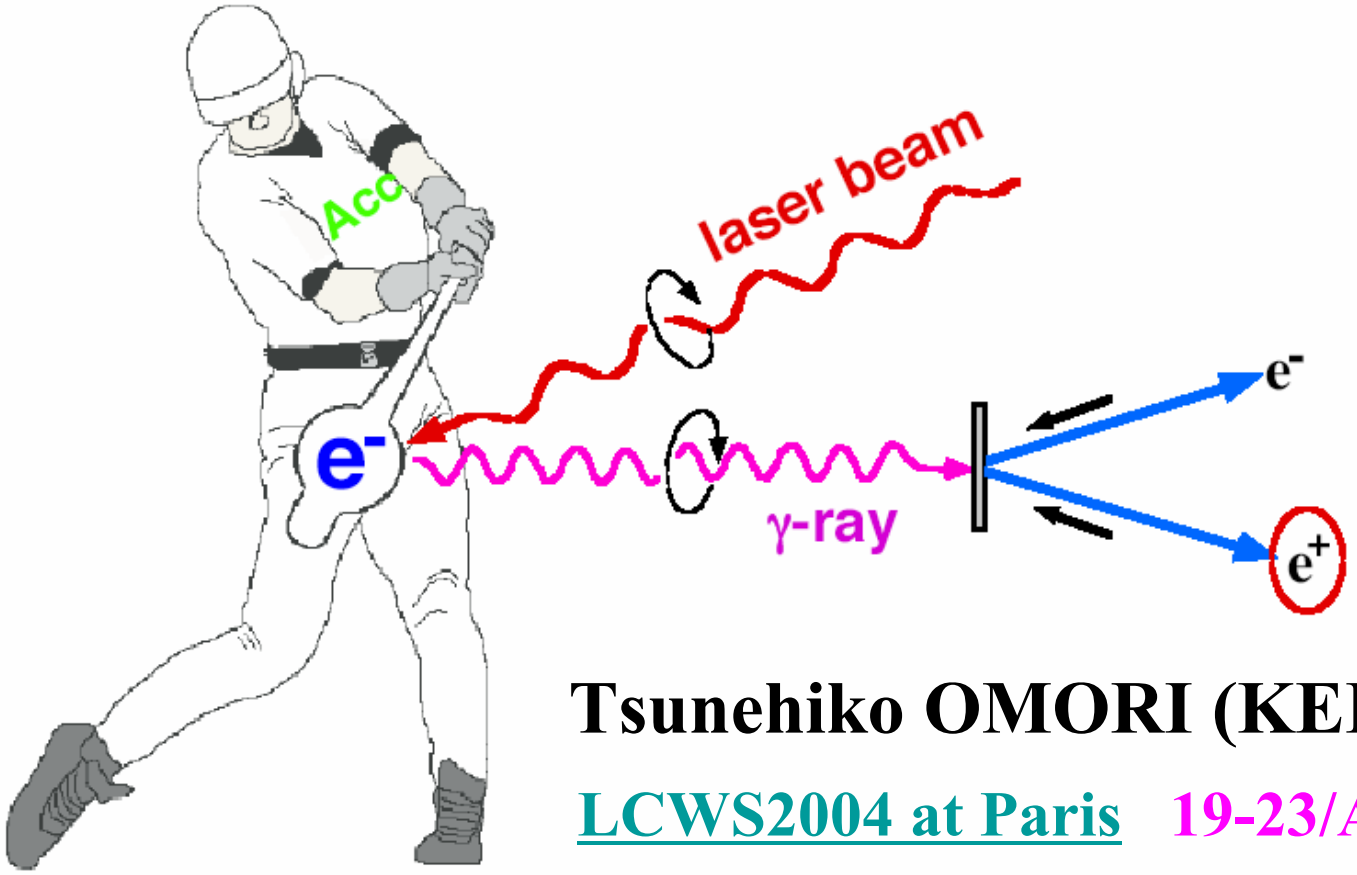
Laser Based Polarized e^+ Source for GLC



Tsunehiko OMORI (KEK)

LCWS2004 at Paris 19-23/Apr/2004

Collaboration

KEK

Y. Kurihara, T. Okugi, J. Urakawa, T.Omori

Tokyo Metropolitan Univ

A.Ohashi

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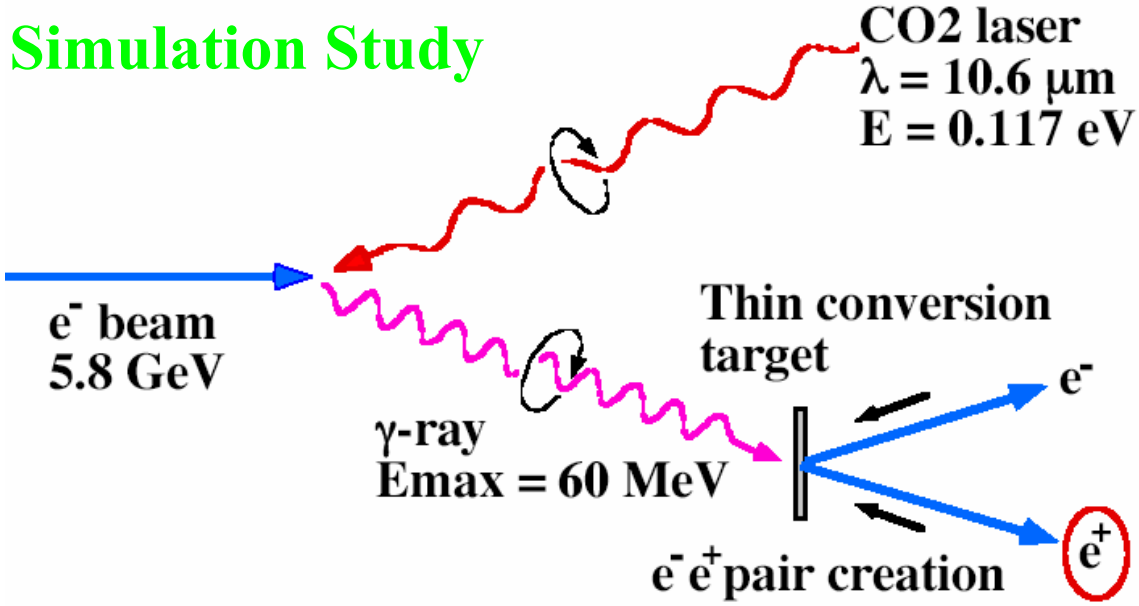
M. Washio, T. Hirose

