POSIPOL 2007 Workshop

Orsay, France 23-25 May, 2007

http://events.lal.in2p3.fr/conferences/Posipol07

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Some Posipol 2007 numbers

- ~ 55 inscriptions
- 3 days workshop
- 8 sponsors
- Different sessions : physics, machines, schemes, lasers, cavities & associated technologies, targets & polarization, capture & industrial –medical applications
- ~ 30 talks
- Europe, Asian and USA labs were represented
- Youngest participant ….less than 1 year old!

Workshop Goals (LC)

1) Take stock of the situation of the different machines, schemes, studies and R&D's.
2) Gather information on the new technologies (fiber laser, mirrors…). Define the possible associated R&D's.
3) Find the overlap with the undulator solution, both for funding (EU FP7…) and common work.
4) Benchmark of the GEANT4 polarized version.
5) Review the industrial – medical applications of Compton machine (extremely important for R&D fund request).

CLIC

- Redefine the parameters. Analyze the differences from the earlier proposal and have a first "feasibility" scheme.

ILC

- Converge towards a scheme that can produce a valid "alternative" design and clearly assess what R&D's are necessary to validate the scheme.
- Point the way to EDR
- Study the possibility of a demonstrator experiment
- Define the aspects of the schemes that still need answering (stacking, costing…) and make a work plan

Workshop Goals (LC)

Main events since Posipol 2006:

- CLIC parameters change
- ILC RDR published. Meetings in Daresbury and Bejing
- ILC next step = EDR
- E166 results
- GEANT4 polarized version

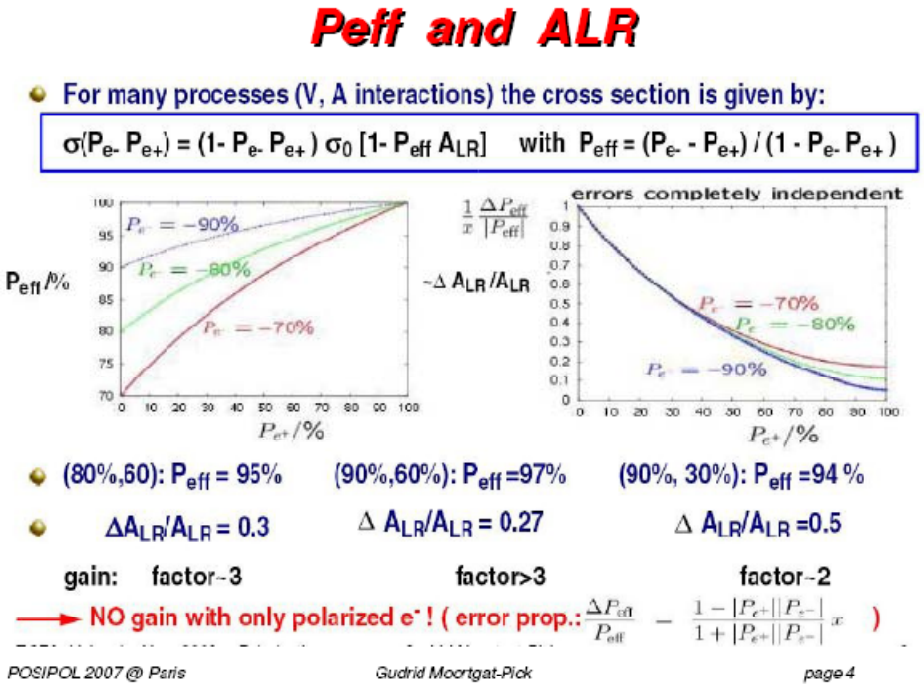
- Compton sources: Fiber Laser Technology opens the way to high power, high repetition frequency lasers
- Daresbury meeting - ERL scheme as possible Compton Driver
- Rising interest the use of low energy Compton sources for Medical-Industrial applications

1st: Polarized Positrons Physics (users)

Gudrid Moortgat Pick and Sabine Riemann

- Physics = f(L,P,E) => Flexible machine= flexible (POLARISED) positron source.
- f = ? In the different cases…
- Particular importance in precision where the P_{eff} counts

What is the balance between P and L? Does it is a function of energy?



