POSIPOL 2010 Summary

22-July-2010
ILC-CLIC e+ studies
T. Omori (KEK)

POSIPOL 2010

Date: 31/May-2/June

http://atfweb.kek.jp/posipol/2010/

Place: KEK

44 participants (including 4 via WebEx/Phone)

36 presentations with discussions

36 Presentations

Welcome and Scope: (2 talks)

Status of e+ sources for colliders :(3 talks)

Compton-based e+ sources for colliders(ILC&CLIC):(10 talks)

Physics: (1 talk)

R/D Plan (ILC-CLIC working group) : (1 talk)

Compton-based X-ray and gamma-ray sources : (4 talks)
(including appl. to material physics)

Undulator-based e+ source for ILC:(4 talks)

Hybrid and channeling e+ sources (CLIC&ILC): (7 talks)

Liquid Pb and Pure Conventional e+ sources (ILC): (3 talks)

Summary: (1 talk)

Welcome

K. Nishikawa, IPNS, KEK, POISPOL 2010

- The JAHEP community's master plan
  - Highest priority is given to ILC
  - Before ILC, promote flavor physics at KEKB and J-PARC
- Action before the ILC approval
  - ILC R&D
  - Completion/commissioning and continuous improvements of J-PARC
  - Upgrade of KEKB/Belle
  - Collaboration in LHC/ATLAS

Welcome

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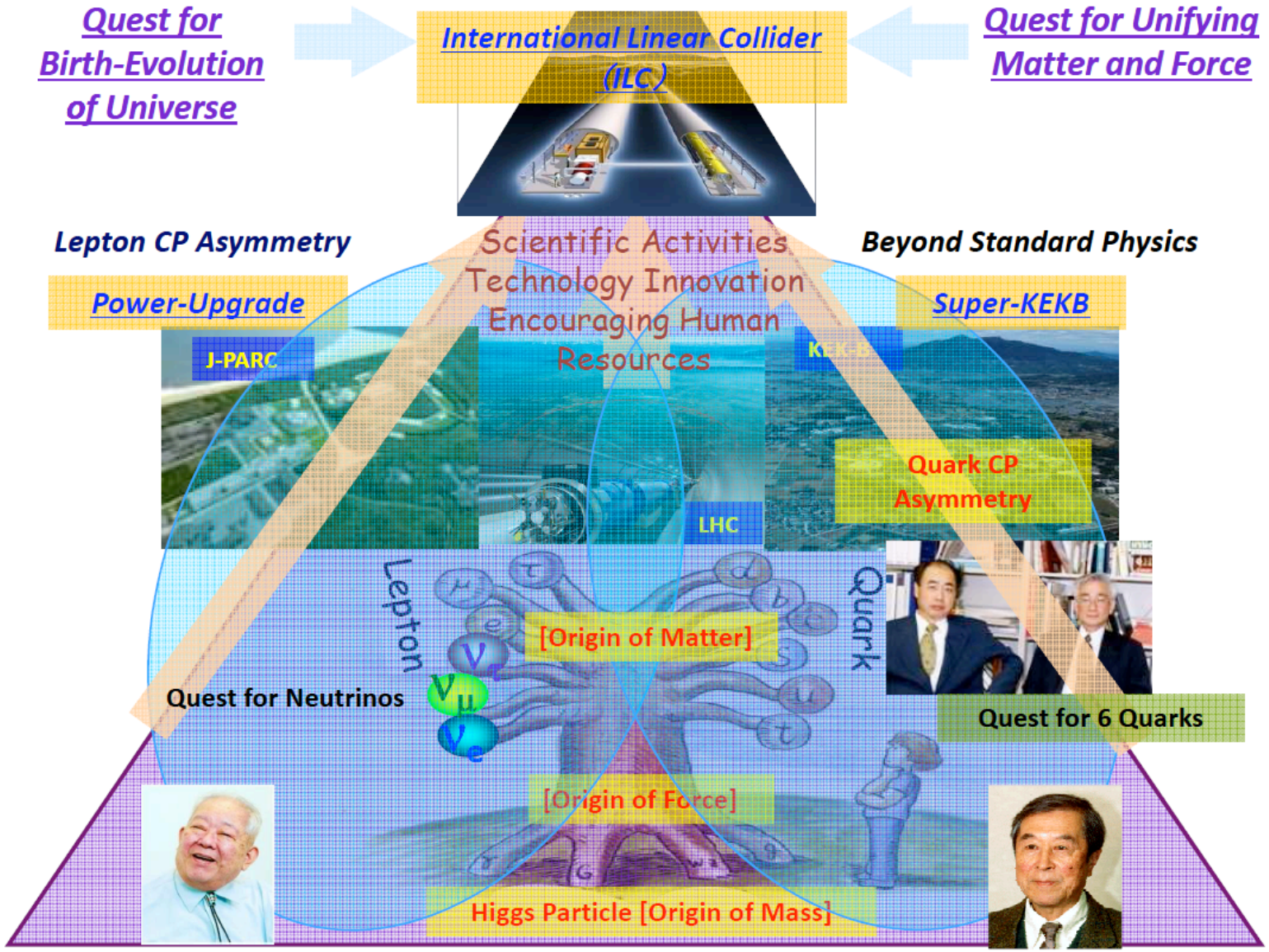
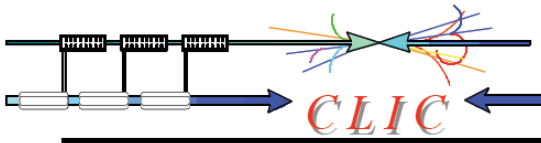


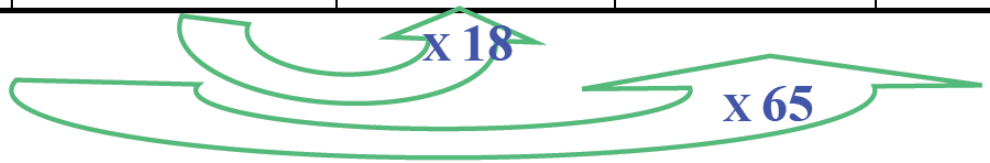
Number of e+s required by LCs

from L. Rinolfi's presentation



Flux of e^+

	SLC	CLIC (3 TeV)	ILC (RDR)	LHeC
Energy	1.19 GeV	2.86 GeV	5 GeV	100 GeV
e^+/ bunch at IP	40 x 10^9	3.72x10^9	20 x 10^9	15x10^9
e^+/ bunch before DR injection	50 x 10^9	7.6x10^9	30 x 10^9	15x10^9
Bunches / macropulse	1	312	2625	20833
Macropulse Repetition Rate	120	50	5	10
e^+ / second	0.06 x 10^{14}	1.1 x 10^{14}	3.9 x 10^{14}	31 x 10^{14}



Status of e+ Sources for Colliders

- **Status of ILC e+ Souce: K. Yokoya (KEK)**
  - **Design reconsideration: SB2009**
    - **undulator location, matching device, ,,,**
  - **R/Ds**
    - **Prototype undulotor**
    - **Target prototype (in Air)**
    - **Target Mockup (in Vacuum)**
    - **Flux concentrator (design study)**

