A Report from PosiPol08

Masao KURIKI
Hiroshima/KEK

Scope of WS

J. Urakawa

- **The PosiPol is a series of workshops discussing about polarized positron source for ILC and CLIC projects.**
- **A primal topic of the workshop is the polarized positron source by laser Compton back-scattering. However, the scope of WS is expanded to related issues to find the best solution among various schemes.**
- **The meeting will also focus on the development and coordination of the R&D programs under way and the need for a costing of the different solutions.**

Ring/ERL Compton e+ source for LC

T. Omori

5. We still need many R/Ds ---> Good! We have many funs.
   (a) e+ stacking, (b) Ring, (c) ERL, (d) e+ capture
   (e) e+ production target, (e) Laser
   (g) Laser stacking optical cavity
   All of R/Ds are very important and correlated.
   "Choice of Ring or ERL" and "Choice of Parameters"
   are highly depends on the results of the R/Ds.

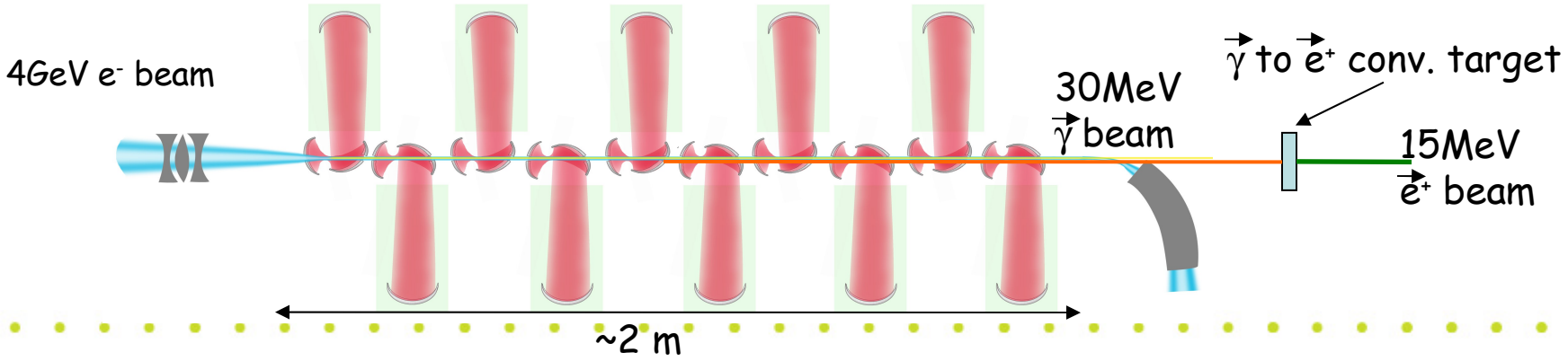
6. We have the world-wide collaboration for Compton.
   Not only for ILC/CLIC e^+ source.
   Also for many other applications.

Ring/ERL R&D list

e+ stacking in DR simulation studies	talk F. Zimmermann
Compton Ring simulation studies	talks P. Gladkikh, E. Bulyak
ERL simulation studies	
e+ capture (common in all e+ sources)	
Simulation study	talk A. Vivoli
Collaboration with KEKB upgrade	talk T. Kamitani
e+ production target	talks E. Bulyak
Laser	
Fiber laser / Mode-lock laser	talk E. Cormier
Laser Stacking Cavity experimental and theoretical studies	talks X. Li, F. Zomer, R. Chiche H. Shimizu, Y. Ushio, S. Miyoshi

In the proposal

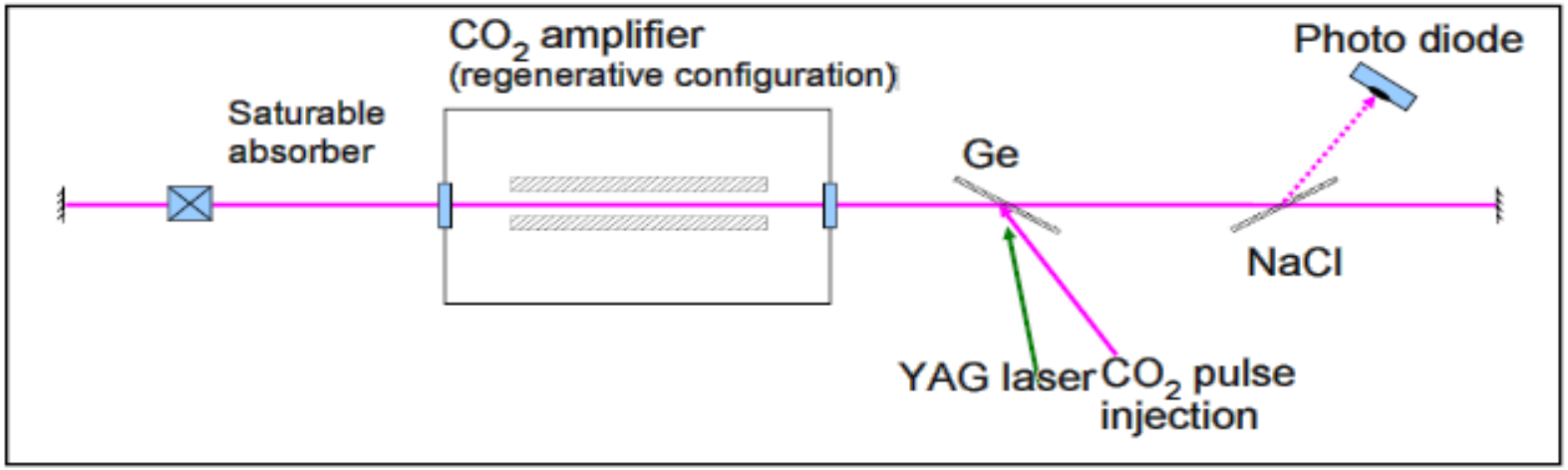
- polarized γ-ray beam is generated in the Compton back scattering inside optical cavity of CO_2 laser beam and ~4 GeV e-beam produced by linac.
- The required intensities of polarized positrons are obtained due to 5 to 10 times increase of the e-beam charge (compared to non polarized case) and 5 to 10 CO_2 laser system IPs.

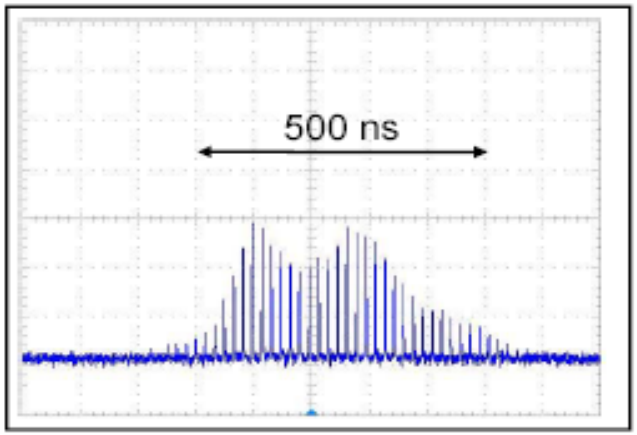


Status of CO2 laser system

I. Pogorelsky

Test #3: Pulse injection with a semiconductor switch





Demonstrated:

- Laser cavity with Compton mirrors and Ge switch
- 5-ps pulse trains over 1 μs duration
- 100 mJ/pulse

Goals for future tests:

Adjusting parameters of laser cavity and active medium to smaller losses and gain and longer pump/relaxation time (multi-isotope mixtures)