Take stock of the proposed solutions & technology

- LC Projects : ILC, CLIC

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LCWS07
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Major CLIC parameters changes

In January 2007, new CLIC key parameters have been adopted:

Accelerating gradient:

150 MV/m => 100 MV/m

RF frequency:

30 GHz => 12 GHz

=> All CLIC study is today under revision, in particular the CLIC Injector complex and the e^+ production (polarized and unpolarized).

Main beam parameters comparison

At the entrance of the Main Linac for e^- and e^+

		NLC (1 TeV)	**CLIC 2007 (3 TeV)**	**ILC (Nominal)**
Energy E	GeV	8	9	**15**
Bunch population N	10^9	7.5	4 - 4.1	**20**
Nb bunches / train n_b	-	190	311	**2625**
Bunch spacing Δt_b	ns	1.4	0.667 (8 RF periods)	**369**
Train length t_{pulse}	ns	266	207	**968625**
Emittances $\gamma\varepsilon_x$, $\gamma\varepsilon_y$	nm, nm.rad	3300, 30	600, 10	**8400, 24**
rms bunch length σ_z	µm	90-140	43 - 45	**300**
rms energy spread σ_E	%	0.68 (3.2 % FW)	1.5 - 2	**1.5**
Repetition frequency f_{rep}	Hz	120	50	**5**
Beam power P	kW	219	91	**630**

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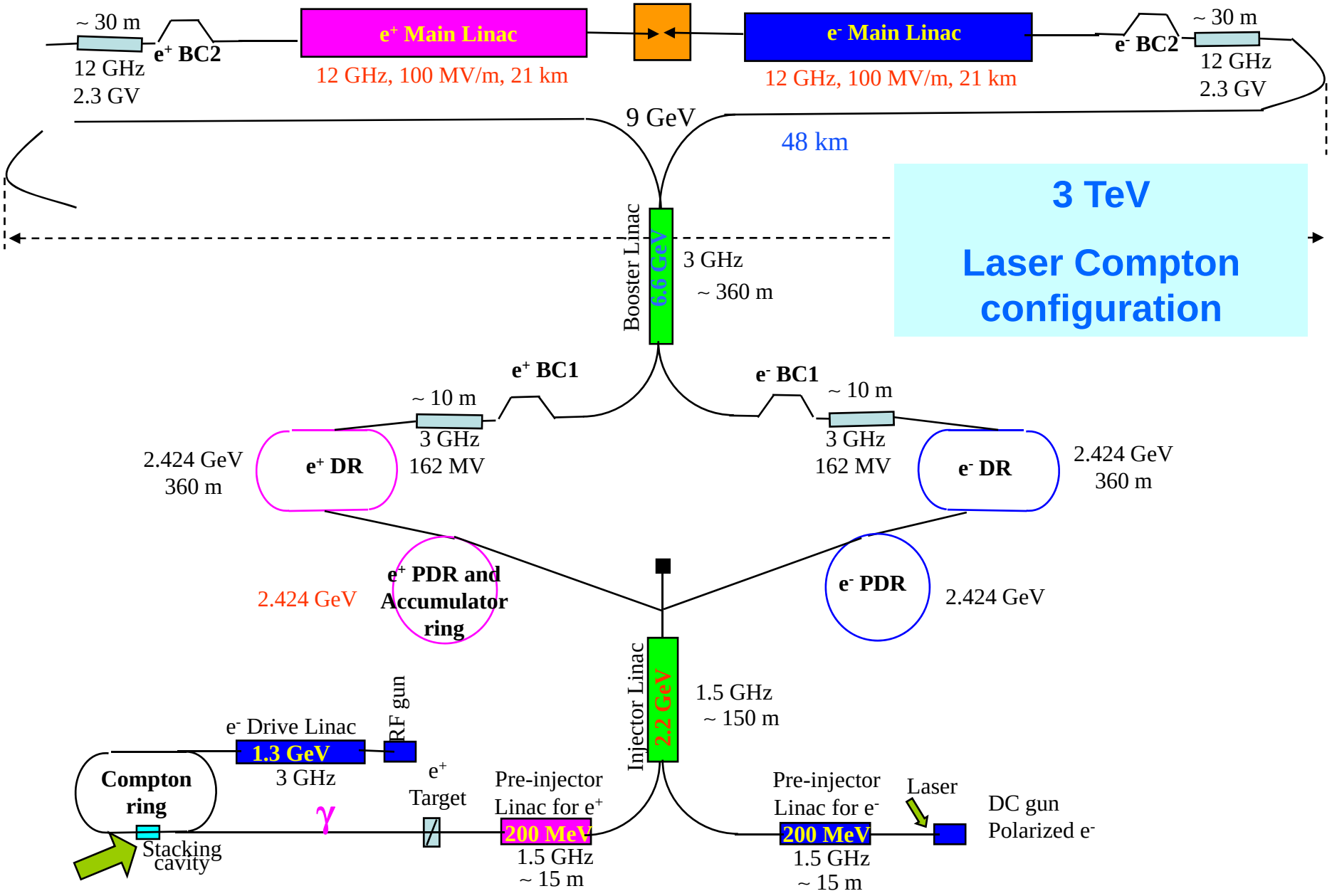

