Alternatives in EDR phase
-in case of ILC positron source-

KURIKI Masao (KEK, ILC-GDE)

What is EDR?

- EDR is not well defined at this moment among GDE members; Making our agreement is one of the most important task in Hamburg LCWS.
- The time schedule of the system development process is strongly depend on the definition of EDR.
  - **If the EDR is a final design report, R&D, technical design, and industrialization should be finished.**
  - **If the EDR is a snap shot, it is only one of mile-stone. R&D and industrialization do not have to be finished.**
- Anyway, let me proceed with the following assumptions.
  - **EDR is a snapshot of ILC design at that point because it is hard to imagine that all of our works, especially industrialization, is completed around 2010. In this context, meaning of EDR is almost same as that of RDR with improved cost estimation and more technical details.**

What is EDR? (2)

- Let me clarify it from a system engineering point of view;
  - **Agreement process (BCD phase)**
    - Define what we want make...ILC, but what is ILC?
    - We have performed this process in the past ILC/GDE meetings.
  - **Project process (RDR and EDR phases)**
    - This process contains modeling, assessment, reconfigure, and design.
    - Those steps are repeated under configuration control.
    - This process is terminated when design is well matured.
  - **Technical process (Mostly post EDR phases)**
    - Technical design.
    - Development.
    - Implementation.

Where are we?

- We are now in transition from RDR phase to EDR phase. In the system engineering terminology, we are in the project process; iterations of modeling, assessment, reconfigure, and redesign.
- EDR contains some technical detail. It covers a part of the technical process, depending on component.
- Then, the iteration of the system optimization is not only inside of the project process, but also in the technical process. It can be considered as one of con-current engineering or Spiral model of system development.
- If EDR is assumed to be an incomplete technical design before the construction (by M. Ross, May 2), time until the approval can be used to make it a complete technical design with aspects of industrialization.

In case of Positron

- In our case, there are many ambiguities; Many R&D are required even for the baseline; Philosophy of con-current engineering is very important.
  - **New technology/knowledge are obtained not only by strategic efforts for ILC, but also by other activities.**
  - **The latest knowledge reveals sometimes that our design is too optimistic and unrealistic. Degrade is possible.**
- If we read our BCD in this context, three schemes described in BCD has each important roll;
  - **Baseline scheme, Undulator, is likely to be possible, but need an amount R&D to give our full confidence.**
  - **Alternative scheme, Laser Compton, has more ambiguities, but tight connections to other disciplines and many improvements are expected.**
  - **Conventional has less ambiguities. If other two schemes are very risky, it is our last candidate.**