Isotopic CO_2 gas

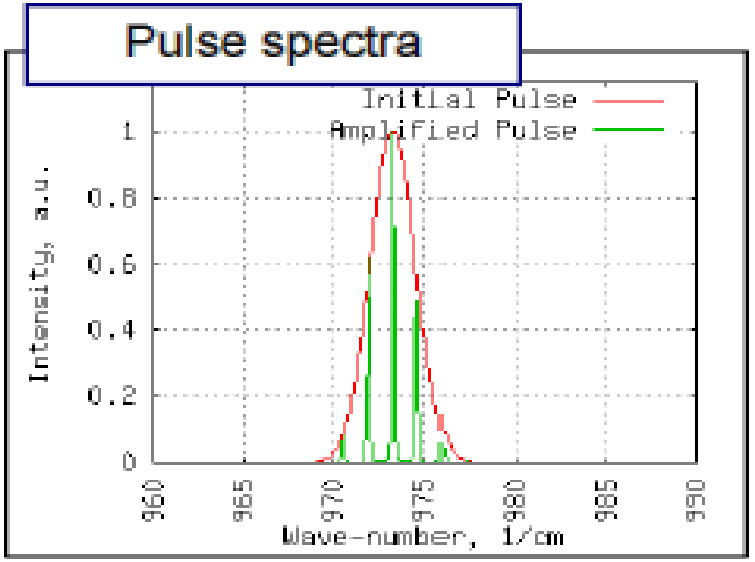
Case shown:

Pulse length = 8.5ps (1/e2)

Gas mixture: CO_2:N_2:He = 1:1:15

Total pressure = 3atm

Amplification = 100



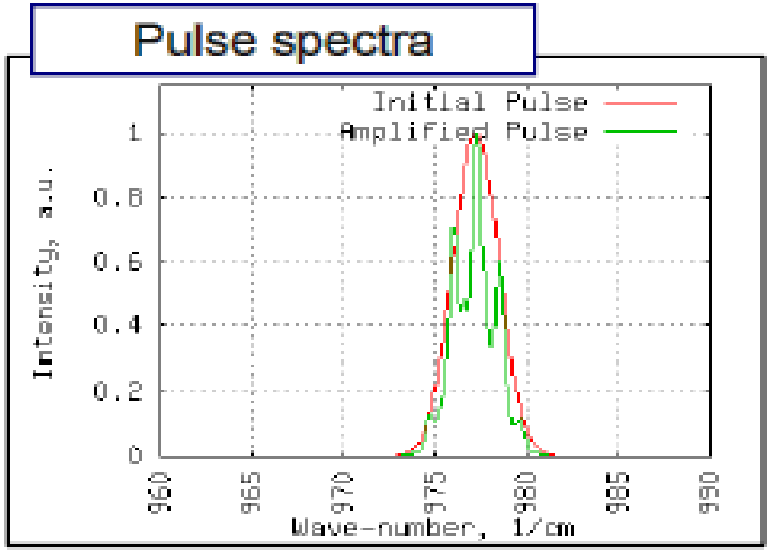
Case shown:

Pulse length = 8.5ps (1/e2)

