Energy spectrometer cavity BPM

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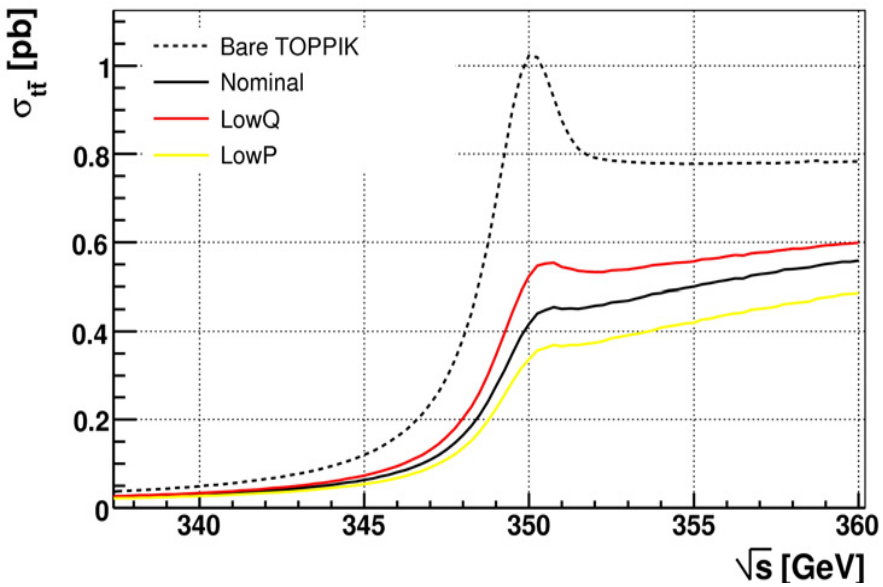
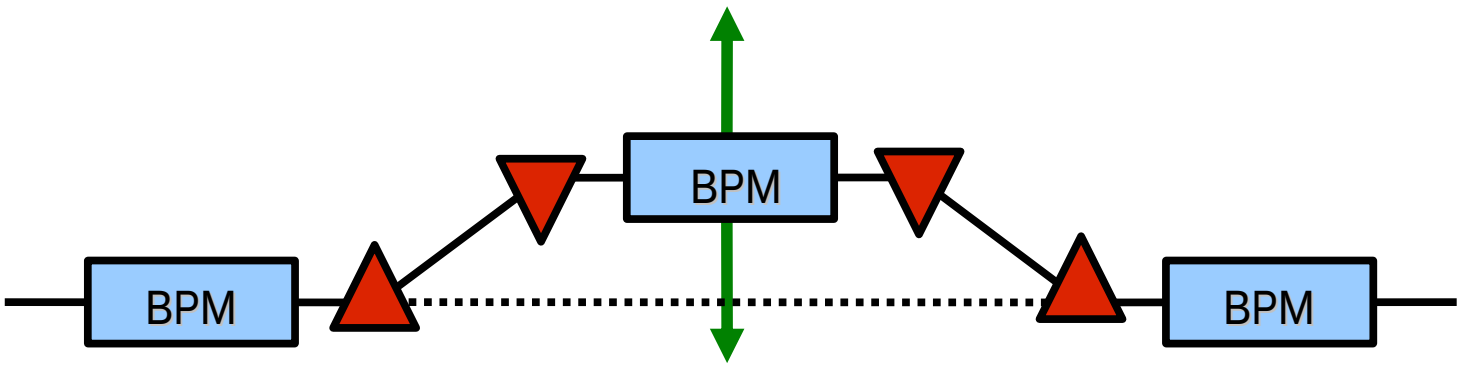
Threshold physics

- ILC will be a precision machine
  - Energy measurement corner stone for <500GeV physics
  - 10 MeV to 50MeV precision required
- ILC baseline 4 magnet chicane
  - 5mm deflection at mid chicane
  - 10s nm BPM resolution required

