Sources Working Group Summary

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Introduction

- Electron Source Update
  - **1 presentation**
- Baseline Positron Source Update
  - **8 presentations**
- Alternative Positron Source Update
  - **4 presentations**
- Polarisation Session summary

Electron Source

- Main R&D areas
  - **Source laser**
    - Generate 3 MHz pulsetrain using mode locked oscillator and fast Pockel's cell
    - regenerative amplifier design using 40 W cw pump laser
  - **Polarised gun development**
    - 'Best' parts of SLAC and JLAB polarised DC guns are being used to develop the ILC gun
    - HV power supply, vacuum design, load lock etc.
  - **Injector**
    - Design and Development of injector specific RF structures
    - Sub Harmonic Bunchers
    - L-band bunchers
    - Pre-accelerating structures
  - **Photocathode Development**
    - Longer lifetime

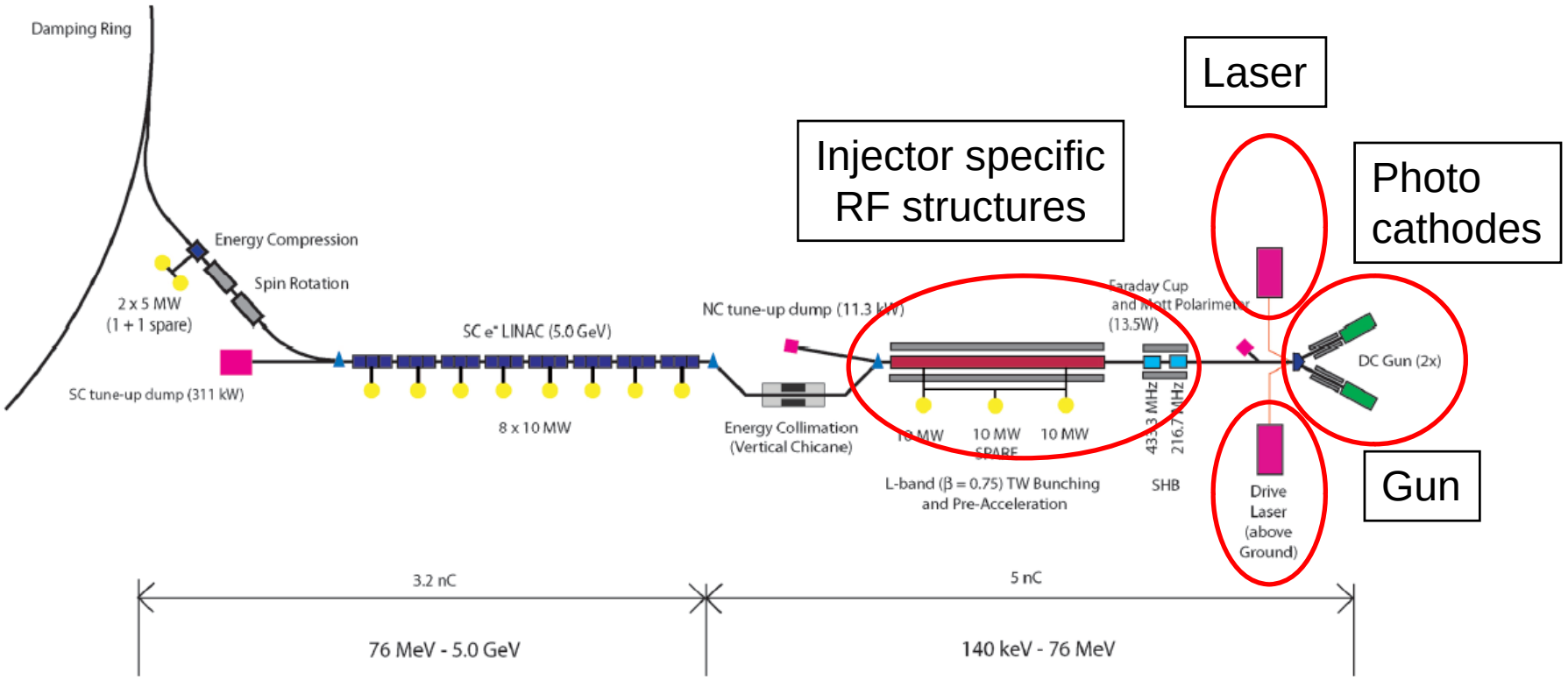
Electron Source

- Current Regional Effort
  - **Americas**
    - SLAC
    - JLAB
  - **Asia**
    - KEK,
    - Universities
    - (not yet collaborating with US labs)
  - **Europe**
    - University of St. Petersburg

e^- Source EDR Planning

- Design is well defined
  - **No alternatives,**
  - **It was decided not to pursue alternative options (e.g. polarized RF-Gun) using ILC funding**
- Much of EDR is part of R&D program
  - **e.g. laser system, gun development**
- EDR part 1:Component design
- EDR part 2:Systems design and integration

EDR Effort Focus



Milestones and Timeline

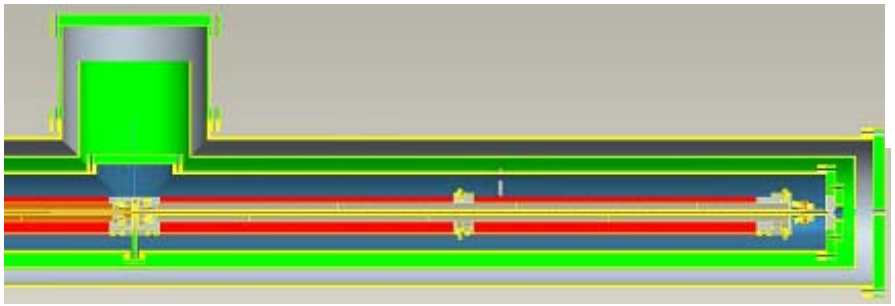
- Dec 07
  - **EDR Scope definition: design depth and breadth, cost, schedule, staff**
- Dec 08
  - **Freeze layout, full component and civil specifications**
- Jan 09
  - **EDR detailed component inventory**
- May 09
  - **First cost review**
- Dec 09
  - **Deliver EDR and preconstruction work plan**