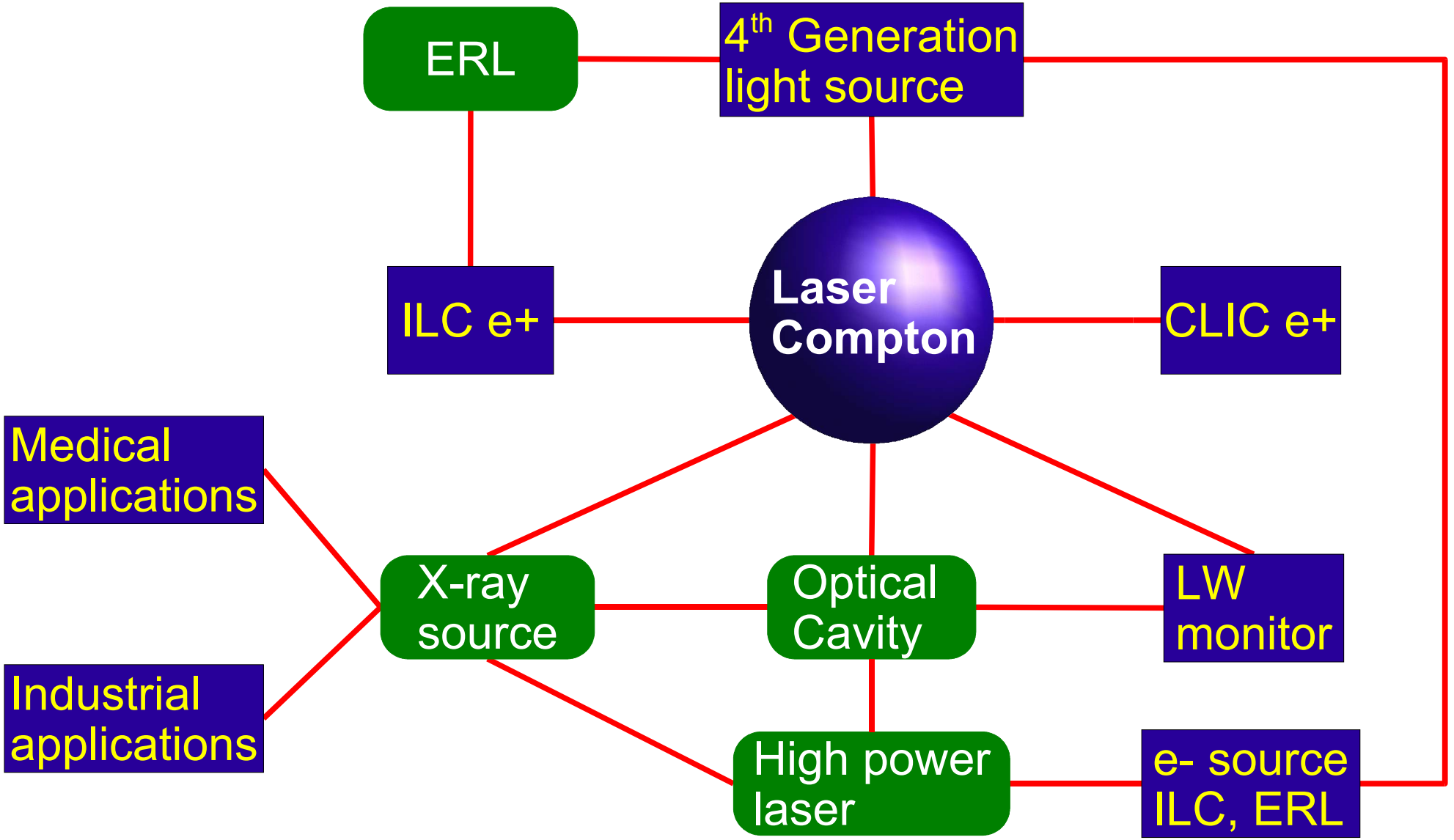
In case of Laser Compton

- Laser Compton as an alternative ILC e+ source is a reasonable choice in following contexts;
  - **From a system point of view, it is more attractive than the undulator scheme because of less inter-system dependence, compactness, demonstrable prior to ILC construction, etc.**
  - **It is still technically ambiguous.**
- From a project point of view, facilitating both base-line and alternative is desirable.
  - **Investment only one way is a big gamble.**
  - **By the definition, the configuration change is a big technical progress and an evolution of project.**
  - **It makes ILC project more technically attractive to outside of ILC community.**

As a Driving Force

- Laser-Compton has a large potential as a future technology.
- Many common efforts can be shared in a context of various applications.
  - **X-ray/SR sources for industrial and medical applications,**
  - **Laser wire beam monitor,**
  - **Polarized Positron Generation for ILC, CLIC,**
- It is not an extension of existing accelerator R&D; This is a new mode of R&D. State-of-the-art technologies are quickly included with world-wide synergy.
- Then, Laser Compton technology can be a powerful driving force by attracting many researchers, who belongs not to ILC effort.

Chart of PosiPol R&Ds



What shall we do?

(presented in Beijing)

- Summarize our status (Done)
  - **What we have,**
  - **What we are doing,**
- Our first task is to establish a conceptual design, which fully satisfy the ILC specifications. This conceptual design can include technical ambiguities, which will be developed eventually by our/general efforts. (Almost Done)
- Simultaneously , we have to define WPs, which avoid the technical ambiguities and are required to start the full engineering design. (Not fully done)
  - **What, Who, When**

In case of Conventional

- It is a part of the BCD, another alternative.
- This scheme also has an ambiguity, but it is not essential.
  - **All of them can be solved by decreasing the positron intensity or multiple positron stations.**
- We have to consider a conceptual design based on Electron Driven.
- Some part of R&D for Electron Driven can be common efforts among different schemes: Capture section, conversion target, Flux concentrator, AMD/OMD, etc.
- It can be also another driving force as same as in case of Laser Compton because most of the existing e+ source are Electron Driven.

LC e+ System Technical Milestones (M. Kuriki)

- Establish a conceptual design, which is fully compatible to ILC requirements.
  - **Laser**
  - **Optical Cavity**
  - **Electron source(ERL), which is collision partner of LC.**
  - **Capture optics.**
  - **e+ stacking.**
- R&Ds for the critical items and technologies;
  - **Laser, Optical cavity, ERL, etc.**
- Component prototyping
  - **Laser and Optical cavity, electron source, target and capture optics, etc.**
- System Prototyping (Mini-ILC)
  - **By integrating the prototype of the components, mini-ILC e+ source is constructed.**

EDR Milestones

- June 07: EDR Scope definition: design depth and breadth, cost, schedule, staff.
- Dec 07: Complete the conceptual design of the components and system.
- Dec 08: Complete basic R&D.
- March 09: Freeze layout, full component and civil specifications
- June 09: EDR detailed component inventory.
- September 09: Cost review for the configuration change.
- Dec 09: Deliver EDR.
- Jan 10: System and Layout design for the mini-ILC e+ source.
- Jan 11 : Start the construction of mini-ILC e+ source based on Laser Compton.

