Report from 2nd Asia ILC R/D Seminar

T. Omori @Euro-Japan Compton Meeting 06-Oct-2008

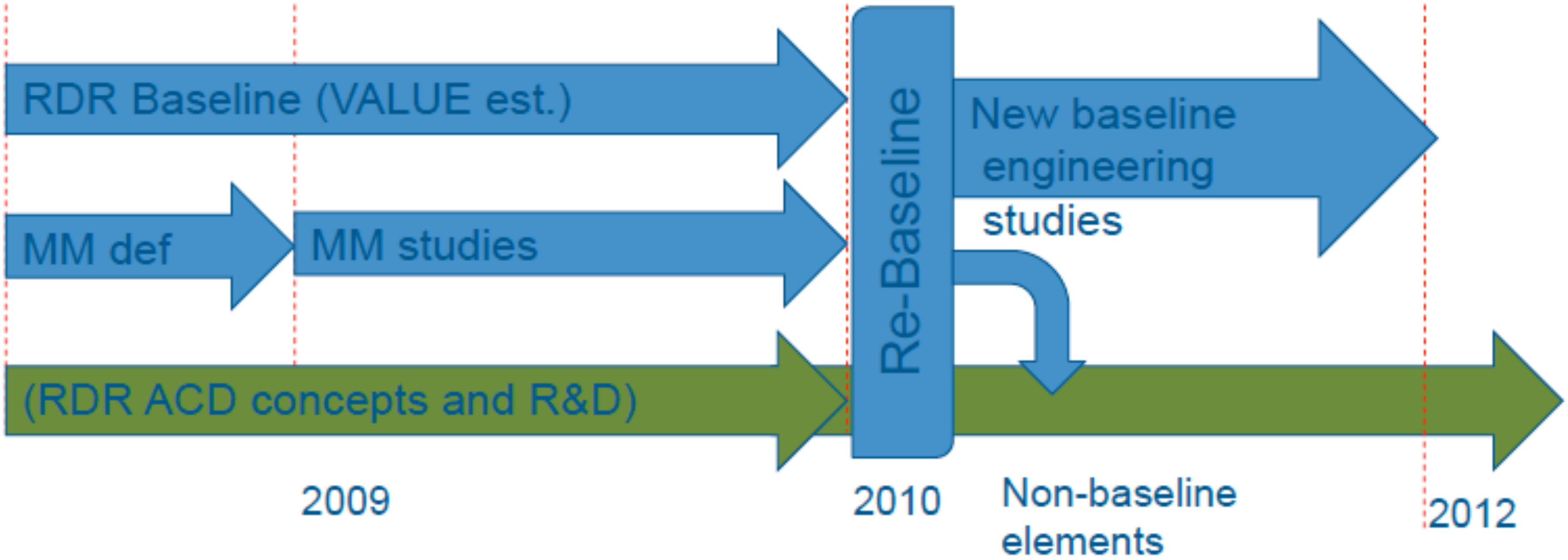
How do we propose to move forward?

General Theme: ***RISK REDUCTION***

- We must re-examine our ILC RDR design and optimize for cost to performance.
- This will require aggressive studies of the major cost drivers, reducing scope, staging, etc. We will do this openly and in full coordination with experimentalists.
- We must develop our technical design, such that major technical questions (gradient, electron cloud, etc) are positively resolved
- We must develop the technical design in preparation of making a construction proposal (plug compatible designs, value engineered concepts, etc.)
- Finally, we must develop an attractive, realistic and flexible Project Implementation Plan