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- Status of e+ Sources for Super B factories: T. Kamitani(KEK)

  Super KEKB and SuperB of INFN

• Status of e+ Sources for SuperB factories, T. Kamitani (KEK)

SuperKEKB e^+ source

- 3.5 GeV e- linac, AMD, L-band capture section, Damping Ring
- R&D work are going on for two AMD candidates,
  [1] flux concentrator and [2] superconducting solenoid
- L-band components are under development
- detailed tracking simulation study are going on

SuperB e^+ source

- 0.6 GeV e- linac, AMD, L-band capture section, Damping Ring
- four scenario of capture section are considered
  [1] S-band Acc, [2] S-band Dcc, [3] L-band Dcc,
  [4] S-band TM020 mode Dcc + L-band Acc
- detailed tracking simulation study are going on
- decceleration approch seems to be promising, especially scenario [4]

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- Status of e+ Sources for Super B factories: T. Kamitani(KEK)
  - Super KEKB and SuperB of INFN

- Status of BEPC II e+ Source : G. Pei (IHEP)
  - Impressive progress from BEPC to BEPC II

- **Status BEPC II e+ Source, Pei (IHEP)**

BEPCII (Design and Achieved)

Parameters		Design	Test results	BEPC
Energy （GeV）		1.89	1.89	1.30-1.55
Current （mA）	e^+	37	66	~5
	e^-	500	550	300
Emittance （1σ, mm-mrad）	e+	0.40	0.35 ~ 0.27	----
	e^-	0.10	0.097~0.079	----
Energy spread （1σ, %）	e^+	0.50	0.371	~0.80
	e^-	0.50	0.295	~0.80
Energy stability (%)		0.15	0.05	----
Orbit stability （mm）		0.30	0.119 ~0.058	----
Repetition rate		50	50	12.5
e^+ injection rate （mA / min.）		50	61.5	1 ~ 3

Compton-based e+ sources for colliders (1)

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  Overview of Compton sources. Linac scheme: Compton ring, and ERL scheme

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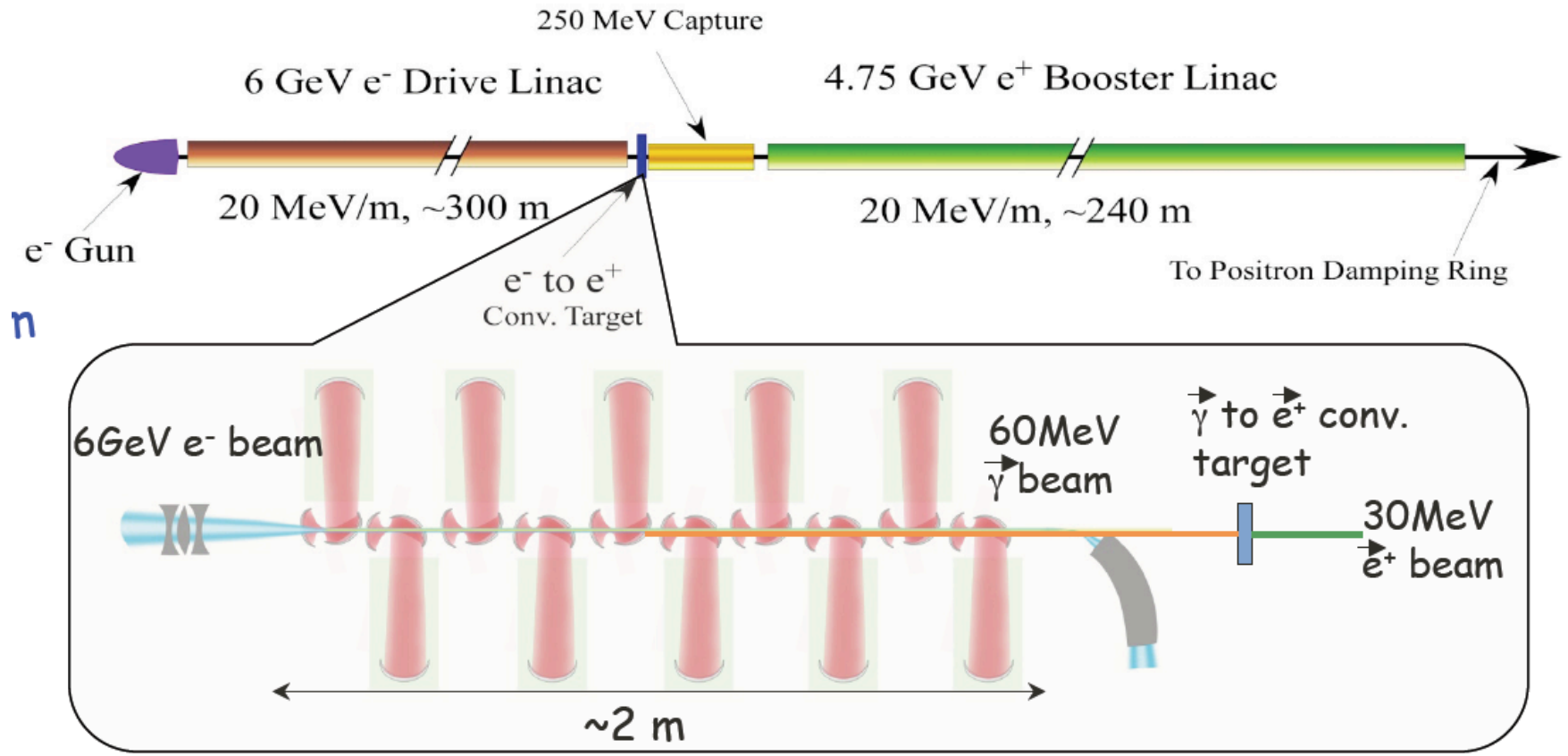

- No positron accumulation is needed:
- **Can be add-on option for non-polarized linac source.**

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  Laser-cooled Compton ring and it's optimization

