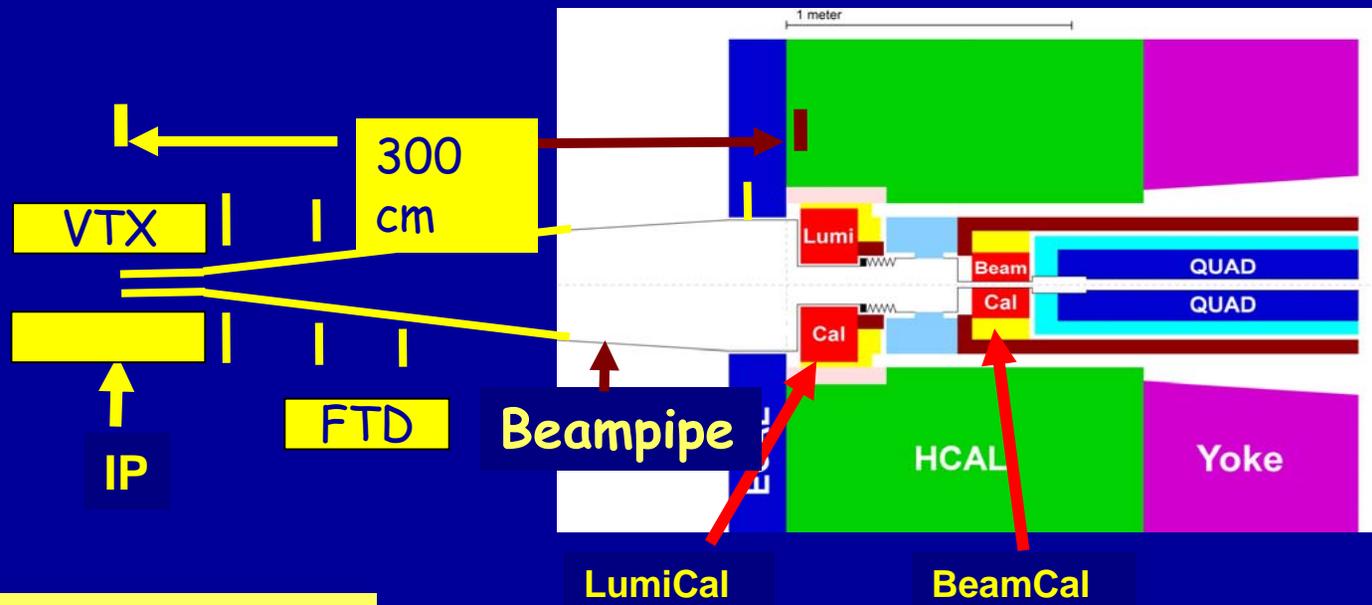


# Testbeam plans for LEP instrumentation

Wolfgang Lohmann,  
DESY

LEP: Luminosity, Energy, Polarisation measurement

# Luminosity Measurement: Very forward calorimeters

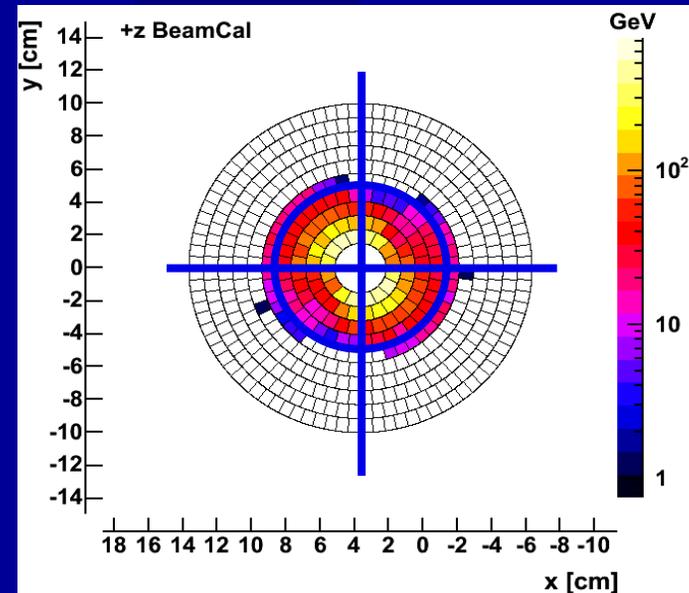


## Challenge: BeamCal

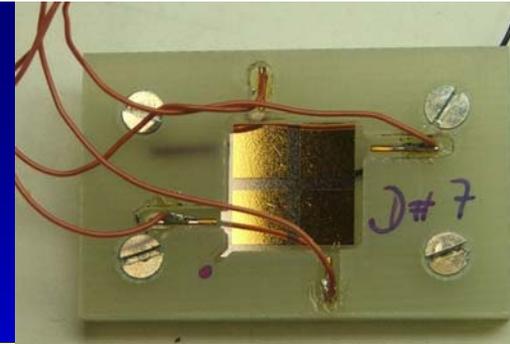
- 15000  $e^+e^-$  per BX, MeV range, total 10 – 20 TeV
- 10 MGy per year



- Radiation hard sensors
- linearity
- compact calorimeters



A sensor prototype:  
1 cm<sup>2</sup> CVD diamond



## Radiation Hardness

Exposure to a ~10 MeV electron beam at  
DANILAC (TU Darmstadt)