Barry Barish, 2nd Asia ILC R&D Seminar, Sep 29-30, 2008

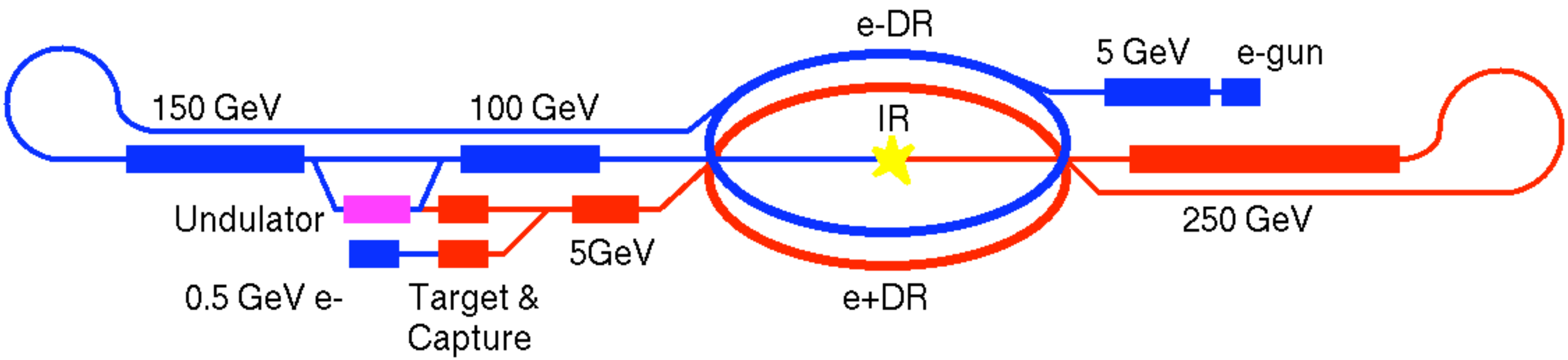
Towards a Re-Baselining in 2010



- **Process**
  - RDR baseline & VALUE element are maintained
    - Formal baseline
  - MM elements needs to be studies/reviewed internationally
    - Regional balance in the AP&D groups involved
    - Regular meetings and discussions
    - (but top-down control from PM)
  - Formal review and re-baseline process beginning of 2010
    - Exact process needs definition (a PM action item for 2009)
    - Community sign-off mandatory

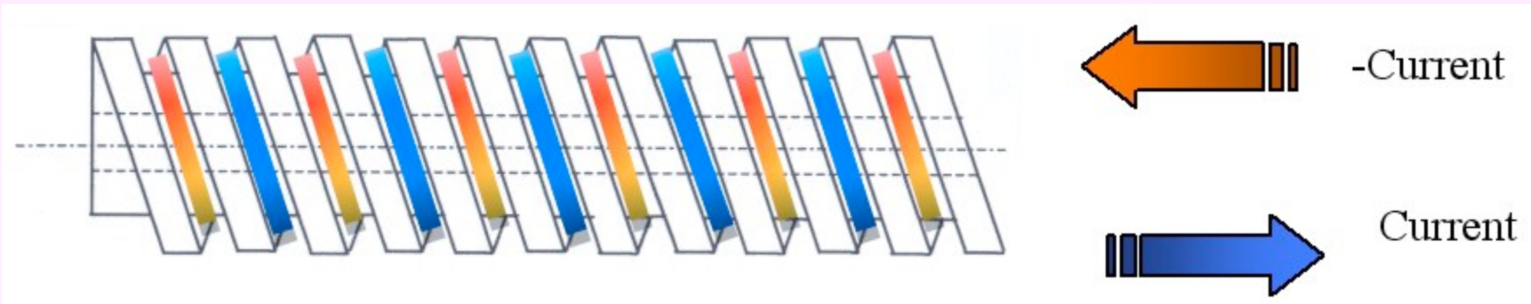
Baseline Design

- It relies upon gamma rays generated by passing 150 GeV electron through 168m undulator.
- Undulator is "inserted" to part way of ML (150GeV).
- A positron source driven by 0.5 GeV electron is a back up for high availability and machine commissioning.