National Institute of Radiological Sciences

M. Nomura, M. Fukuda

1) Conceptual Design : GLC

Simulation Study



10 CO2 lasers

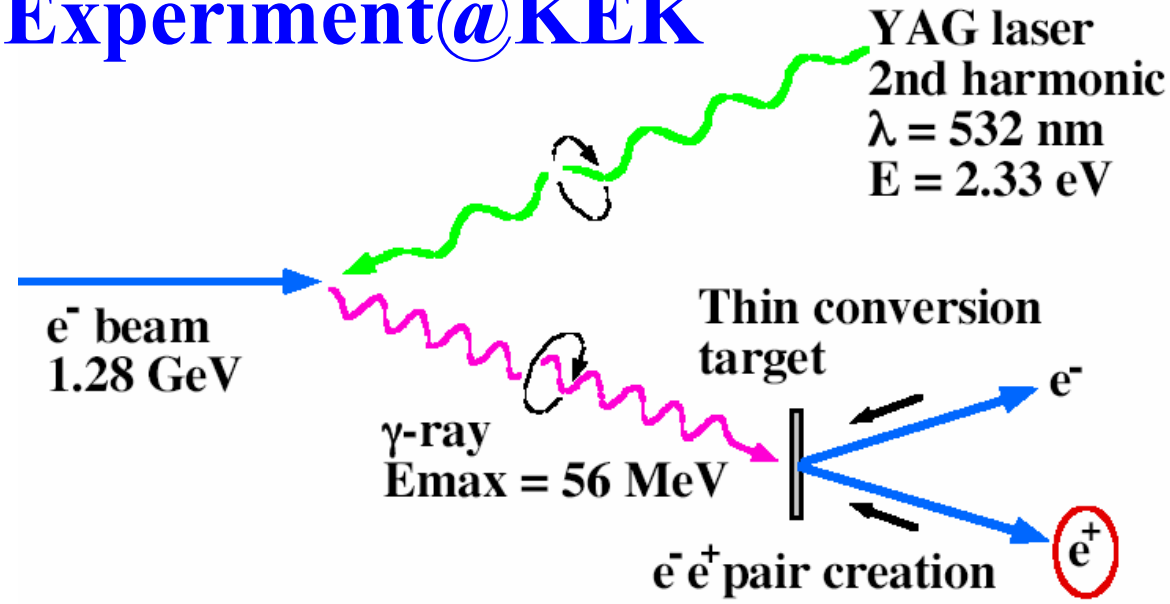
+

High Current

e- accelerator

T. Omori et al.,
NIM A500 (2003)
232-252

2) Experiment@KEK



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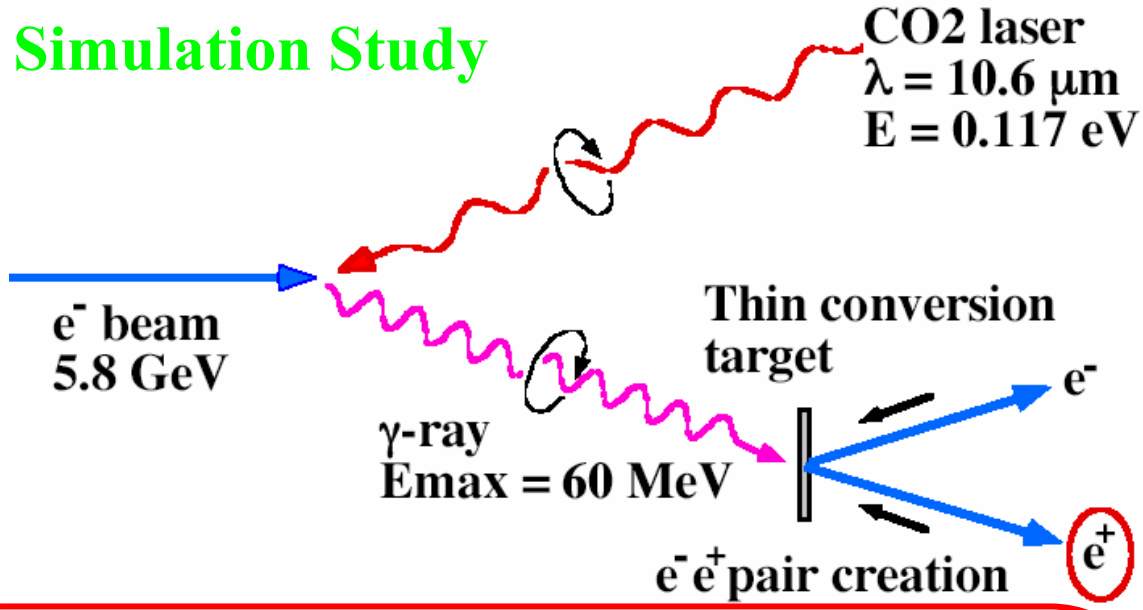

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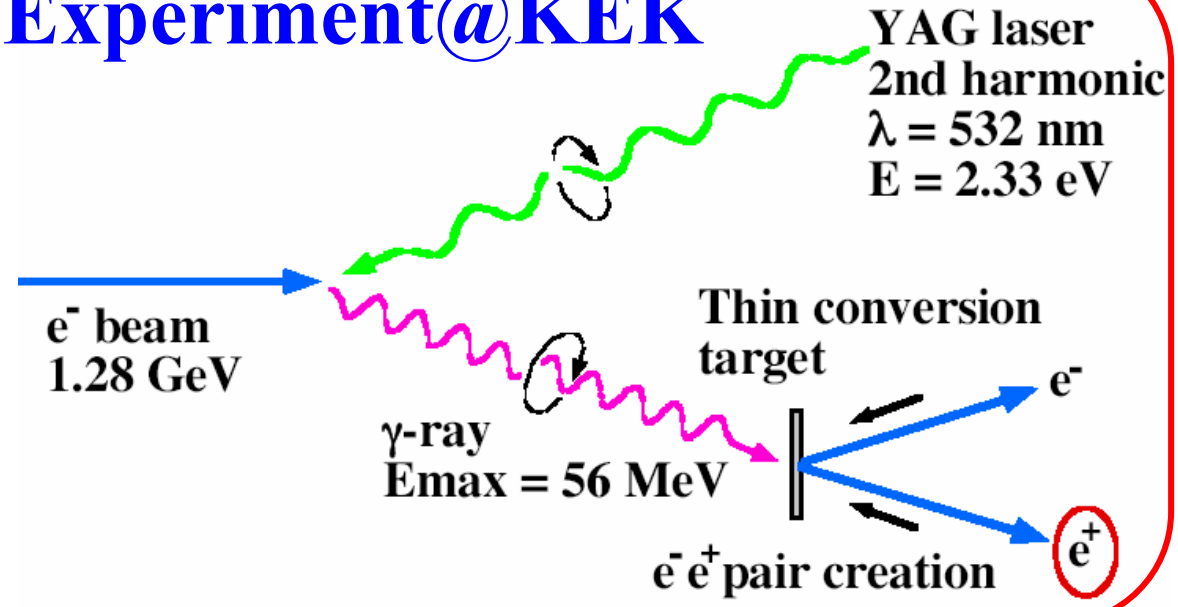
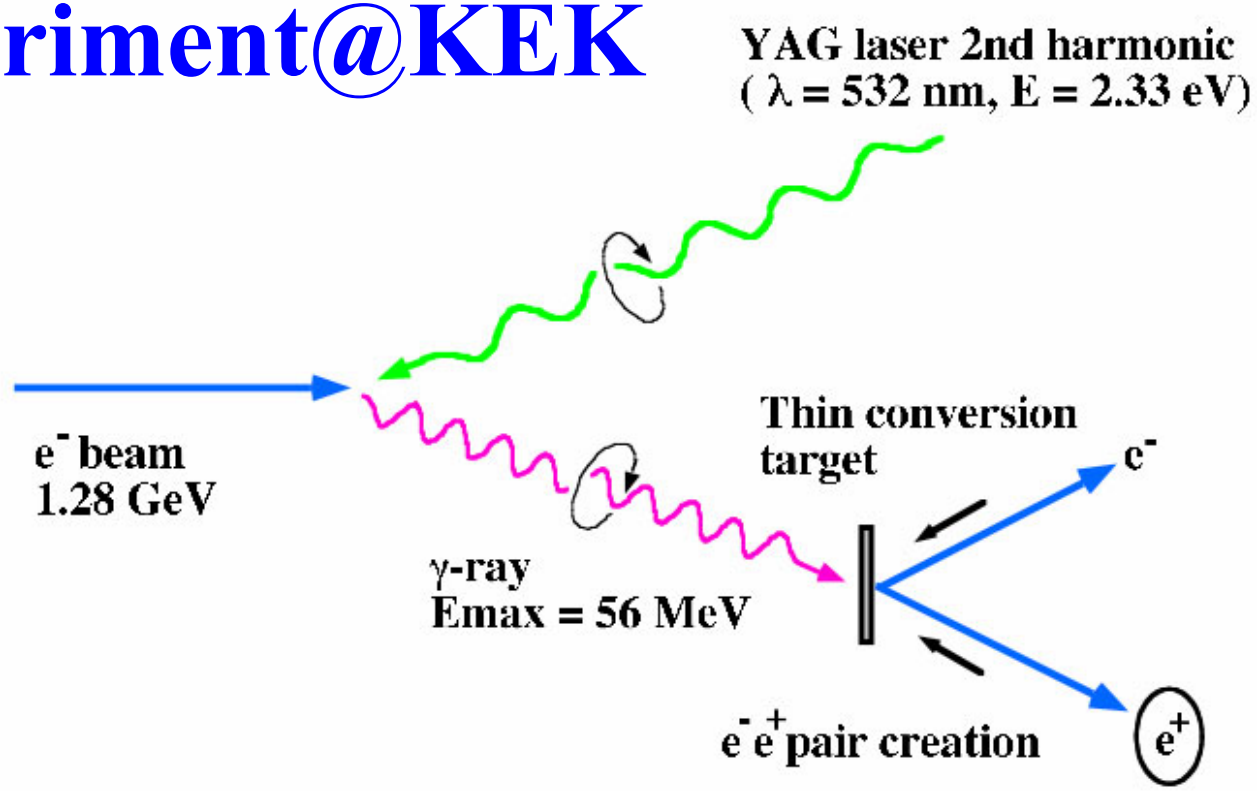