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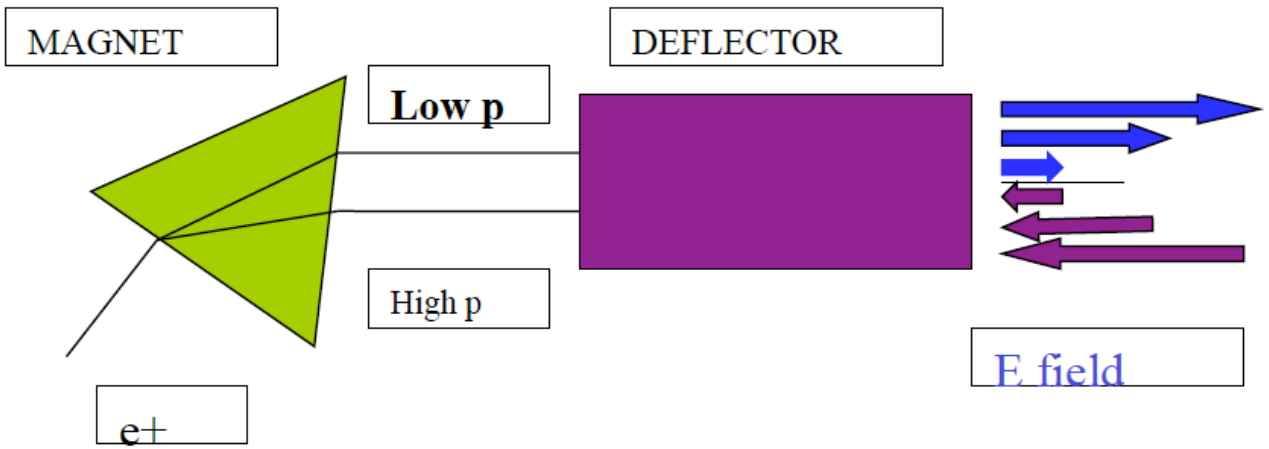
  New scheme of energy compression: an isochronous line + Deflector

- **Energy compression to optimize the stacking of e+ bunches: R. Chehab**

  - **Use of an isochronous line + Deflector**
  - **The scheme:**



The scheme has been proposed by W.Gallagher in "Energy spectrum improvement with the HEM-11 mode (LA-3609)

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- **Status of 4-mirror cavity for ATF : F. Zomer (LAL)**
  The 4-mirror cavity and the laser is ready at LAL and coming to KEK

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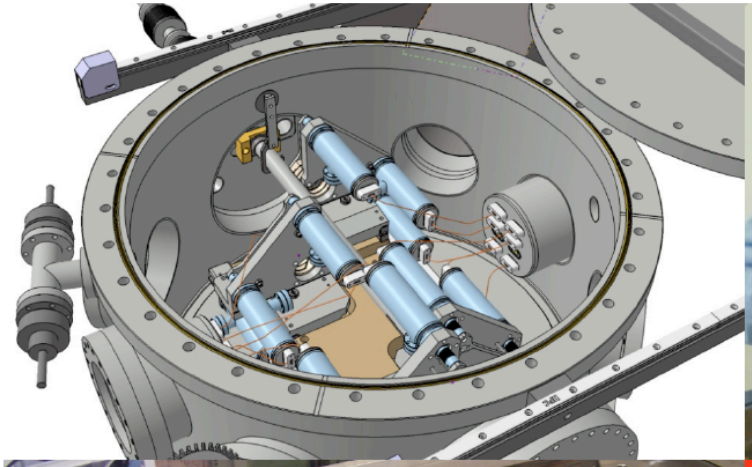
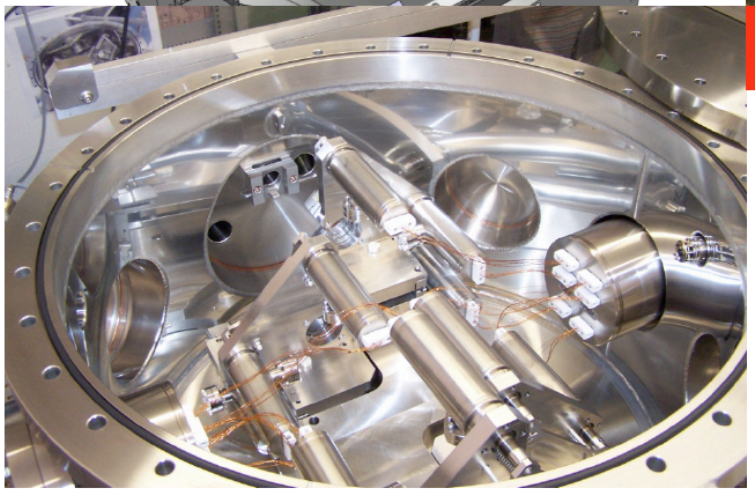
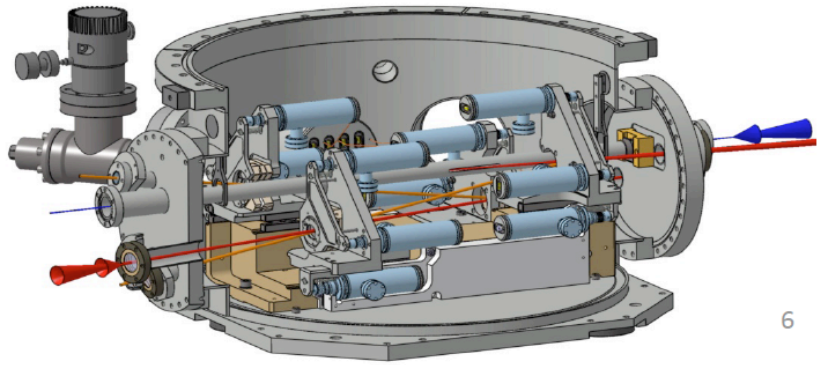
Cavité Fabry-Perot mounting (in a class 10 clean room)





Viton joint & turbo Pump → ~ 10^{-7} mbar



Compton-based e+ sources for colliders (2)

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  Construct a calculation model incorporating the effects of image rotation, and compare the model and measurements.

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  Stacking simulation for CLIC "two stacking ring" scheme.
  See the minutes of the phone meeting on 24-June-2010.

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  Photons flux with multiple IPs line. 10 IPs with 2 crossing LASERs.
  Optimal -> 5 IPs: detaild study for 5 IPs

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- **Status of the experiment with the 2-M cavity at KEK-ATF: S. Miyoshi (H)**
  The enhancement factor was improved from 250 to 760.
  Next step will be Bunch by bunch gamma ray measurement.

Physics

- **New from physics with polarized beams: G. Moortgat-Pick (DESY)**

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Conclusions

- P(e+) only gains, independent in which direction the NP points!
  - 'enhances luminosity' in direct and indirect searches
  - enables separate study of couplings (properties of SUSY particles!)
  - improves signal vs background, e.g. factor in light Higgs searches!
  - enables 'model-independence' in indirect searches
  - enhances precision in Standard Model tests (GigaZ, WW threshold)

→ Polarization more important than 'pure' luminosity

- P(e+) crucial for 'being prepared for the Unexpected' !

→ full potential of the ILC could only be realized with $P(e^-)$ and $P(e^+)$

- in particular important at $\sqrt{s} = 500$ GeV ('maximize' results, outline of upgrades!)
- high accuracy guaranteed: expected depolarization less than ~1% !

→ potential of CLIC in the multi-TeV region would also strongly benefit

R/D plan

- **New milestones for the CLIC/ILC e+ generationWG: L. Rinolfi (CERN)**

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Important reduction of resources have registered in several institutes.

Therefore the ILC/CLIC work plan is reviewed according to the available resources from the different institutes around the world and the possible contributions are presented.