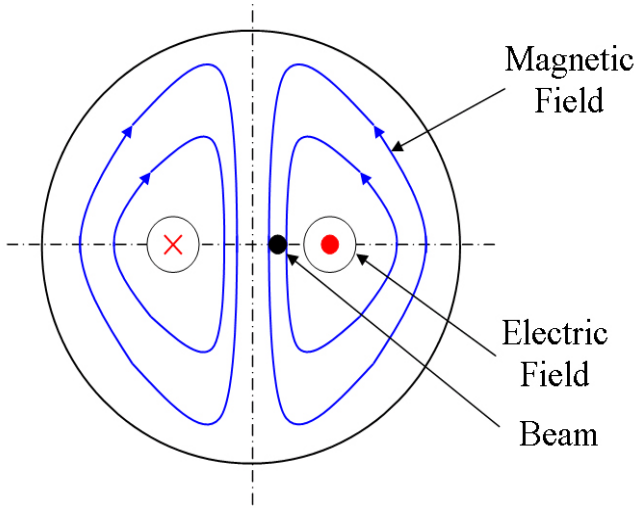


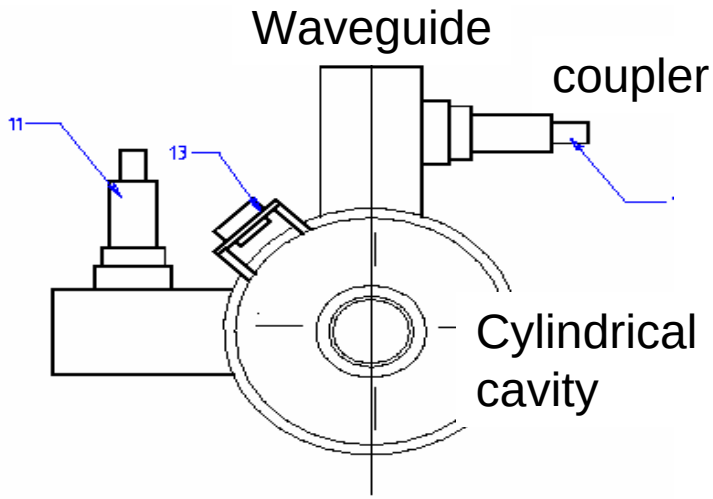


Important technology for the whole ILC beam delivery system

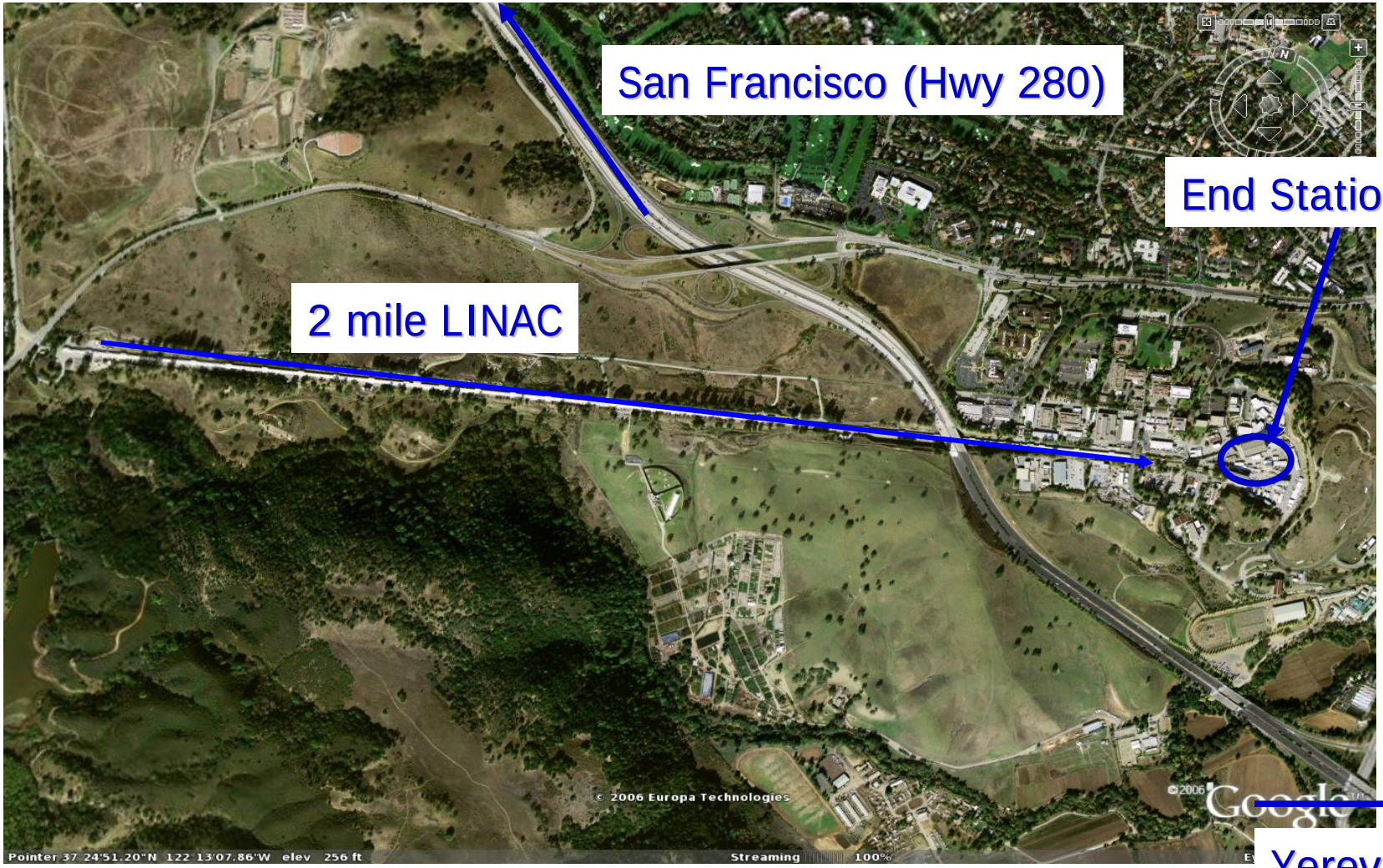
Beam position monitors (BPMs)

- Beam position monitors essential diagnostic for accelerators
  - Beam orbit in accelerator
  - Specialist applications such as energy spectrometer
- Many different varieties exist
  - Operate via electromagnetic interaction with structure placed around the beam
    - Button (1mm - 10μm)
    - Stripline (100 μm - 1 μm)
    - Resonant cavity (1 μm - 20 nm)
- Resonant cavity
  - Beam passage sets up EM standing wave in structure
  - Voltage in TM_{110} Mode depends linearly on beam position in cavity
  - Microwave radio frequency signal read out via waveguide and receiver electronics

