
- Collimation, scrapers to reduction of physical aperture with & w/o crabs
- DA measurements (possible ?)

Intensity dependent measurements (emittance blow-up, impedance)

- Coherent tune shift and impedance
- Instabilities
- Beam-beam effects (BBLR – tune scan, current scan)
- Other non-linearities (octupoles)

Operational scenarios

- Accumulation of beam with crab-on & crab off
- Beam loading with & w/o RF feedback & orbit control
- RF trips and effects on the beam
- Energy dependent effects
- Long term effects with crab-on, coasting 120 GeV