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The CLIC Injector complex

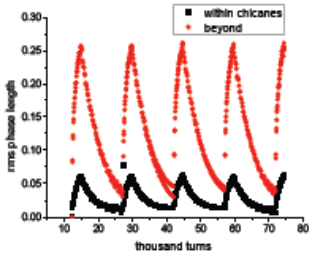
ILC alternative design

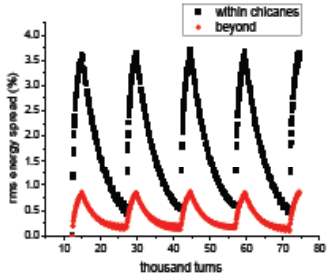
- A path towards EDR has been illustrated
- Three schemes under investigations
- Common expertise shared
- Impressive R&D advancements and projects
- Needs stacking evaluation
- Funding (Baseline and Ind. applications)

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.

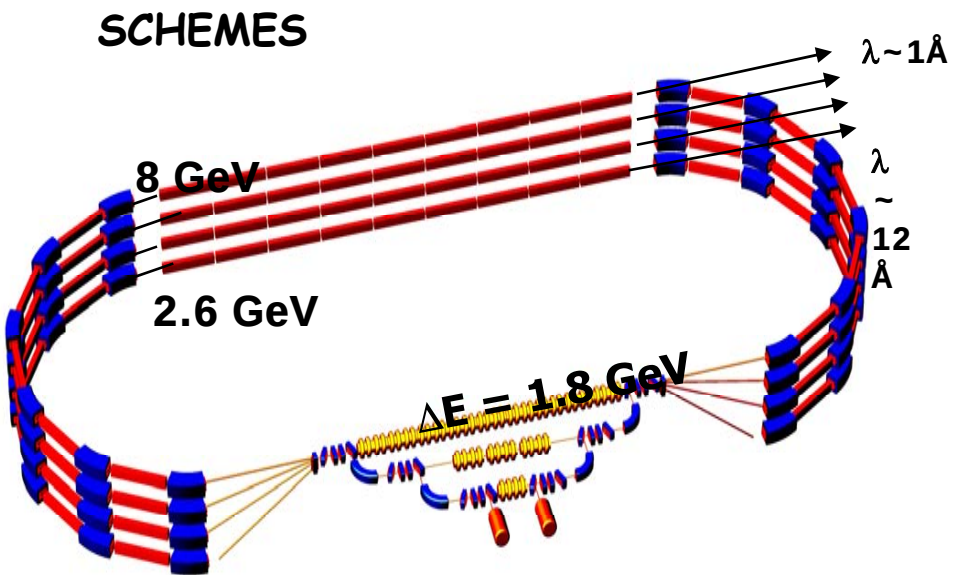
Longitudinal Low-β: Simulation CLIC–20





Parameters

- Beam energy 1.06 GeV
- Max energy of gammas 20 MeV
- RF frequency 1.875 GHz
- RF voltage 150 MV
- Chicane $\lambda = 0.98$
  - magnet length 1.3 m
  - gap length 1.2 m
  - field strength 1 T
- Laser pulse energy 0.6 J



