Summary of LCWS05
Accelerator Sessions

Roman Pöschl
DESY ILC Meeting
8/4/05

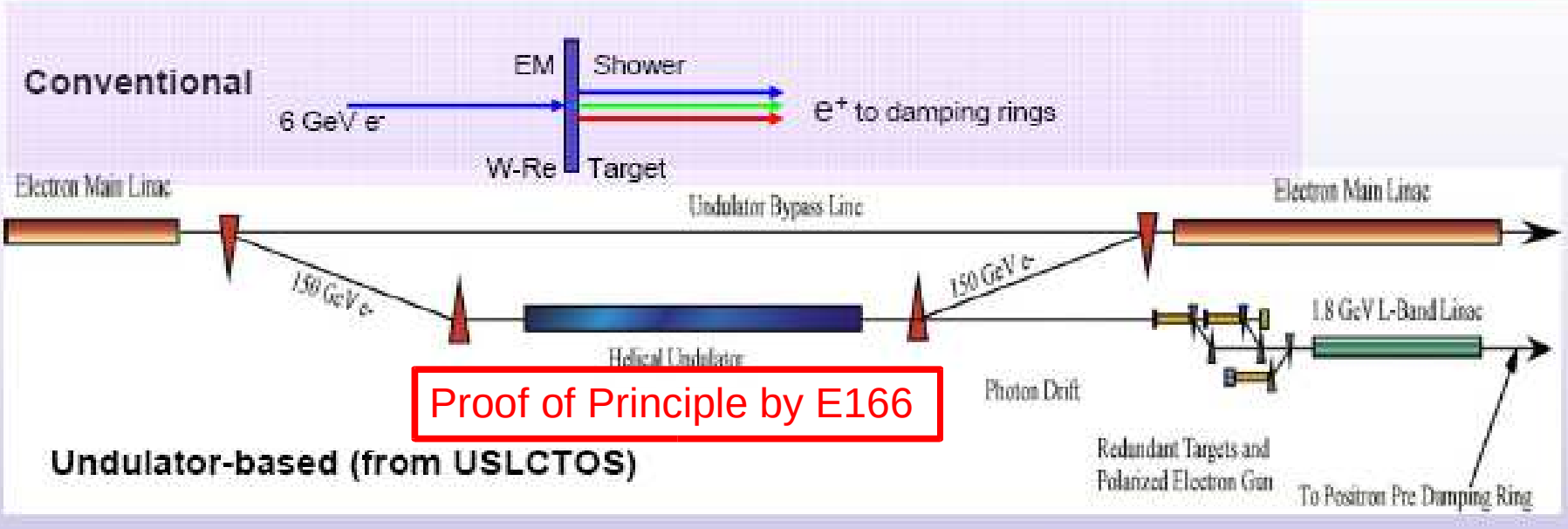
All talks can be found under http://www-conf.slac.stanford.edu/lcws05/program/session.asp#l

Outline

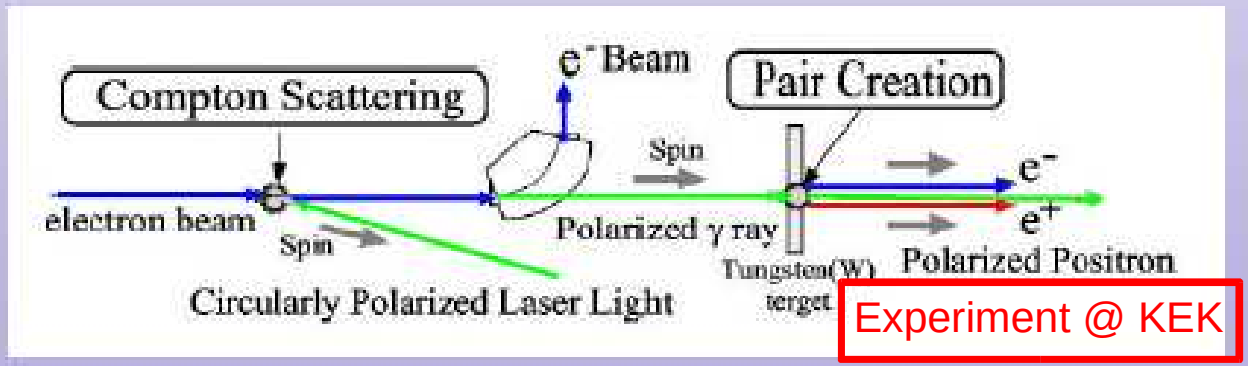
- Polarized Positron Sources for the Linear Collider
  - The E166 Experiment
  - KEK Polarized Positron Source
- A Fabry Perot Cavity for Polarimetry
- ATF2 a facility to study ILC-like beams
  - Feedback Systems
- Damping Rings

Polarized Positron Sources

POSITRON PRODUCTION SCHEMES – DRIVE BEAMS



Proof of Principle by E166



Experiment @ KEK

Three Principles ...