Today's talk

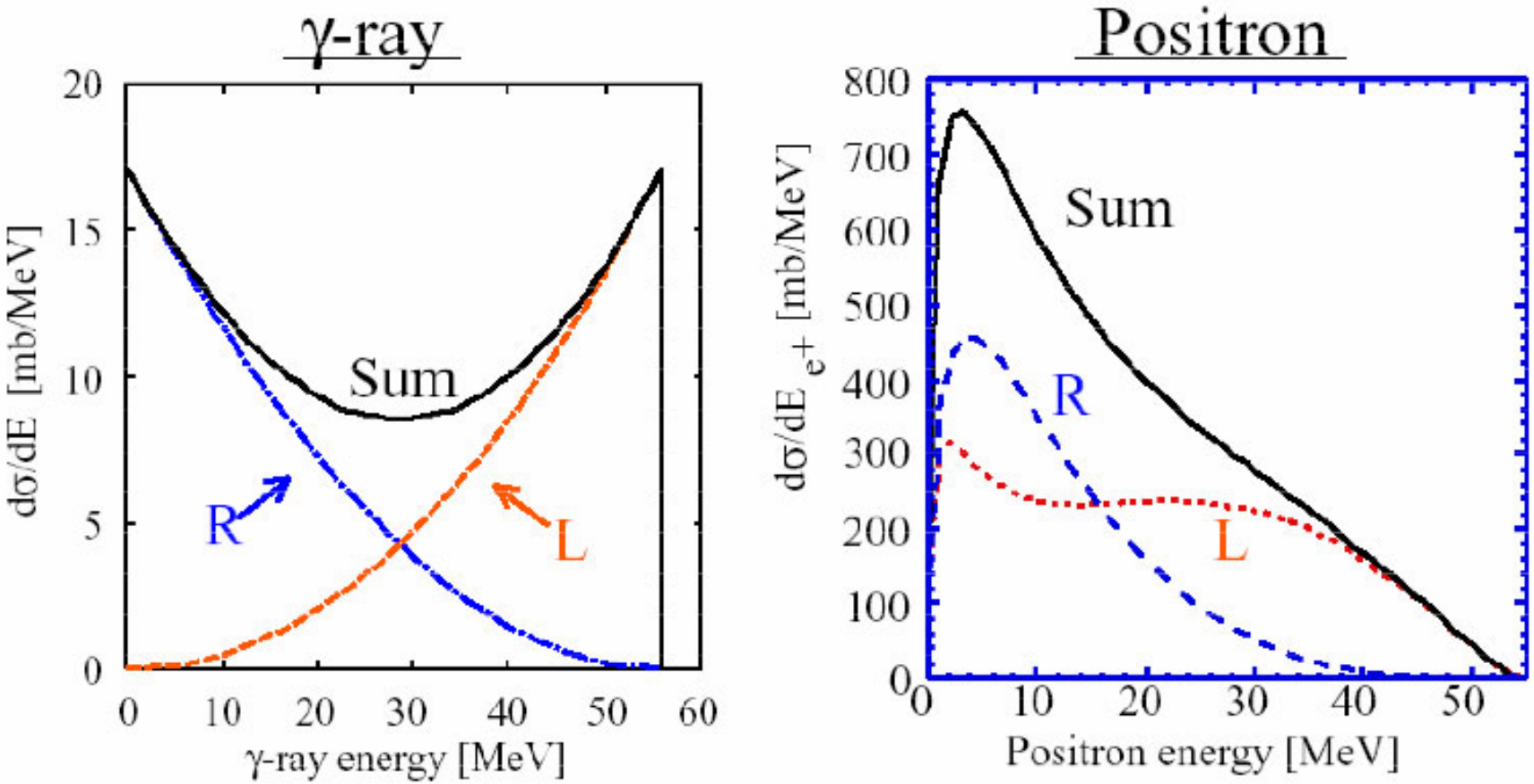
Experiment@KEK



i) proof-of-principle demonstrations

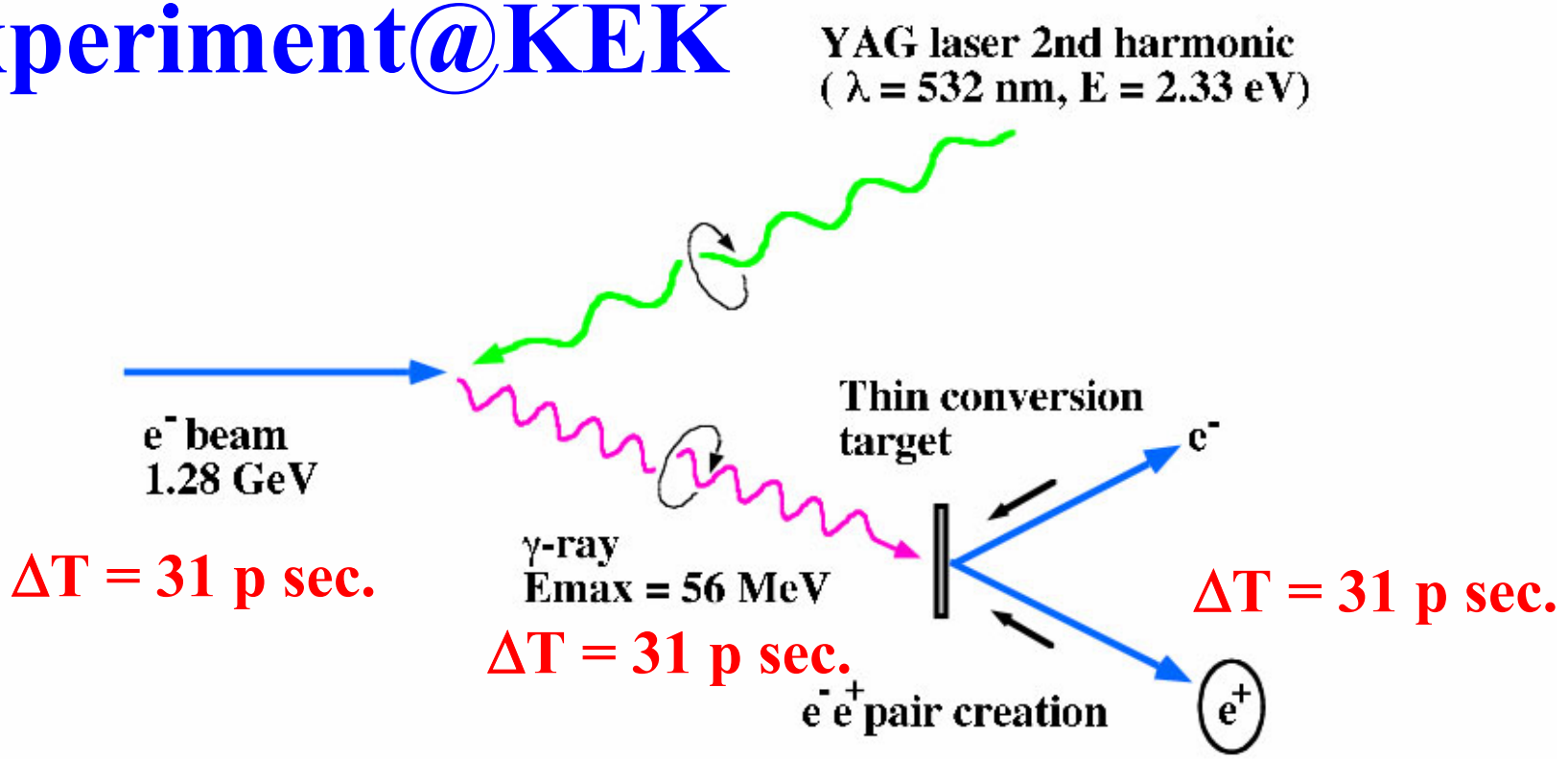
ii) accumulate technical informations: polarimetry, beam diagnosis, …