April 2006,  
Late 2006

Energy, electron current tunable:  
2.5 - 120 MeV, 1 nA - 50  $\mu$ A

O(MGy)  
per week

JINR Energy few MeV (Microtron)

2006/2007

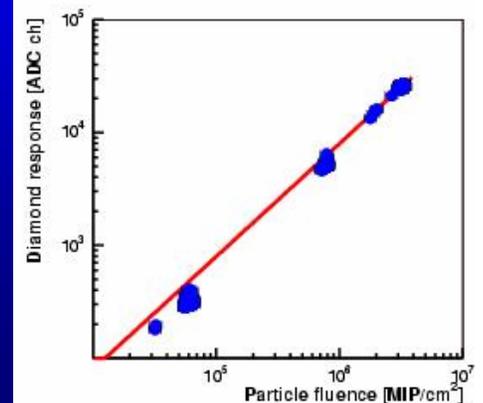
## Linearity

CERN PS

Late 2006/2007

Energy (mixed beam): few GeV  
 $10^3$  -  $10^6$  particles in ~10 ns

Repeat and refine previous measurements  
(better flux calibration)



## Compactness

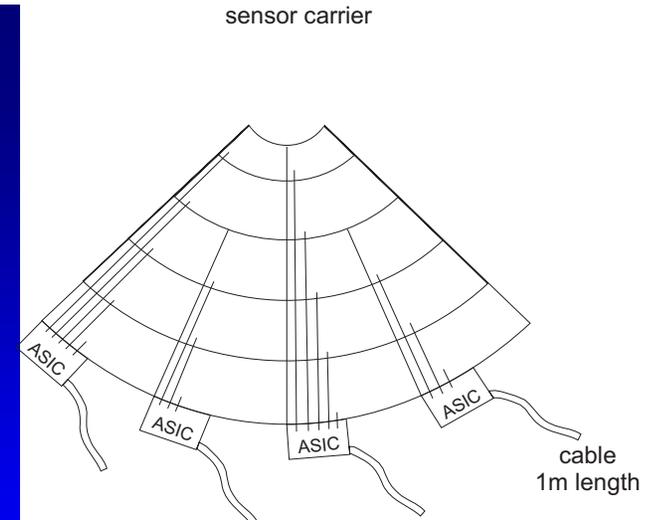
Thin instrumented  
sensor plane  
prototypes

DESY

Few GeV electrons,  
EUDET infrastructure

Goal: Test of assembled sensor planes, measurement of the performance ...