Parameter	*total*	*harmonics*
Number of x-ray photons at IP	3×10^{8}	1.6×10^{7}
Integral x-ray energy at IP (eV)	10^{12}	1.5×10^{11}
Number of x-ray photons at detector	7×10^{7}	1.5×10^{7}
Energy on detector (eV)	4×10^{11}	4×10^{10}
Filtered energy on detector (eV)	3.1×10^{10}	3.0×10^{10}

LINAC scheme needs R&D from electron gun

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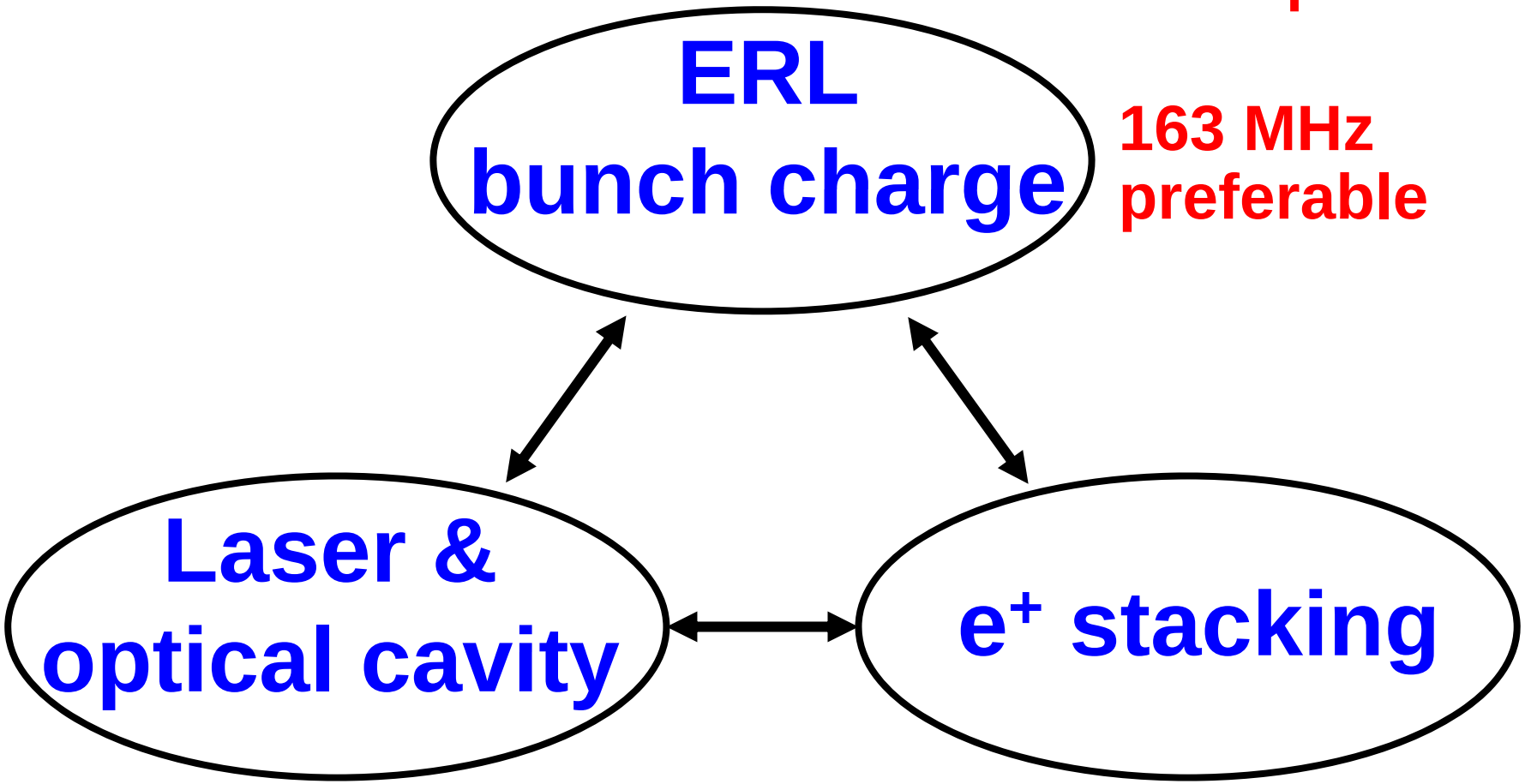
Selection of bunch repetition: f_{rep}