Cross section (calculation)



γ & e^+ : short bunch length 31 psec

Experiment@KEK



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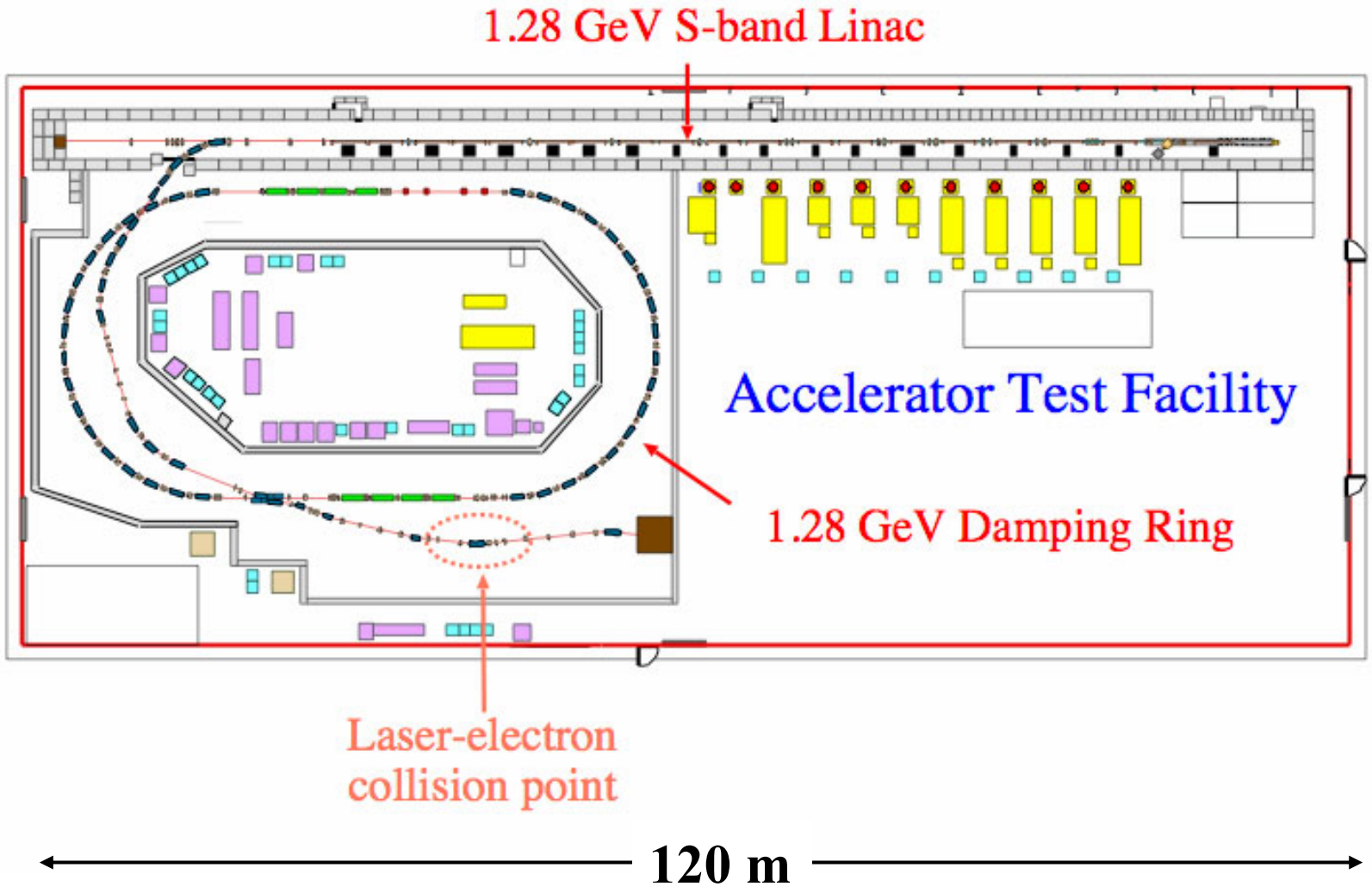
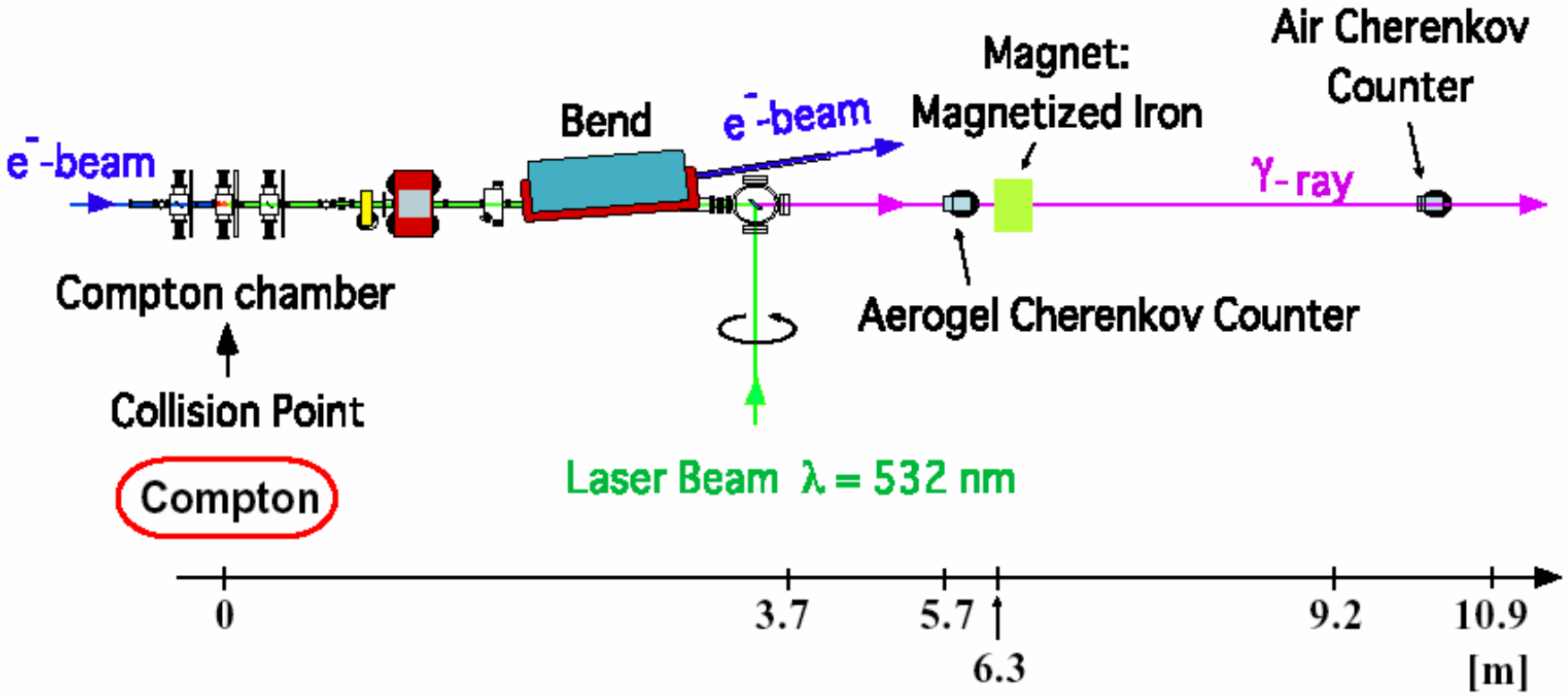
Accelerator Test Facility@KEK