Two are seriously considered

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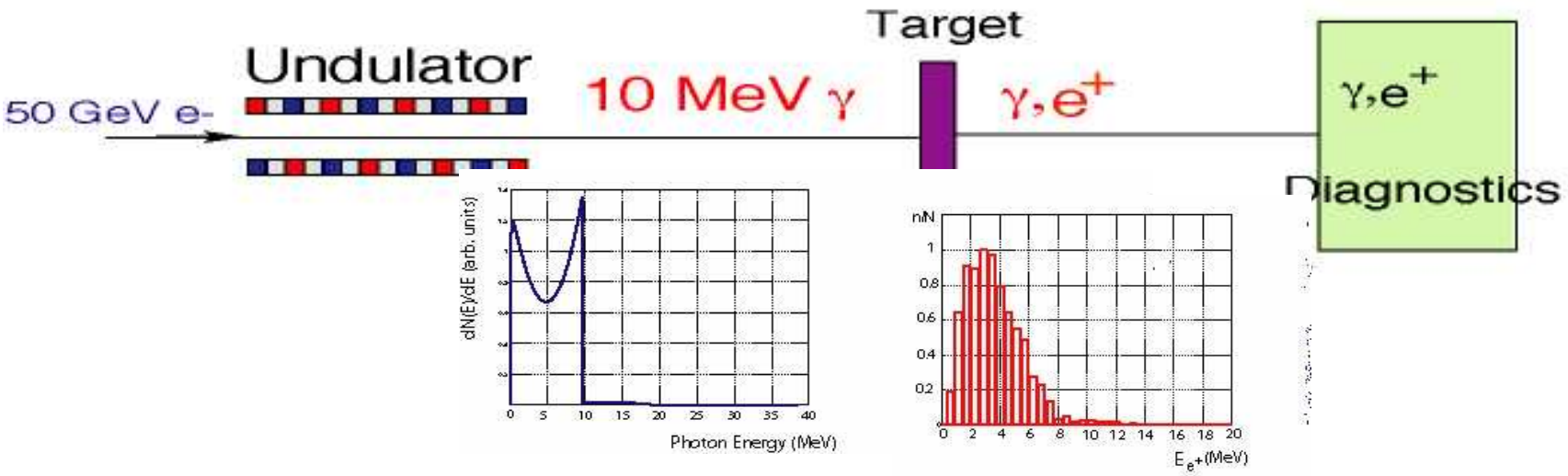
Principle of the E166-Experiment