Conventional e+ System Technical Milestones (M. Kuriki)

- Establish a conceptual design, which is fully compatible to ILC requirements.
  - **Driving Electron Source (OK)**
  - **Rotating W-Re target (OK)**
  - **Liquid metal target**
  - **Flux concentrator**
- R&Ds for the critical items and technologies;
  - **Liquid target. flux concentrator**
- Component prototyping
  - **Liquid target, flux concentrator, etc.**
- System Prototyping (Mini-ILC)
  - **By integrating the prototype of the components, mini-ILC e+ source is constructed. It can be a prototype of the keep alive source.**

EDR Milestones

- June 07: EDR Scope definition: design depth and breadth, cost, schedule, staff.
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- Jan 10: System and Layout design for the mini-ILC e+ source.
- Jan 11 : Start the construction of mini-ILC e+ source (keep alive source).

Work Packages (Laser Compton)

			Work			
			Conceptual Design	R&D	Prototyping	Engineering Desing
Laser Compton	System Design		Many			
	Light Source	Laser Oscillator	KEK,BNL,LAL	KEK,BNL,LAL	KEK, LAL	KEK, LAL
		Laser Amplifier	KEK.BNL,LAL	KEK.BNL,LAL	KEK, LAL	KEK, LAL
		C02 laser	BNL	BNL	BNL	BNL
	Optical Cavity	2-mirrors cavity	KEK	KEK	KEK	KEK
		4-mirrors cavity	LAL	LAL	LAL	LAL
	ElectronSource	Electron Injector	BNL, KEK	BNL, KEK		
		Storage Ring	Kharkov	Kharkov		
		ERL	ERL projects	ERL projects	ERL projects	
	Target	Rotating W-Re				
	Capture Optics	Lithium lens	BINP, Cornell	BINP, Cornell	BINP, Cornell	BINP, Cornell
	Capture RF	NC L-band Acc				
	E+ stacking	e+ stacking	LAL, CERN	LAL, CERN	LAL, CERN	LAL, CERN
	System Integration	Laser + Cavity + e- beam	KEK,BNL,LAL, Hiroshima	KEK,BNL,LAL, Hiroshima	KEK,BNL,LAL, Hiroshima	KEK,BNL,LAL, Hiroshima
		ILC e+ prototyping	KEK, BNL, LAL, IHEP, Hiroshima	KEK, BNL, LAL, IHEP, Hiroshima	KEK, BNL, LAL, IHEP, Hiroshima	KEK, BNL, LAL, IHEP, Hiroshima

Work Packages (Conventional)

			Work			
			Conceptual Design	R&D	Prototyping	Engineering Desing
Conven-tional	System Design	System Design	KEK, BINP			
	Electron Source	Electron Source	KEK, BINP	KEK, BINP	KEK, BINP	KEK, BINP
	Target	Rotating W-Re				
		Crystalline target	KEK, Thomsk	KEK, Thomsk	KEK, Thomsk	KEK, Thomsk
		Liquid target	BINP, Cornell	BINP, Cornell	BINP, Cornell	BINP, Cornell
	Capture Optics	Flux Concentrator	BINP, KEK	BINP, KEK	BINP, KEK	BINP, KEK
		Lithium lens	BINP,Cornell	BINP,Cornell	BINP,Cornell	BINP,Cornell
	Capture RF	NC L-band Acc	Common	Common	Common	Common
	System Integration	ILC e+ prototyping	BINP, KEK	BINP, KEK	BINP, KEK	

Future Perspective

- LC ILC e+ source will be developed involving many efforts of many different disciplines.
- We can save our resource for R&D effort by this reason, but this synergy is not fully synchronized to ILC effort. They do not care about EDR at all. We have to be careful for the missing pieces, but it is not a serious issue as long as the EDR is not a final technical report.
- Eventually, we have to make a decision whether these alternative schemes can be delivered within a reasonable time scale for ILC after a realistic schedule of ILC is presented. That is also true for the baseline scheme and even for the whole ILC project. Points are
  - **Resource management**
  - **Technical achievement**

