Experiments at ATF2 - KEK

Marc Ross (Fermilab) for
ATF Collaboration and ATF2 Project

ILC Detector Test Beam Workshop

Background

- Accelerator Test Facility at KEK (ATF) Mission:
  - **Prove design of ILC injector systems and ILC Beam Delivery Systems**
  - **Develop technology for precision beams**
  - **Train Accelerator Scientists and Engineers**
- Organization:
  - **The ATF is an MOU-based International Collaboration**
    - http://atf.kek.jp/collab/ap/about/organization/index-organization.php
    - (August 2005)
  - **19 signatories including ILC institutions**
  - **Led by Professor Junji Urakawa, KEK**
    - International Collaboration Board
    - Technical Board
    - System / Coordination Group

Present Status

- Unique facility for ILC RD
  - **Damping ring low emittance tuning & coherent effects**
  - **Machine – Detector Interface instrumentation and Controls Development**
  - **Beam Delivery Demonstration Project Construction**
- A large fraction of the non-SCRF ILC beam testing can be done at ATF
- Operation
  - **Fully supported by KEK**
  - **22 weeks / year; 12 shifts / week (down Jul/Aug/Sep)**
  - **Excellent opportunity for students**

ATF2 Project

- Beam Delivery Optics, Tuning, Control and Instrumentation Demonstration
  - 2008 - 2010
  - **35 nm vertical beam size**
  - **2 nm stabilization**
- Fully international project with funding and in-kind contribution from all three regions.
- Project meetings 2x yearly
  - http://ilcagenda.linearcollider.org/categoryDisplay.py?categId=47
- (Strong SLAC participation)
- Project Leadership: Andrei Seryi (SLAC) & Toshiaki Tauchi(KEK)