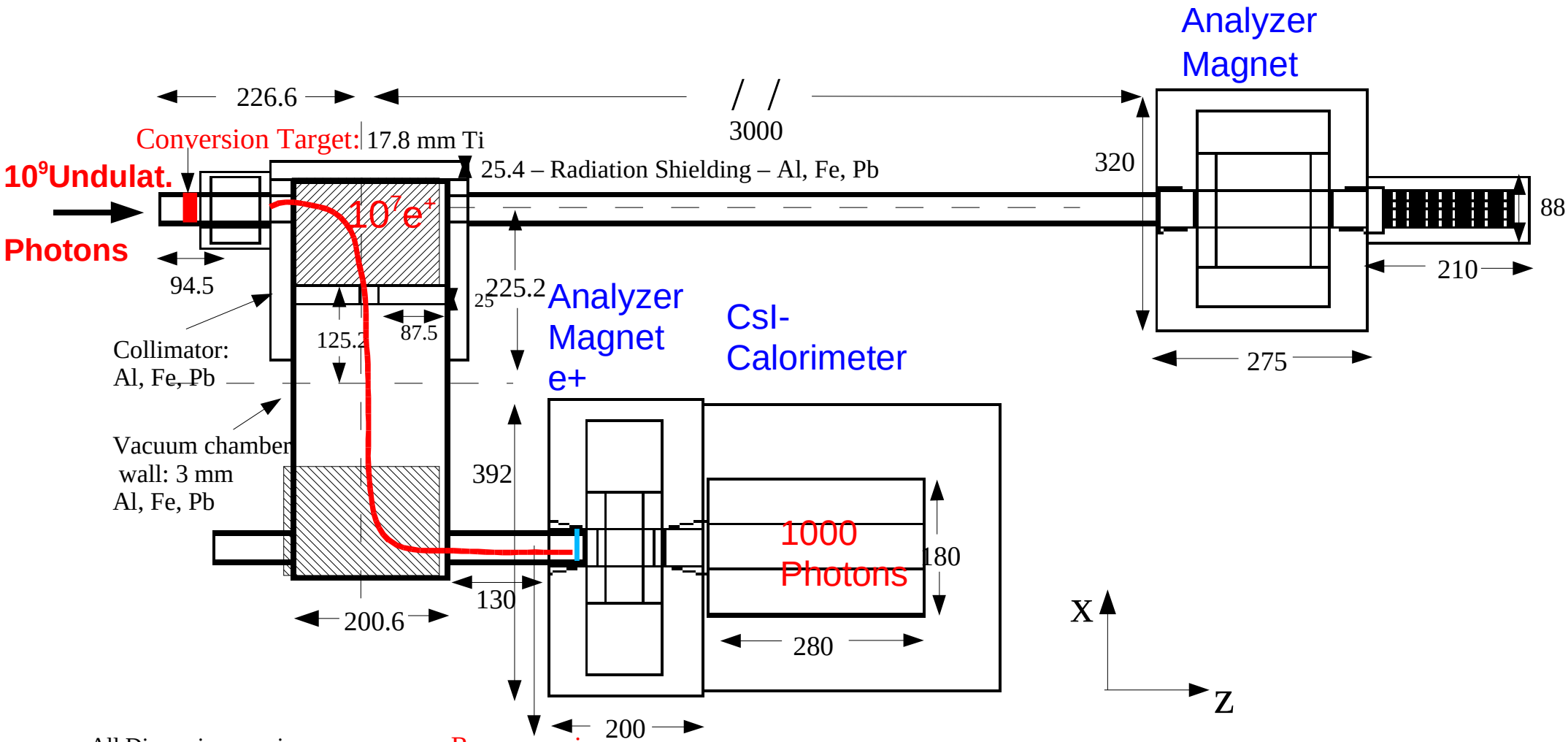


- **E-166 uses the 50 GeV SLAC-Beam in conjunction with a 1m long helical Undulator for the production of Polarized Photons.**

- **These photons are converted by a ~0.5 X_0 thick Absorber into Polarized Positrons (und Electrons).**

- **The Polarization of the Positrons (und Photons) is measured**

Schematic Overview of the E166 Polarimeter

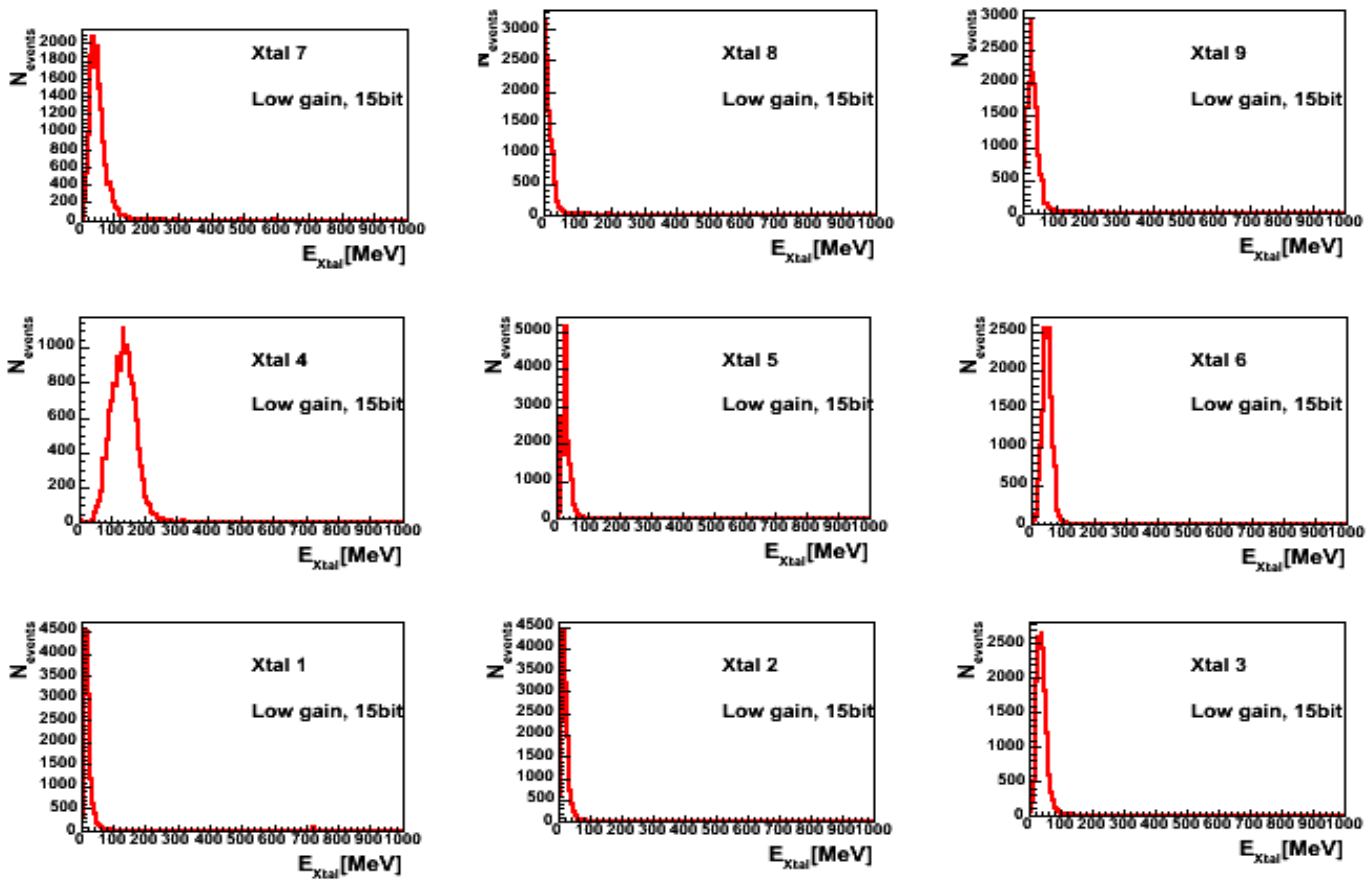


Transmission Polarimetry

Reversion of magnetic field in analyzer magnet leads to Asymmetry in Photon yield in CsI Calorimeter => e^+ Polarisation