Alternative Treatment

- BCD is under control of CCB (Change Control Board).
- BCD should always show the latest configuration and efforts in EDR phase should consistent to BCD.
- Current rule for baseline and alternative treatment is
  - **Small configuration changes is determined and approved by CCB.**
  - **Major changes are examined by CCB and approved by EC.**
- In EDR phase, not only the change configuration, but also the R&D efforts should be controlled by PMT (Project Management Team).
  - **"R&D is needed into alternative solutions that will mitigate remaining technical risks. Any proposal to adopt an alternative solution as a new baseline must include costs information and a plan for the necessary technical development." (M. Ross, May 2)**

WP time line (Laser Compton)

	Year	07			08				09				10			
	Quarter	2nd Q	3rd Q	4th Q	1st Q	2nd Q	3rd Q	4th Q	1st Q	2nd Q	3rd Q	4th Q	1st Q	2nd Q	3rd Q	4th Q
Laser Compton	System Design															
	Laser Oscillator															
	Laser Amplifier															
	CO2 laser cavity															
	Optical Cavity															
	2-mirrors cavity															
	4-mirrors cavity															
	System Integration															
	Electron Injector															
	Storage Ring															
	ERL															
	Solid target															
	NC L-band Acc															
	SI Laser + Optical Cavity + e- beam															
	ILC e+ Prototyping															

Legend: Conceptual Design, Basic R&D, Prototyping, Engineering Design

If the EDR deadline is Dec 09,
prototyping and EDR is swapped for each items.

WP time line (Conventional)

	Year	07			08				09				10			
	Quarter	2nd Q	3rd Q	4th Q	1st Q	2nd Q	3rd Q	4th Q	1st Q	2nd Q	3rd Q	4th Q	1st Q	2nd Q	3rd Q	4th Q
Conven-tional	System Design															
	Electron Source															
	Rotating W-Re															
	Liquid target															
	Flux Concentrator															
	Lithium lens															
	NC L-band Acc															
	ILC e+ prototyping															

Legend: Conceptual Design | Basic R&D | Prototyping | Engineering Design

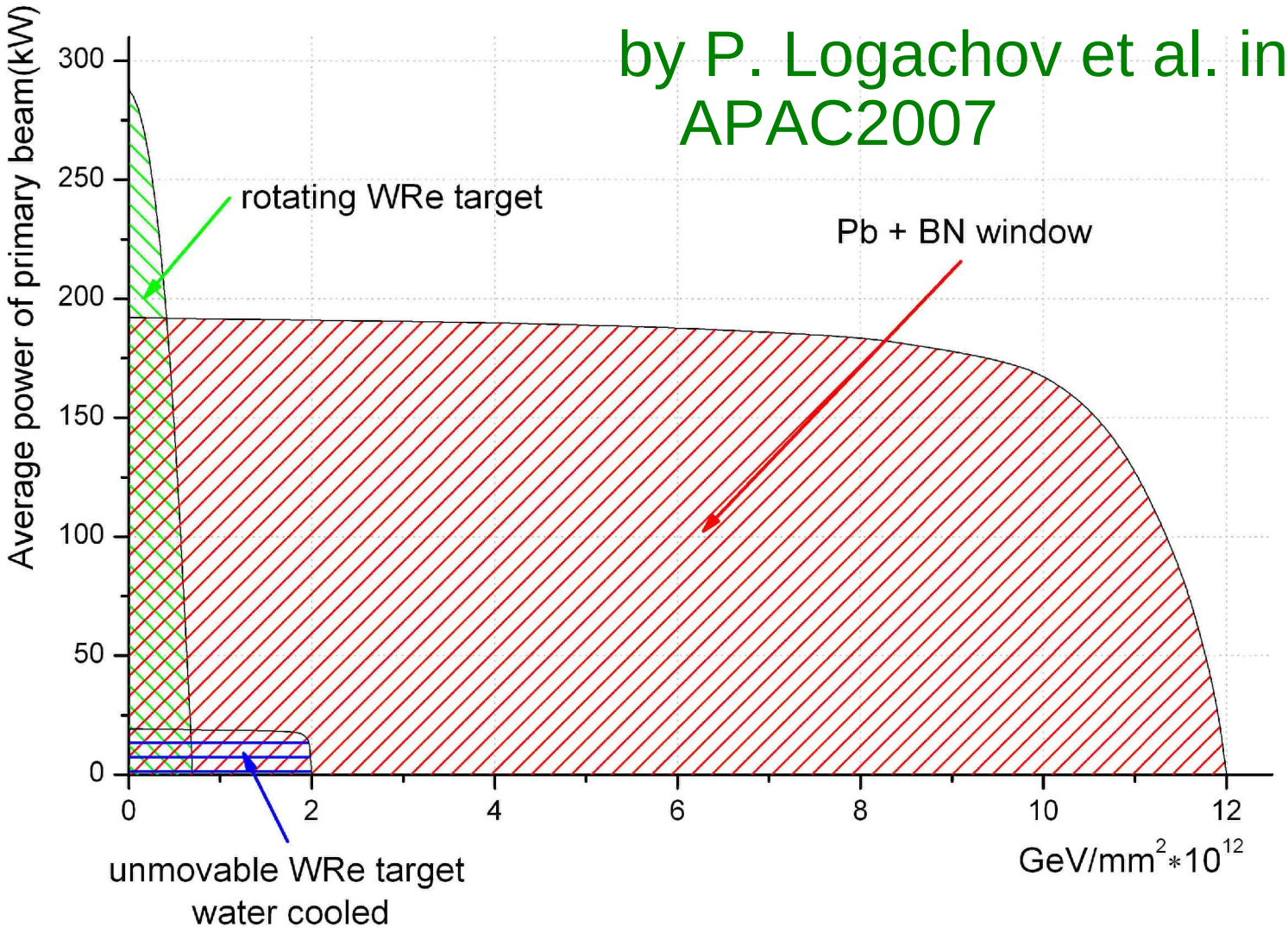
If the EDR deadline is Dec 09,
prototyping and EDR is swapped for each items.