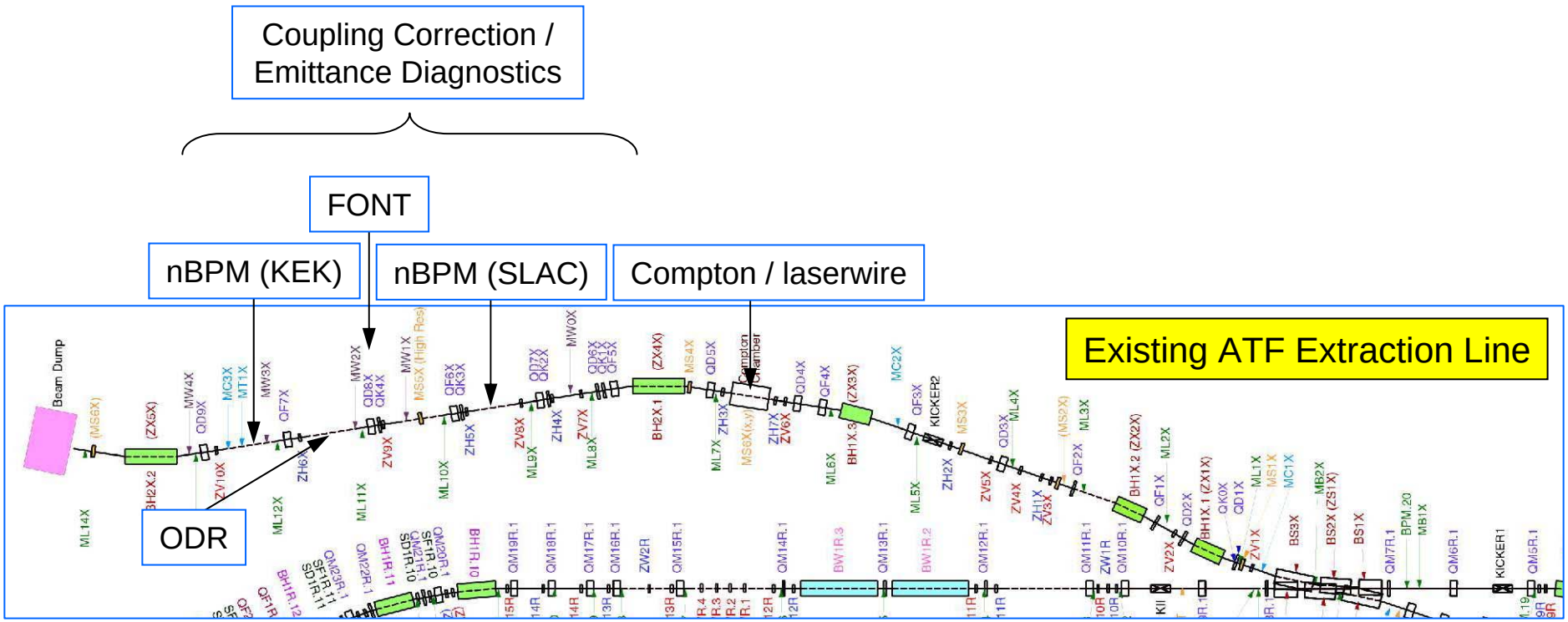
ATF – extracted beam

- ε_x = 2 nm-rad
- ε_y = 15 pm-rad
- σ_z = 8mm
- I = 1.4e10 / bunch
- n_b = 3
- t_b = 150 ns
- E = 1.28 GeV
- typ. β = 5m