Prepare the assembly of a prototype



Late 2006/  
2007/2008

# ESA Testbeam Program

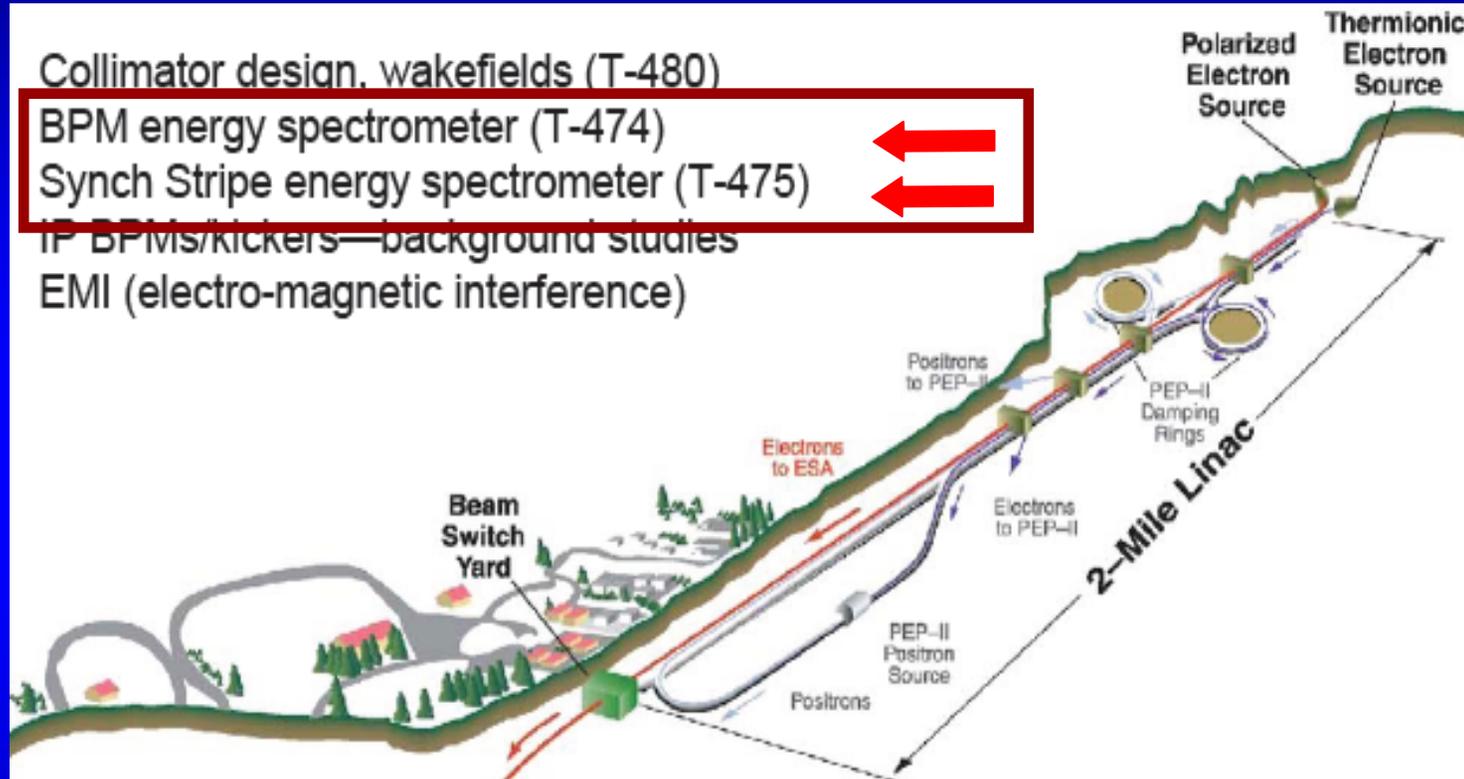
Collimator design, wakefields (T-480)

BPM energy spectrometer (T-474)

Synch Stripe energy spectrometer (T-475)