Proposed (requested) EDR Staff Resources

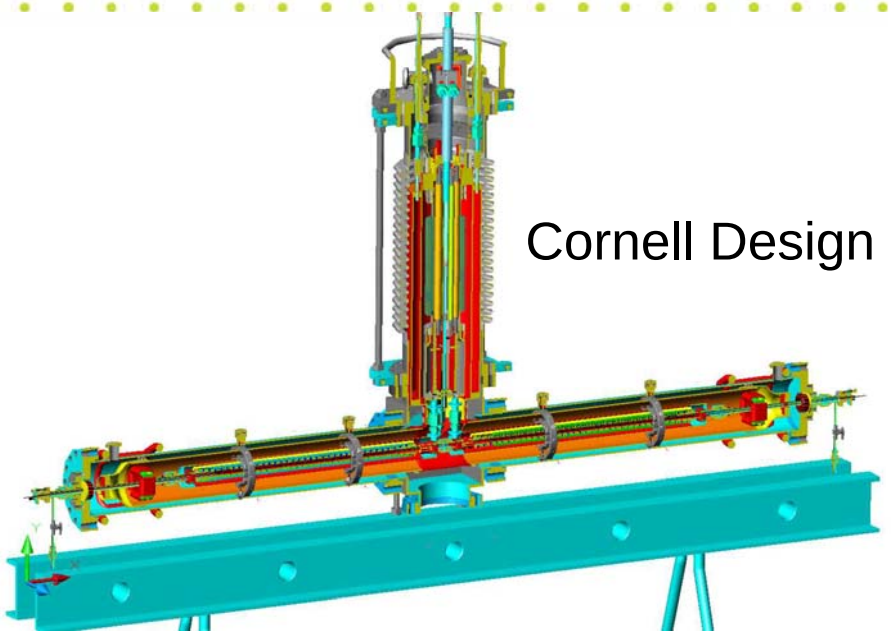
Work Package	FY08	FY09
2.3 (Design)	1.25	2.5
3.3.1.1 (Laser)	0.5	1
3.3.1.2 (Gun)	0.75	1.5
3.3.1.3 (Injector)	0.5	1
3.3.1.4 (Photocathode)	0.5	1
Totals	3.5	7

Baseline Source R&D

- Main R&D Areas
  - **Undulator**
    - Build working prototypes
      - UK/Cornell
      - Different Parameters



UK Design

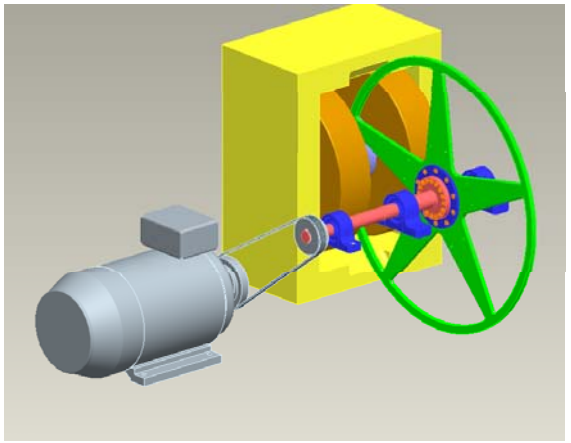


Cornell Design

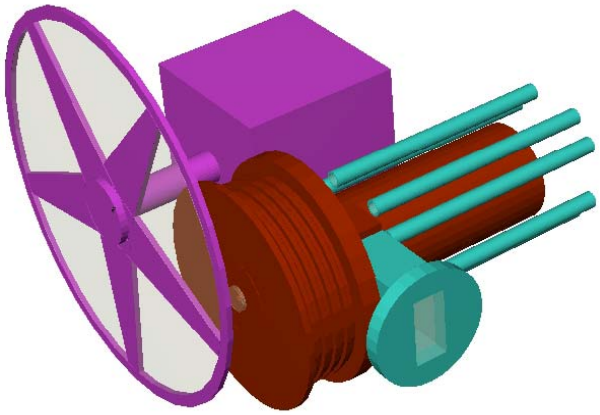
    - Effects on electron beam
      - Many completed
      - (there's always more you can think of…)

Baseline Source R&D

- Target Development
  - **Eddy Current braking experiment**
  - **Test vacuum and water feed-through components**
    - (Daresbury/Liverpool/Cockcroft)
  - **Confirm activation calculations with experiment to benchmark codes**
    - SLAC/DESY/Daresbury/CERN



L.Fernandez, FLUKKA Simulation of target



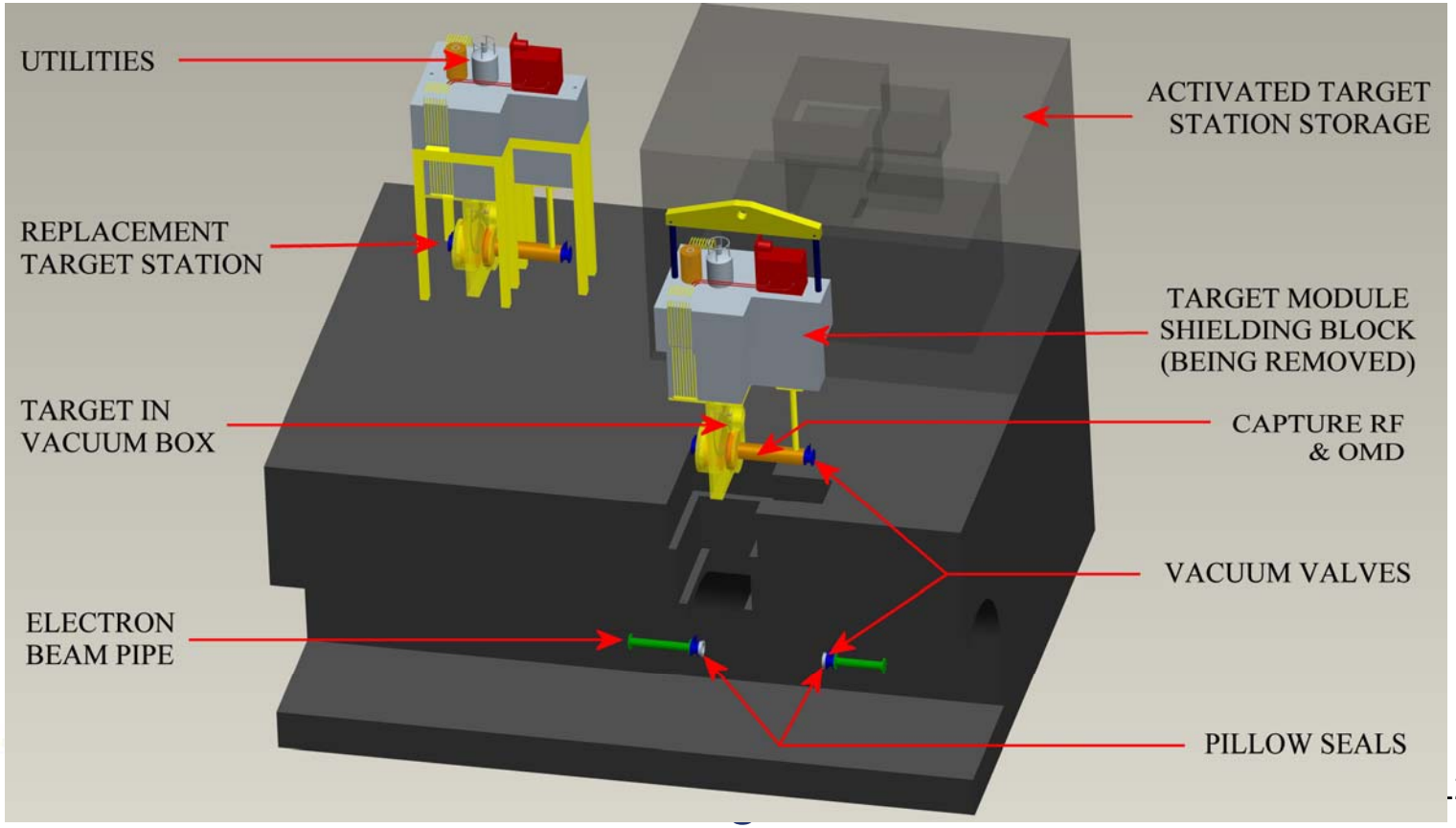
Ushakov - Max dpa in target is ~0.01 dpa / cm^3 After 5000 hours of operation