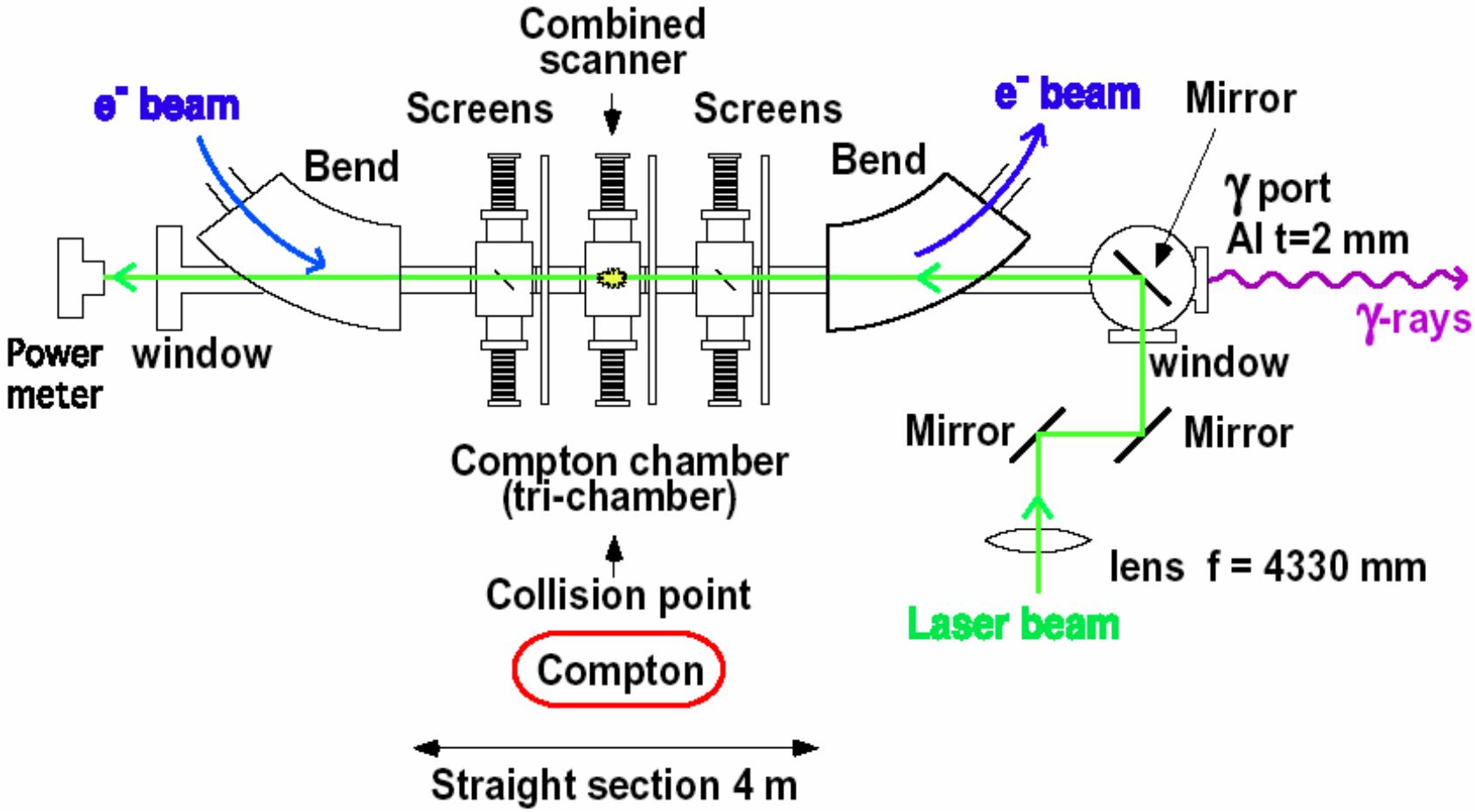


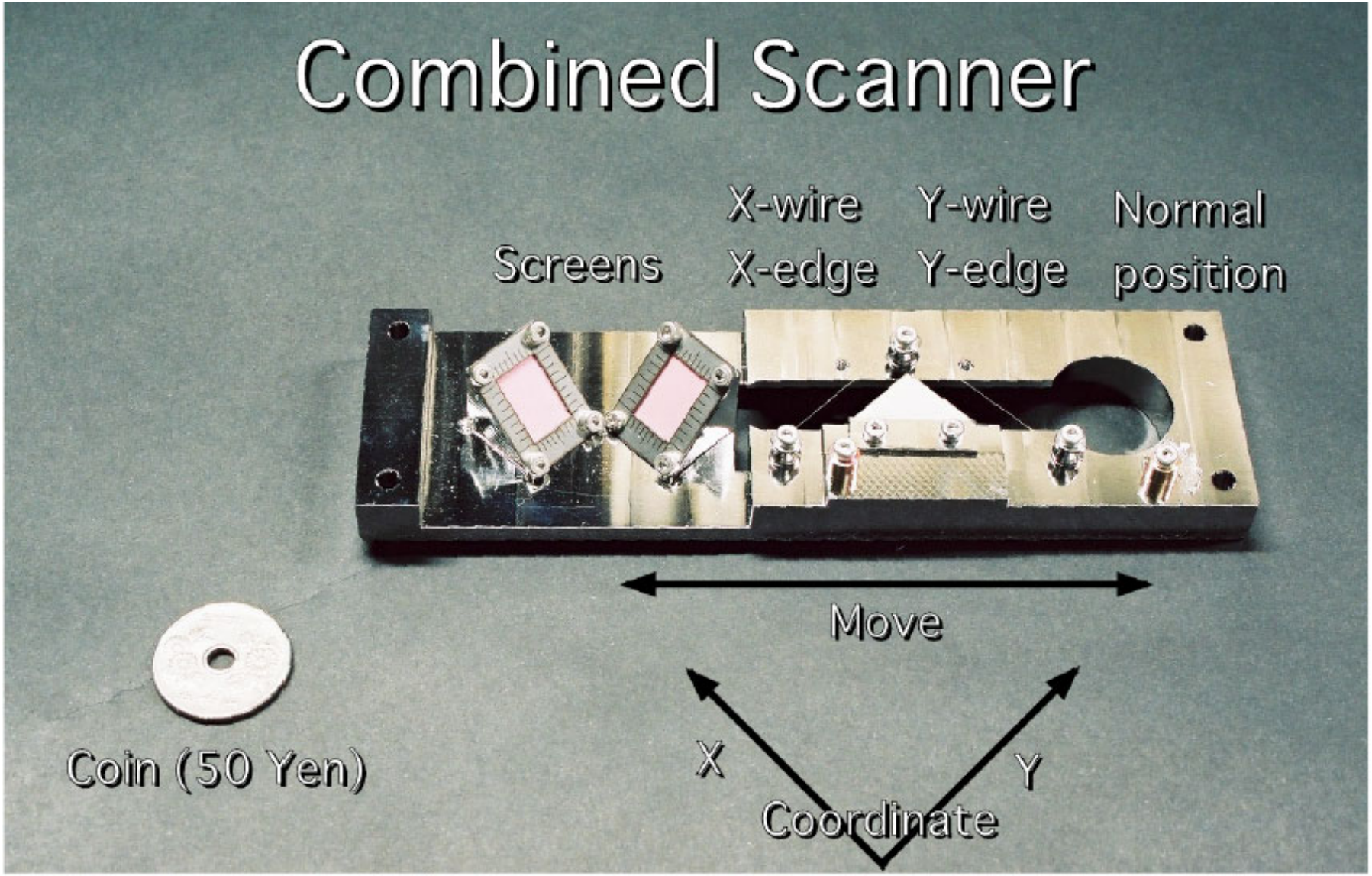
γ-ray:
production, detection, and polarimetry