IP BPMs/kickers—background studies

EMI (electro-magnetic interference)



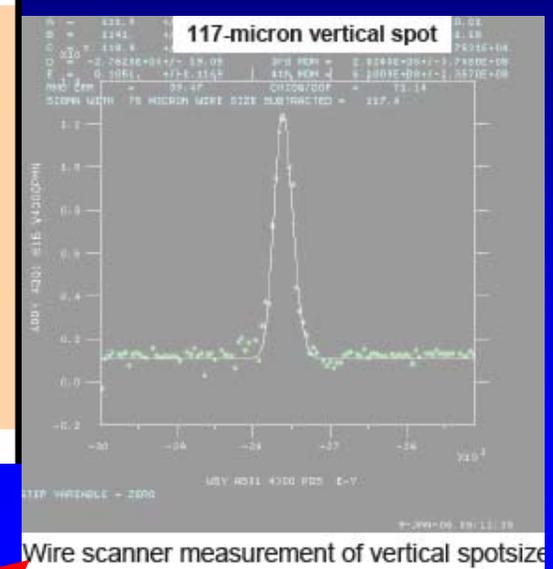
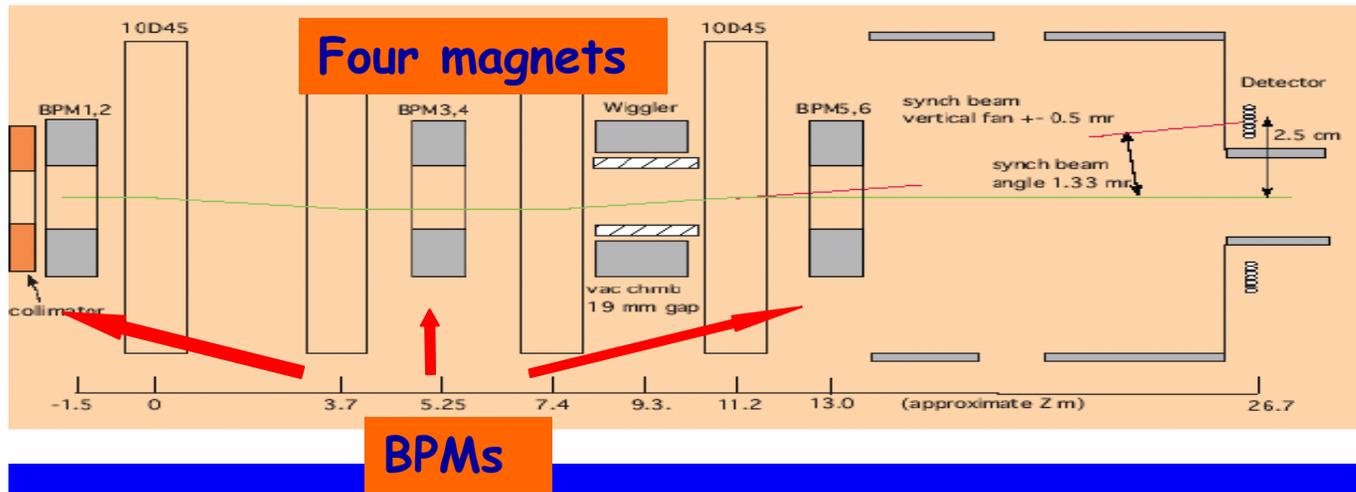
<http://www-project.slac.stanford.edu/ilc/testfac/ESA/esa.html>

PAC05 paper/poster: SLAC-PUB-11180, e-Print Archive: physics/0505171

CCLRC	LLNL	QMUL	U. of Bristol	UMass Amherst
CERN	Lancaster U.	SLAC	UC Berkeley	U. of Oregon
DESY	Manchester U.	TEMF TU Darmstadt	U. of Cambridge	
KEK	Notre Dame U.	U. of Birmingham	UCL	