Gas mixture: CO_2:N_2:He = 1:1:15

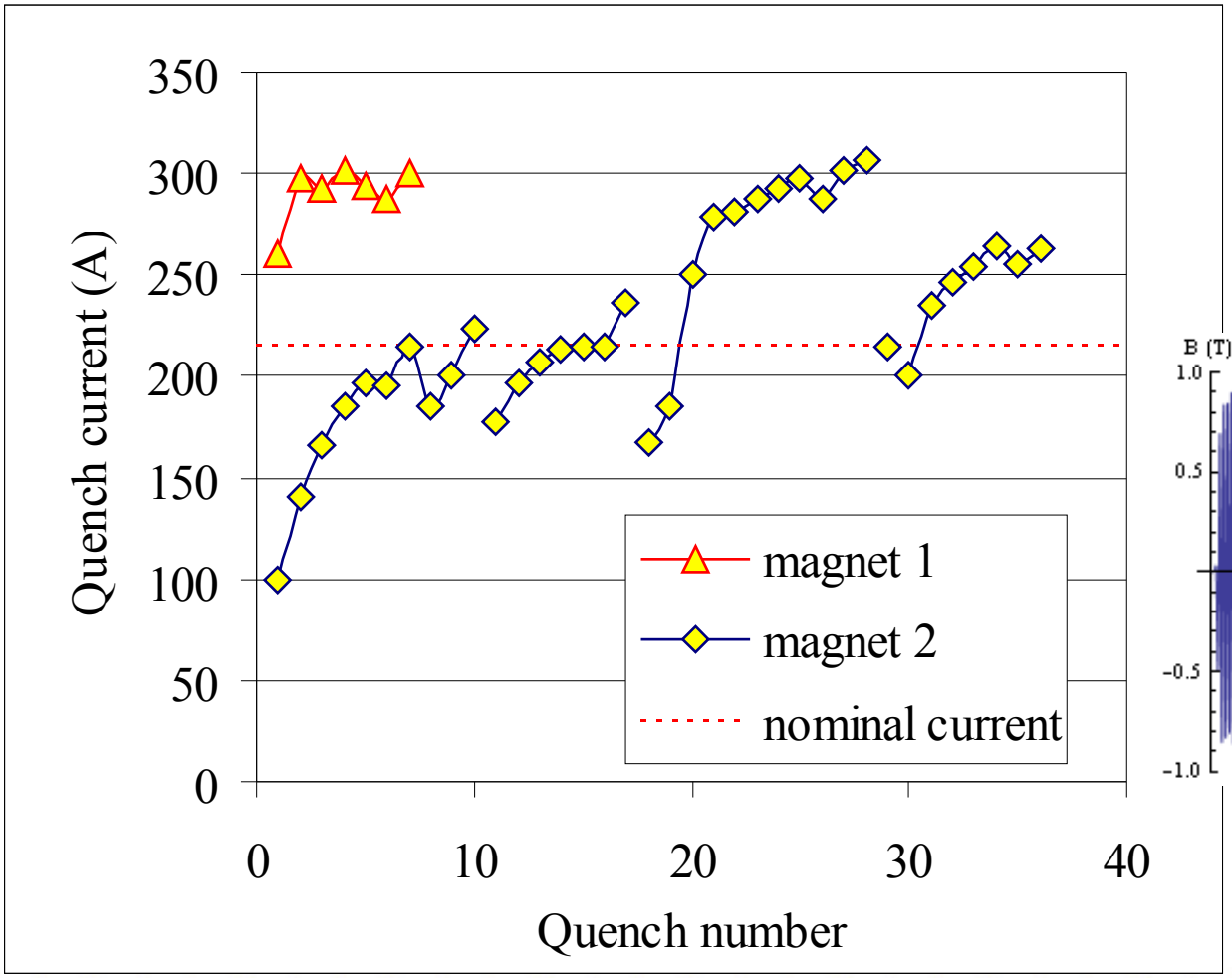
CO_2 isotopes: 626:628:828 = 1:2:1

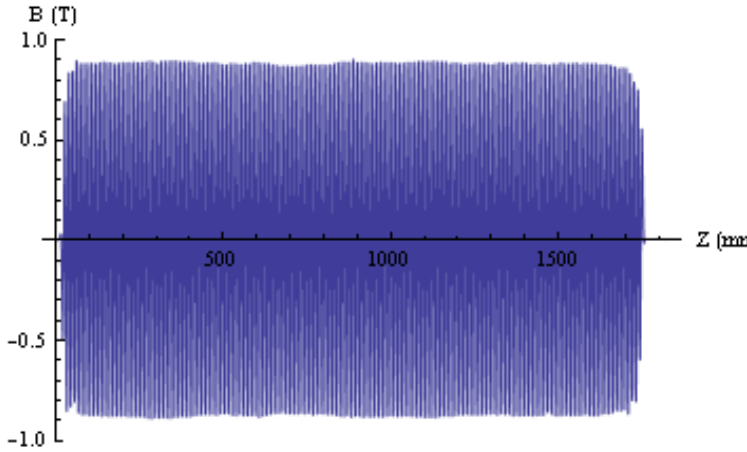
Total pressure = 10atm



Status of Undulator Based Positron Source Design for the ILC

J. Clarke





OMD

J. Gronberg

- For ILC wiggler:
  - **High field at the target seems ruled out**
    - Some work on non-conductive materials has been done
  - **The ¼ wave solenoid seems realizable and appropriate for the baseline**
    - Flux concentrator seems to be a challenging engineering problem
    - Lithium lens detailed design exists
      - Some work on survivability in the beam remains
- For Warm wiggler / short pulse:
  - **Pulsed flux concentrator is probably a good choice**
- For Compton Ring:
  - **Superconducting solenoid may be best choice**

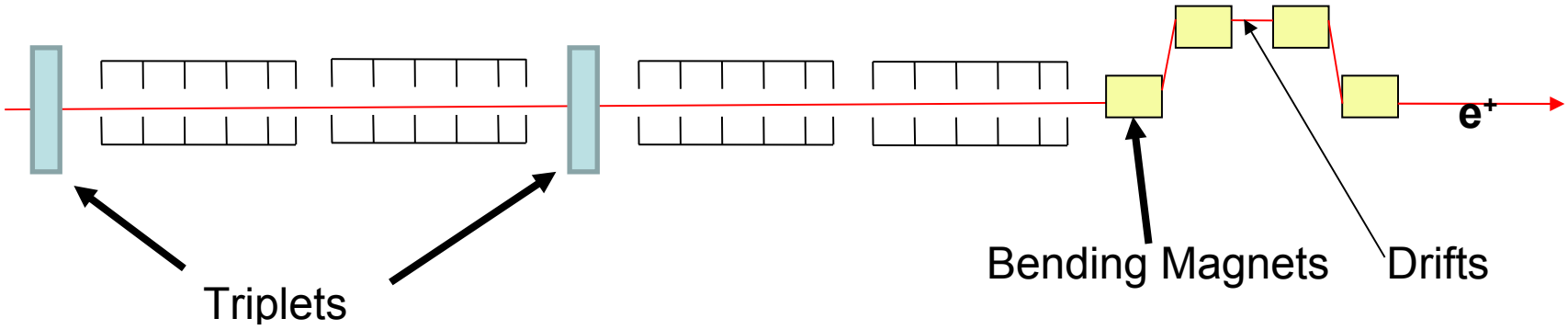
Stacking Simulation

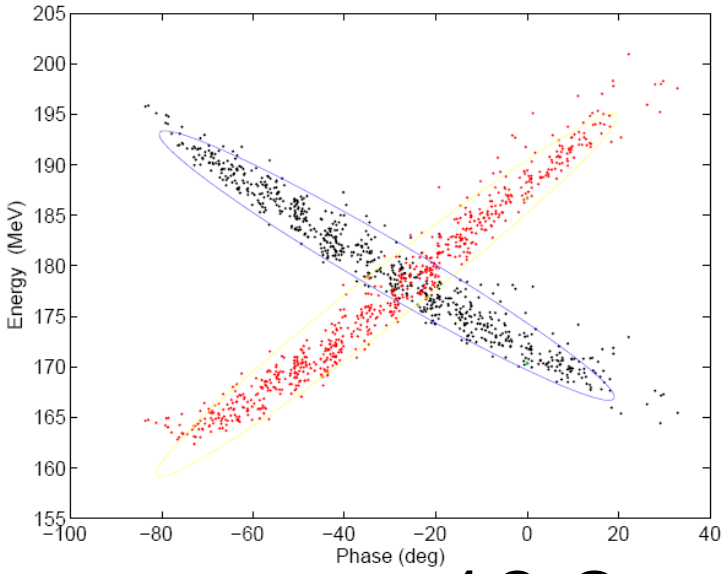
F. Zimmermann

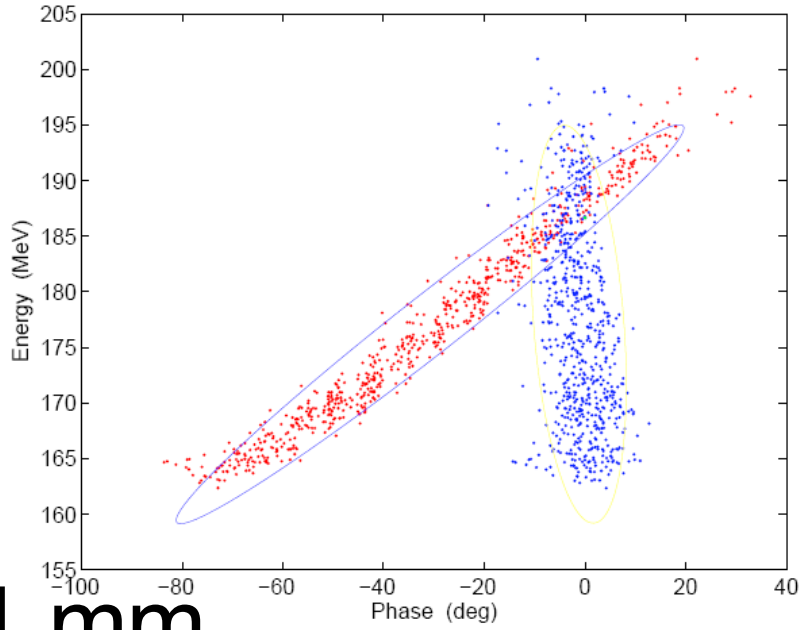
- **Simulation results:**
  - **90% for ILC-CR (300 inj's, σ_δ=2 MeV spread)**
  - **91% for ILC-CERL (1020 inj's! σ_δ=0.5 MeV)**
- both for Compton version of ILC DR with energy pre-compression - ***Compton version of ILC-DR acceptable? #e+ / pulse for C-ERL scheme?***
- CLIC simulations: still work in progress