- typ. σ_x,y = 40 x 10 μm
  - **(ILC ring extraction)**

- 2008:

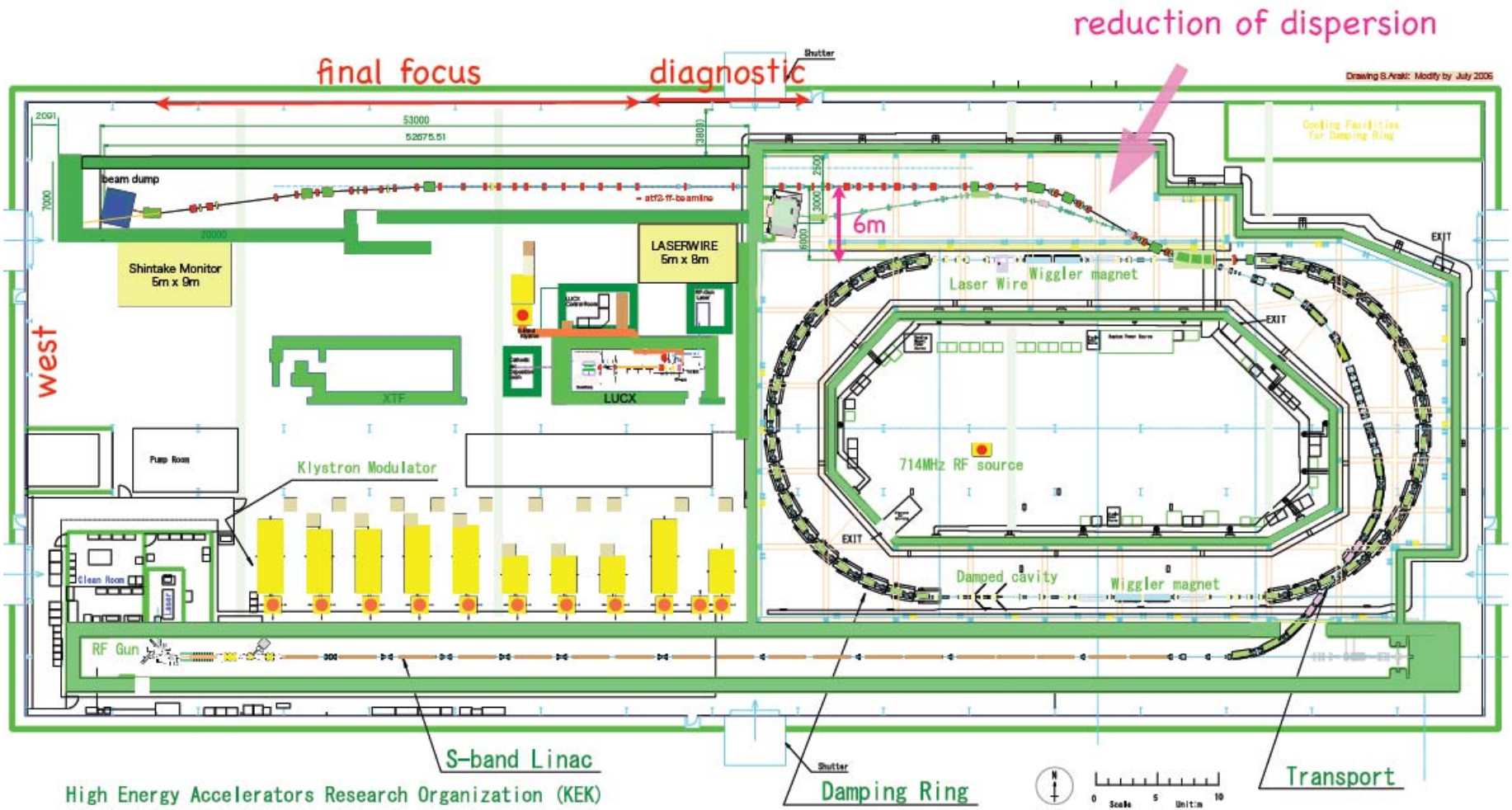
- I = 2e10
- n_b = 3 (60)
- t_b = 300 (150) ns
  - **1% (2%) ILC**