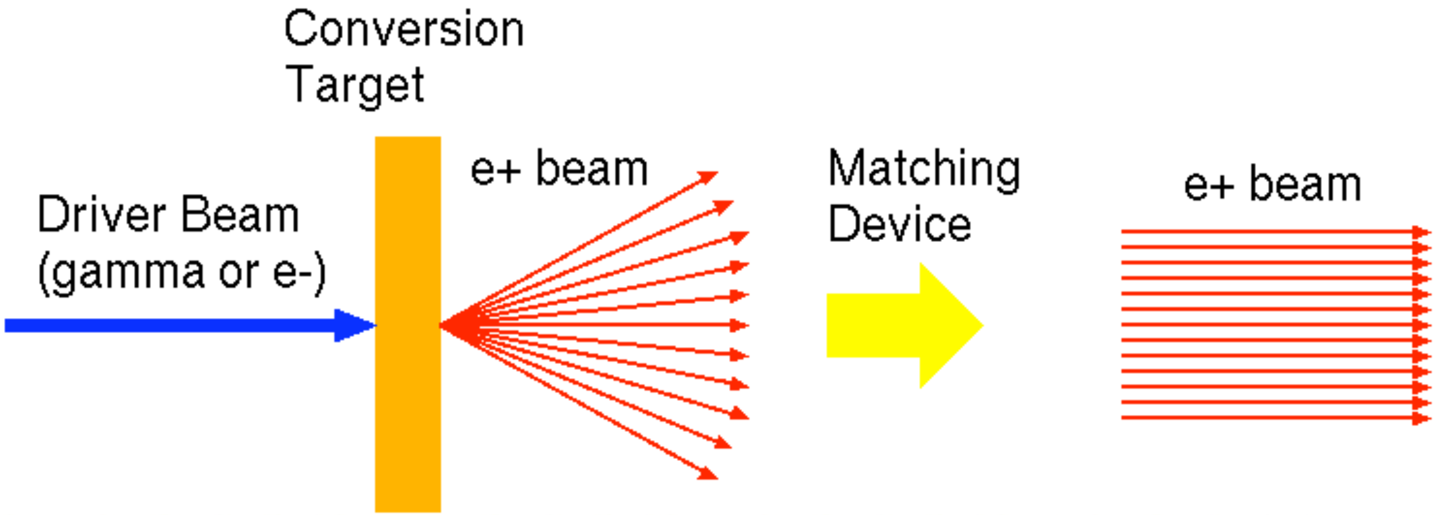
Undulator Parameters

Parameter	Value
Electron drive energy	150 GeV
Electron beam energy loss	4.5 GeV
Undulator length	147 m (168m)
Undulator period	11.5mm
Undulator Field	0.86 T
Undulator strength	0.92
Photon energy (1^{st} hrmc)	10 MeV