Plan 2010 - 2011 for Asian, American, and European labs are reviewed

Compton-based X-ray and gamma-ray sources

- **Compton Programs in KEK: J. Urakawa (KEK)**

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  Compact ERL as a laser Compton X-ray source

  Scientific opportunities

  - Ultrafast X-ray sciences

  - Phase contrast X-ray imaging

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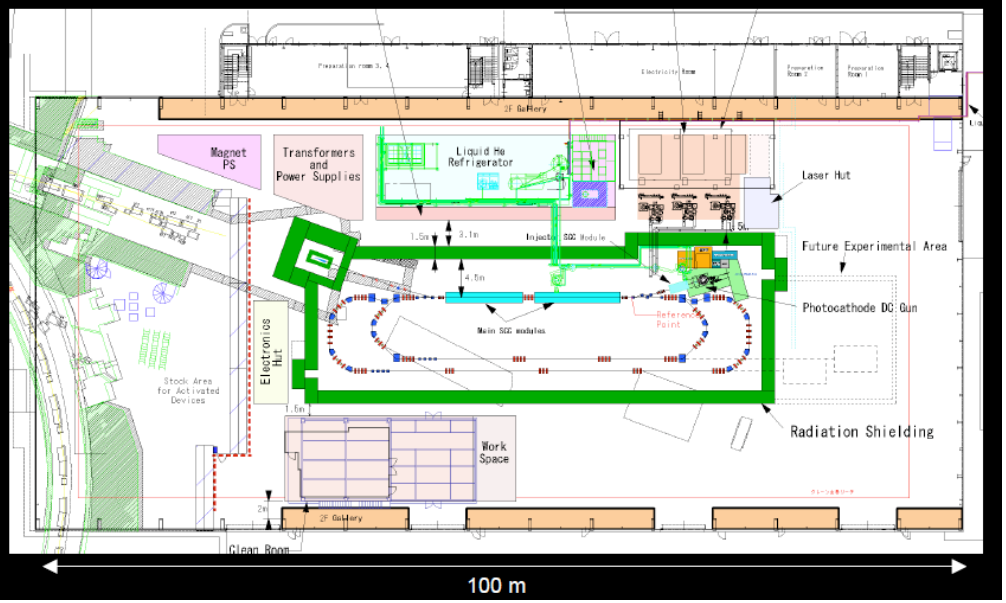
Compact ERL for ERL technological R&D

Parameters of the Compact ERL

	Parameters
Beam energy	35 - 245 MeV
Injection energy	5 MeV
Average current	10 - 100 mA
Acc. gradient (main linac)	15 MV/m
Normalized emittance	0.1 - 1 mm·mrad
Bunch length (rms)	1 - 3 ps (usual) ~ 100 fs (with B.C.)
RF frequency	1.3 GHz



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  Mono-energetic X/gamma-ray generated by LCS can be used for nuclear security applications: detection and measurement of nuclear material.

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- **Compton ring for nuclear waste management: P. Gladkikh (KIPT)**
  Compton Ring for Nuclear Resonance Fluorescence
  APPLICATIONS:
  - nondestructive assay of radioactive nuclides;
  - management of nuclear waste;
  - advanced safeguard technologies of non-proliferation

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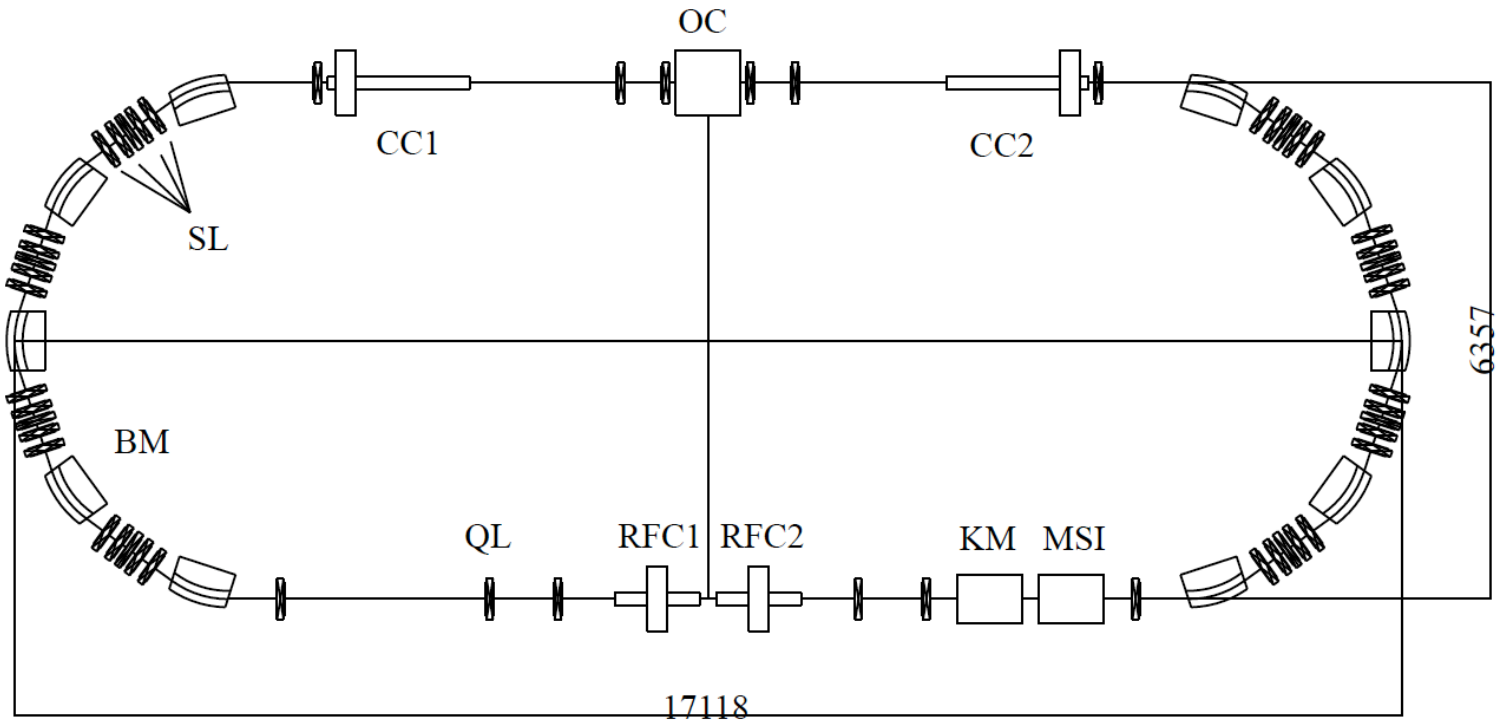
Ring layout



BM, bending magnets; QL, quadrupoles; SL, sextupoles; RFC, rf cavities; OC, optical cavity; KM&MSI, injection magnets

Undulator-based e+ sources for ILC

- **Polarization issues with the undulator based sources: W.Gai (BNL)**
  - **Higher harmonics are important and can influence the overall polarization.**
  - **Polarization and yields are always conflicting, compromises need to be made.**
  - **Lower energy drive beam (150 GeV) is more practical in achieving high degree polarization than higher drive beam energy (250 GeV).**