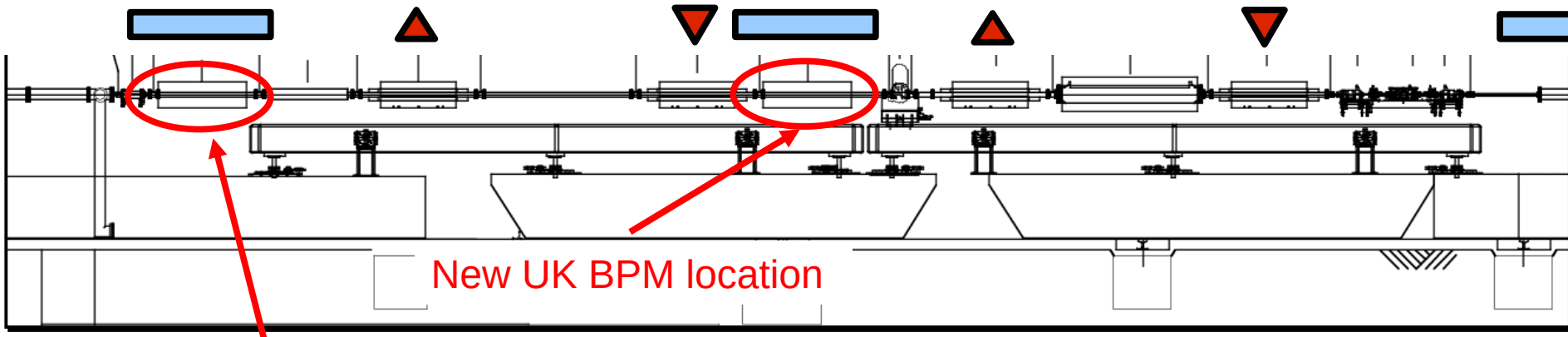


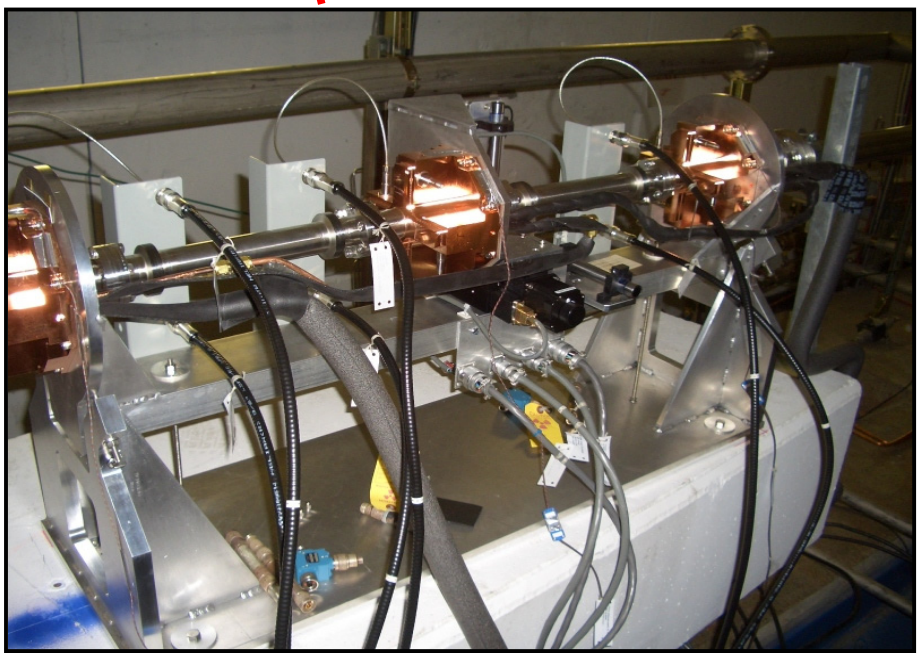


SLAC End Station A



SLAC End station A



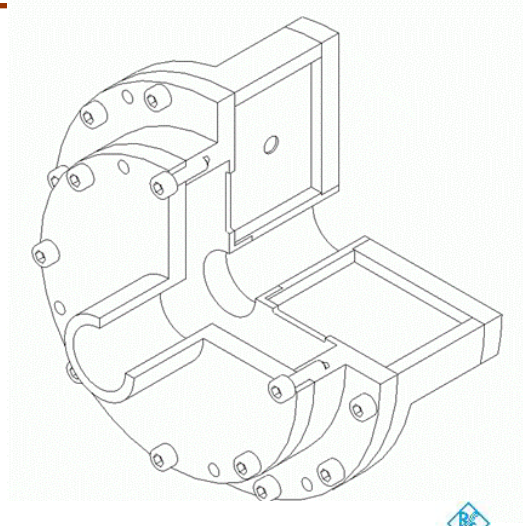


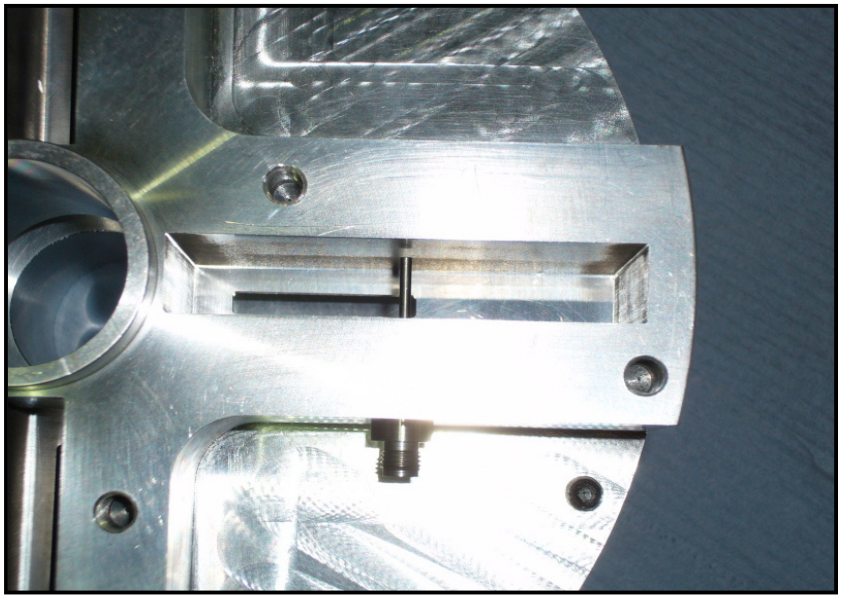
- Plan to install Cu prototype in Jan/Feb 07
  - Simple mover calibration system
- Continuous analysis & improvement of ESA BPM data
  - BPM resolution ~200-700nm
  - Systematic drifts of ~500nm