Baseline Source R&D

- Alternative target designs
  - **Ceramics**
    - (silicon carbides, aluminium nitrides etc.)
    - RAL
  - **Cornell**
    - Ti needle target
    - Liquid metal target with Pb/Bi or Hg
    - Tungsten disk
- Optical Matching Device
  - **Due to eddy current concerns design of a ¼ wave focusing optics and lithium lens is under way (works “today“)**
    - Argonne

Baseline Source R&D

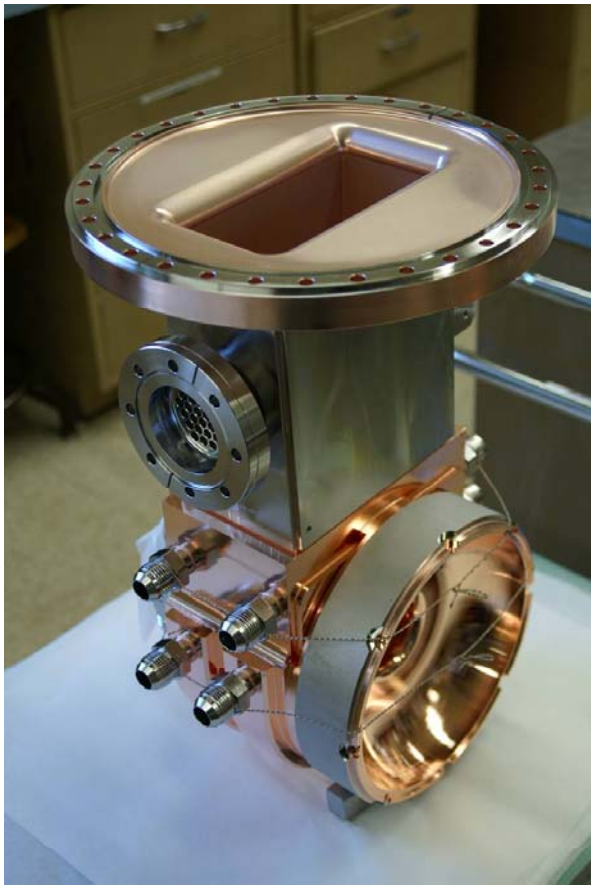
- Remote Handling
  - **Develop RAL concept to minimise hot spare replacement time (currently 53 hours)**
    - **Nobody working on this!**



Baseline Source R&D

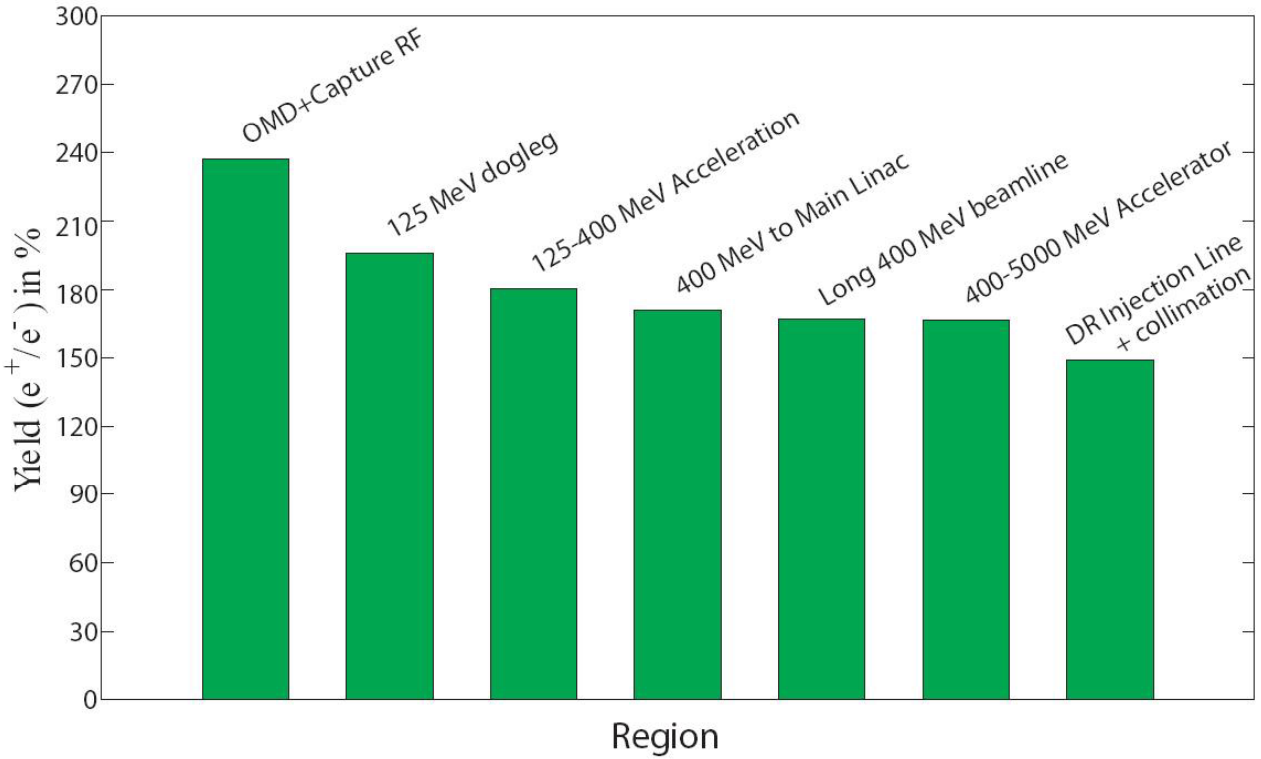
- Capture RF
  - **Develop prototype for heat load tests**
    - SLAC