End Station A

# Energy Measurement: BPM energy spectrometer

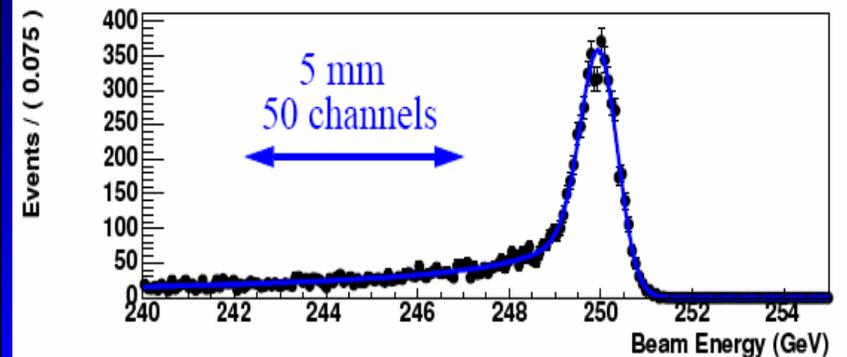
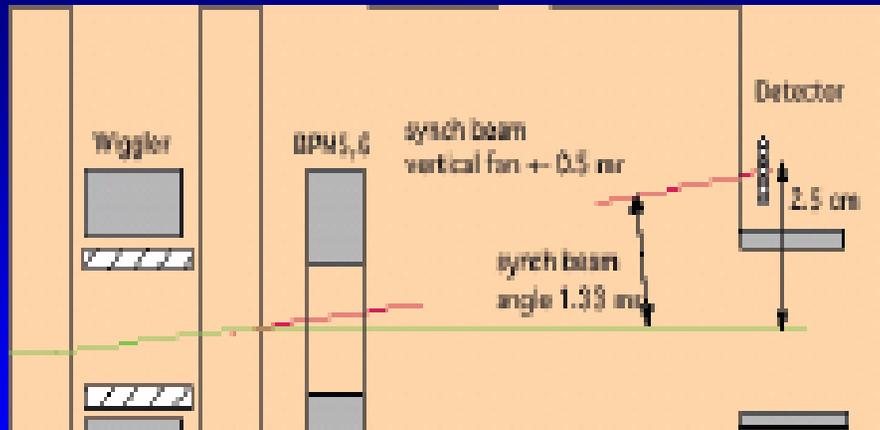


- Initially, will use SLAC Linac BPMs. New electronics based on nanobpm work at KEK, being developed by UC Berkeley.
- New BPMs will be designed at UC London in collaboration with SLAC experts
- Will test ILC Linac BPMs being developed by C. Adolphsen and G. Bowden

Commissioning run in Jan., very successful; prepared for data taking in march 2006

Goal: Proof of principle of the beam momentum control at  $10^{-4}$  accuracy

# Synchrotron stripe energy spectrometer



Beam Energy mapped to y position on detector plane  
Order 1 GeV/mm sampled at 100  $\mu$ m pitch

Use quartz fibers: low efficiency, but rad hard  
and some background tolerance. Large dynamic  
range with MAPMTs. 64 channels/PMT.



Prototype quartz fiber detector ( $8 \times 100 \mu$ m,  $8 \times 600 \mu$ m), with multi-anode PMT is installed in the A-line SLM

## ESA Testbeam Program

- In addition:
- Collimator wakefield studies (optimisation of the shape)
  - Bunch length studies (within LCLS activities)
  - EMI studies

28.5 GeV  $e^-$  beam, bunch charge  $2 \times 10^{10}$ , bunch length  $\sim$  ILC

### Data taking

Two weeks April 2006  
Two weeks July 2006  
Two 2-week runs in  
2007 (planned)

- Future plans:
- background studies for BPM/kickers (FONT) (generate spray beam using a target-mimic pair background, study influence on instruments with an instrumented mockup of the ILC IR),
  - EMI

# ESA Testbeam Program

Future of SLAC testbeams:

-primary beam

available up to 2008 (end of PEP-II era)

later (LCLS era) under discussion;