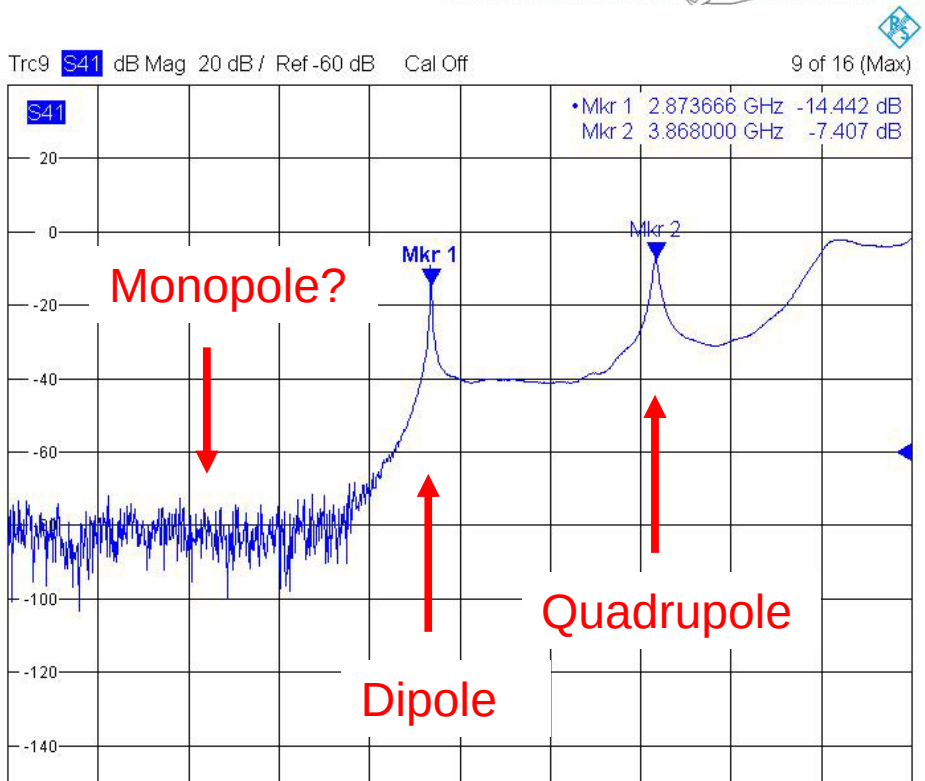
SLAC linac cold BPM prototypes

Cavity design

- New S-band cavity design
  - 2.88 GHz, Q_{ext}~2000, τ=250 ns, σ~10-20nm
- Aluminium 1st prototype finished
  - First tests positive, small monopole coupling
- Start copper vacuum prototype next week