at ATF Extraction line



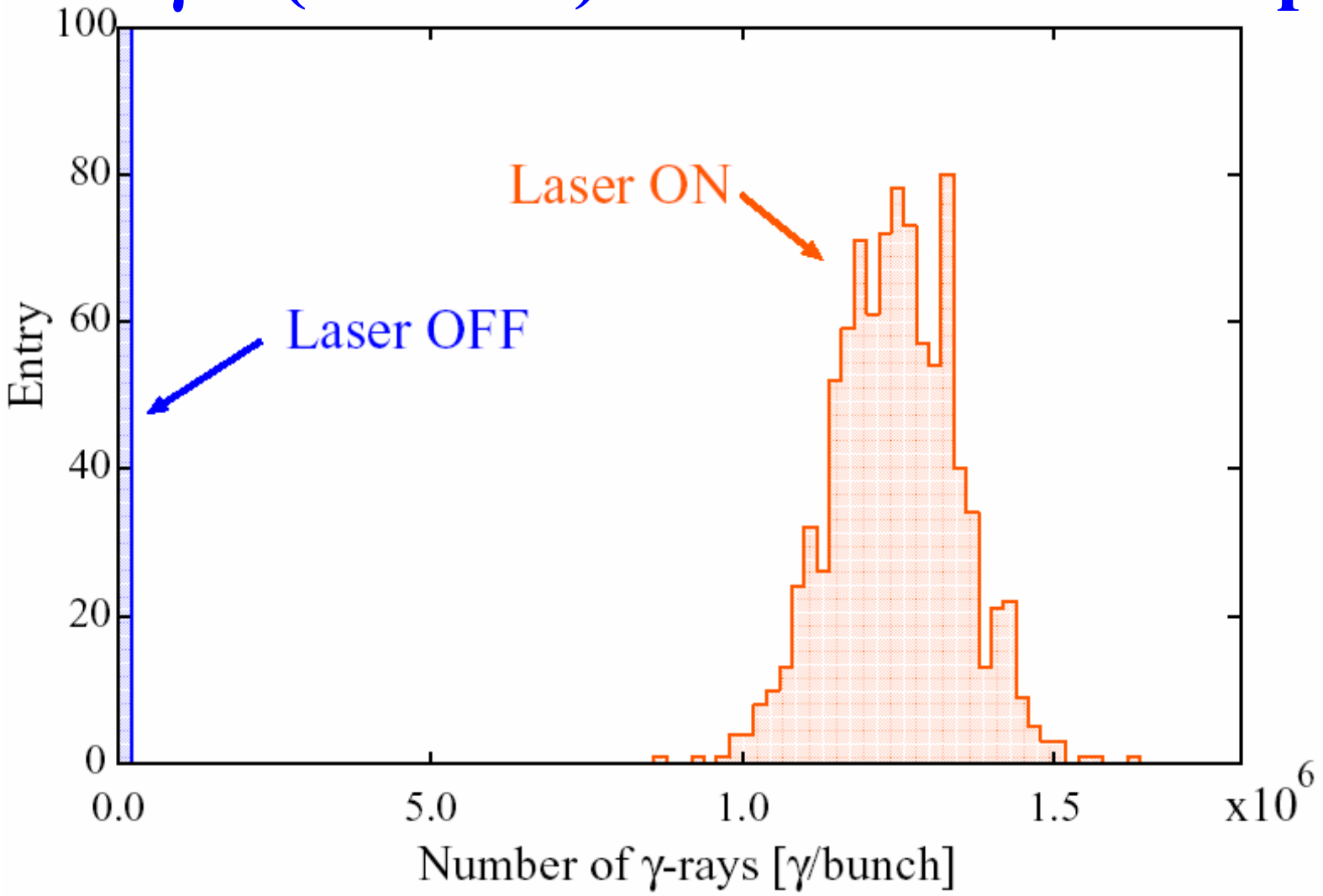
Compton chamber




Combined Scanner
Screens
X-wire
X-edge
Y-wire
Y-edge
Normal
position
Move
Coin (50 Yen)
X
Y
Coordinate