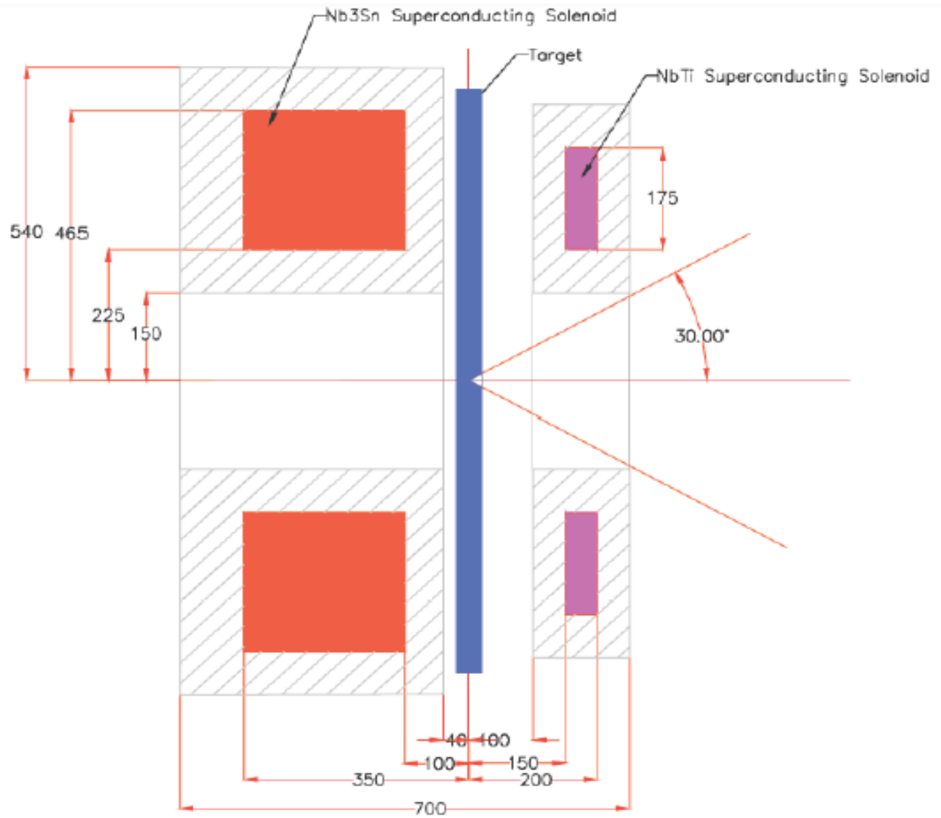


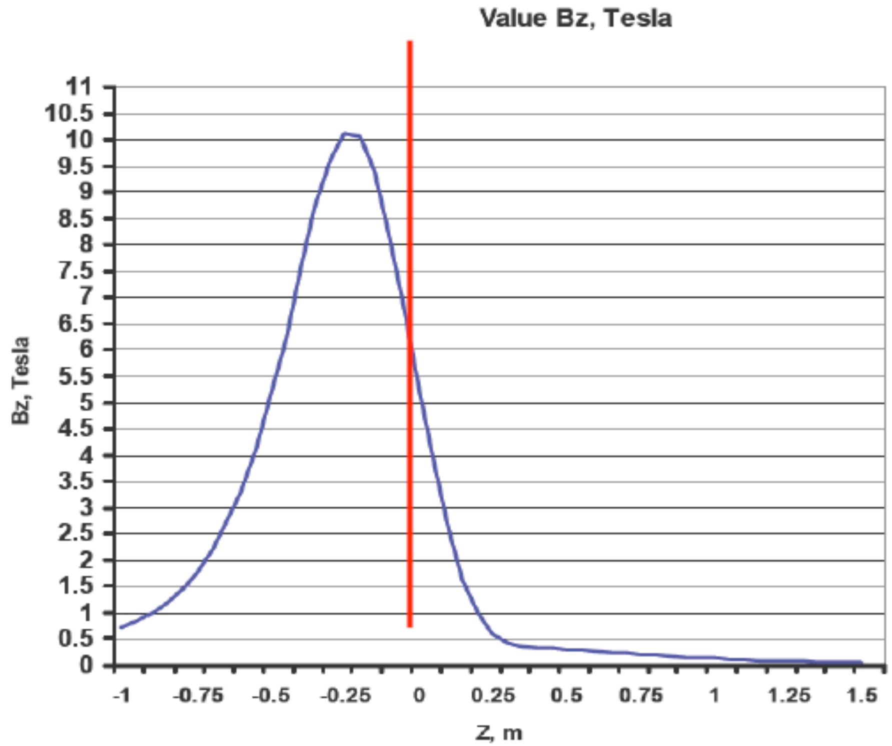
Matching Device

- The generated positrons is a point like with a large transverse momentum spread.
- That should be converted to a parallel beam for further acceleration; The matching device does it.
- Depending on the matching device, it increases capture efficiency from 10% to 40%.