First Beam Spectra – Run 518 10/10/04

Goal: Bring beam to beam dump and first noise check



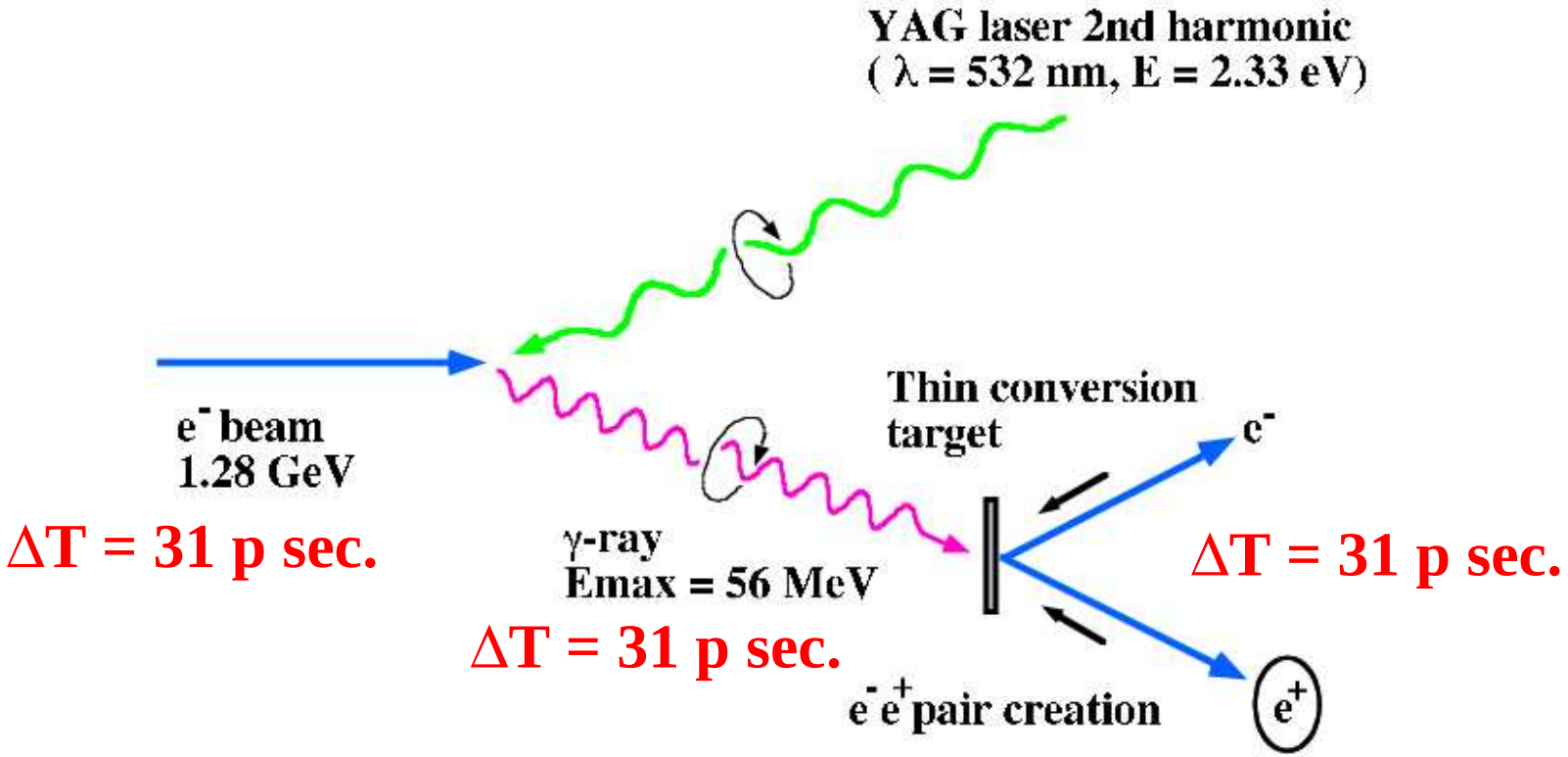
Small background < 100 MeV

Compare with 1000 x 5 MeV Photons= 5 GeV Energy depos.

Promising Result

E166 Data taking interrupted by SLAC Accident. Resumption in June ?