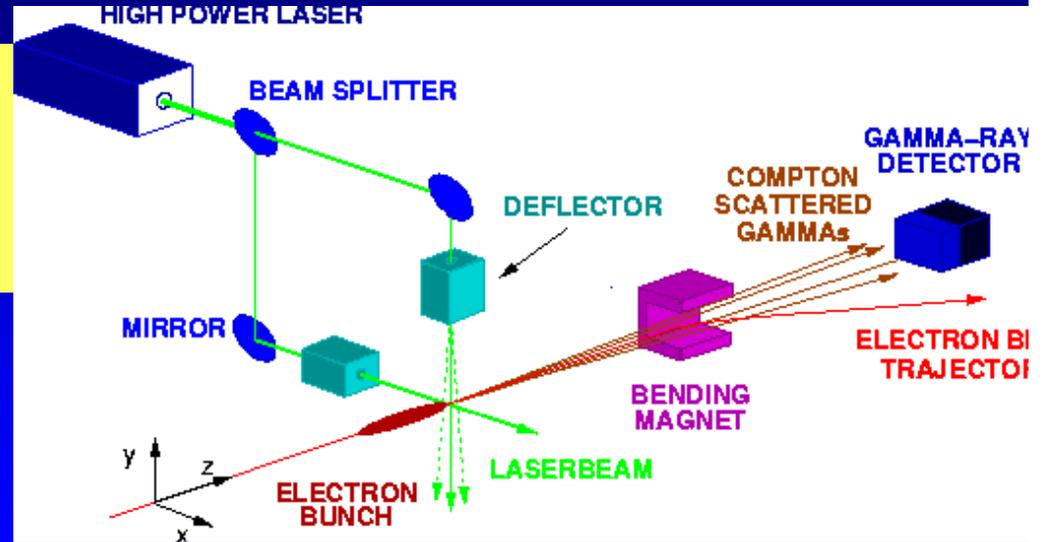
14 GeV (LCLS), up to 50 GeV

but: ESA needs a new PPS system

-secondary beams (e.g, pi, p), 1 - 25 GeV, 10 Hz) might be available

# Beam Diagnostics with a Laserwire

Determination of the transverse profile of bunches with a Laserwire



Test set-up at PETRA (DESY)

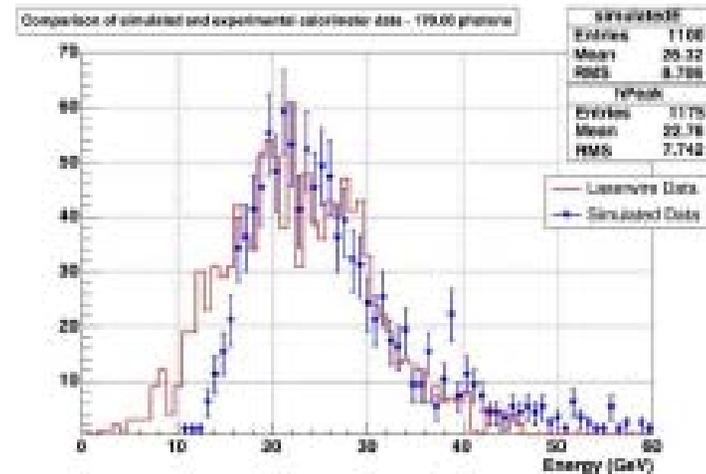


Figure 4: Calorimeter energy spectra for data and simulated events.

