ILC WG3 Status and Plan

KURIKI Masao

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History

- 1st (9/22)
  - WG tasks (Kuriki)
  - New idea related to ILC injector (Oide)
- 2nd (10/6)
  - Review of SCLC DRs (Kuriki)
  - Review of SCLC Kickers (Mimashi)
  - First look for Dog-bone DR with SAD (Oide)
- 3rd (10/13)
  - Conventional positron production (Kamitani)
  - Positron production in TESLA (Omori)
  - Electron cloud effect in DR of LC (Ohmi)
- Joint with WG1(10/15)
  - Review of TESLA injector design (Kuriki)

- 4th (10/20)
  - First look for Dog-bone DR with SAD (2) (Oide)
  - Dynamic aperture issues (Onishi)
- 5th (10/27)
  - Fast switching (Takayama)
- 6th (11/2)
  - Polarized electron source atNagoya univ. (Yamamoto)
  - Fourier series kicker R&D at ATF (Naito)
  - Polarized e+ production with Laser Compton scattering (Omori)
  - E+ target damage test at KEKB. (Mimashi)
- 7th (11/10)
  - Discussion for ILCWS.

- 8th (04/11/19)
  - Positron production R&D at BINP (Logachev)
- 9th (04/12/1)
  - Post ILC-WS plan, R&D plan, etc.
- 10th (04/12/15)
  - Positron target experiment at KEKB (Kuriki).
  - Strip-line kicker study plan at ATF (Naito).

Presented materials can be obtained from

http://hirune.kek.jp/mk/ilc/

ILC Asian WG3 management

- The WG is taken once in two weeks.
- Any related topic can be presented.
- The project leader is required to give a short report periodically. Once in a month is desirable.
- Convener : Kuriki
- Vice-convener : Shidara
- Secretary: Alternate
- It is an issue to involve the activities on outside of KEK. Video Conference may be a solution.

Projects

- Demonstration of proof of principle of the fast kicker in ATF (Naito)
- Positron Target Test at KEKB (Kuriki)
- Dogbone examination with SAD (Oide, Onishi)
- Instabilities in DRs (Ohmi)
- 3km DR design (Kuroda)