3 factors to determine f_{rep}

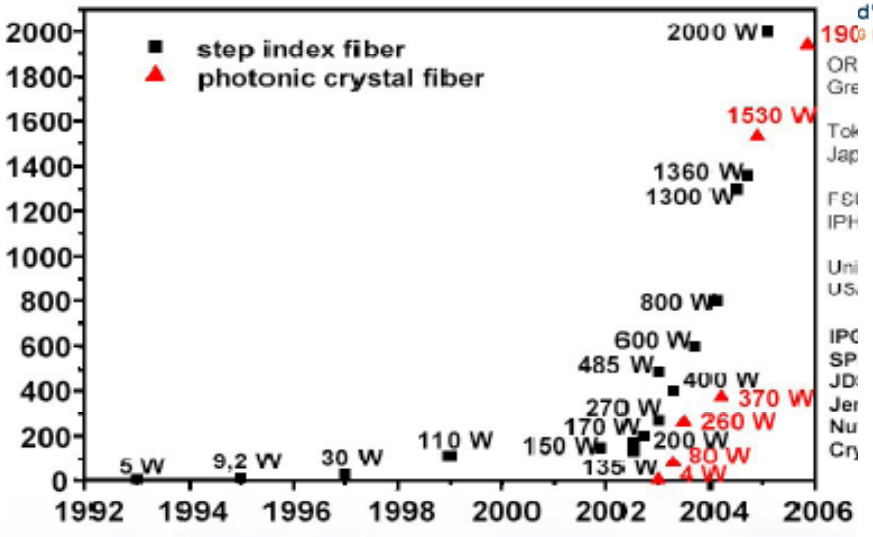


2) Gather information on the new technologies (fiber laser, mirrors…). Define the possible associated R&D's.

- Technical aspects

We need to go towards a collision regime of ~ joule/pulse with less than 10 microns waists

- LASERS!!!!!!
- CAVITIES (electronics, mechanics…)
- Mirrors
- Too much to say only few snapshots



INSTITUT d'OPTIQUE GRADUATE SCHOOL

State of the ar

- High average power femtosecond fiber amplifier

  Röser et al., Opt. Lett., vol. 30, no. 20 (2005) Jena group (J. Limpert)

  131 W 220 fs 73 MHz

- High energy femtosecond fiber amplifier

  Liao et al. CLEO 2006 postdeadline CPDB4 Michigan group (A. Galvanauskas)

  500 µJ 520 fs 5 kHz

- Review paper

  Tunnermann et al., Topics in applied physics vol. 96, pp.35-53 (2004)

R&D for 200W (fund request pending)
No basic limits to extend up to the kW regime
CO2 laser + ring cavity => very interesting results, needs tests at high power