Capture Study

A. Vivoli





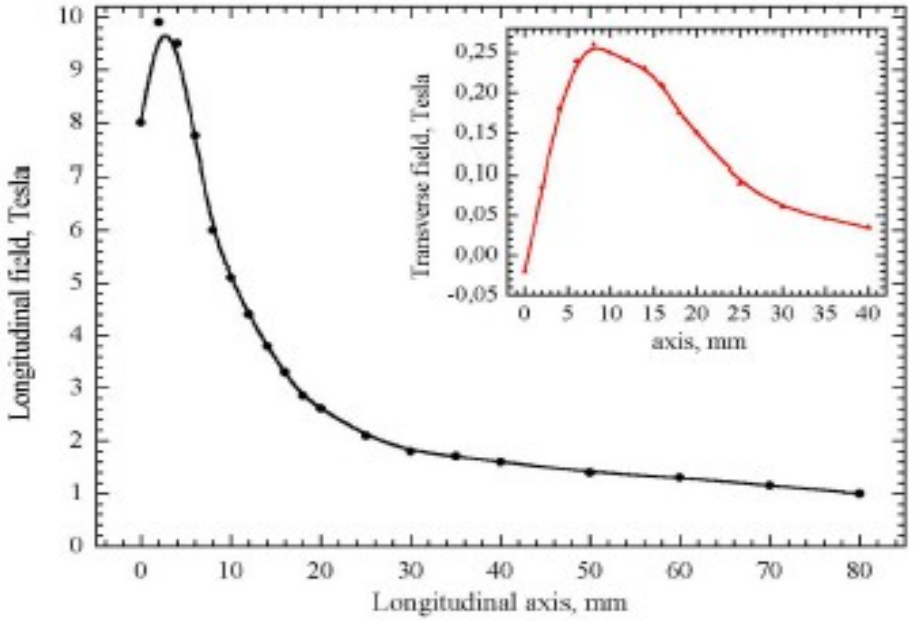


16.2 -> 3.1 mm

11

FC for KEB upgrade

T. Kamitani



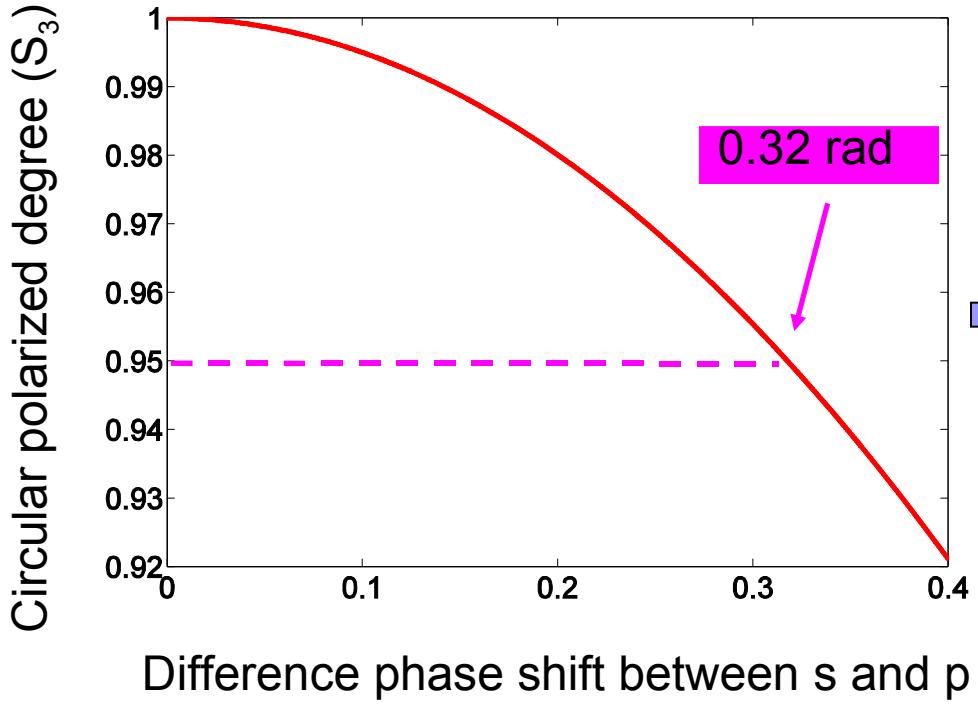
1. 10-T field can be achieved.
2. Design efforts performed with some prototypes to minimize transverse field component.
3. Field axis offsets 1 ~ 2 mm.

Polarisation effects in 4 mirrors cavities

F. Zomer

Polarization-preserving of laser beam in Fabry Perot Cavity

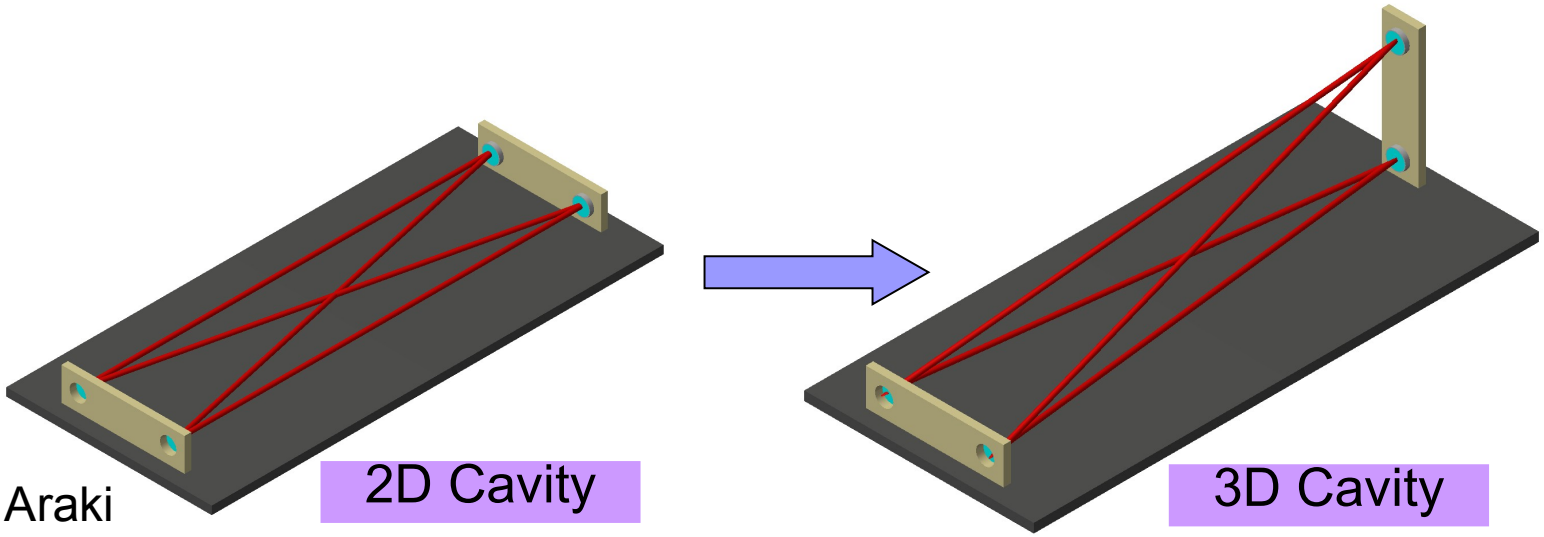
X. Li



To keep at least 95% circular polarization:

The different phase shift between s and p should be smaller than 0.32rad

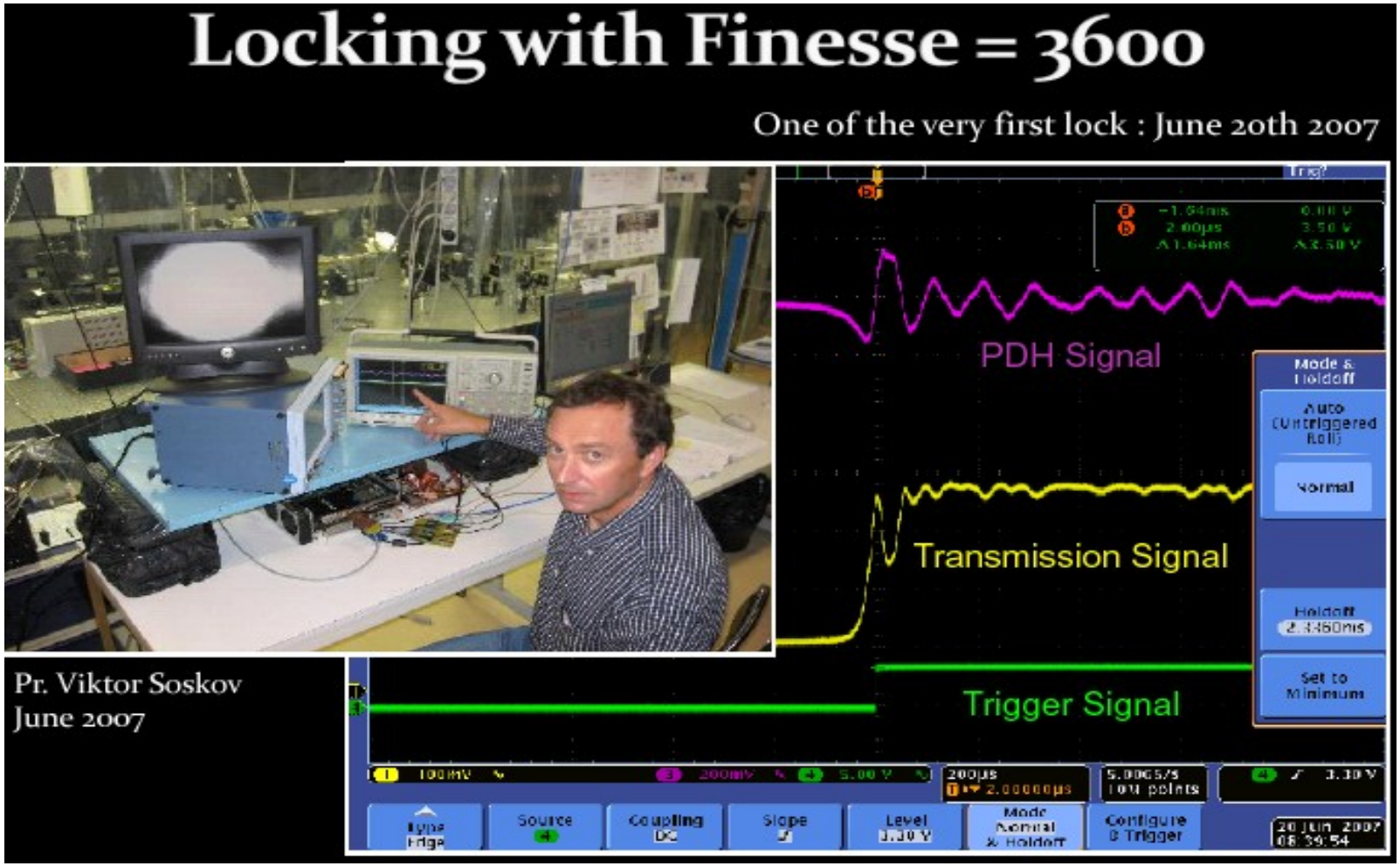
- **2D cavity**
  - Instability of the polarisation of the eigen mode
  - Instability of the *polarisation mode matching* between the incident and circulating fields
- **3D cavity**
  - Eigen modes allways circular
  - Power stable