Demonstration of Proof of Principle for the Fast Kicker - Motivation -

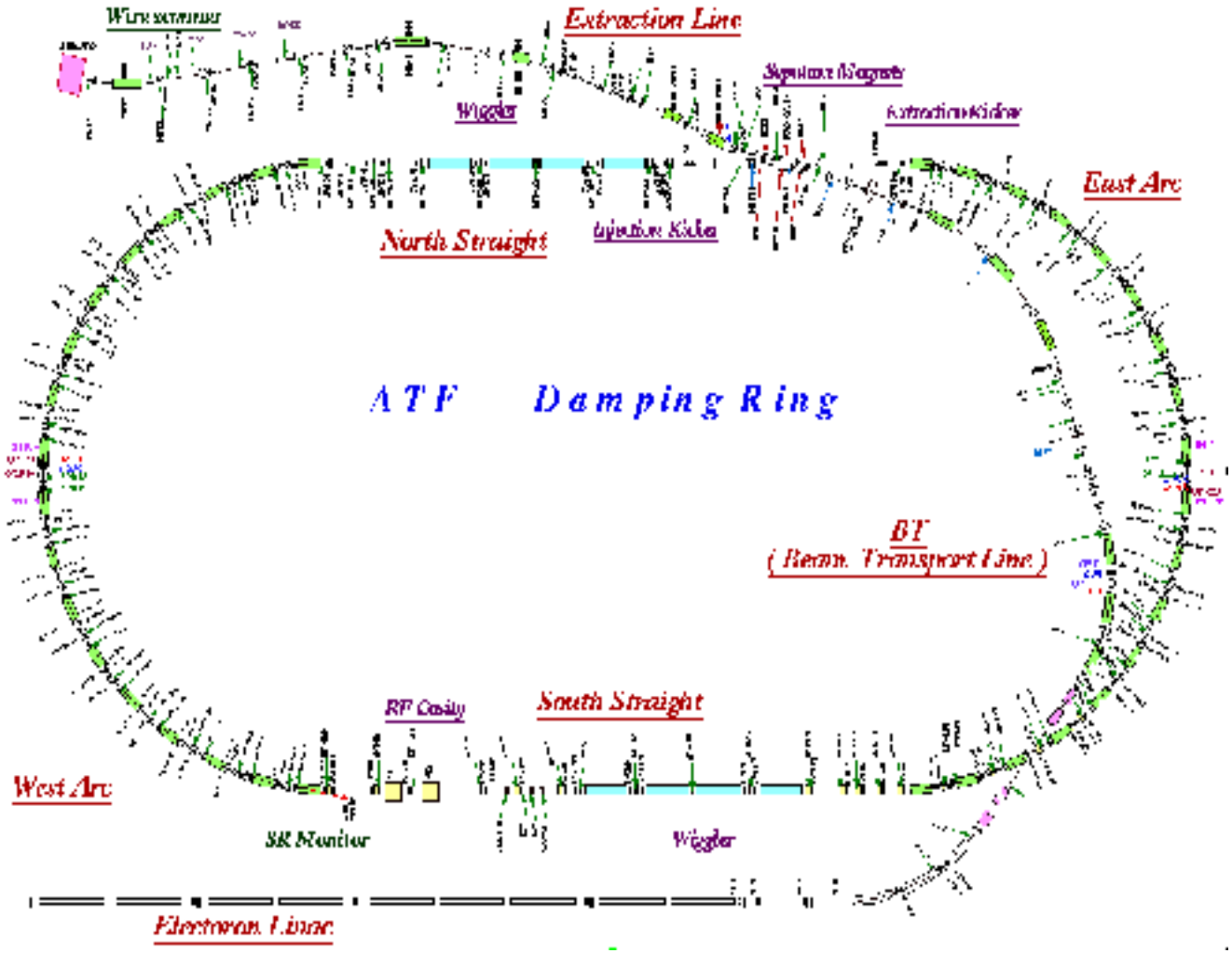
- A fast kicker is a key component to decide the DR layout that will be determined in Snowmass 05.
- Any reasonably enough demonstration has been never carried out for the fast kicker.
- If the short bunch spacing in ILC DR was proved, a smaller DR which has many merits, was realistic.

Motivation (2)

- This is an only experiment which can be carried out quickly.
- The project is already started as a collaboration among KEK, SLAC, and DESY.
- Project leader is Naito (takashi.naito@kek.jp).