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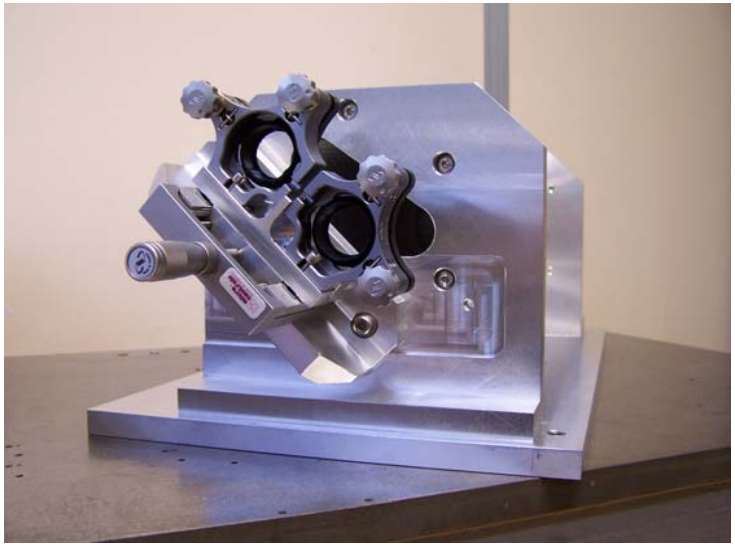
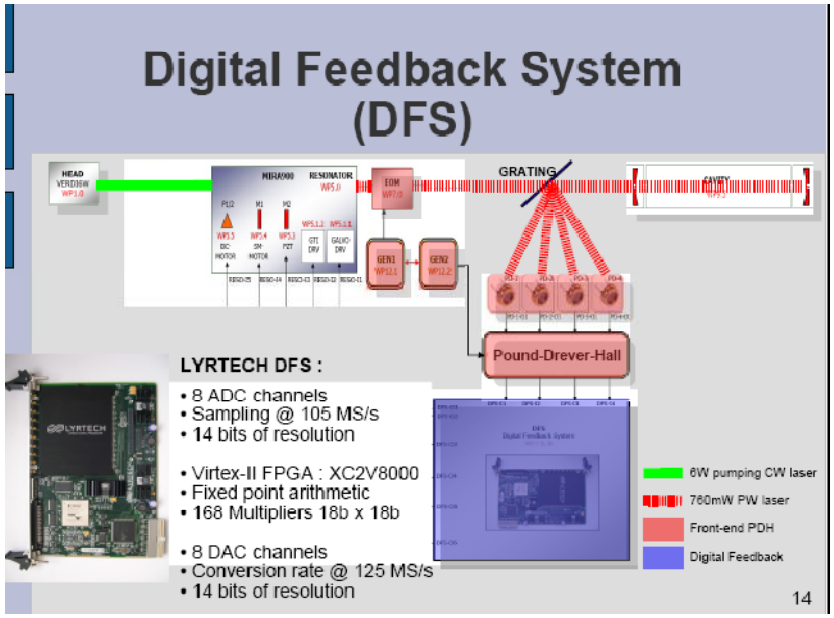
cavities





Autumn => test in ATF
Less than 20 microns waists + stability achieved
Limitation : experimental = mirror sizes, simulations = matrix precision
10^4 gain => feedback in place
Collaboration with LMA Lyon (mirrors) : 1 ppm cw. We are working at 10 and 100 ppm
Their experience showed no problem for reflectivity with ΔT up to optical damage threshold

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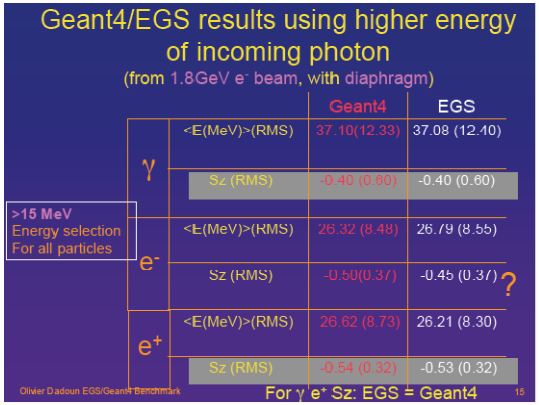
- POLARISED GEANT/EGS/NEW SOFT
- CAPTURE
- TARGETS

- Target problem : some common point with baseline
- Geant4 and EGS benchmarking started :

  Agreement at high energy not at lower…..

  V Strakhovenko code expected for further comparisons
- Good results in capture : 2% at ~45 % pol
- Need of low gradient simulations (ERL)
- No variations between 25 and 7 MeV/m



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Compton scattering & medical / industrial applications

- Extremely important : more and more fundamental science needs applications.

3 talks

- Jeff Rifkin
- Sakae Araki
- Philippe Balcou

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• Recommendations & How to proceed.

ILC

- **Baseline : need for E166 published result (V Important also for simulation benchmark)**
- **Find the common work topics (not an intellectual exercise …funding)**

Attempt : Capture section (simulation and prototyping), target (repository as suggested by I. Bailey), Polarization generation, transport and manipulation.