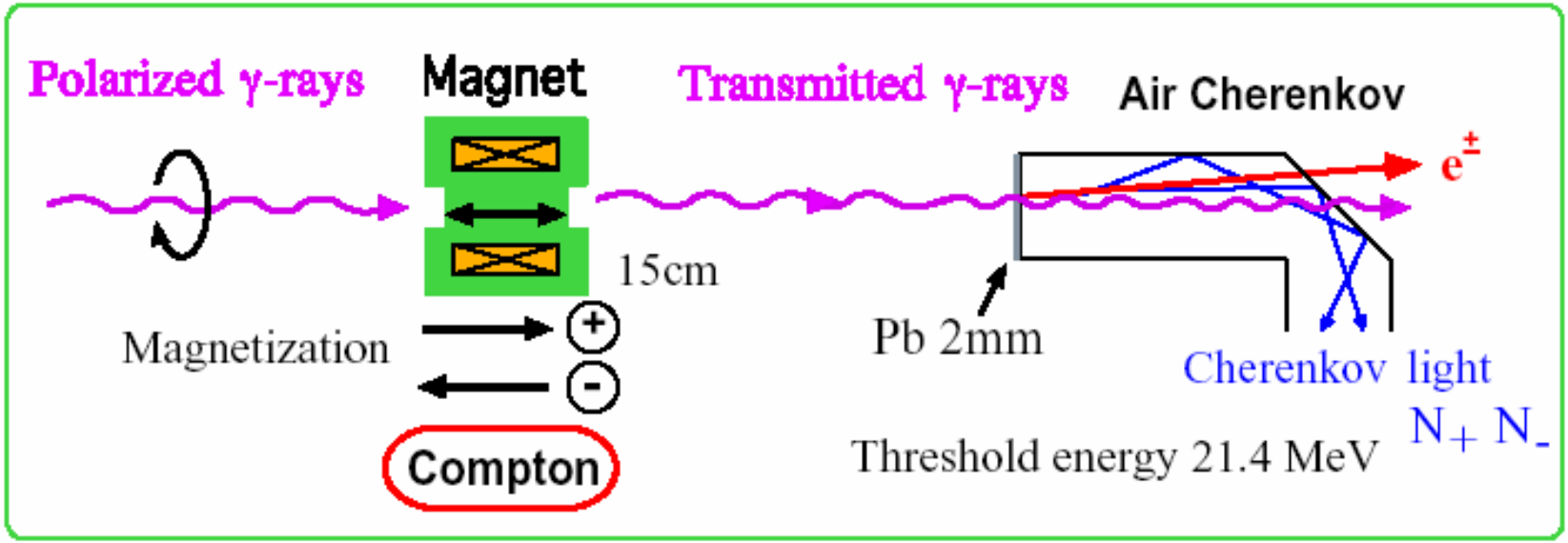
Measured Number of γ-rays

$N\gamma = (1.1 \pm 0.1) \times 10^6$/bunch in 31 p sec



Measure Asymmetry

ΔT=31 psec → can NOT measure each γ-ray



Cross section of Compton scattering

$$\sigma(\uparrow\uparrow) < \sigma(\uparrow\downarrow)$$

$$\Downarrow$$

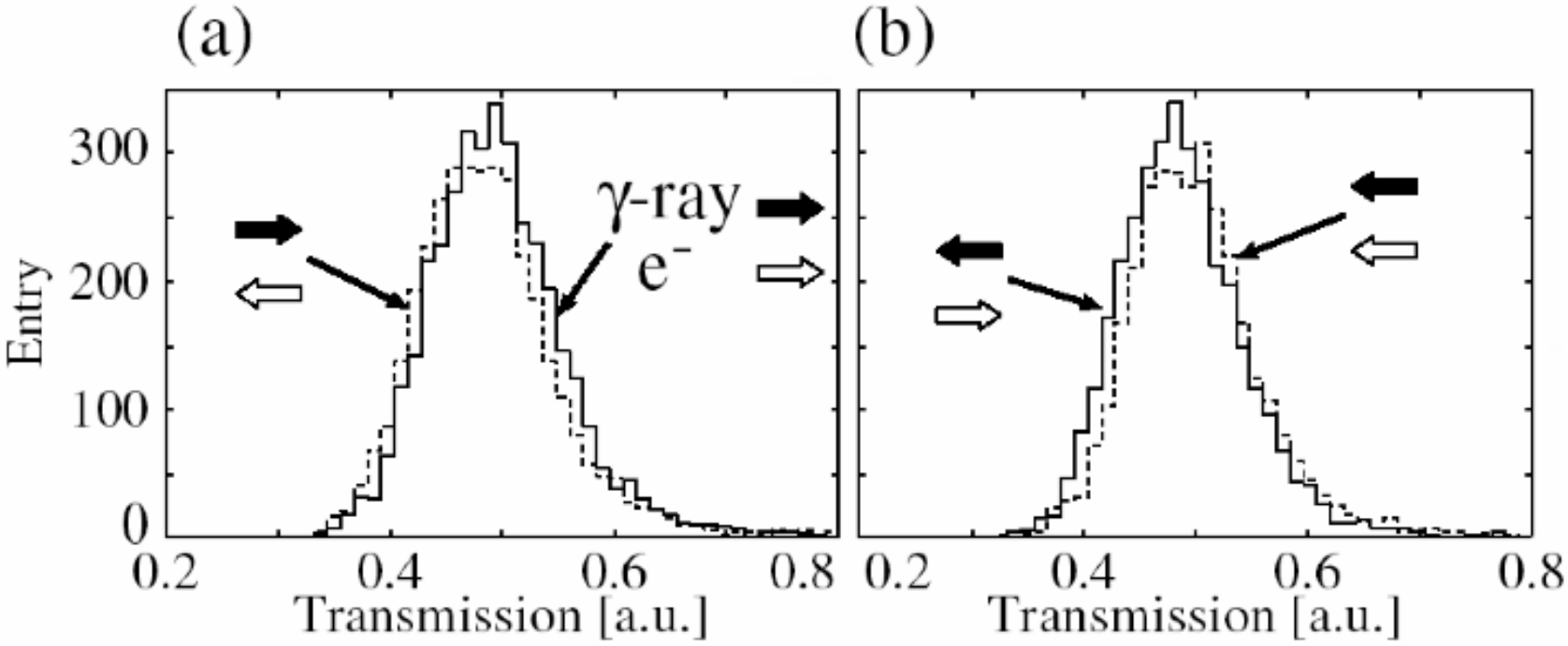
Transmission depends on
the direction of the magnetization

Expected asymmetry

$$A = \frac{N_+ - N_-}{N_+ + N_-}$$

A = 1.3 % (Pol.=88%)
(E_{th} = 21.4MeV)

Measured Asymmetry



A= -0.93± 0.15 %

laser pol. = - 79 %

A= 1.18± 0.15 %

laser pol. = + 79 %

Pol. γ-ray Production

Done: Mar. 2002

$N\gamma \approx 1 \times 10^6$ /bunch

$\Delta T(rms) = 31$ psec

Pol. : $\gamma = 88$ % (if laser pol. = 100%)

(measure $E\gamma > 21$ MeV)

M. Fukuda et al., PRL 91(2003)164801

Pol. e^+ Production

Now Under Way

Design values

$N\gamma = 1 \times 10^7$ /bunch (with new laser)

↓

$Ne+ = 3 \times 10^4$/bunch (E_{e^+} = 25 to 45 MeV)