Also being worked on at **INR**



Baseline Source R&D

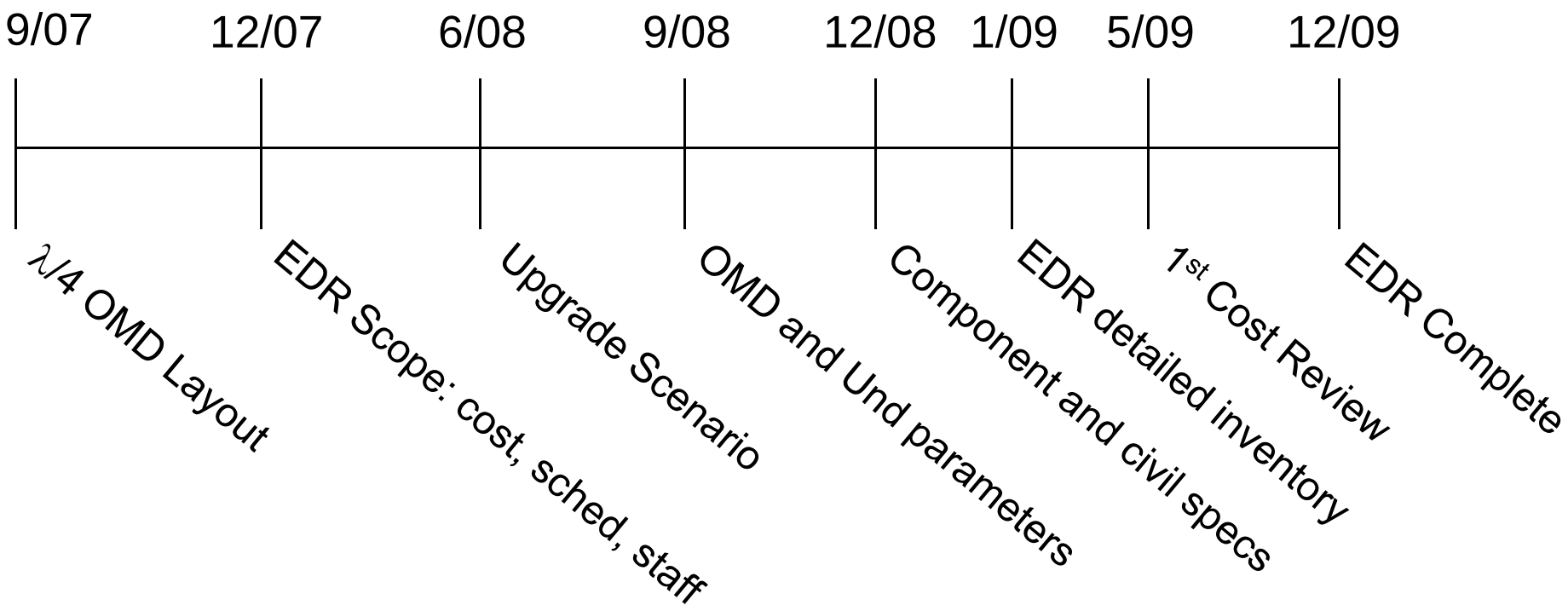
- Capture optics
  - **Optimise losses**
  - **Too high % of 500MeV positron lost (design a collimation system)**
    - SLAC