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- **Rotation vacuum seal and flux concentrator update: T. Piggott (LLNL)**
  - **Continued analysis of flux concentrator- extending to different geometries stress, thermal, and B-field are evaluated.**
  - **Beginning setup and planning for vacuum seal tests.**

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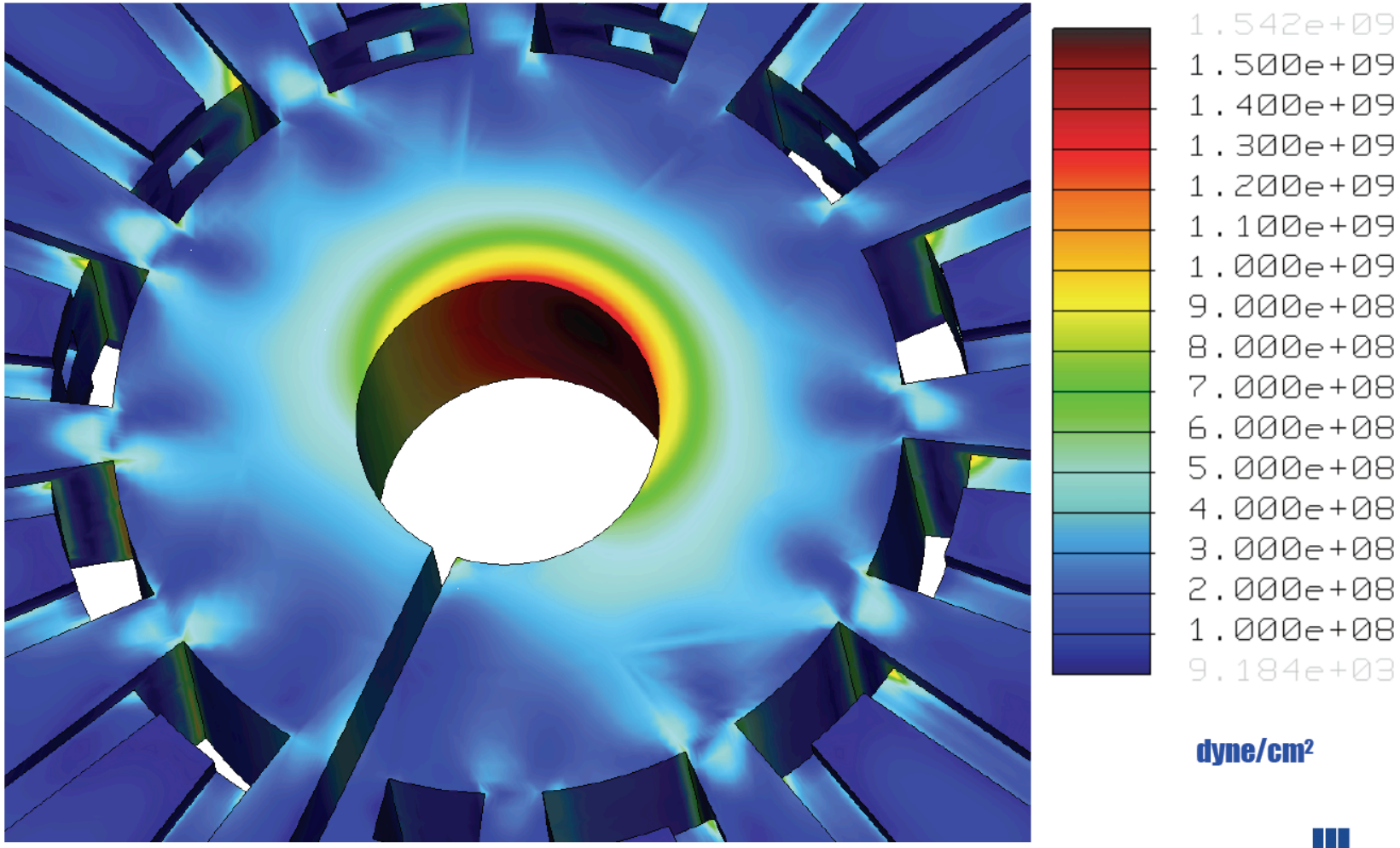
Stresses scale linearly with field reduction- 100% field



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- **Status of Positron Source Simulation in Zeuthen: A. Ushakov (DESY)**
  - **Polarized Positron Source Simulations (PPS-Sim)**
    Geant4-based application for e+ source modeling
  - **Simulation Results for Conventional Source**

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- **Discussion toward re-baseline: All**
  - **Prototype test of vacuum rotating seal with the real size disk is important.**

Hybrid and channeling e+ sources (1)

- **Channeling of Radiations from Leptons to X Photon: S.B. Dabagov**
  - **Channeling of charged particle and channeling radiation**
  - **Wave guiding of X-ray and neutron by capillary.**

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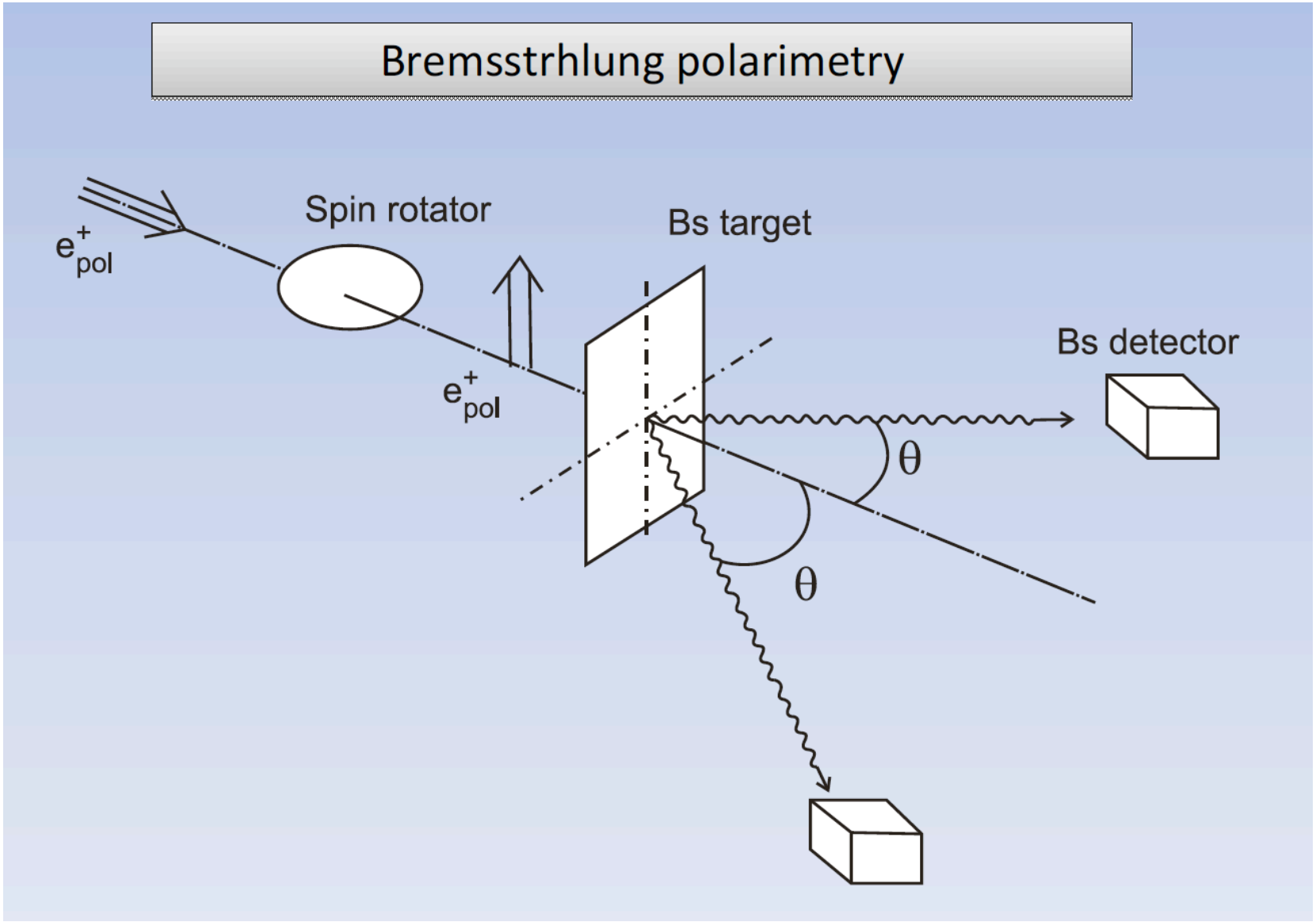