by Araki

Pulsed Laser Injected Cavity

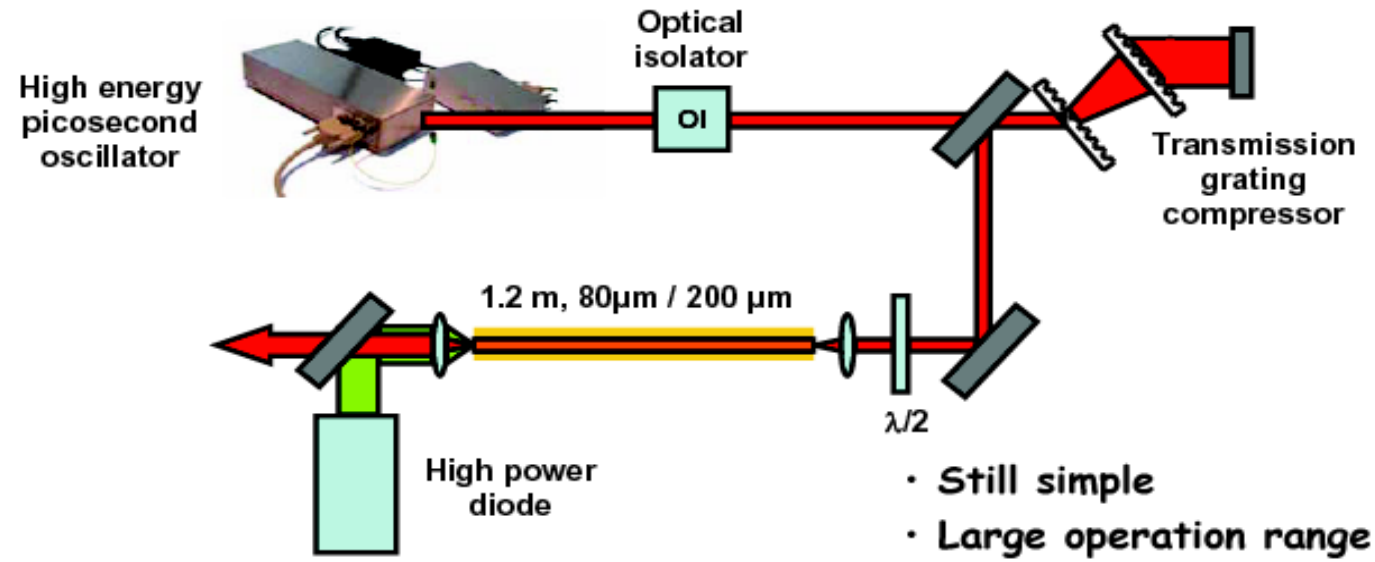
R. Chiche



High power picosecond fiber amplifier

E. Cormier

SPM induced spectral compression



Max peak power = 0.21 MW

τ = 4 ps

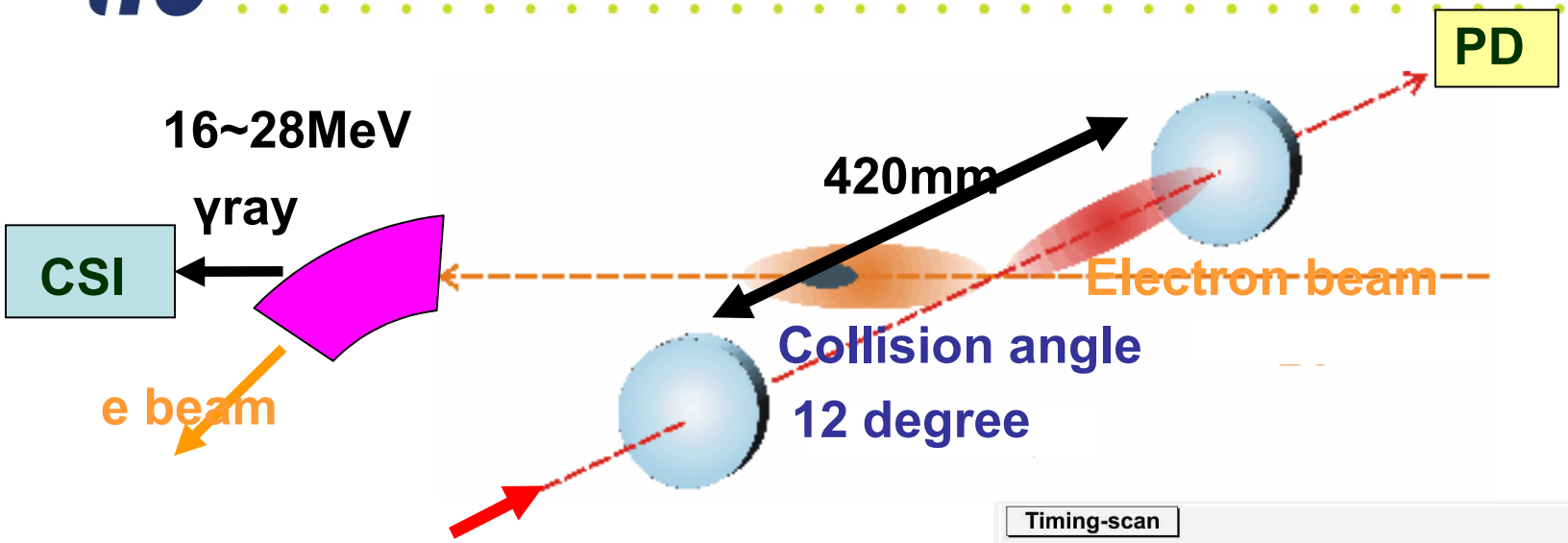
E = 0.84 µJ

ν = 178.5 Mhz

P ~ 150 W

Optimal for cavity enhancement on ATF@KEK

Experiment at KEK-ATF



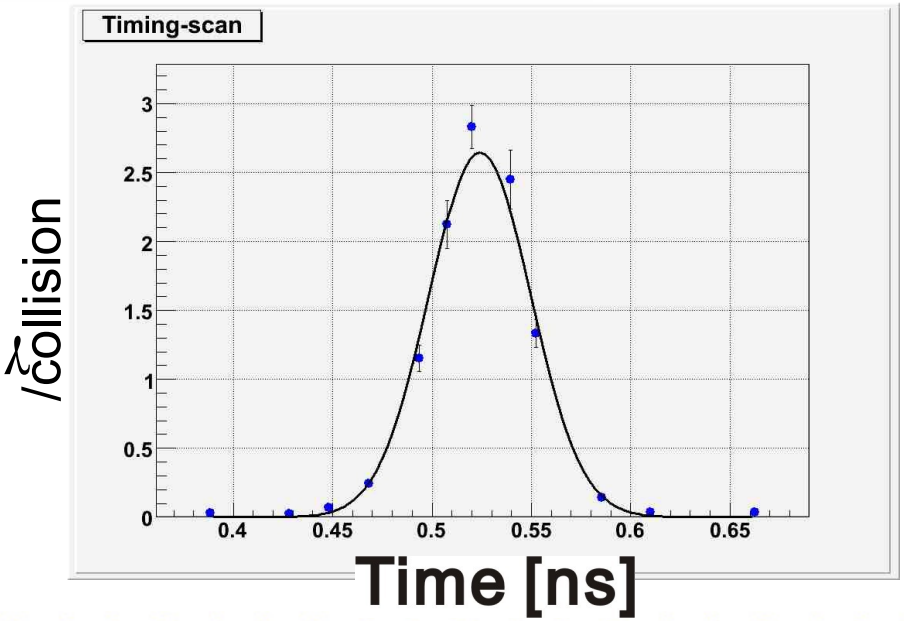
λ:1064nm

10W=28nJ , 2.8ns spacing

Pulse length : 7ps

Finess = 780

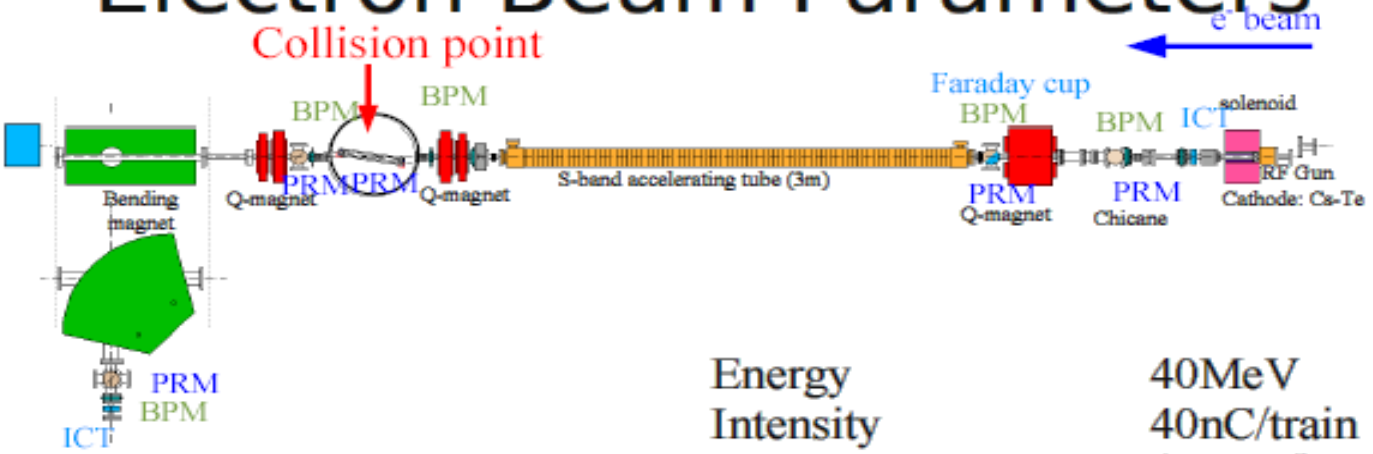
σ = 30 μm

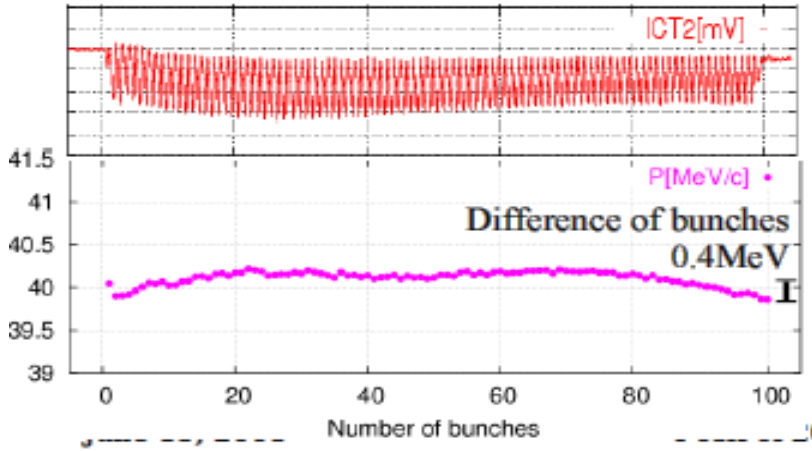


Development of a compact X-ray source with a pulsed laser cavity at LUCX

M. Fukuda

Electron Beam Parameters





Energy	40MeV
Intensity	40nC/train (0.4nC/bunch)
Number of Bunch	100bunches/train
Bunch spacing	2.8ns
Rep. Rate	3.13Hz
Emittance	8-10 [π mm mrad]
Energy Spread	0.12% (r.m.s.)
Beam size at C.P.	80um x 40um

Expected number of X-rays

	Laser (in Cavity)	e^- beam
Energy	λ = 1064 nm (1.17eV)	40 MeV
Intensity	112μJ/bunch	0.4nC/bunch
	3.0×10^{14} photons/bunch	2.5×10^9/bunch
Beam size	σ = 30 μm	σ_x, σ_y = 80μm, 40μm
Pulse width	7ps	10ps
Number of bunch		100 bunches/train

Measured number of X-rays is 247photons/train/2.17mrad.
(Total: 1.5x10^4 photons/train)