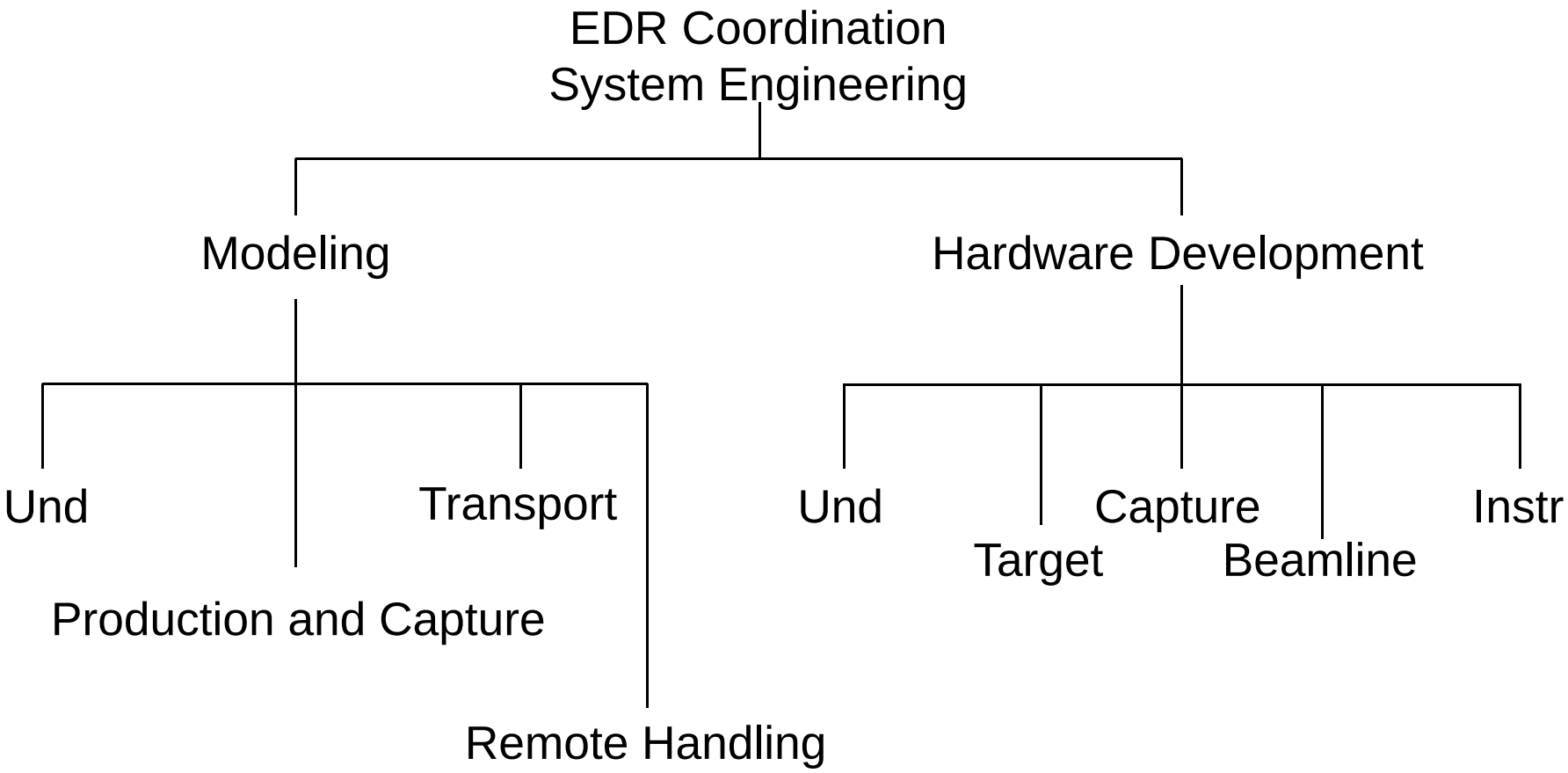
Baseline Source R&D

- Upgrade Scenarios
  - **Polarisation**
    - More detailed polarised source specification
    - Length of undulator,
    - Beam Jitter effect on polarisation,
    - Spin preservation (jointly with electron spin preservation)
      - DESY/Cockcroft
  - **Energy**
    - Relocate entire system
    - If the undulator is kept at the same point in the linac then the emittance increase due to chicane is a problem

ILC Positron EDR Milestones/Timeline



Positron EDR Work Packages draft)



Work Package Development for 12/07

Assign WP Leader (Institution/Individual)

Define Deliverable

Identify Resources

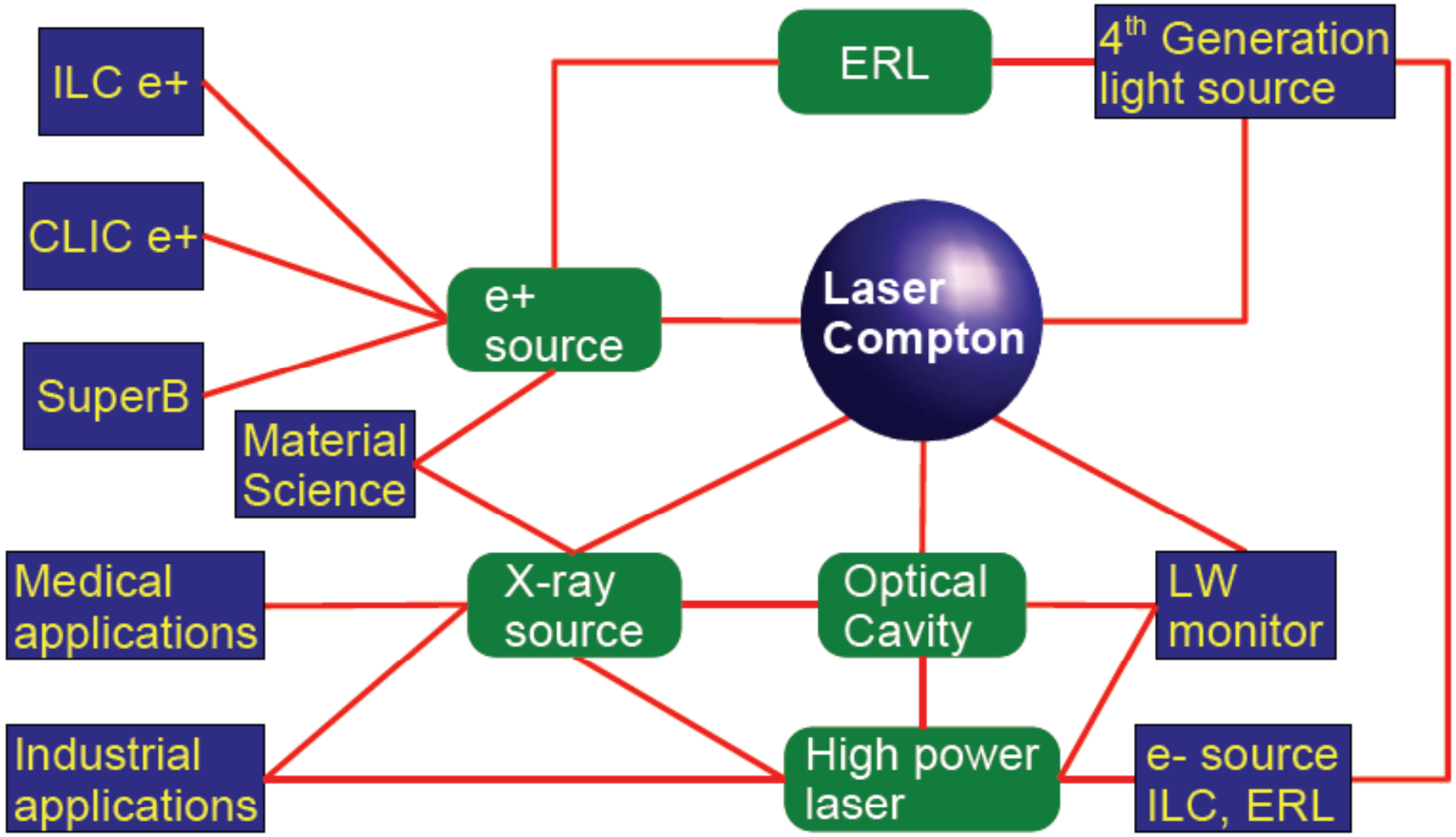
Discuss at ANL September ILC e+ Collaboration Meeting