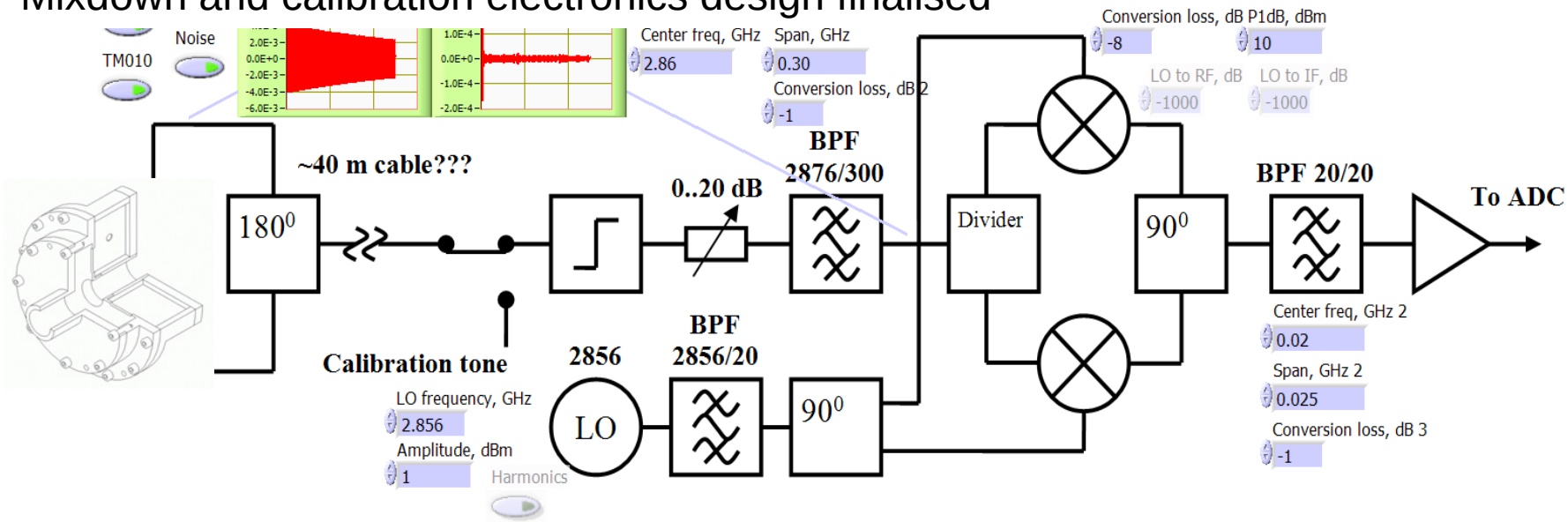


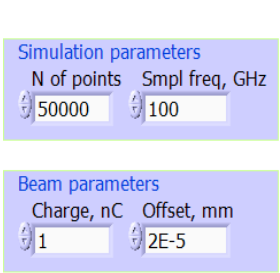


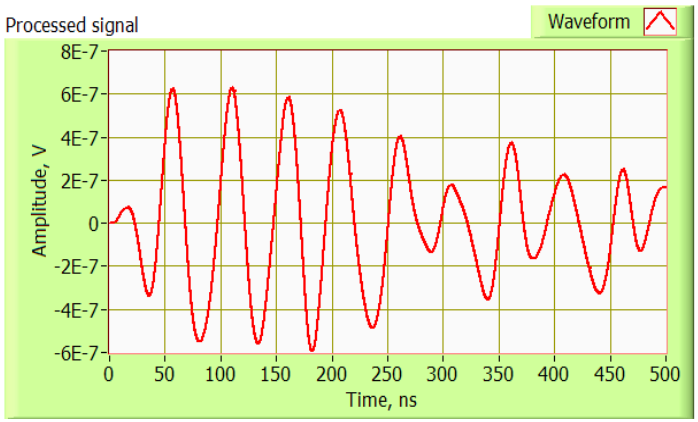


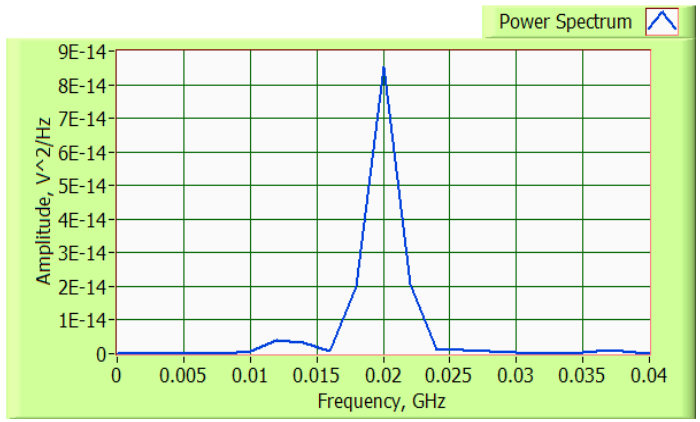
Electronics design