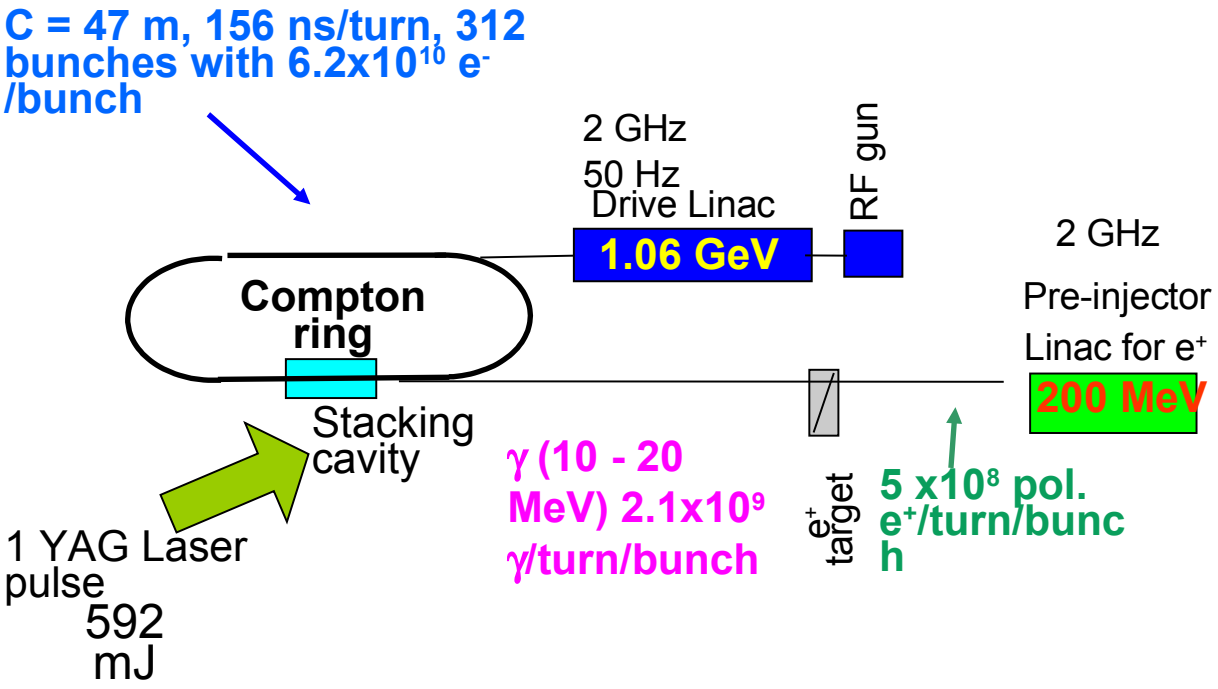
Expected number of X-rays is 798 photons/train/2.17mrad.
(Total: 4.8x10^4 photons/train)

However, it is larger by factor of 3 than the experimental results.

CLIC Compton scheme

L. Rinolfi

Compton configuration for polarized e^+ and high e^+/γ yield



W sliced rod target 3 rad length => yield 0.48 e^+ / γ

=> Stacking simplified

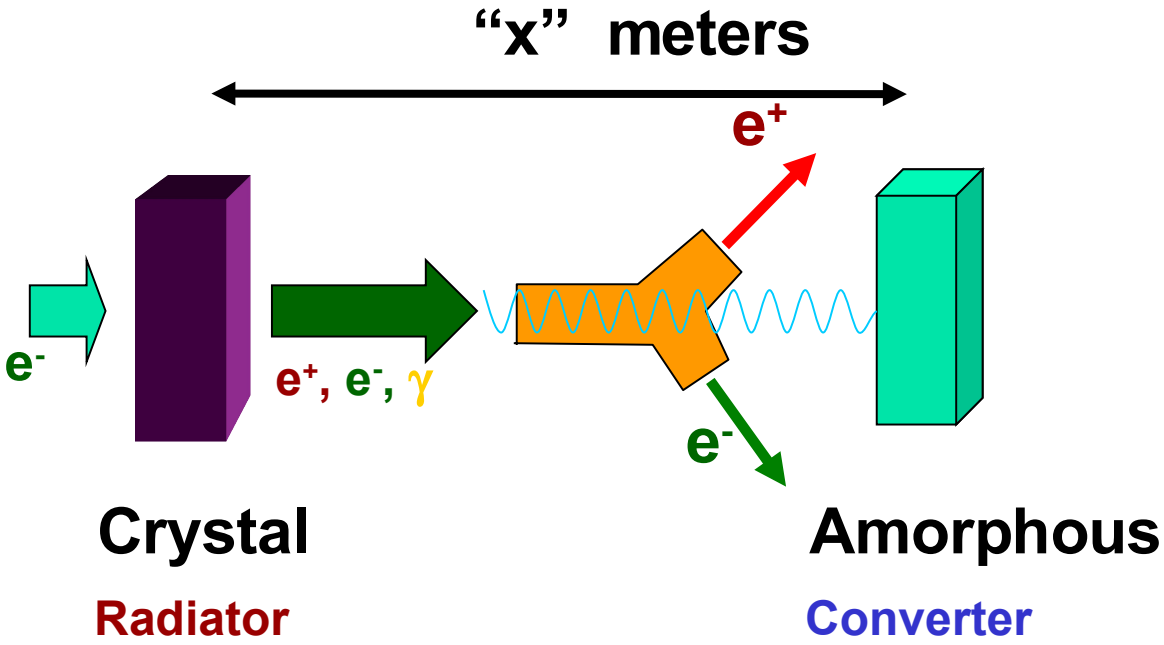
E. Bulyak / NCS KIPT

- **Collaboration between CLIC and ILC on subjects with strong synergy;**
  - **Makes the best use of available (too scare) resources**
  - **Extremely beneficial to both studies**
  - **Any progress on one study profitable to the other**

- **Collaboration on Positron Generation strongly supported by CLIC and ILC managements**
- **Plea to join our efforts to work together on R&D of Compton scheme as the favored alternative of both studies**
- **Welcome participation for common work at:**
  - **CLIC08 Workshop @ CERN: Oct 14-17, 2008**
  - **ILC08 LCWS Workshop @ FNAL: Nov 16-20, 2008**

POSITRON SOURCES USING CHANNELING FOR ILC & CLIC

R. Chehab



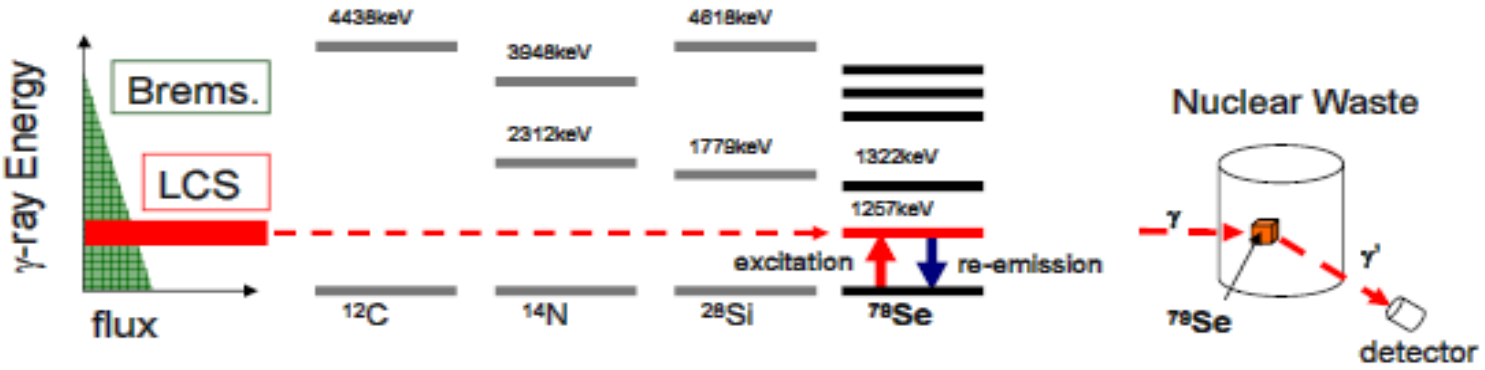
Only the photons are impinging on the converter: that limits the energy deposition in the amorphous target. The yield is less than if the particles coming from the crystal were also impinging on the amorphous target

- A single target works for CLIC, but multi-target is needed for ILC limited by PEDD.