ATF extracted beam optics -



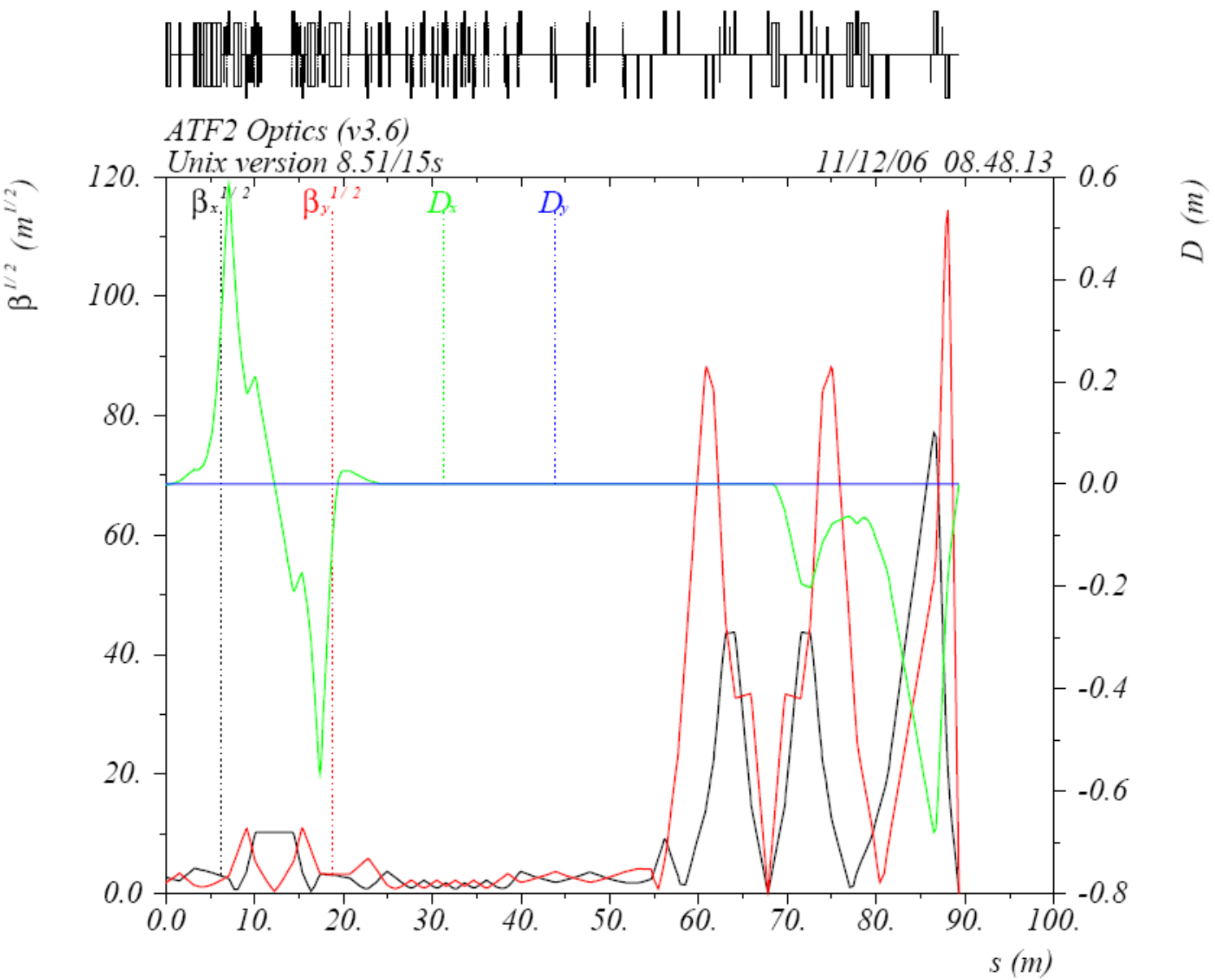
KEK - ATF

Optics v3.5, 1 July 2006



High Energy Accelerators Research Organization (KEK)

ATF2 Optics


ATF2 Optics (v3.6)
Unix version 8.51/15s
11/12/06 08.48.13
$\beta_x^{1/2}$
$\beta_y^{1/2}$
D_x
D_y
$\beta^{1/2}$ ($m^{1/2}$)
D (m)
s (m)
120.
100.
80.
60.
40.
20.
0.0
0.6
0.4
0.2
0.0
-0.2
-0.4
-0.6
-0.8
0.0
10.
20.
30.
40.
50.
60.
70.
80.
90.
100.