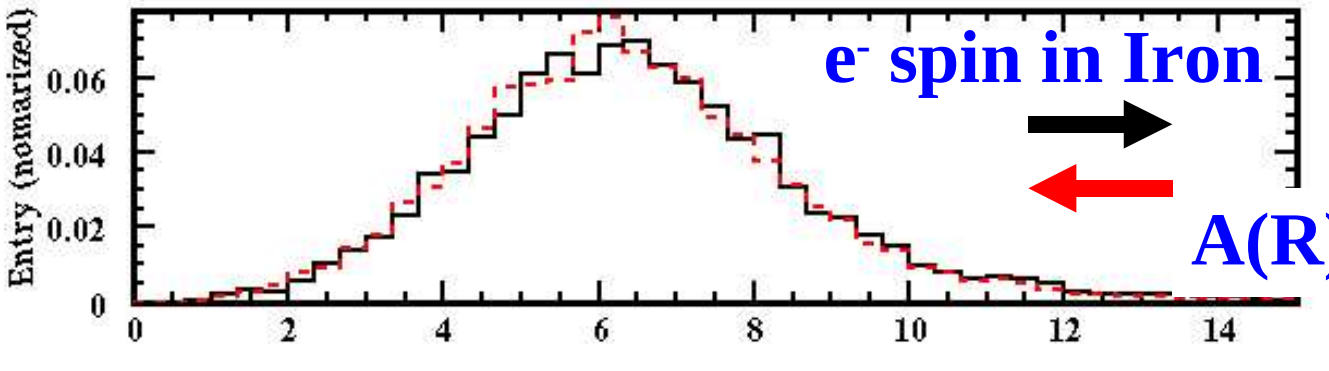
Experiment@KEK



Yield: 10^4 e^+/bunch (Compare with 10^7 e^+/bunch @ E166)
Laser Power is an issue
Would need 100 Lasers to produce sufficient amount of e+

e^+ polarization (e^+ run)

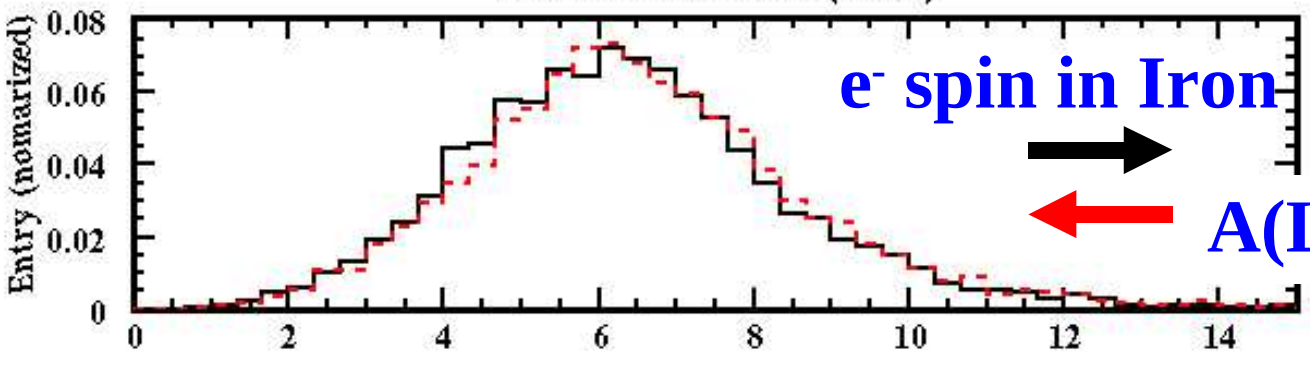
preliminary results



e^- spin in Iron

e^+ beam spin

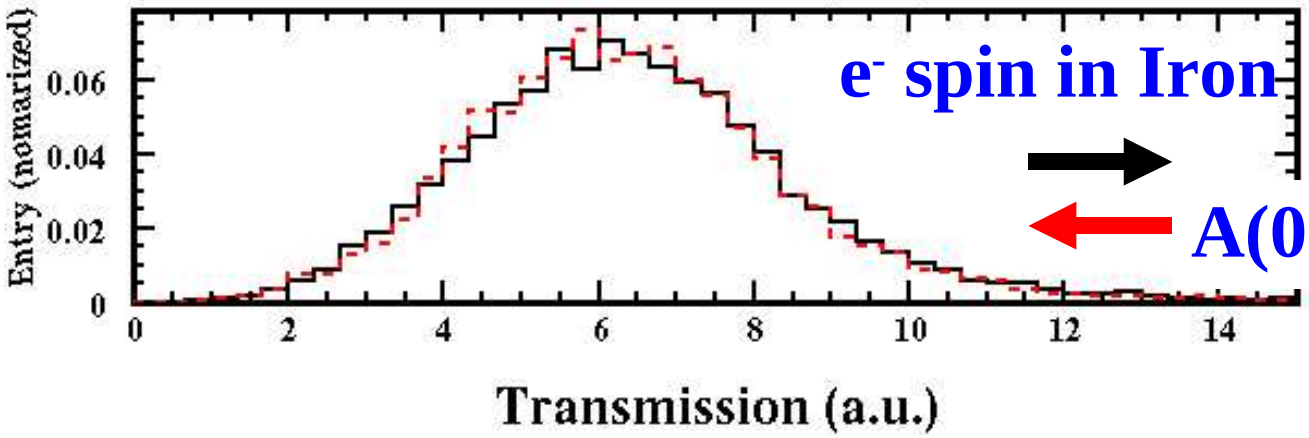
A(R)= +0.72± 0.28%



e^- spin in Iron

e^+ beam spin

A(L)= -1.07± 0.28%



e^- spin in Iron

e^+ beam spin non

A(0)= +0.33± 0.28%

Derived 80% e^+ Polarization from Asymmetries !!