Complete WP Definition by December, 2007

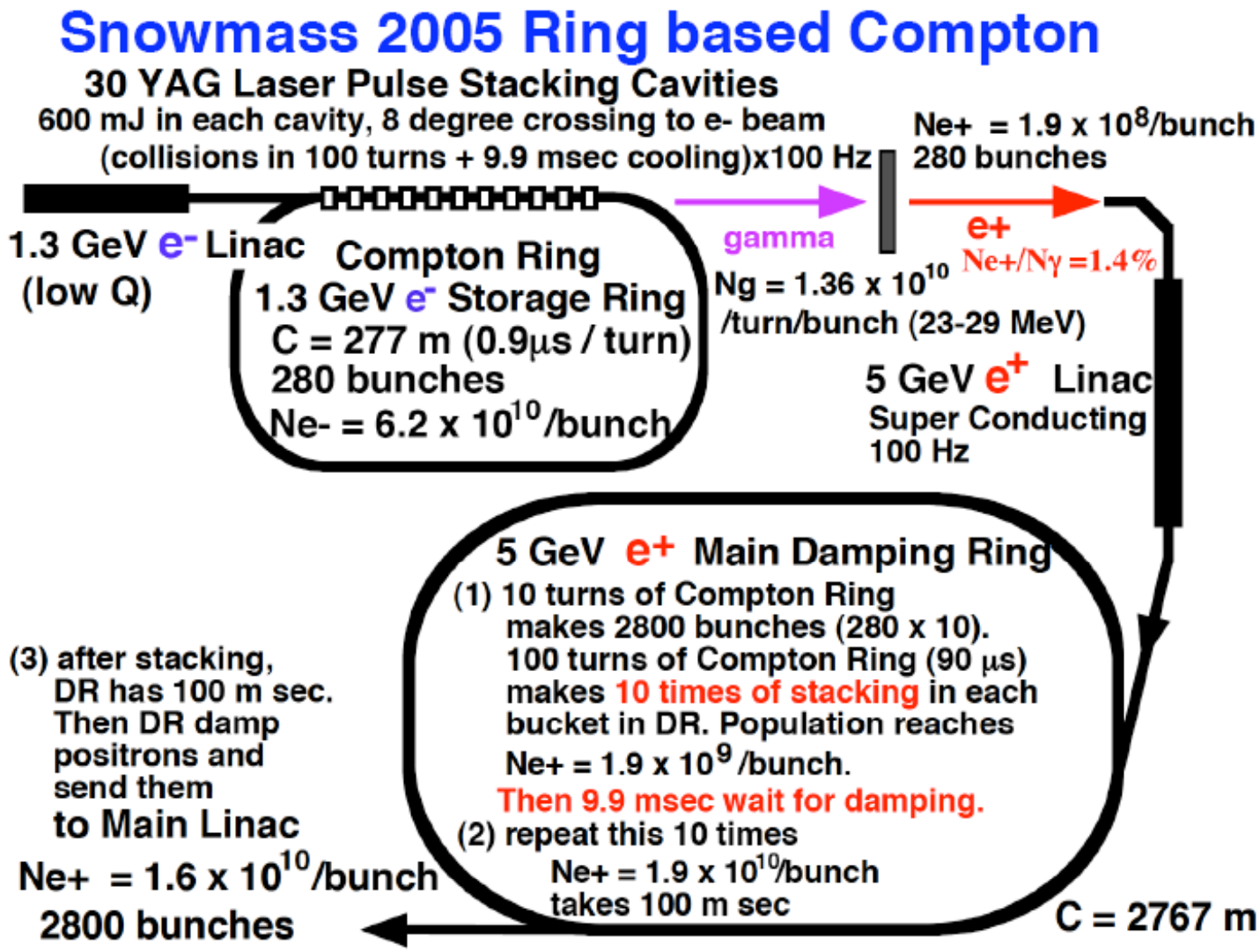
Alternative Positron Source

- Alternative positron source is based on Compton scattered photons
  - **Advantage**
    - Independent operation
  - **Disadvantage**
    - Many technical challenges
- Three options
  - **Energy Recovery Linac based Compton**
  - **Ring based Compton**
  - **Linac Based Compton**
- Each option is still in ‘concept’ stage

Compton Source



Ring Based Compton



ERL Based Compton

- Advantage
  - **New, high quality beam every turn**
- Concept based on some working assumptions, i.e.
  - **Top up injection is possible**
  - **…**
- Many parameter choices are still to be made
  - **repetition frequency**
- Issues
  - **Coherent Synchrotron Radiation, Stacking, ERL study, laser study, capture study**

Example ERL design

- **For more information on an example ERL concept see:**

  “ERL based Compton e+ source for ILC”
  Tsunehiko OMORI (KEK)

Laser/optical cavity R&D

- Several areas of laser / cavity development
  - CO2 laser development for Linac based compton and a 4 GeV linac **(BNL)**
  - Fabry Perot resonators program in LAL-Orsay
  - Compton gamma-ray generation experiment by using an optical cavity in ATF

See

"**Experimental Effort for Alternative Schemes** "