# Beam Diagnostics with a Laserwire

2-dim scans

PETRAII

2006/2007

Laser wire  
calorimeter

DESYII  
ATF

2006

2006-2008

Emittance  
measurement  
with laser wire

ATF2

planned

Upgrade of the  
PETRA system

PETRAIII

2008

# ATF Testbeam at KEK

ATF 2006

- **High quality beam extraction**

*Huge amount of vertical emittance growth at EXT:*

*multi-pole component of kicker and septum are under study.*

*Double kicker system will be replaced by the **SLAC kickers**.*

- **nm resolution BPM test & demonstration**

*Development of new precise mover & new cavity-BPM electronics.*

- **Fast feedback test & demonstration**

*Basic test of feedforward and feedback are under way.*

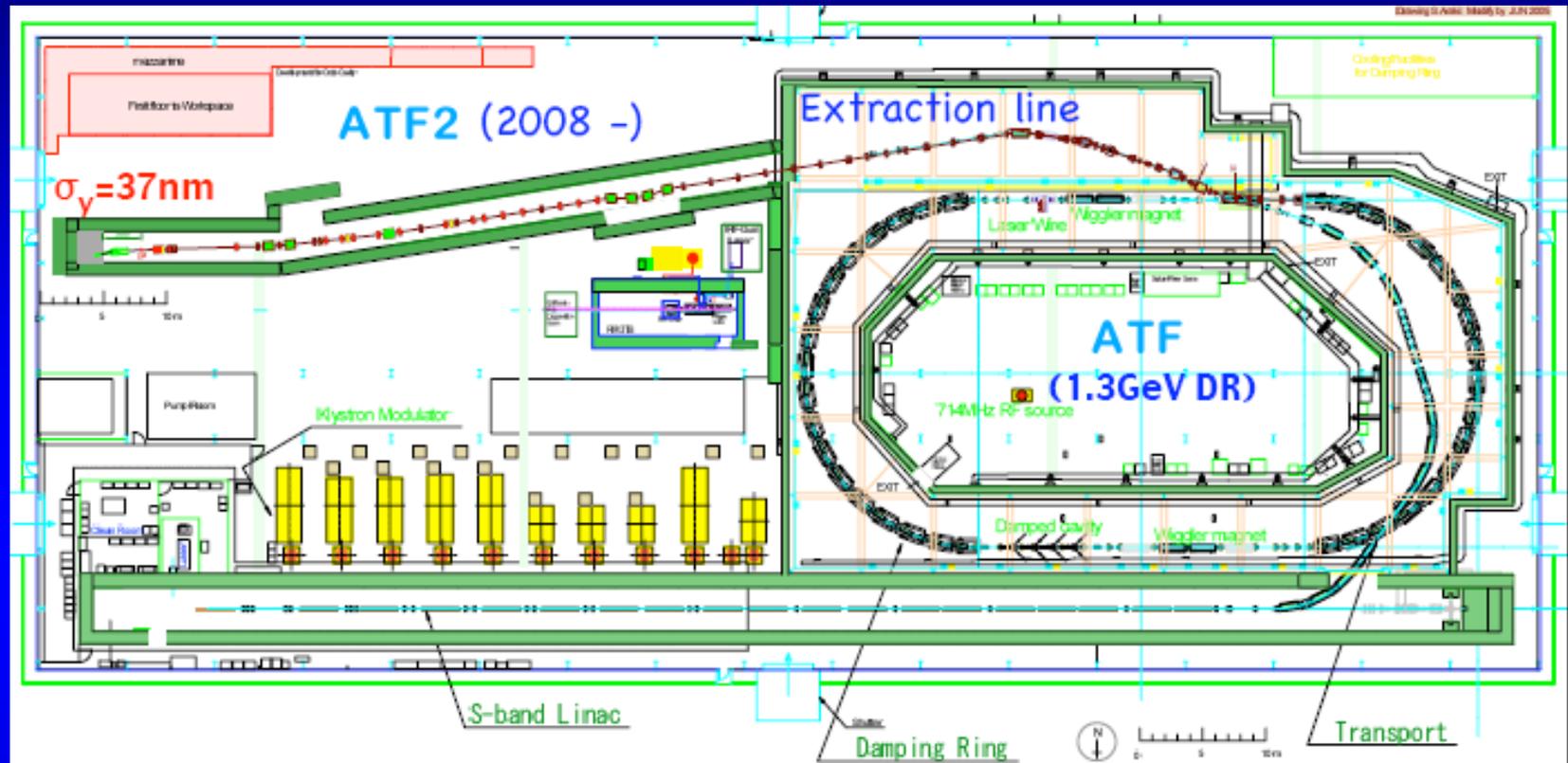
*Fast feedback test by 3 train extraction (ILC-like bunch spacing) will be done.*