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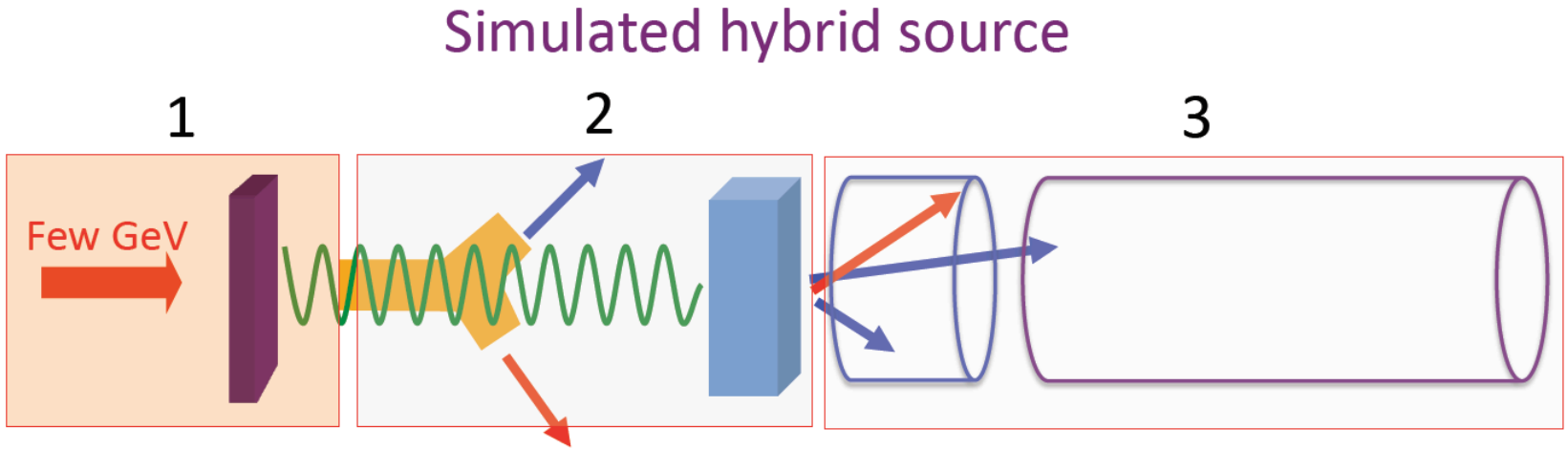

1. V. Strakhovenko's simulation

to add the crystal simulation inside Geant4

2. Geant4, EGS, Fluka … (PPS-Sim A. Ushakov's talk) ✔

3. Geant4, Astra, Parmela … (Capture optimization A. Vivoli's talk) ✔

LAL Geant4 simulation : amorphous + flux concentrator + pre-accelerator

➔ Let us say that step 2 & 3 are OK

➔ Crystal simulation : step 1 is a critical point

I know 2 (now 3) simulations : V. Strakhovenko, X. Artru & S. Dabagov

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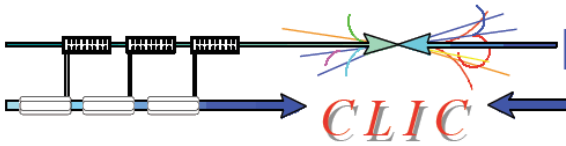
- **Atomic undulator to generate unpolarized e+ for CLIC & ILC: R. Chehab**
  - **An axially oriented crystal having very high fields needs 2 orders of magnitude less energetic e- beams to generate photons.**
  - **Separating the crystal-atomic undulator- from the conversion target, enables use of only photons, decreasing significantly the level of PEDD.**

Hybrid and channeling e+ sources (2)

- **CLIC e+ source for the baseline configuration: L. Rinolfi (CERN)**
  - **Overall and detailed picture of CLIC hybrid source (baseline).**