"Hirotaka Shimizu2

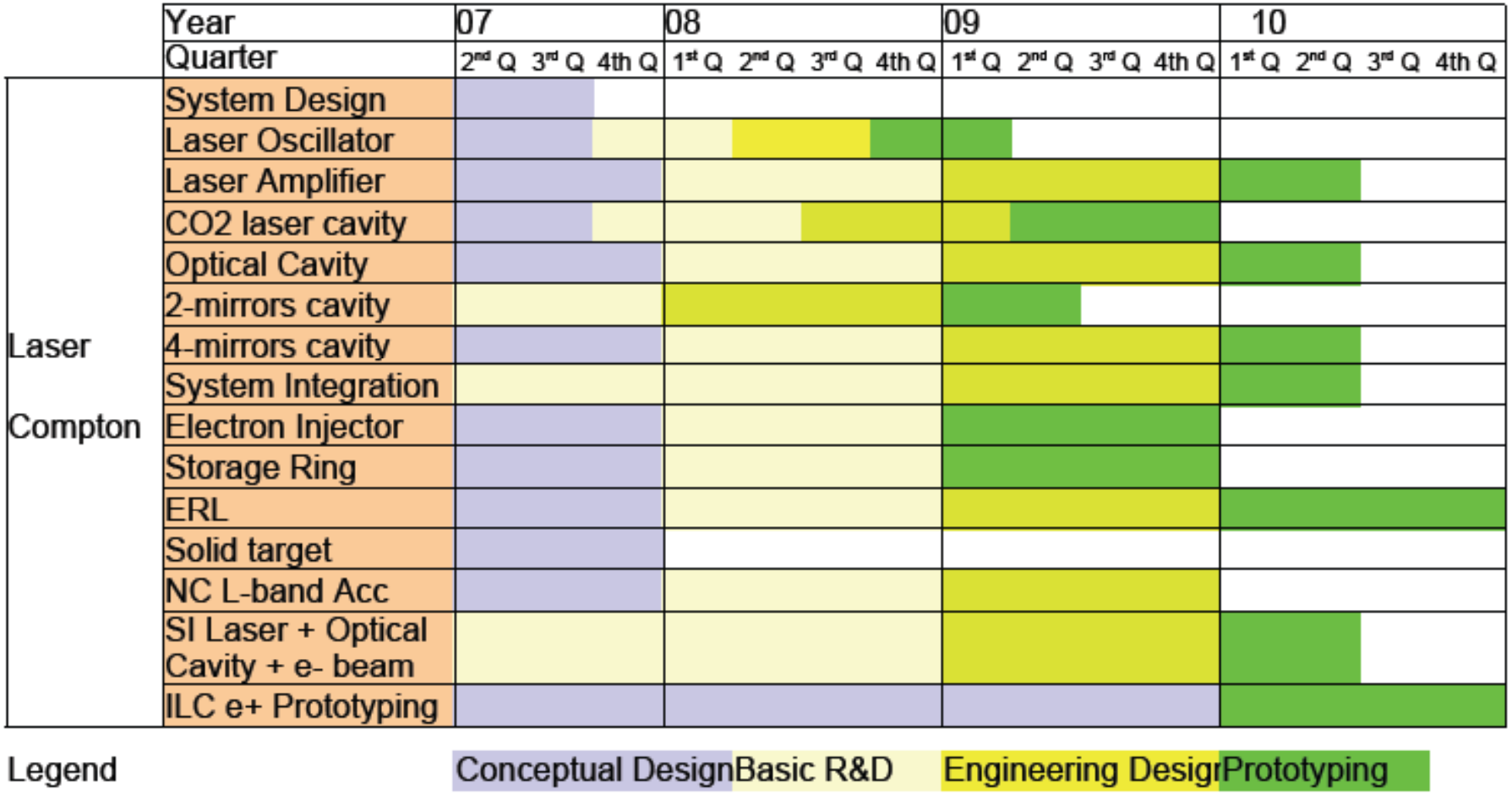
Compton EDR Milestones

- 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.

Work Packages

			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

Time-Line


Year
07
08
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Quarter
2nd Q 3rd Q 4th Q
1st Q 2nd Q 3rd Q 4th Q
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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
Engineering Design
Prototyping

Sources Summary (personal view)

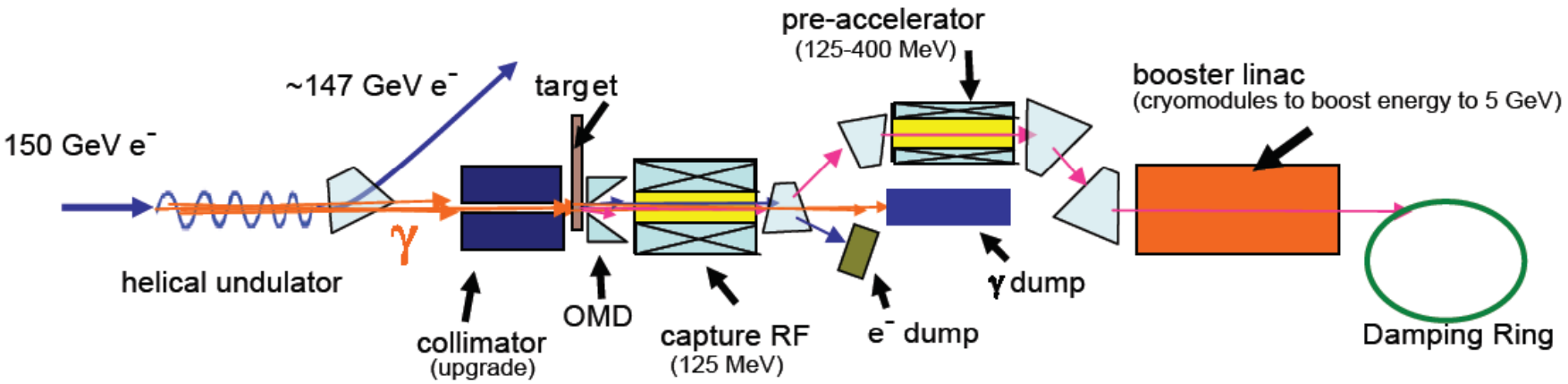
- Electron Source
  - **OK**
- Baseline positron source
  - **Nobody working on remote handling**
  - **More coherent systems engineering required**
  - **More effort required on upgrade scenarios**
- Compton Source
  - **Choose a design**
  - **Costings**
- Why can't Compton and Undulator groups work on similar problems?
  - **Capture, target…**

Part of Polarization Session Summary

RDR: Positron Source

helical undulator, 148 m length (k=0.9 , λ=1.15cm)

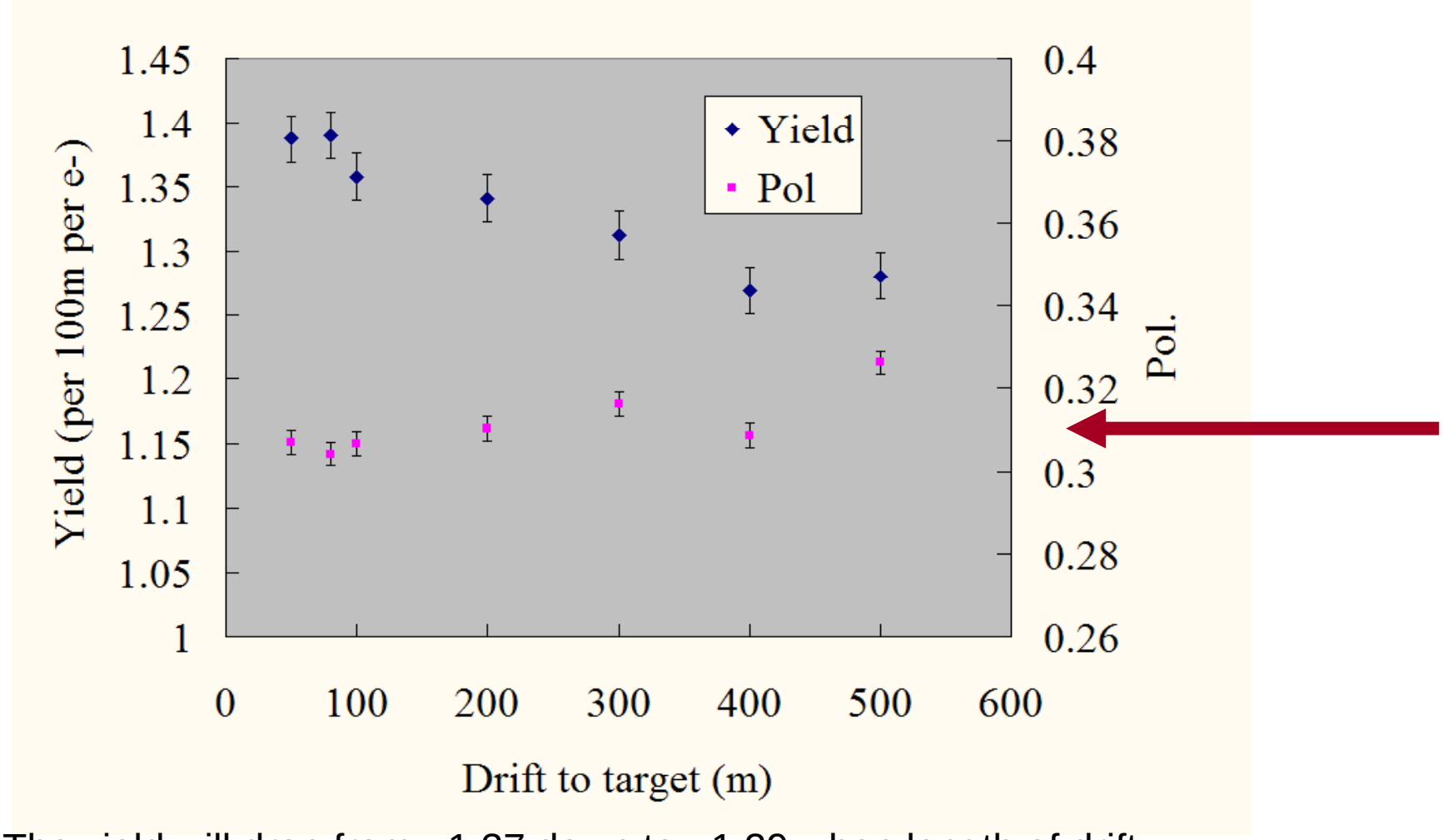
Polarization: ~30% (60% upgrade value)