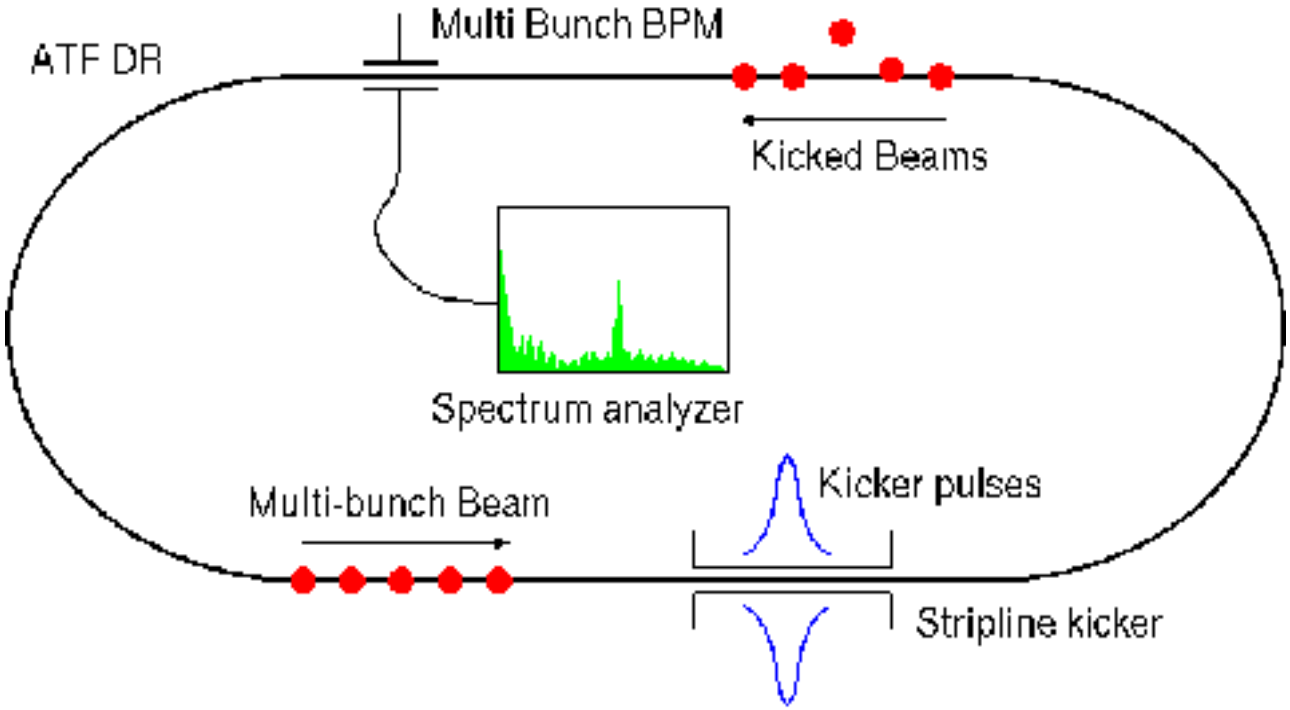
ATF Overview

- E = 1.28GeV
- N = 2×10^{10} e/bunch
- 1 ~ 20 bunches
- $\varepsilon_{x/y}$ - 1.5nm/4pm
- 20 weeks/year
- 2 weeks/month



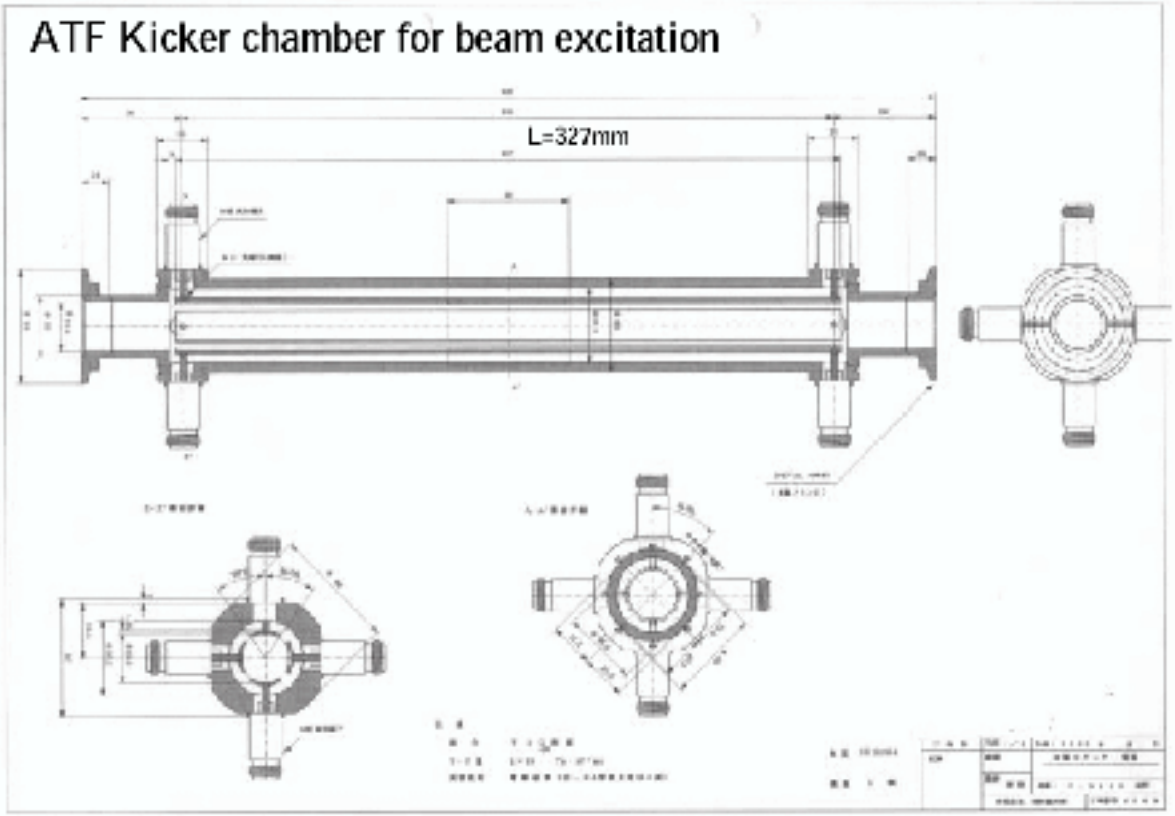
The Experiment

- A strip line kicker deflects Multi-bunch beam to qualify the shortest bunch spacing for the individual beam handling.
- The kick is observed by a multi-bunch BPM as a betatron enhancement .