Mixdown and calibration electronics design finalised

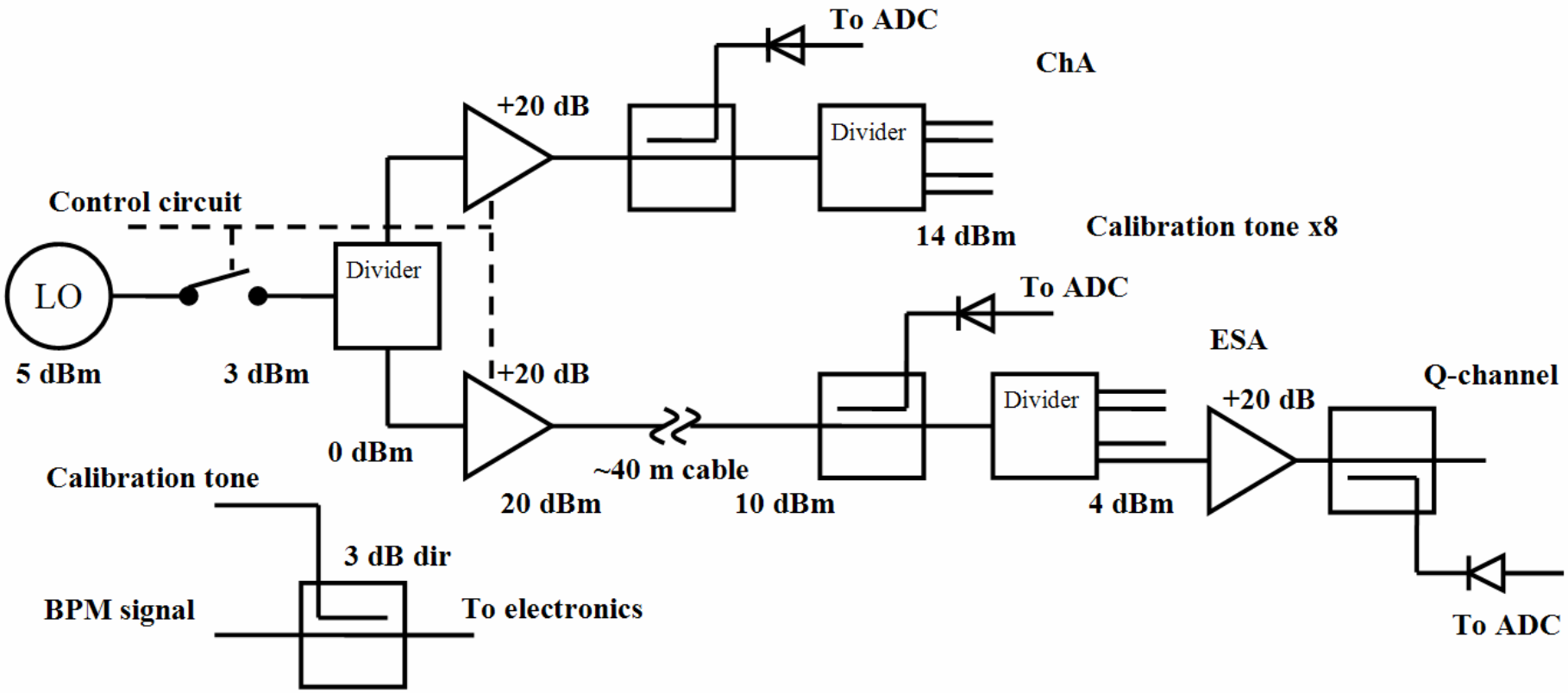






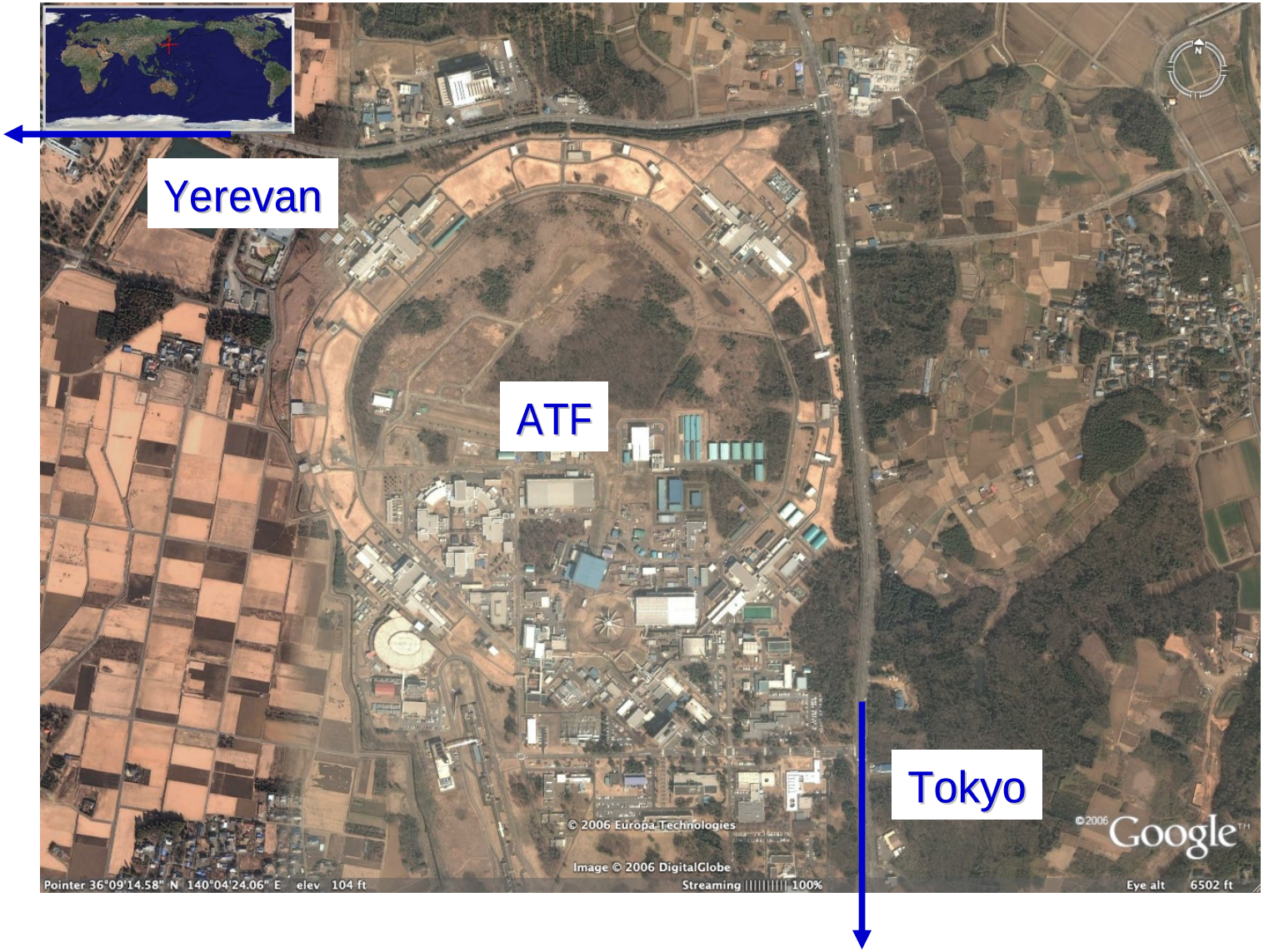


Calibration scheme



- Simple calibration system
- Components defined (diodes a bit of a problem)