Extracted Beam Instrumentation / MDI 2001→ present

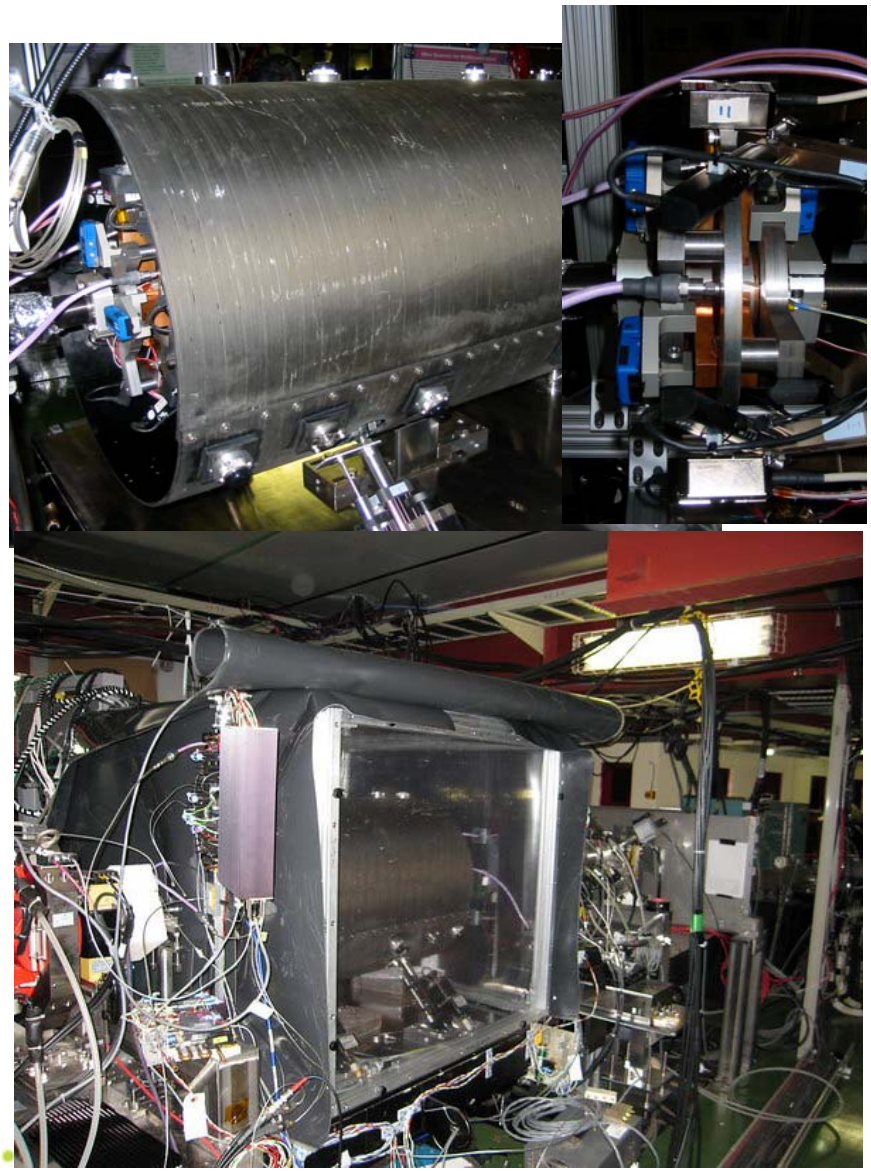
- Energy Spectrometer (MDI) (S. Boogert)
  - **UK Univ, Cockroft, US Univ, SLAC, KEK, Japanese Univ**
  - **demonstrate 1e-4 abs E online monitor**
- Laserwire (Instrumentation) (G. Blair)
  - **UK Univ, Adams KEK, SLAC**
  - **demonstrate 1um resolution**
- Fast feedback (Controls) (P. Burrows)
  - **UK Univ, KEK**
  - **intra-train 'IP' feedback**

Extracted Beam Instrumentation / MDI 2001→ present (2)

- Optical Diffraction Radiation
- Compton-based generation of polarized e+
- Ultra-high resolution optical transition radiation
- Cavity Beam Position Monitor
- High resolution wire scanners
- Fast avalanche photo-diode detectors

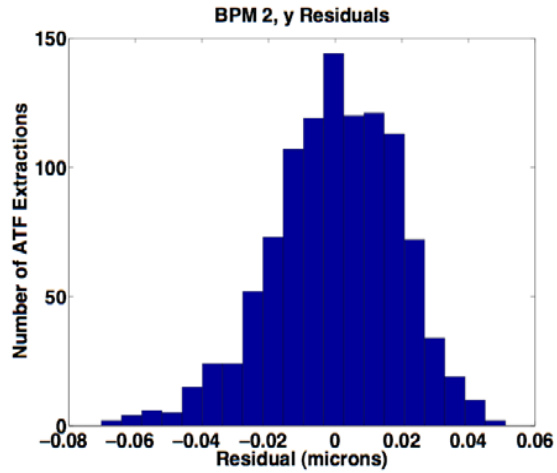
NanoBPM: ATF → ATF2

- Precision BPM test stand
- Processing electronics and algorithms
  - **First/early pulse calibration**
  - **Automation and readout**
- BPM stabilization, thermal, mechanical
  - **Thermal monitoring and control**
  - **Position (nanoGrids)**
  - **Triplet stabilisation with wrt to other BPM systems**