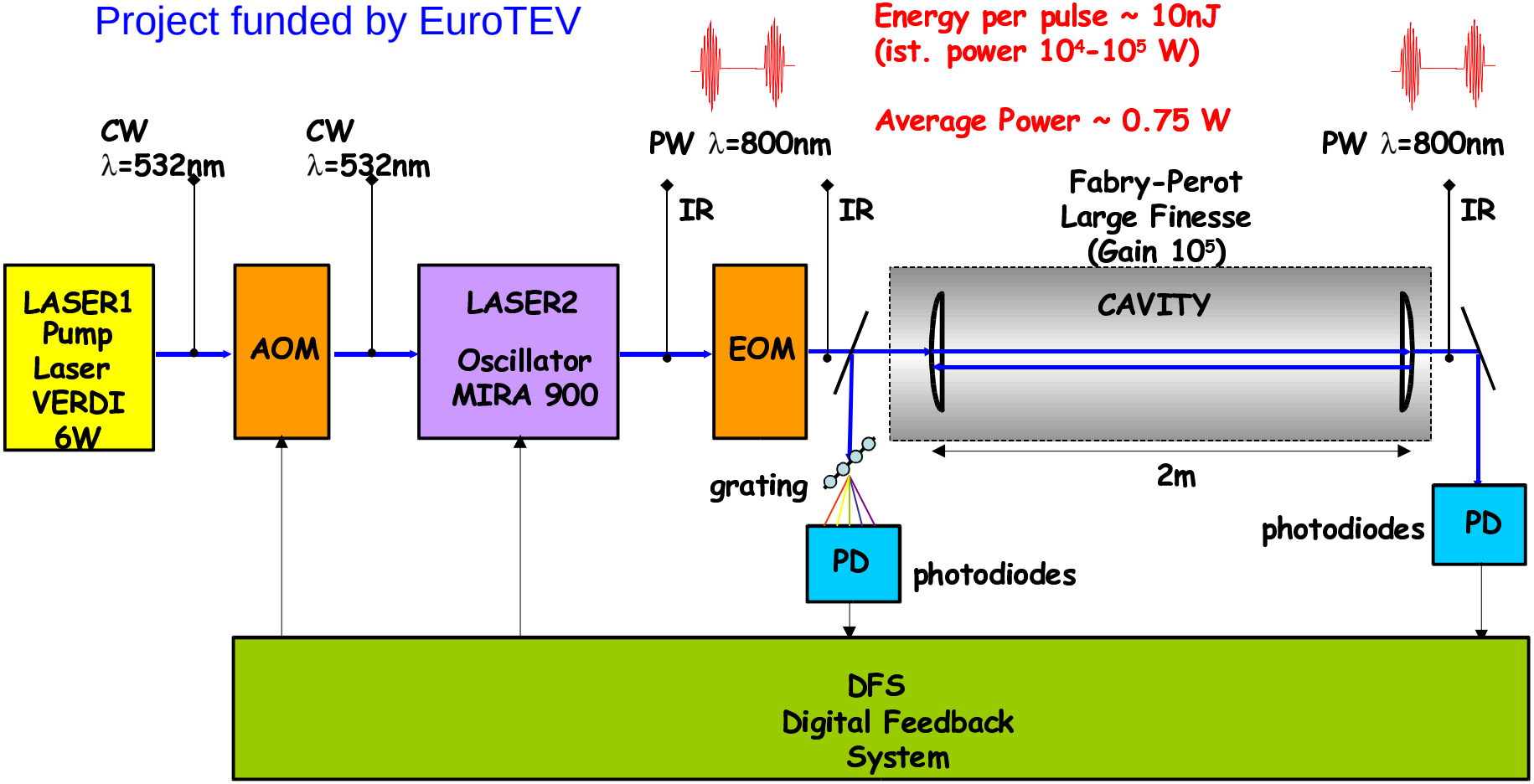
A Fabry Perot Cavity for Polarimetry

F_{REP}=75MHz, Pwidth = 100fs-1ps

Energy per pulse ~ 10nJ
(ist. power 10^4-10^5 W)