KEK


Yerevan
ATF
Tokyo
© 2006 Europa Technologies
Image © 2006 DigitalGlobe
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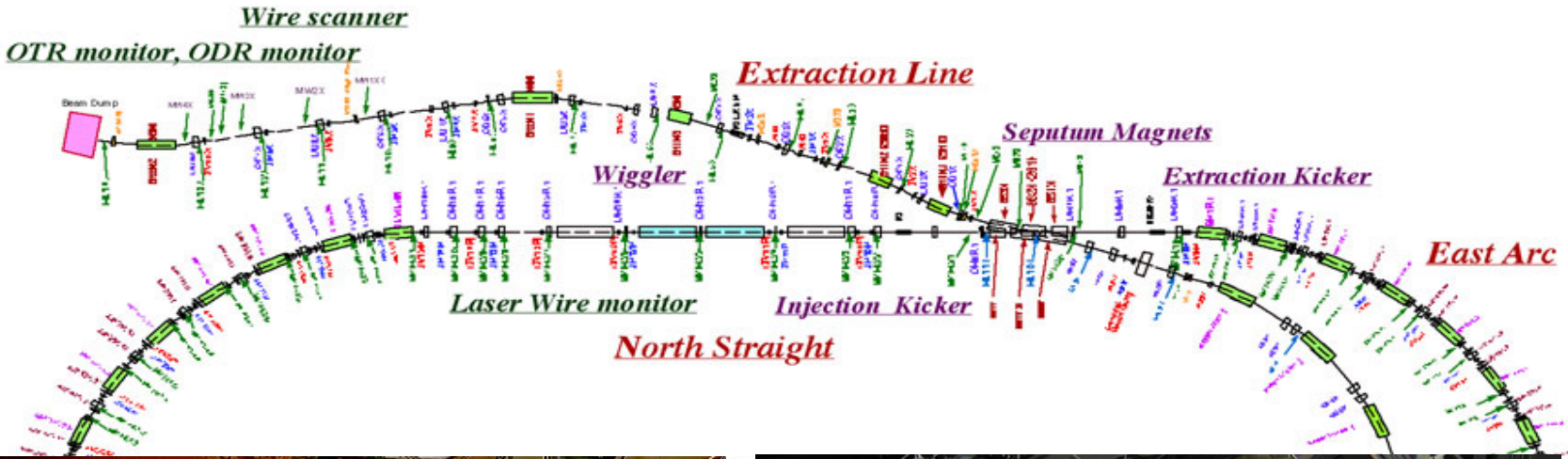
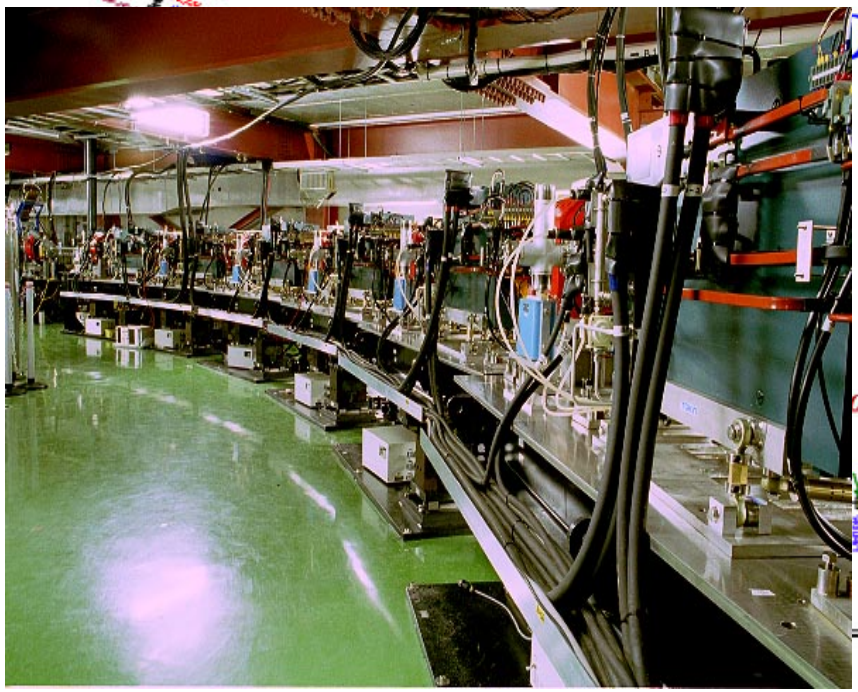
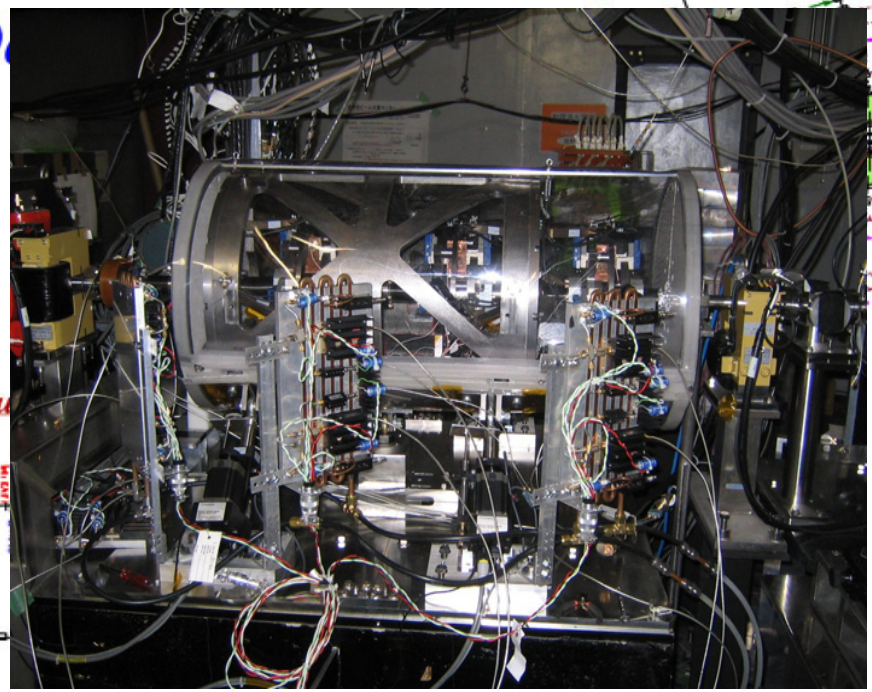
Pointer 36°09'14.58" N 140°04'24.06" E elev 104 ft
Streaming 100%
Eye alt 6502 ft

KEK ATF(2)


Wire scanner
OTR monitor, ODR monitor
Extraction Line
Septum Magnets
Wiggler
Extraction Kicker
East Arc
Laser Wire monitor
Injection Kicker
North Straight