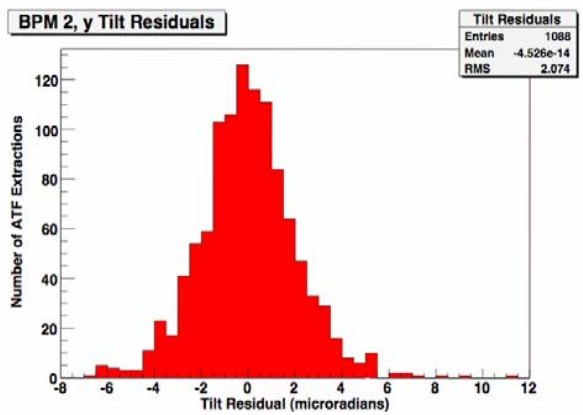


NanoBPM program in ATF2

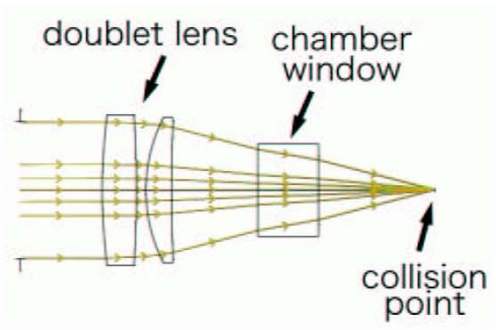
- Resolution performance verified
  - **Vertical 15.6nm**
  - **Angular vertical 2.1 μrad**
  - **Stability over multiple hours**



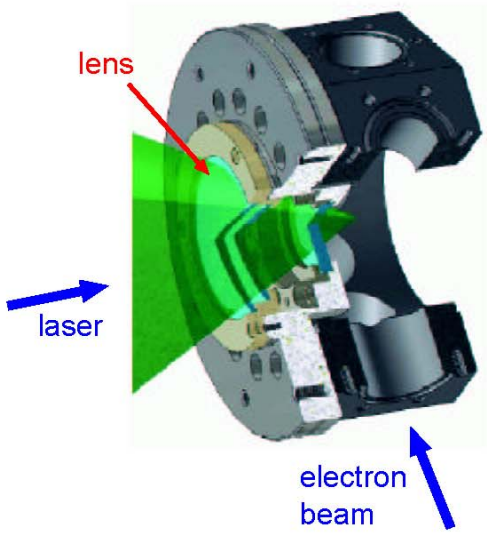
- Longer term plans
  - **Calibration systems**
  - **Long term stability**
  - **Full exploitation of BPM monitoring systems**
  - **Electronics noise not dominant**

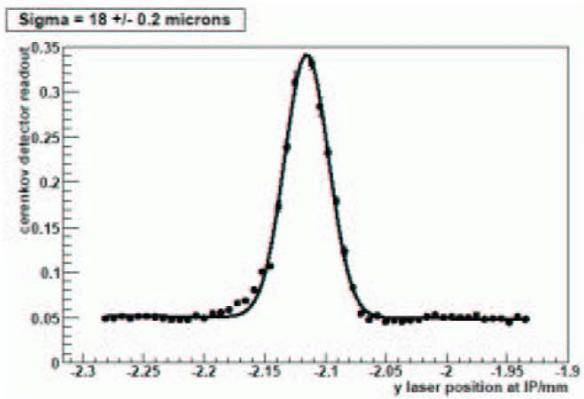


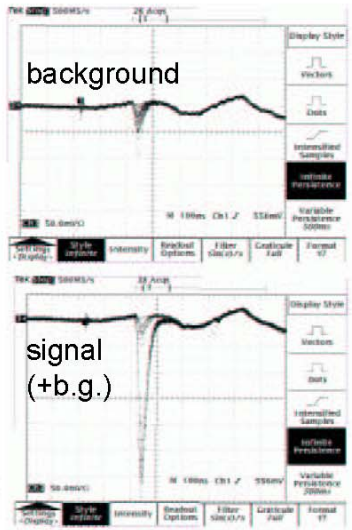
Laser-based Profile Monitor



designed F#2 lens







- Royal Holloway University London
- First scans April 2006

- encourage submission of proposals for the ATF/ATF2 R&D program.
  - **can be submitted from the ATF homepage: http://atf.kek.jp/collab/ap/about/index-new-program.php .**