Applications of high-flux gamma rays to radioactive and nuclear waste management

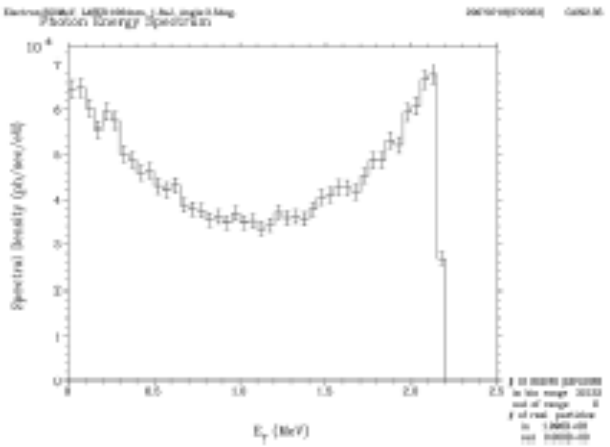
R. Hajima

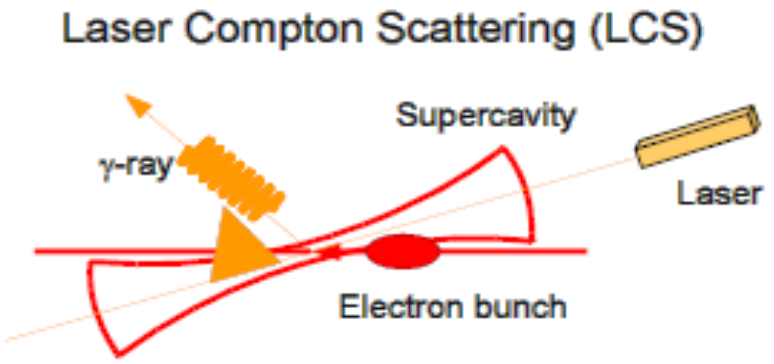
Nondestructive Assay by Nuclear Resonant Fluorescence

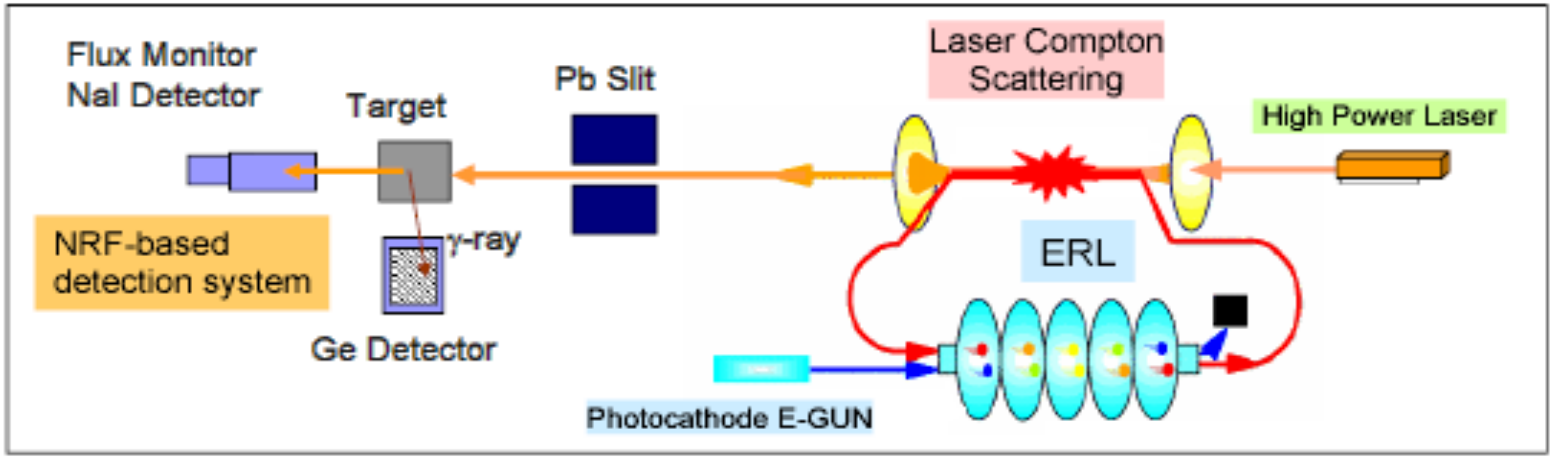


- Irradiation of γ-rays tuned at a NRF energy of nuclide to detect
- Detection of scattered γ-rays by energy-resolved detectors
- NRF is a unique fingerprint of nuclides → radioactive and stable nuclides can be detected
- Using 1-4 MeV γ-rays → applicable to thick objects

Concept of a high-flux γ-ray source

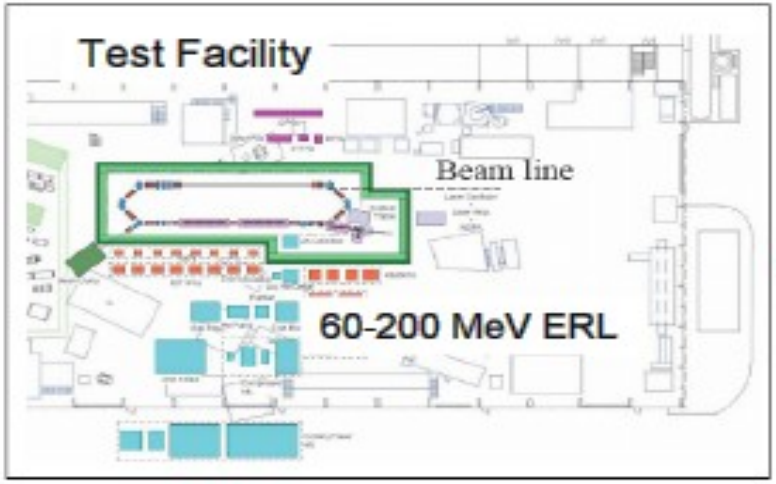






R&D's at the ERL collaboration in Japan

A collaboration has launched towards a future ERL light source in Japan.
KEK, JAEA, ISSP and other laboratories.



Components relevant to the ERL light source are under development.

electron gun, superconducting cavity ...

These components are common to the γ-ray source

Summary

- PosiPol08 was held with 32 participants. 10 of them were through WEBX. 40% of talks was given remotely.
- WS covers a wide variety of topics from fundamental physics to applications related to e+ source for LC.
- The weather was excellent even it was rainy season in Japan. We believed that the participants enjoyed the whole life at Hiroshima.
- Next WS, PosiPol09 will be near CERN.