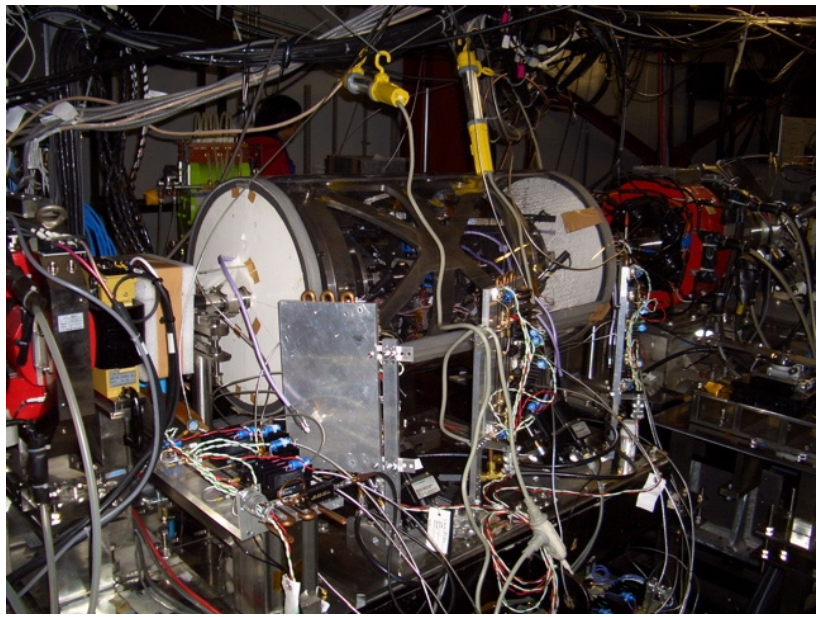


KEK ATF(2)

- World's most advanced BPM system
  - UK collaboration leading the nanoBPM physics program and analysis
  - Best resolution ~15nm!
- ATF2 cavity system
  - Worlds largest number of high resolution cavity BPMs
  - AL's Electromagnetic design
  - Analysis based on WP9 developments
- Spectrometer specific measurements
  - Long term stability (>4 hours)
  - Tilt resolution
  - Multi-bunch performance

Typical runs ~few hours

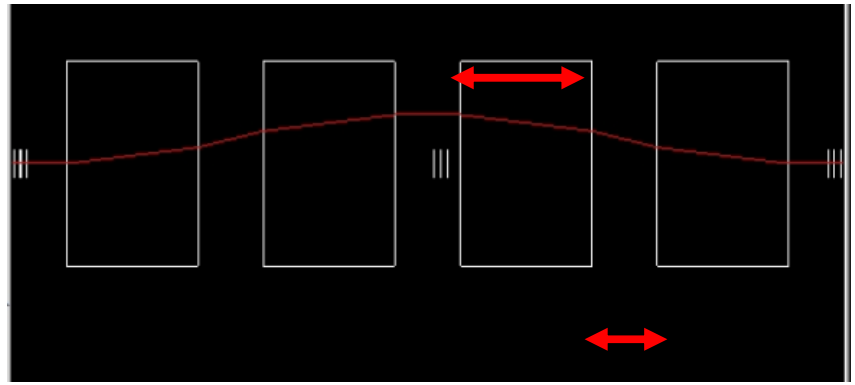
QuickTime™ and a
TIFF (LZW) decompressor
are needed to see this picture.

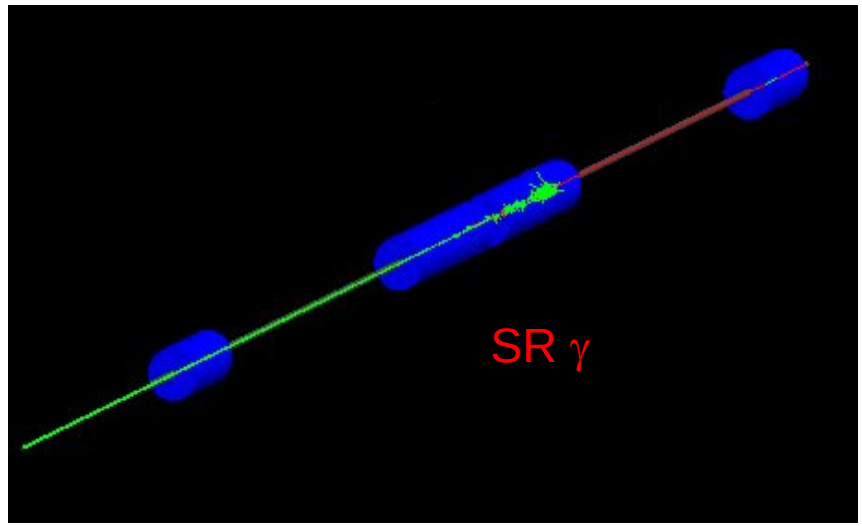


Simulation and integration

- Magnets critical for spectrometer performance
  - Design & specification
  - Characterization and measurement
  - Operation (ramping during luminosity production)
- Backgrounds and systematics
  - Synchrotron radiation
  - Halo, charged background effects
- Systematics
  - Z pole calibration?
  - Energy loss to the IP

Geant4/BDSIM simulations of spectrometer





Summary

- RHUL/UCL/Cambridge collaboration
  - BPM design more or less finalized
  - Make first S-Band cavity next few months
  - Test in SLAC in Spring 07
- T474 Spectrometer test beam
  - Full magnet test beam during 07
  - Magnet refurbishment and installation now!
- ATF/ATF2
  - Use BPMs for systematics studies
  - 3/4 magnet chicane
  - Calibration/gain drifts
  - Electromagnetic centre tracking