Average Power ~ 0.75 W

Project funded by EuroTEV

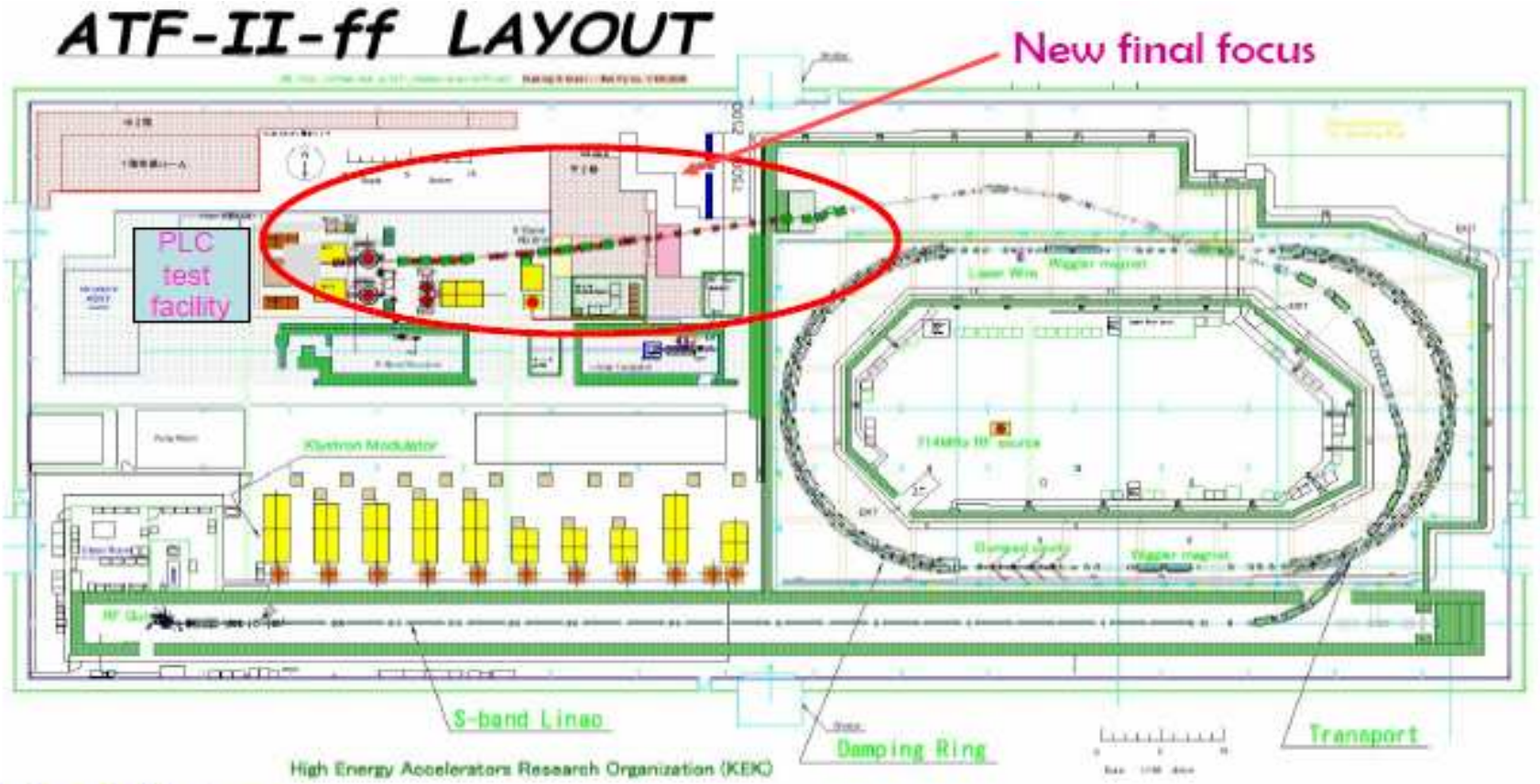


Studying f_{rep} and Phase shift of pulses

Wide Range of Applications !? Solution for “Power Problem” of KEK pol e+ Source ?

Alternative to Compton Polarimeter proposed by P. Schüler et al. ?

ATF2 -A facility to study ILC-like beams



ATF2 Goals & stages:

(A) Small beam size (with Shintake BSM at IP)

(A1) Obtain σ_y ~ 35nm

(A2) Maintain for long time

(B) Stabilization of beam center (with nano-BPM at IP)