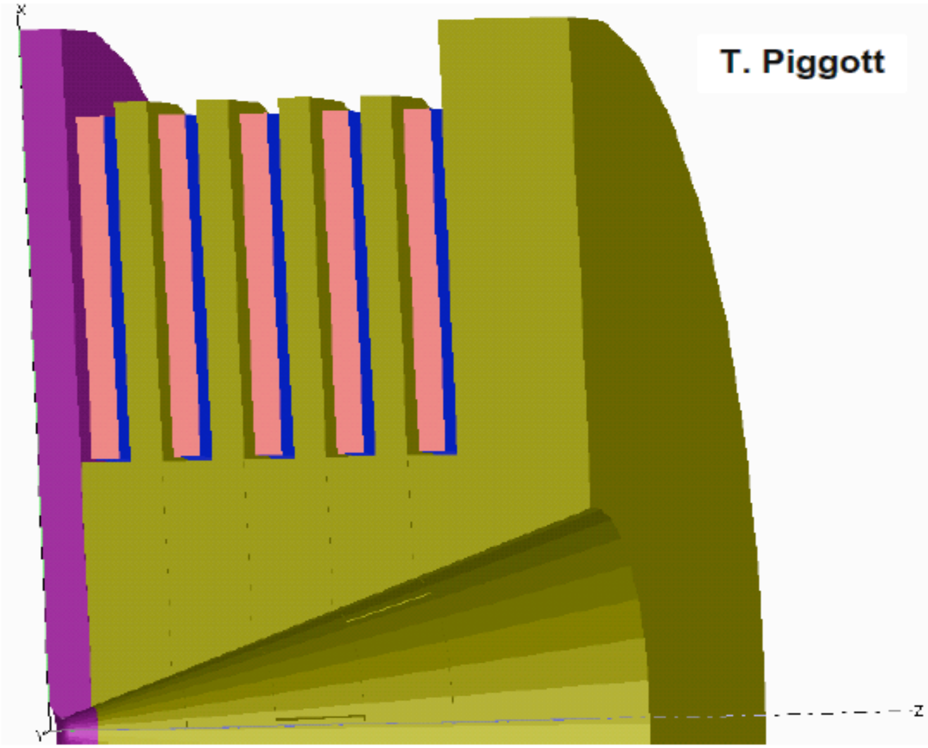
DC Solenoid

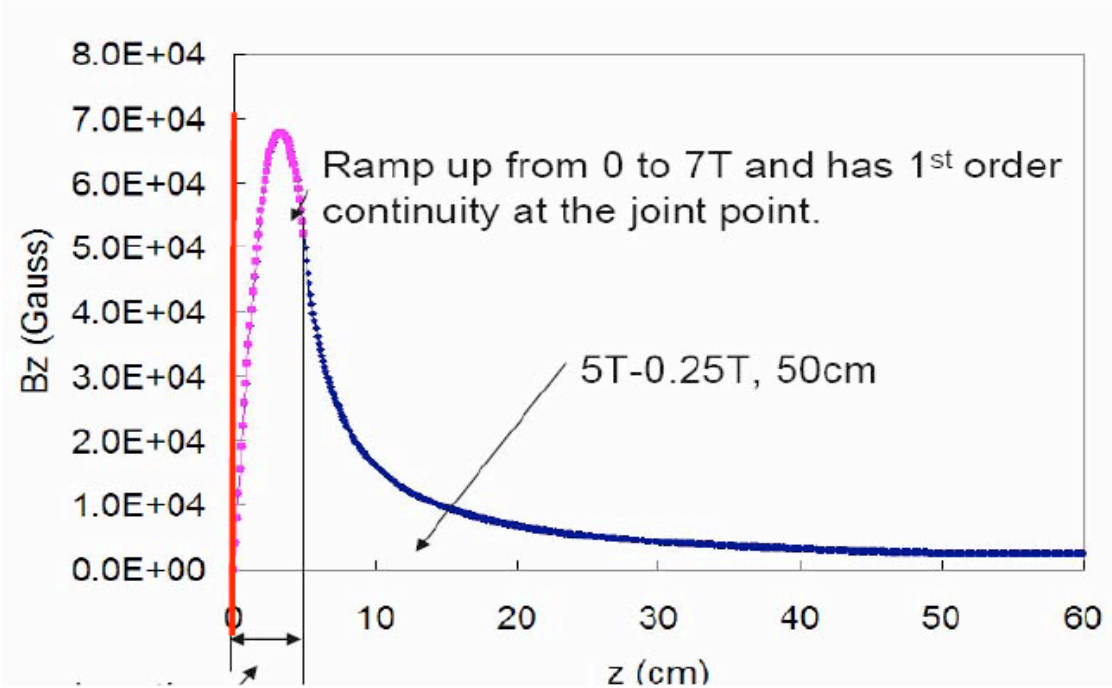




- High field (6T) and high capture efficiency(30%).
- Similar to other DC SC magnets; It is technically matured.
- It is not feasible for ILC since 100's of kW of eddy current in a fast rotating metal target.