maintain e+ polarization → spin rotation before and after DR

Yield and Pol.

W. Gai (Feb 07)



The yield will drop from ~1.37 down to ~1.29 when length of drift increased up to 500m from 50m.

Use 30% e+ Pol for Physics

Needs:

- ✓ spin rotation
- ✓ polarimeter @ IP

Physics:

Desire fast reversal of (+) AND (–) helicity of positrons,

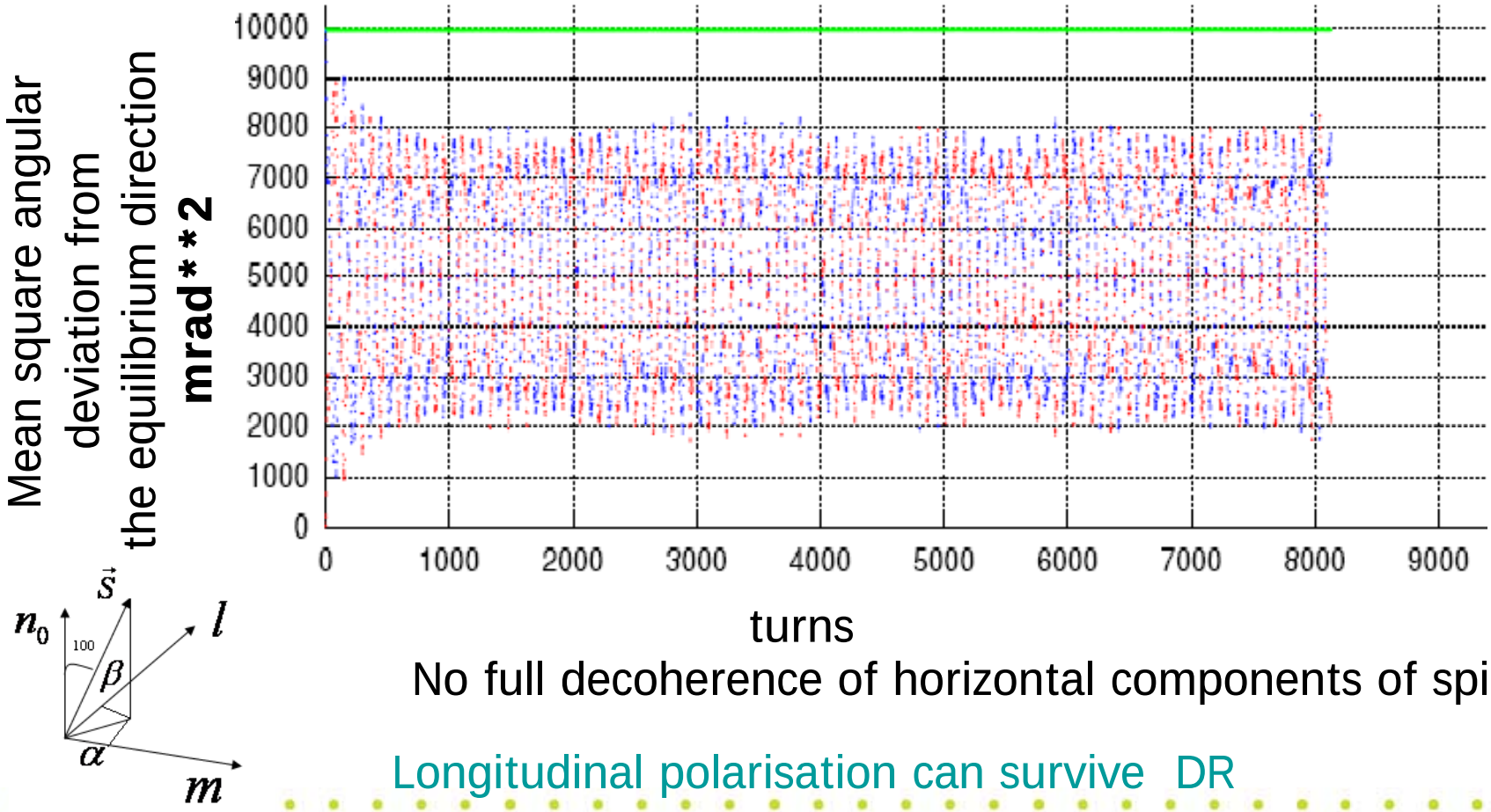
Without reversal we would spent 50% of the measurements to the wrong pairing of initial states (lower cross sections)

Remark: If no polarization is needed ⇔ we have to destroy the 30%!

Studies on Depolarization in DR: L. Malysheva:

- Loss of polarisation in DR insignificant for new OCS6 lattice
- Depolarisation of positron beam with its large energy spread and transverse dimensions was estimated and found negligible
- The horizontal component of polarisation will survive in DR!

OCS Spin Diffusion at 5.066GeV for spins initially at 100 mrad from $\hat{n}_0$



No full decoherence of horizontal components of spins

Longitudinal polarisation can survive DR

Simulation Tools

Talks on simulation tools and studies:

CAIN

Dependency of background pair processes on beam polarization (Hartin)

GEANT4 with Polarized Processes (Release 8.2, 8.3)

Polarized Geant4 -- Applications at the ILC (Schaelicke)

GEANT3

ILC positron production target simulation (Gharibyan)

KONN

The status of positron source development at Cornell (Mikhailichenko)

- The END

Slide Title