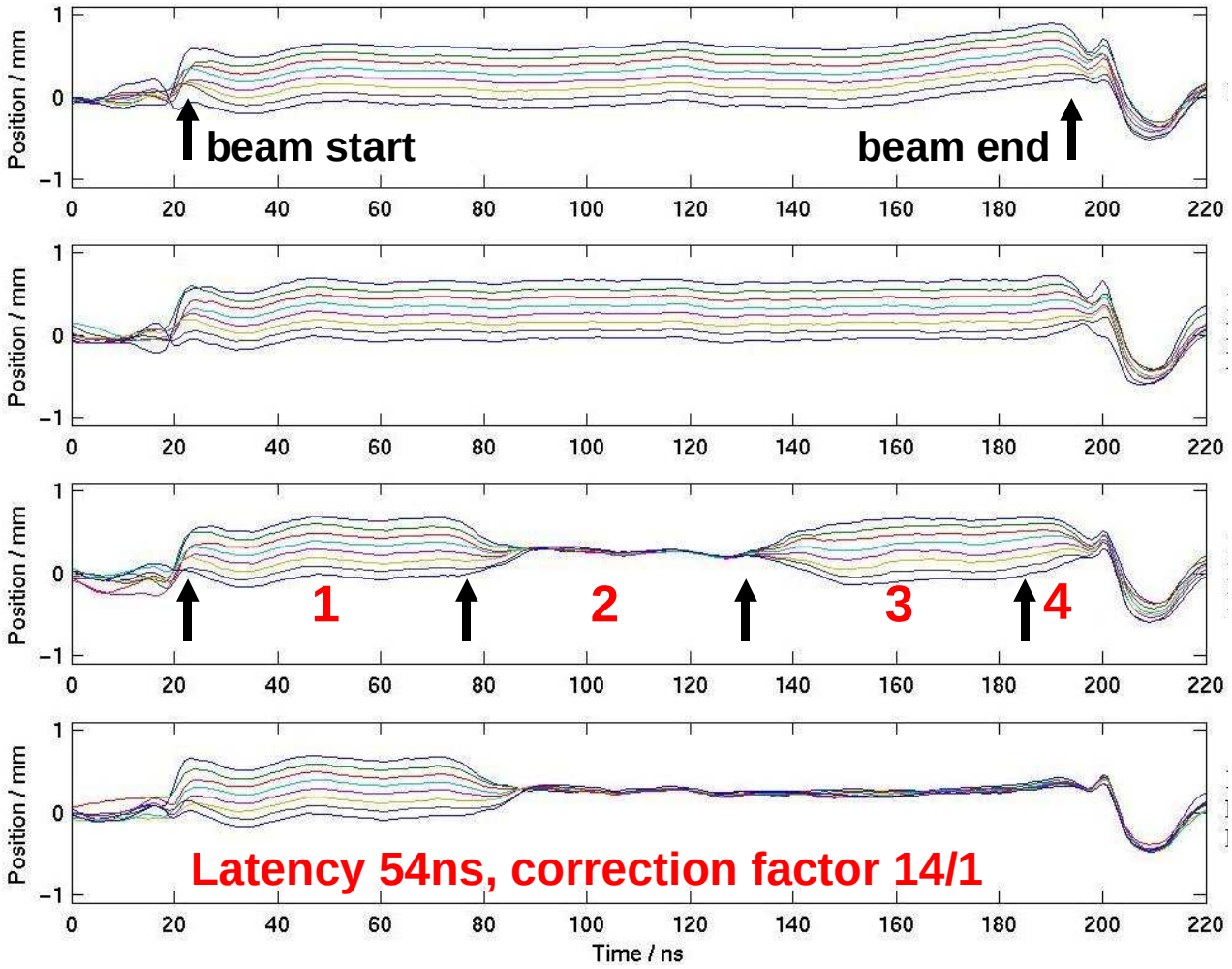
(B1) Down to < 2nm by nano-BPM

(B2) Bunch-to-bunch feedback of ILC-like train

20 bunches x 300 ns

Feedback On Nanosecond Time Scale – FONT Project

FONT2 results: feedback BPM (Jan 04)



Beam starting positions

Beam flattener on

Feedback on

Delay loop on

Latency reduced to 20ns for FONT3
Studies were dedicated for NLC like bunch timing
Still valuable for ILC like bunch timing

Damping Rings Issues

Requirements for ILC Damping Ring

- **Compress 1 ms linac bunch train in to a "reasonable size" ring**
  - Fast kicker
- **2820 bunches, 2×10^{10} electrons or positrons per bunch, bunch length= 6 mm**
  - instabilities
- **Damping of $\gamma\varepsilon_{x,y}$= 10^{-2} m-rad positron beams to $(\gamma\varepsilon_H, \gamma\varepsilon_v)=(8\times10^{-6}, 2\times10^{-6})$ m-rad**
  - Low emittance
- **Cycle time 0.2 sec→ τ=27 ms**
  - Damping wiggler
- **Dynamic aperture ≥ 10 σ**
  - Injection loss < 1 %

Damping Ring Topics

- **Lattice design and optimization**
  - TME or FODO
- **Dynamic aperture**
- **Automatic lattice design**
- **Space charge tune shift**
  - Coupling bump
- **Collective effects**
  - Electron cloud, fast ion→ vacuum vessel and level
- **Novel schemes**
- **Tracking to determine injection efficiency**
- **Error tolerance in lattice and wiggler**
- **Wiggler technology**
- **Kicker R&D**
- ***And many more!***

Some ILC Damping Ring Designs

Parameters	TESLA DB (W. Decking)	SLAC DB (Y. Cai)	LBL (DB) (A. Wolski)	ANL-FNAL Circular (A. Xiao, L. Emery)
Energy E(Gev)	5	5	5	5.0
Circumference (m)	17,000	17,014	15,815	6114
Horizontal emittance (nm)	0.50	0.62	0.715	0.8
Damping time (ms)	28	27	27	27
Tunes, ν_x,ν_y,ν_s	76.31, 41.18, 0.071	83.73, 83.65, 0.072	75.78, 76.41, 0.41	56.58,41.62,0.0348
Momentum compaction α_c	1.22×10^{-4}	1.11×10^{-4}	5.6×10^{-4}	1.42×10^{-4}
Bunch length σ_z (mm)	6.04	5.90	6.0	6
Energy spread σ_δ/E	1.29×10^{-3}	1.30×10^{-3}	1.63×10^{-3}	1.3×10^{-3}
Chromaticity ξ_x, ξ_y	-125,-62.5	-105.27, -106.70	-90.98, -94.86	-74.4,-55.4
Energy loss per turn (MeV)	20.4	21.0	19.75	7.73
Cavity Voltage (MV)	50	50	312	27

3 "Dogbone" proposals

One "circular" proposal

Conclusion

- 2005 will be interesting year for evaluation of positron sources
  - Successful production of polarized e^+ by KEK experiment
  - E166 data taking starts in June
  - ILC-Undulator development at Daresbury (not mentioned in my talk)

- Alternative appraoches for Polarimetry
  - Fabry Perot Cavity vs. “Conventional” Approach
  - Solution for “KEK Laser Power Problem” ?

- ATF2 is facility to study many aspects of ILC-like beams

- Personal Remark: I was happy to summarize the Accelerator Session
  - Insight into an interesting field of research for the ILC