- **Alternative : Proceed towards STACKING simulations, Optimization, explore the different schemes and converge to a single proposal => COSTING**

CLIC : Definition of a "polarised" scheme with the new parameters. What could be a demonstrator experiment?

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Recommended and supported R&D's

Lasers & cavities:

LAL : 200W fiber laser, 10exp4 gain cavity, 4 mirror cavity at high finesse, full digitalized feedback

KEK (very important) : Cavity in ATF (very important)

CO2 : demonstrator of intra cavity CO2 laser (dedicated test stand, non linear optics, damages)

Mirror damages @ High frep

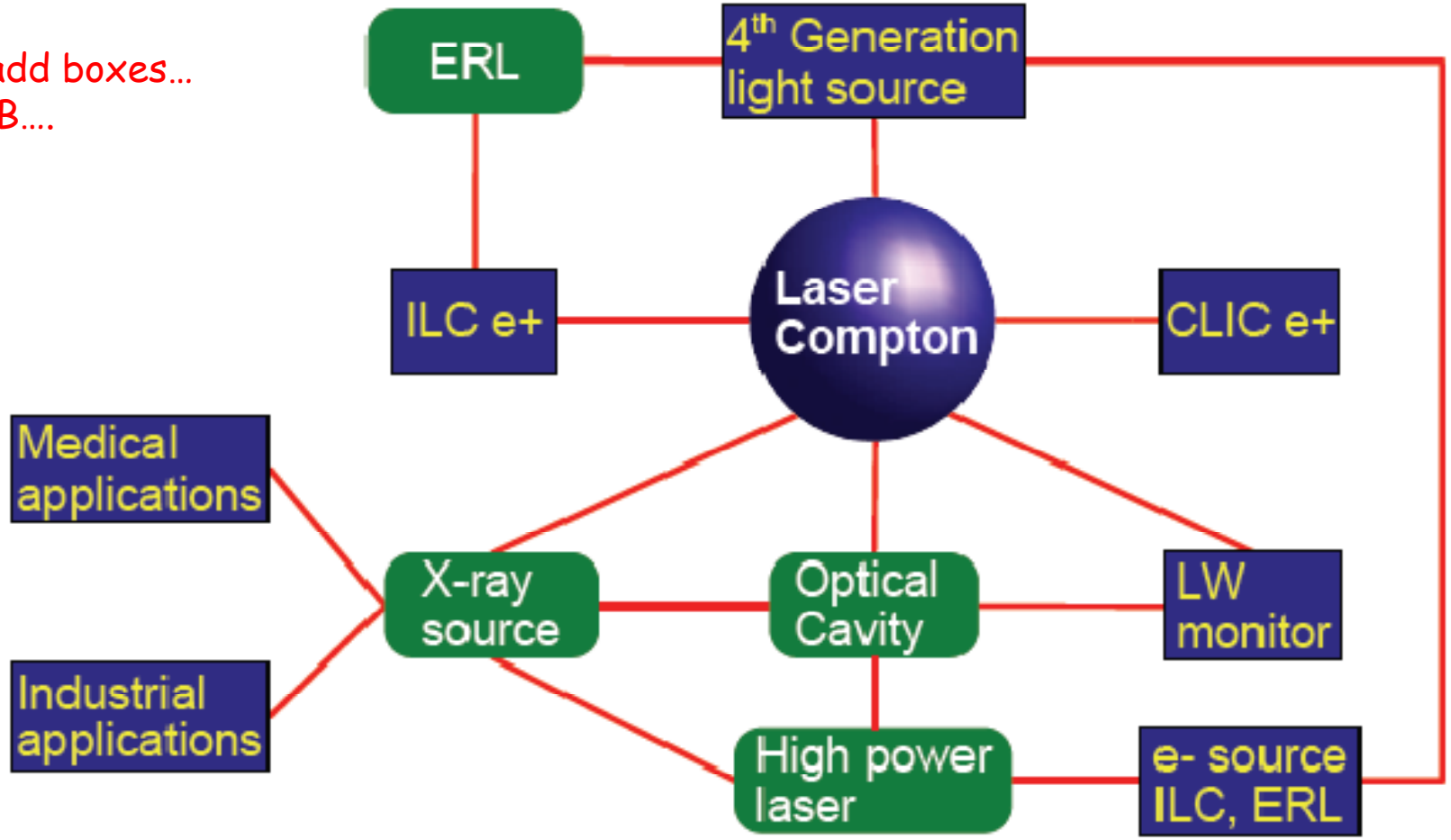
Target : ILC demonstrator

Accelerators tech: High rep frequency and high charge per bunch e- guns

ALL this need coordinated effort of the POSIPOL community

Chart of PosiPol R&Ds

Let's add boxes…
SuperB….