ATF Strip-line kicker

- 2.2ns rise/fall time (determined by the propagation time).
- 327mm length.
- 10 kV (+-5kV).
- Kick angle ~ 60 urad makes more than 200um displacement.



Fast Pulser

FID GmbH pulse power supply
FPG 5-3000M

Maximum amplitude at 50 Ohm -5 kV

Rise time - 1-1.2 ns

Pulse width at 50% of amplitude - 2-3 ns

Jitter - not more than 100 ps

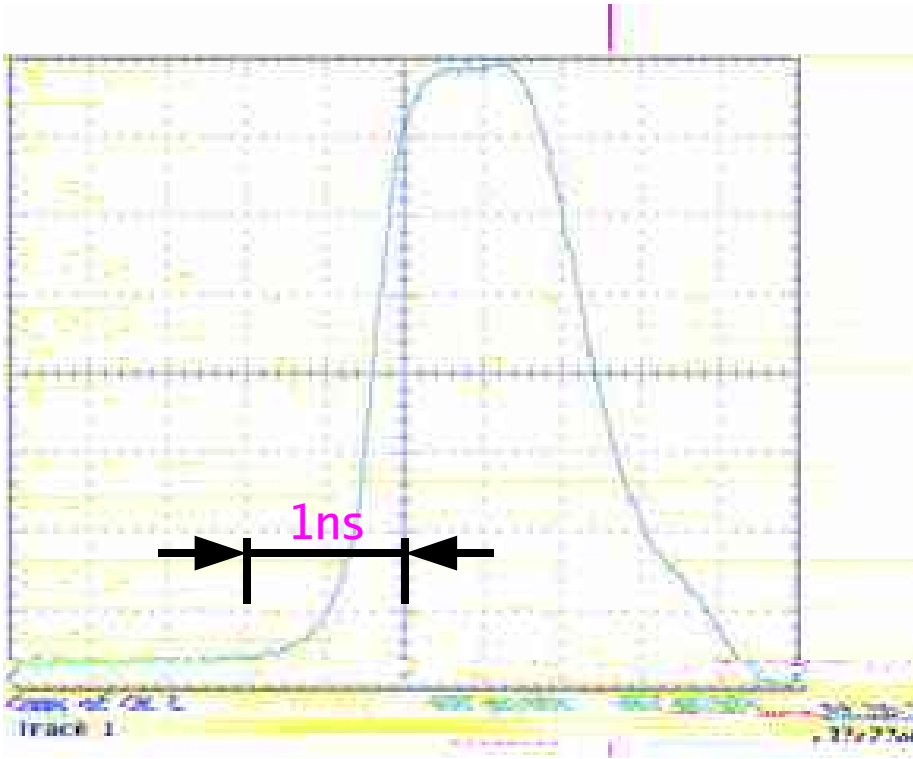
Maximum PRF in burst mode -3 MHz

Delivery - 5-6 months

Warranty - 12 months

Price - 1 pc EUR 53000

2 pcs EUR 99000 (From Naito)

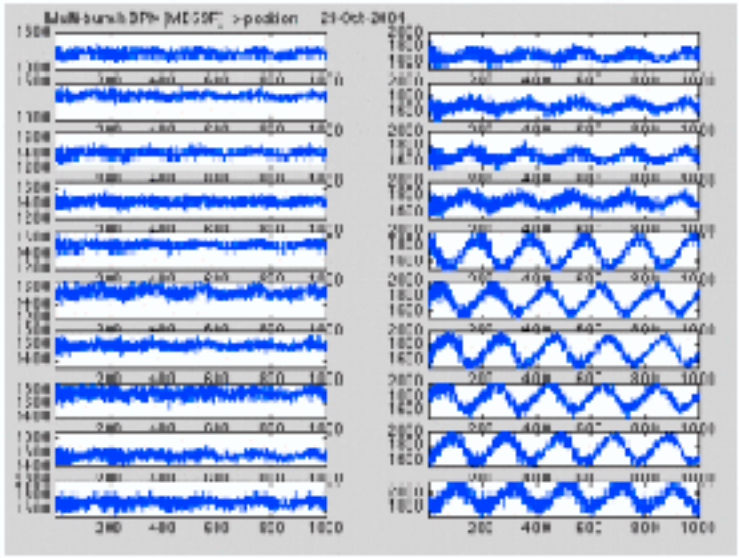


Compatible to ILC requirement!