- **CLIC e+ source for the baseline configuration: L. Rinolfi (CERN)**



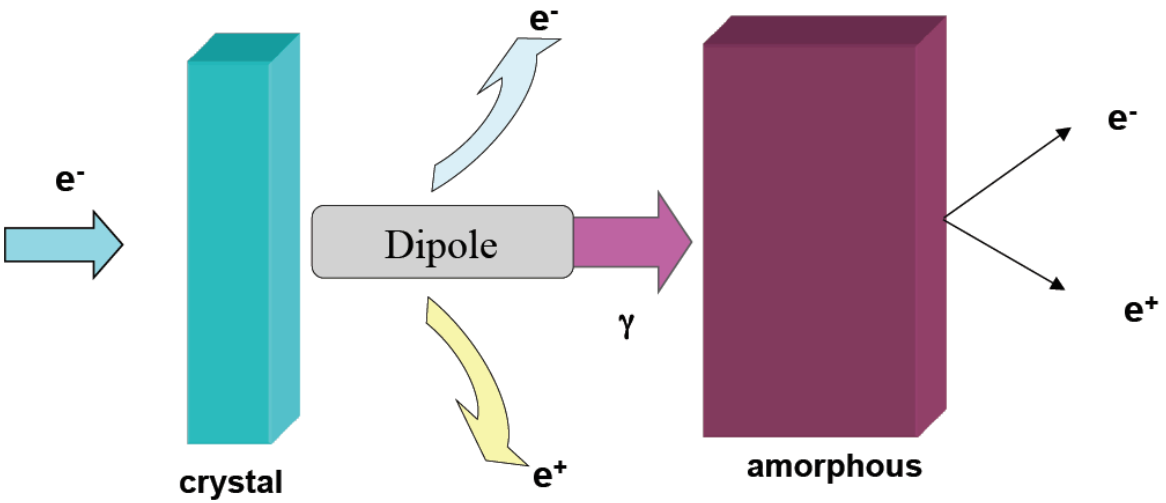
Parameters for CLIC hybrid targets

R. Chehab, V. Strakhovenko, A. Variola

Primary electron beam Linac

5 GeV

2.34 10^{12} e^-/train



Crystal thickness: 1.4 mm
Oriented along the <111> axis

Optimized for 5 GeV
X. Artru et al., NIM 266 (2008) 3868

Distance (crystal-amorphous)
d = 2 m

Amorphous thickness
e =10 mm

Optimized for CLIC
O. Dadoun et al., CLIC Note 808

Hybrid and channeling e+ sources (2)

- **CLIC e+ source for the baseline configuration: L. Rinolfi (CERN)**
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- **Optimization of the CLIC Positron Source: A. Vivoli (CERN)**
  Optimization of the capture section for non-polarized positrons is necessary and will be performed soon.

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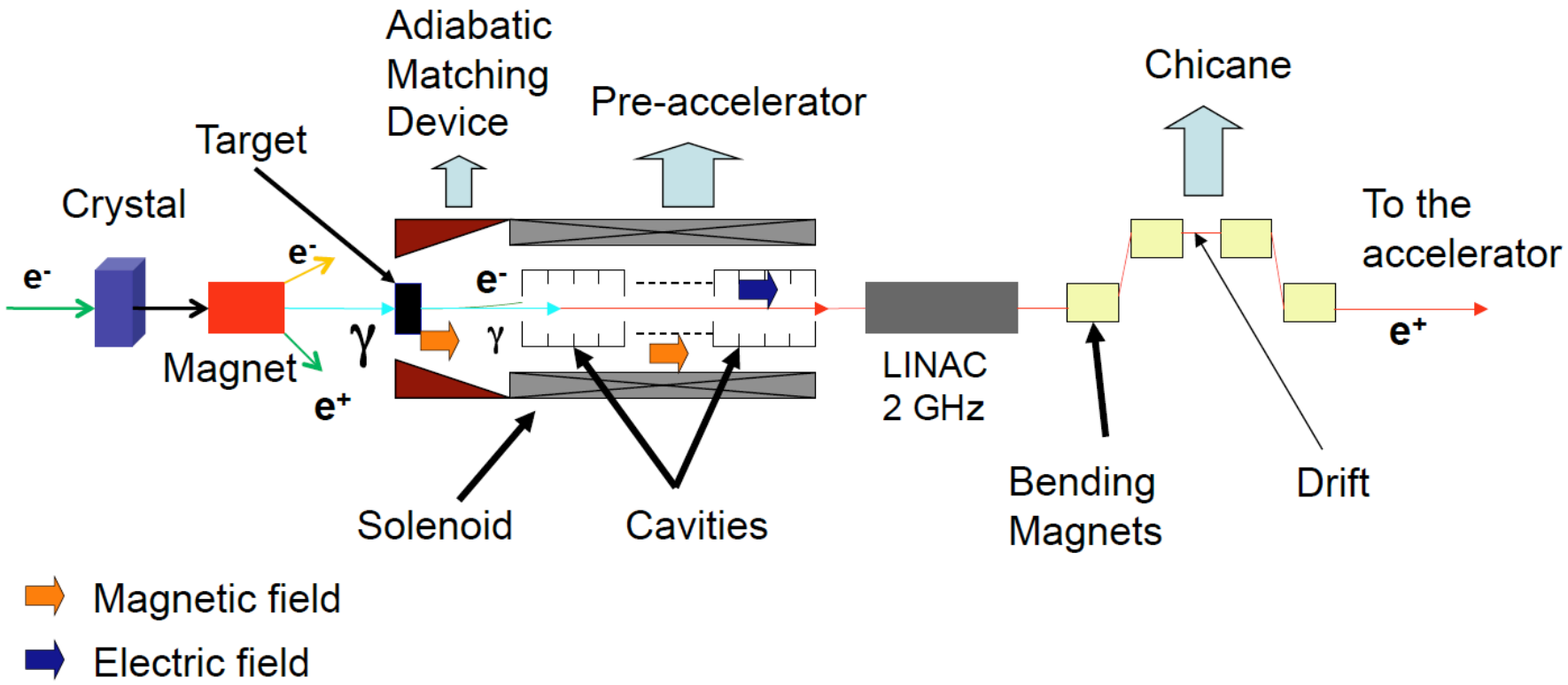
Capture Section (+ Bunch Compressor)



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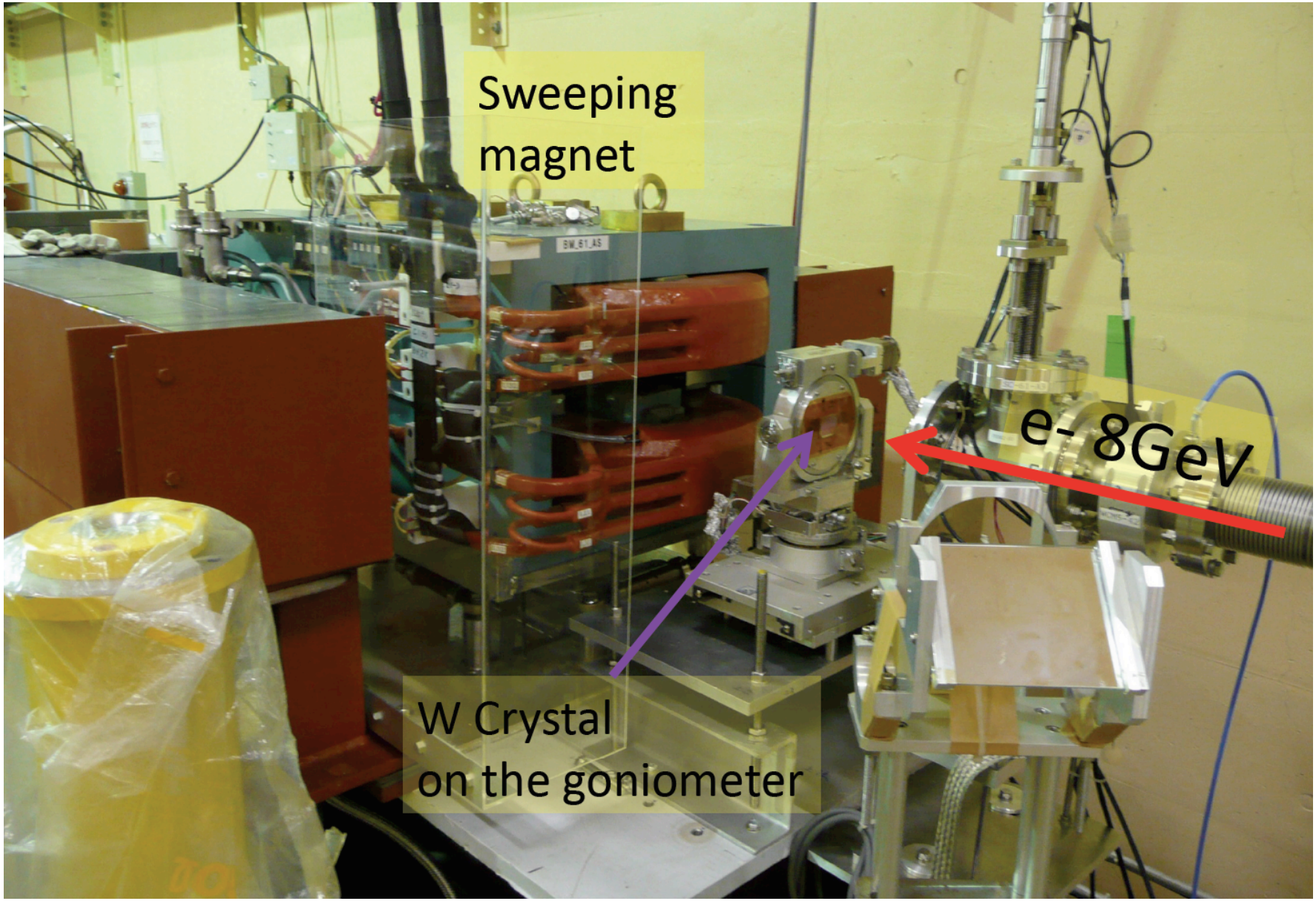
- **Hybrid Experiment at KEK Linac: T. Takahashi (Hiroshima U.)**
  - **Experimental study is ongoing at KEK Linac.**