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- Undulator :CLIC system, demonstration with the ILC K design and high intensity e- beam

- Ring :beam lifetime, correlation with the DR injection (starting model exists), Gamma energy definition

- ERL:cw structures in capture section lowering the Gradient(@ Novorsibinsk ~ 1MeV/m) , recirculating en spread, Gamma energy definition

- LINAC :bunch & train structure, correlation with the DR injection, Gamma energy definition

広島大学

PosiPol 2008

- Hiroshima Univ. proposes to hold PosiPol 2008 in Hiroshima with support of KEK.
- The period will be May or June, which will be fixed later.

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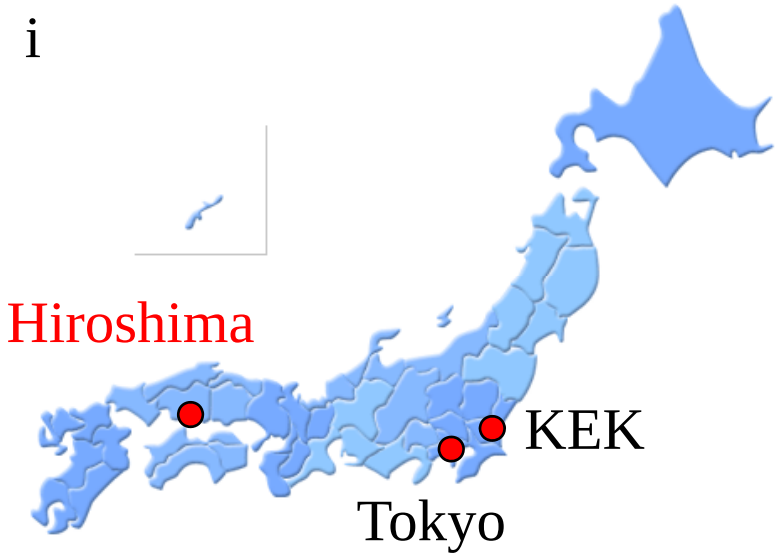
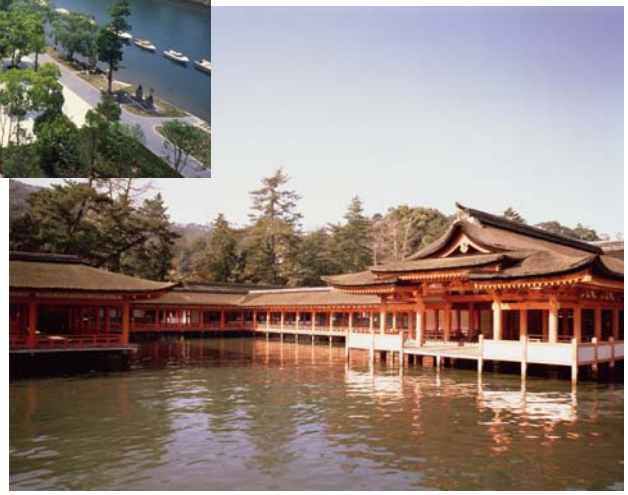


Atomic Bomb
Memorial Dome

Itsukushima
Shrine



2 world heritages

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Summary and Outlook

- CLIC parameters redefined and schemes introduced
- Schemes : defining the parameters, needs feedback from stacking
- R&D goals well defined. Programs are already running. To be supported by local agencies
- Advancements in technology => impressive
- EDR path illustrated
- Compton community is rising with many applications
- Alternative solution is an important step since it can take a lot of advantages and cost reduction to the ILC. It is approaching to a concrete proposal but the effort in the ILC community must be improved. Needs for support of local agencies.