Multi-bunch BPM

- A button type BPM with FADC turn by turn processing.
- Individual turn by turn position measurement for each bunch.
- By analyzing the data, the betatron oscillation amplitude is obtained with a high accuracy (~several tens um) which is enough to observe the enhancement.

An example of MB oscillation measurement



Schedule

- The strip-line kicker is ready.
- MB BPM will be implemented in January 05.
- The pulser will be manufactured until March 05.
- Several pulsers will be tested.
- The experiment is carried out on May and June 05.

Kicker Projects

- Fast kicker development to extract the beam in ILC format from ATF.
  - Several fast pulser R&Ds are in progress as collaborations with SLAC, DESY, etc.
  - When any reliable device is established for ATF operation, the kicker is manufactured and installed.
- Epoxy magnet kicker making a very long pulse to extract all bunches in DR for the fast feedback experiment.
  - SLAC will manufacture it.
  - The technology is well established.

Kicker Projects (2)

- Fourier series kicker as a future option of ILC.
  - Array of RF deflectors with different frequencies make a sharp peak which allows a shorter bunch spacing.
  - Stability will be excellent due to the CW operation, but the technology is still premature.
  - It is going to be a good option for shorter bunch spacing operation with less bunch intensity at the energy upgrade.

Experiment on Positron Target at KEKB - Motivation -

- Positron production candidates:
  1) Conventional + CS
  2) Undulator
- Conventional is more reliable, more simple, and more cost-effective.
- Undulator is a new scheme, more complex, and more expensive.

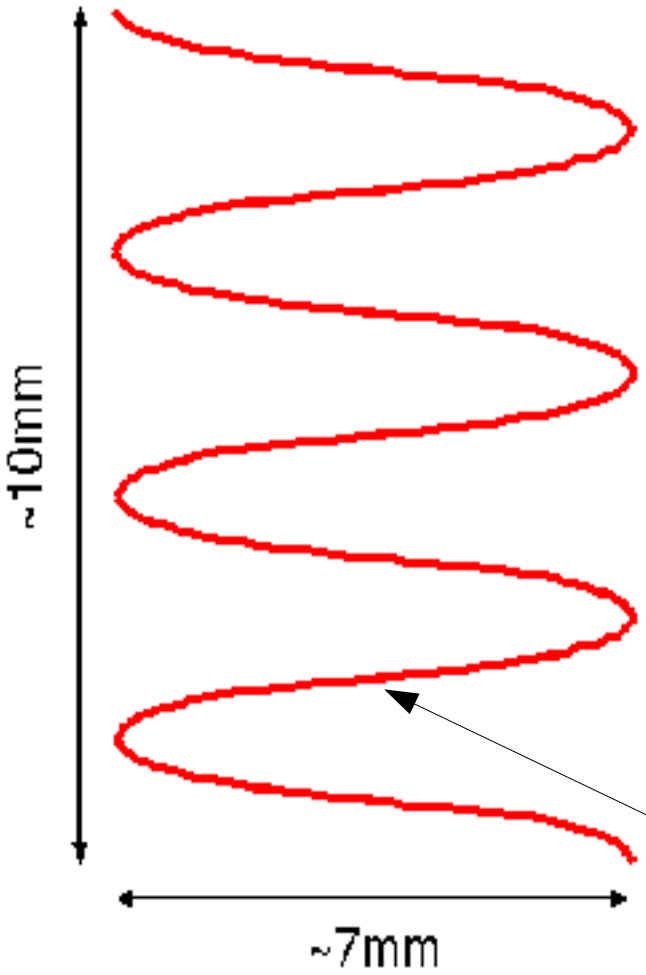
Motivation (2)

- In the view of the system simplicity, the conventional scheme is desirable.
- The biggest issue for the conventional scheme is radiation damage including the target break and the environmental contamination.
- The choice will make in Snowmass 05. This is an only experiment qualifying the target damage which can be carried out quickly.
- The project leader is Kuriki (masao.kuriki@kek.jp).