Summary

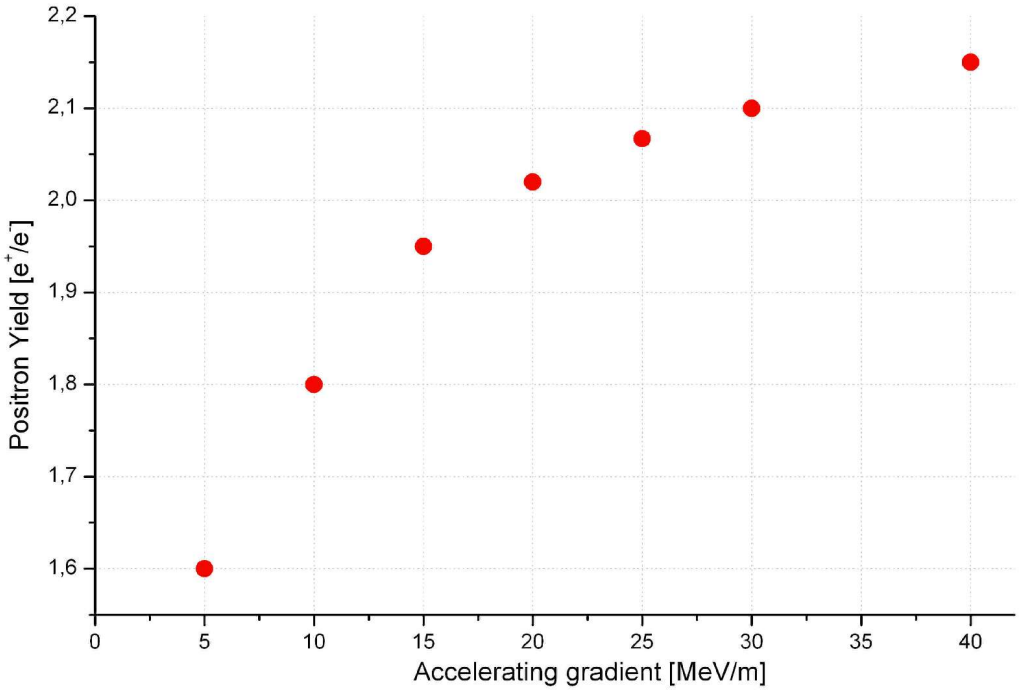
- By assuming EDR is not a final technical document, alternative treatment during EDR phase is considered.
- Alternative schemes (Laser Compton, Conventional) are very important as driving forces by attracting wide variety of people. Facilitating both baseline and alternatives is very important to ILC from the project point of view.
- R&D efforts can and should be shared with various efforts to save our limited resources, but be careful about deliver time and missing pieces.
- A clear rule for the configuration change and resource management during the EDR phase should be defined. (M. Ross's note is an proposal).

What is ability of Conventional?

by P. Logachov et al. in APAC2007



What is ability of Conventional(2)



by P. Logachov et al. in APAC2007

- Higher gradient on the capture RF make the effective positron yield higher.
- Liquid Pb target + BN window + pulsed RF operation for higher capture RF compose a reliable positron source based on Conventional positron production.