- **Hybrid Experiment at KEK Linac: T. Takahashi (Hiroshima U.)**



Liquid Pb and Pure Conventional e+ sources

- **Liquid Pb Status: T. Omori (KEK)**
  - **BN window test prepared at KEKB ring.**
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- **Purely Conventional: T. Takahashi (Hiroshima U.)**
  - **survey (again)parameters of conventional targets in the drive beam energy – target thickness plane**
  - **See if conventional sources survives the ILC criteria**

- **Purely Conventional: T. Takahashi (Hiroshima U.)**

Parameter Plots for 300 Hz scheme

e- directly on to Tungsten

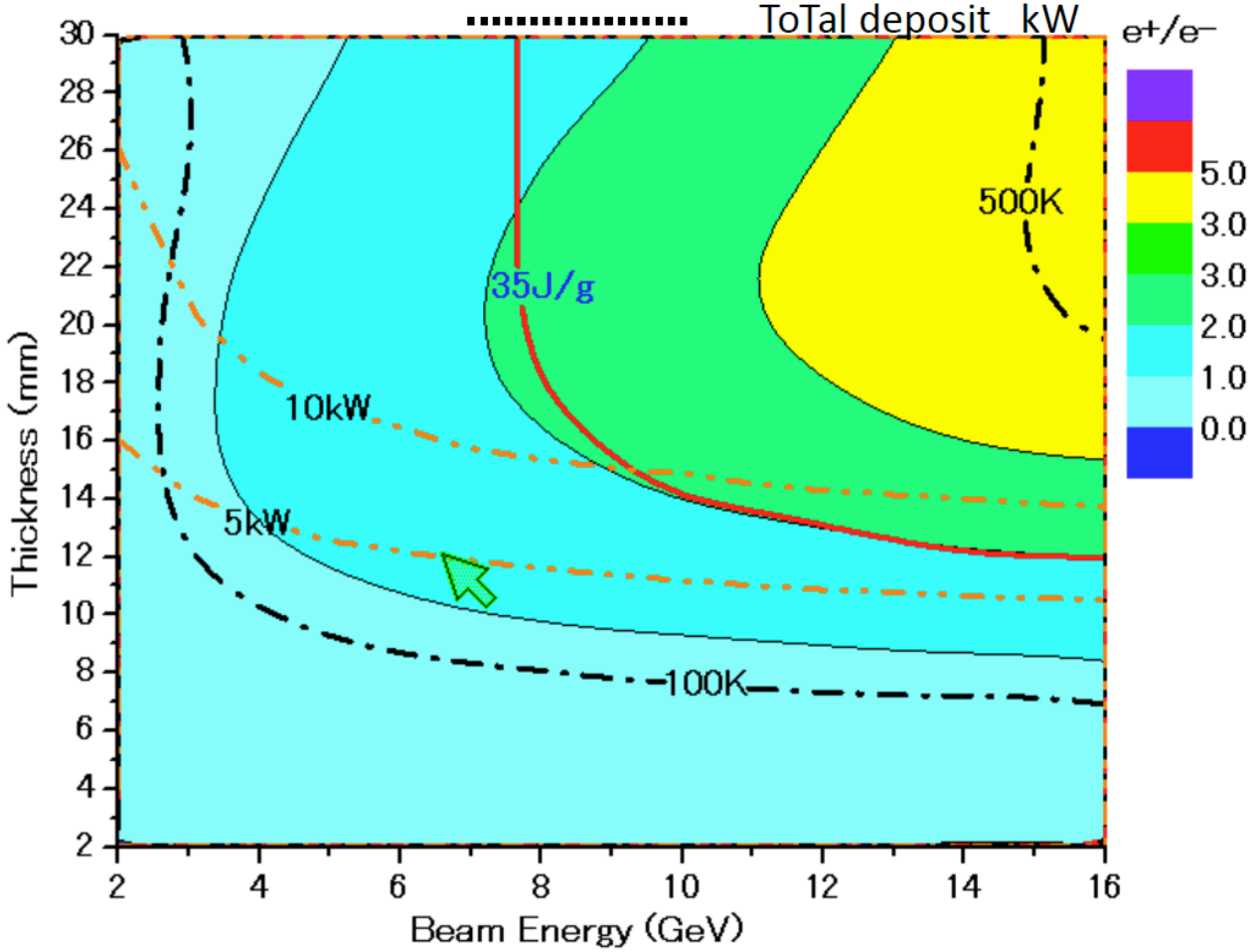
σ=4.0mm

colored band — accepted e+/e-

PEDD J/g

dT/triplet (132 bunc)

ToTal deposit kW



Concluding Remarks

At the last of the workshop, Omori (LOC chair) expressed the appreciation.

Thanks, all participants.
Thanks, all IPC members
Thanks, all LOC members
Especially to Ms. Ikeda, Ms. Kusama, and Mr. Araki

Ms. Kimiyo IKEDA

Ms. Hitomi KUSAMA

Mr. Sakae ARAKI

Next and Next Next POSIPOL

POSIPOL 2011 at Beijing hosted by IHEP.

POSIPOL 2012 at Hamburg hosted by DESY.