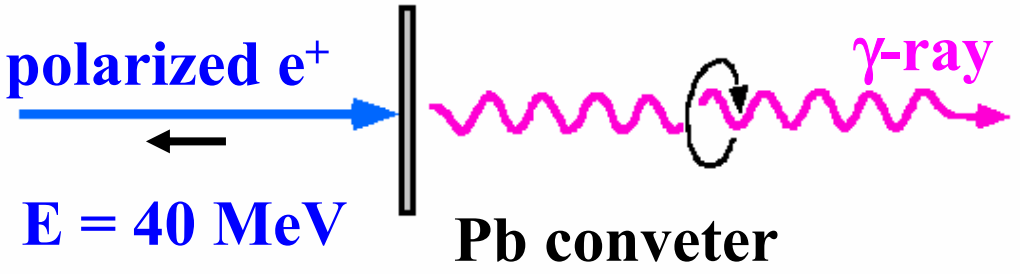
Pol. e^+ = 77 %

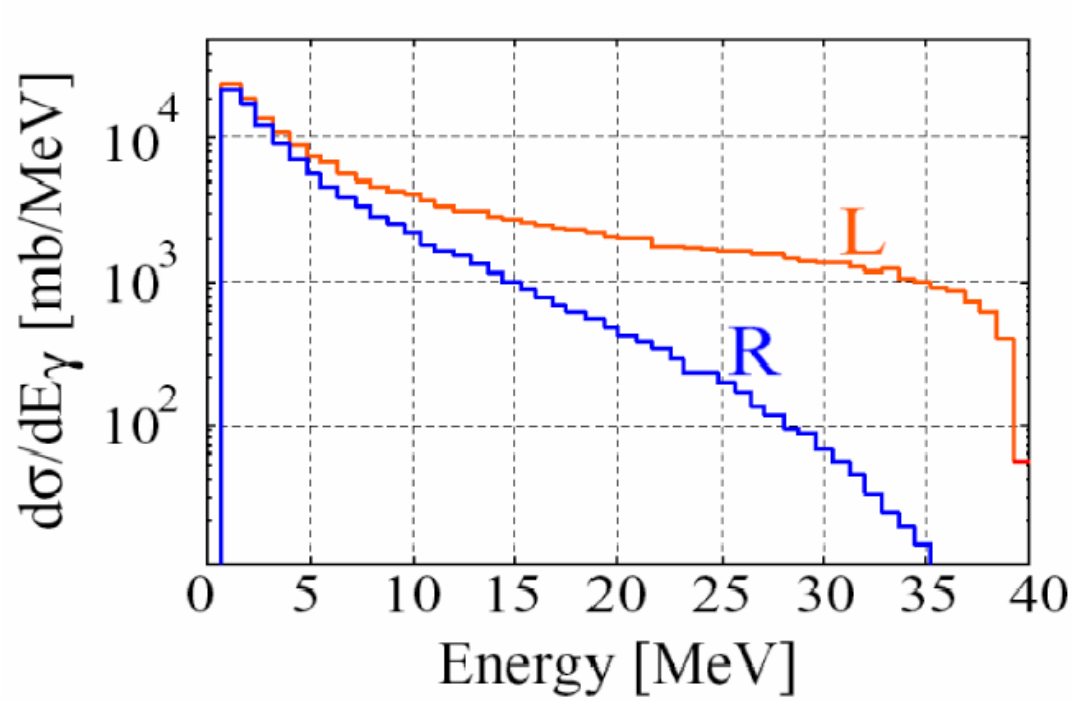
$\Delta T(rms) = 31$ psec

→ Can NOT measure each e^+

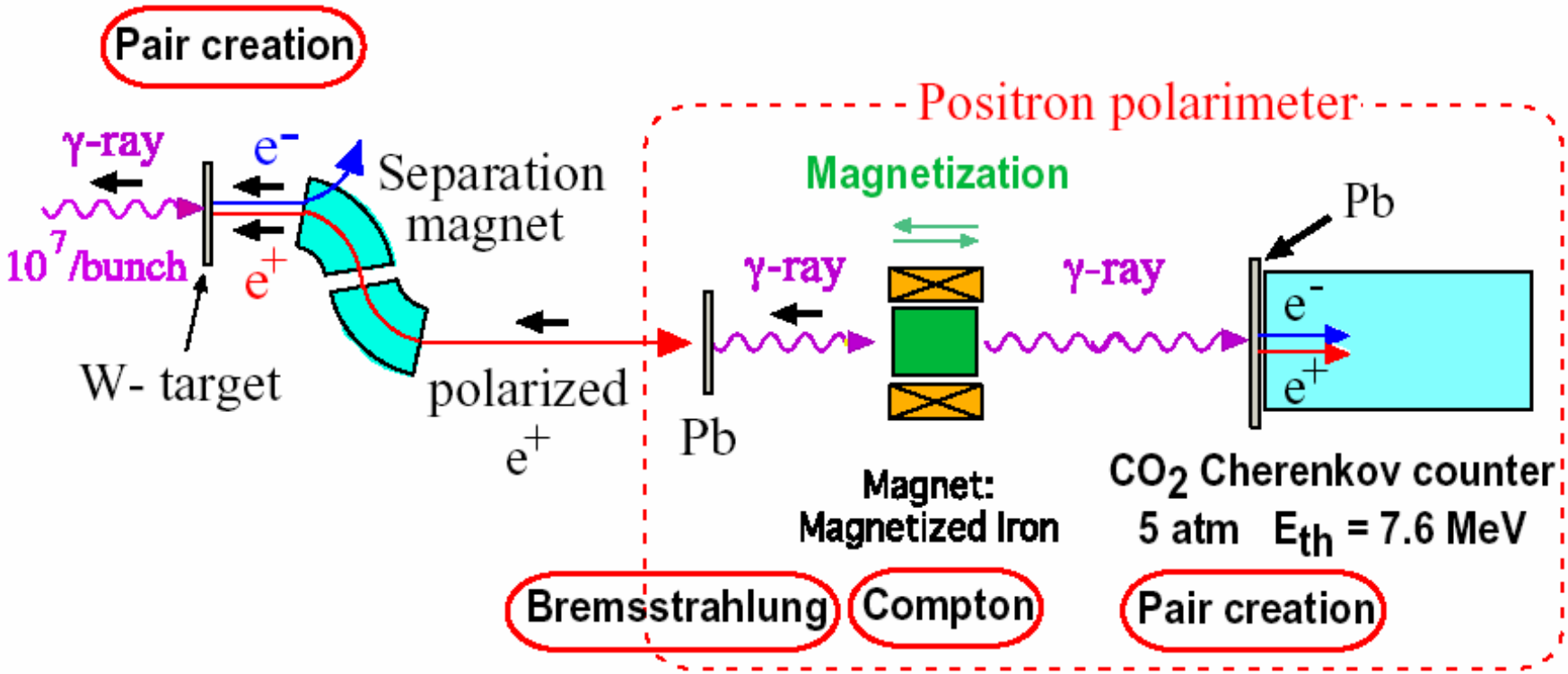
→ Polarimetry ?

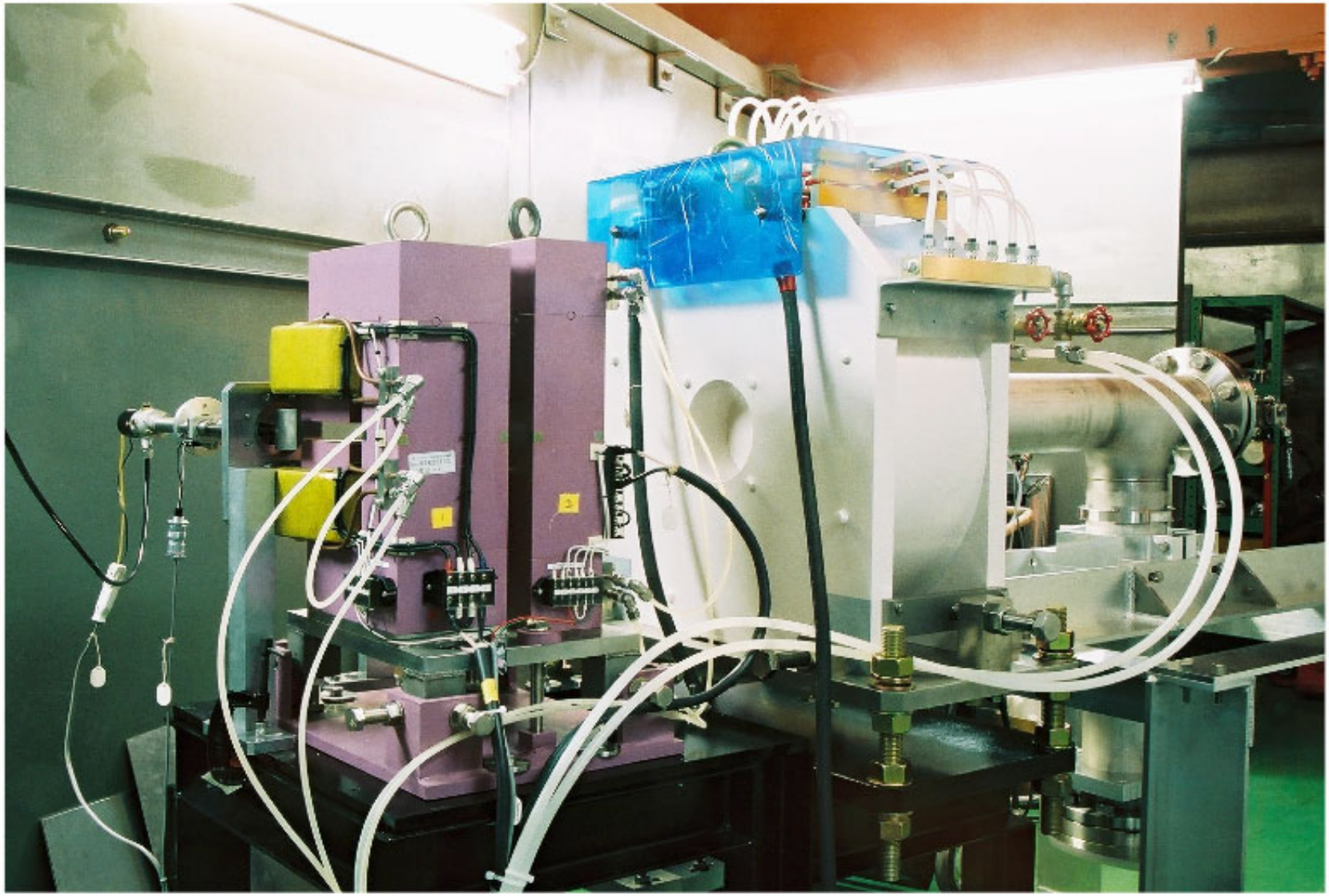
Measure e^+ polarization : use Bremsstrahlung γ-ray





Positron: production, selection, and polarimetry





Current Situation

Whole hardware: ready with small problems

--> we are fixing them.

$N\gamma \approx 1 \times 10^7$ /bunch : achieved (last week)

Pol. e+ production and polarimetry :

<--- now under way

target: finish by end of June.

Summary

1) Production of pol. γ and pol. e^+

i) Pol. γ: finish 2002

ii) Pol. e^+: now under way

2) Polarimetry

i) We established polarimetry of short pulse & high intensity γ-ray.

ii) The same method will be applicable to polarimetry of e^+.