***FONT3, FONT4***

- **Instrumentation developments**

*Pulsed LW, ODR monitor, FONT, Straightness monitor, etc.*

# ATF Testbeam at KEK



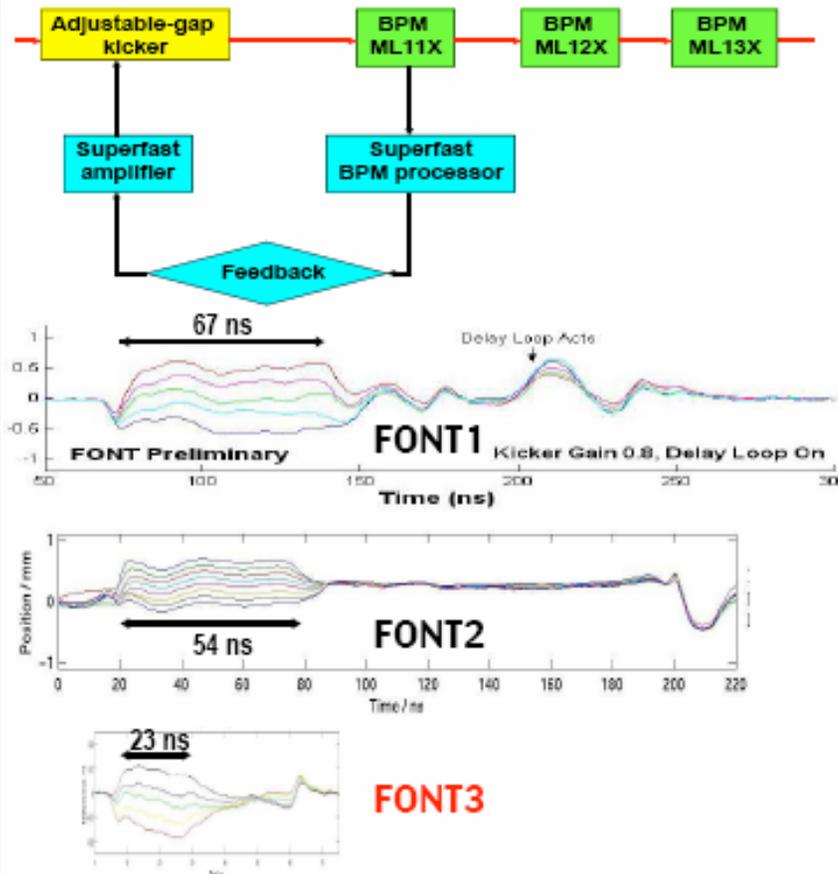
Goal: Ensure controlled collisions of nm beams!

ATF	1.3 GeV e <sup>-</sup>	beam size few $\mu\text{m}$	
ATF II	"	37nm	(2008)

# ATF Testbeam at KEK

## Intra-train Beam Feedback at ATF-EXT

Diagram of FONT3 @ ATF



FONT  
(Feedback On Nanosecond Timescales)

- Queen Mary Univ.
- Daresbury Lab.
- Oxford Univ.
- SLAC
- KEK

FONT1/2 (2002-2004) ... NLCTA  
latency 54 ns 65MeV, 170ns, (87ps bs)

**FONT3 (2004-2005) ... ATF**  
**latency 23 ns**

FONT4 (2005-2006) ... ATF

- Digital FB system
- Latency 100 ns

Vital component of ATF2 beam stabilisation systems

- Extension of these studies to ATF2 - stabilisation of a final doublet system
- Continuation of the nano-BPM research