The Experiment

- ILC : 6GeV, 3nC, 2850 bunches.
  - 18 J for one bunch.
  - 51300 J for one pulse.
- KEKB: 8GeV, 10nC, 1300 bunches.
  - 80 J for one bunch.
  - 104000 J for one pulse (stored beam).
- By injecting the KEKB stored beam into a test target set on the beam dump, the target damage in ILC could be reproduced.

KEKB Beam Dump

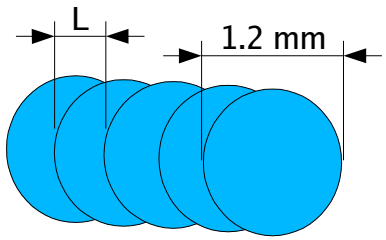


- HER: 8GeV, 10nC, 1300 bunches.
- Bunch spacing 6 or 8 ns.
- The beam is deflected as shown when it is dumped.
- The step size for next bunch depends on the position:
  - The smallest step is 0.007mm.
  - The largest step is 0.053mm.

Bunch Overlap

- Assume 0.6mm radius giving 1mm^2 spot size instead of the KEKB beam size because of the EM shower development.
- Taking beam energy E(GeV), intensity N(nC), and step size L(mm), the energy deposit Q (J/mm^2) .

$$Q = \frac{2 \times 0.6}{L} E \times N$$



Energy Deposit

- ILC : 6GeV, 3nC, 340ns spacing, 0.017mm shift for next bunch (50 m/s rotation).
  - 18 J/mm^2(*) for one bunch.
  - 70.6 bunches overlap giving1270 J/mm^2.
- KEKB: 8GeV, 10nC, 7ns spacing, 0.007 – 0.053mm shift for next bunch.
  - 80 J/mm^2 (*)for one bunch.
  - 23-172 bunches overlap giving1810 – 13700 J/mm^2.

* Assume 1mm^2 spot size.

Comparison

	SLAC	ILC	KEKB
Bunch energy (J)	320	18	80
Energy deposit (J/mm^2)	320	1270	1810 – 13700

- KEKB energy deposit is more than that in ILC. The ILC energy deposit can be reproduced by adjusting the intensity.
- Both energy deposits are well above the single bunch threshold observed in SLAC (320 J/mm^2).
- The damage on the ILC positron production target can be qualified with this experiment with assistance of simulations.

Schedule

- Design the target load system : until January 05.
- Writing a proposal to LCPAC until February 05.
- The experiment is carried out until July 05.

Dogbone Examination by SAD, Instabilities in DR

- Beam dynamics studies are important for ILC DR stable and reliable operation.
- The leaders are
  - Oide (katsunobu.oide@kek.jp) for the emittance issue.
  - Onishi (yukiyoshi.onishi@kek.jp) for the dynamic aperture issue.
  - Ohmi (kazuhito.ohmi@kek.jp) for the instability issue.

3km DR design

- A short DR instead of 17 km Dog-bone DR is desirable for cost, operation, and construction.
- 3km DR is designed by Kuroda in 2004 Nov.
- The lattice is modified by M. Korostelev (CERN) to improve the dynamic aperture and decrease the damping time.
- He and F. Zimmerman are going to investigate the instability in the DR.
- The leader is Kuroda (shigeru.kuroda@kek.jp) .

ATF Future

- Improve ATF performance: A large impact on ATF II.
  - 1pm emittance by a super high-resolution BPM.
  - Extracted beam stabilization with a feed-forward beam control.
  - Improve the extracted beam emittance by reducing XY coupling in the extraction line.
- These projects are natural extensions of the current activities of the collaborations (FONT, NanoBPM, and ATF II).

Summary

- ILC Asian WG3 organizes the activities related to the ILC injector R&D. It will continue until Snowmass 05.
- Many projects are in progress within the framework of the WG.
- It is an issue to involve the activities on the outside of KEK. Video Conference may be a solution.