Shielded Flux Concentrator

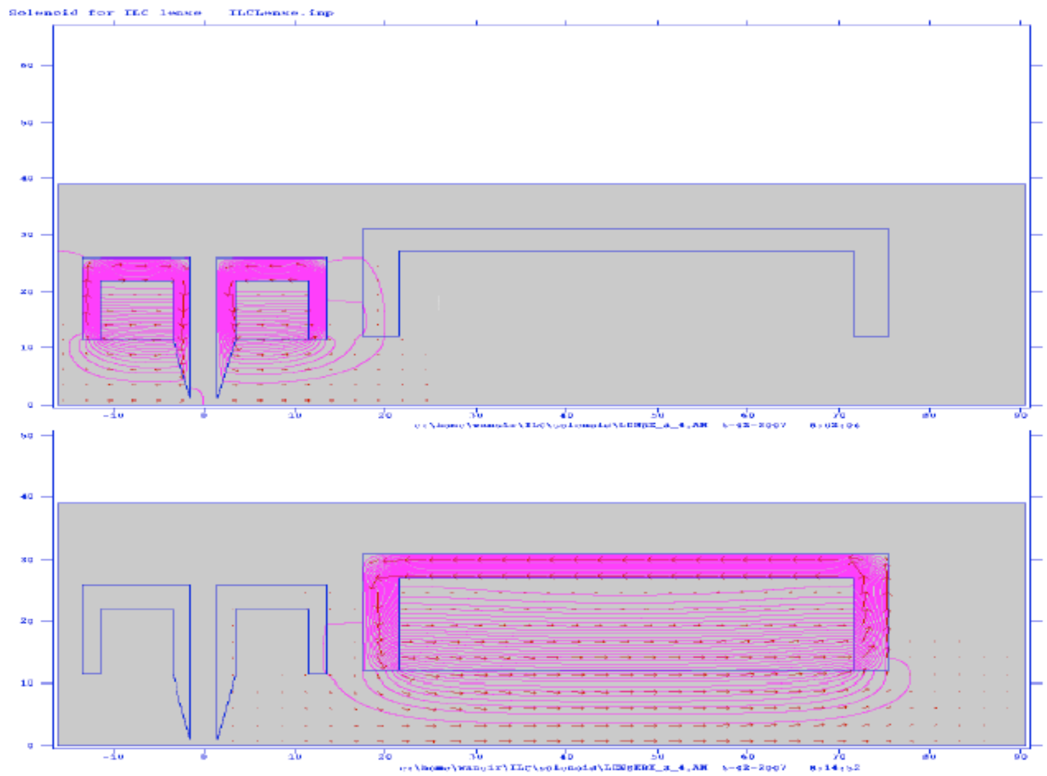




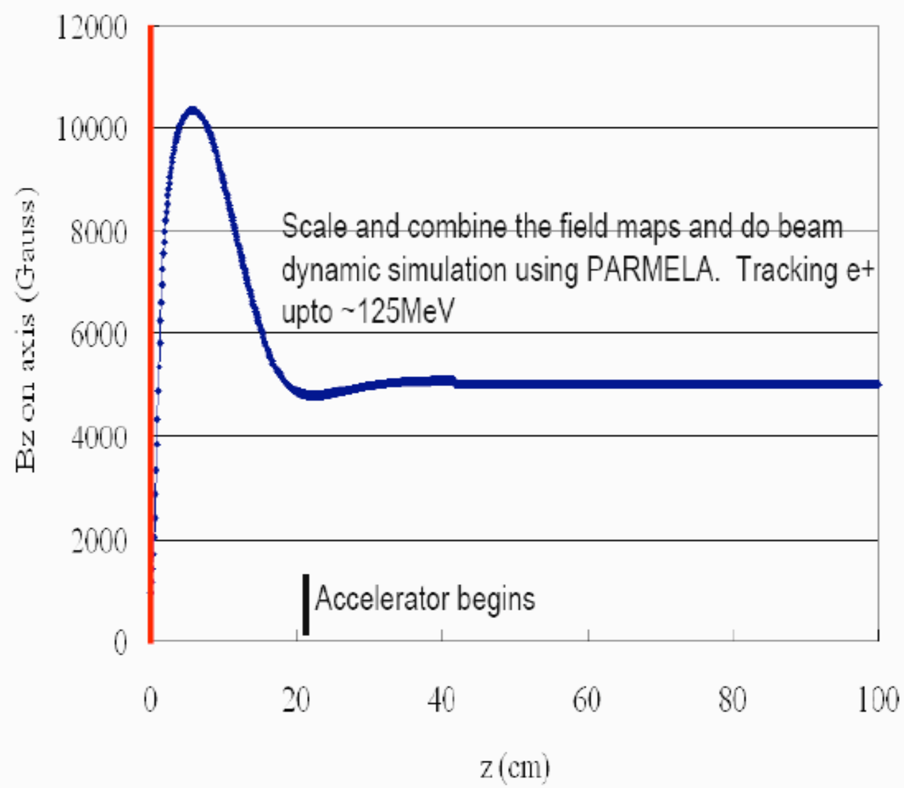
W. Liu

- Ramping from 0T to 7 T in 2cm (no field on target).
- Capture Efficiency ~21%
- Difficult technically to sustain 1ms pulse train length.
- Further study needed to prove feasibility (prototype).

Quarter Wave Transformer



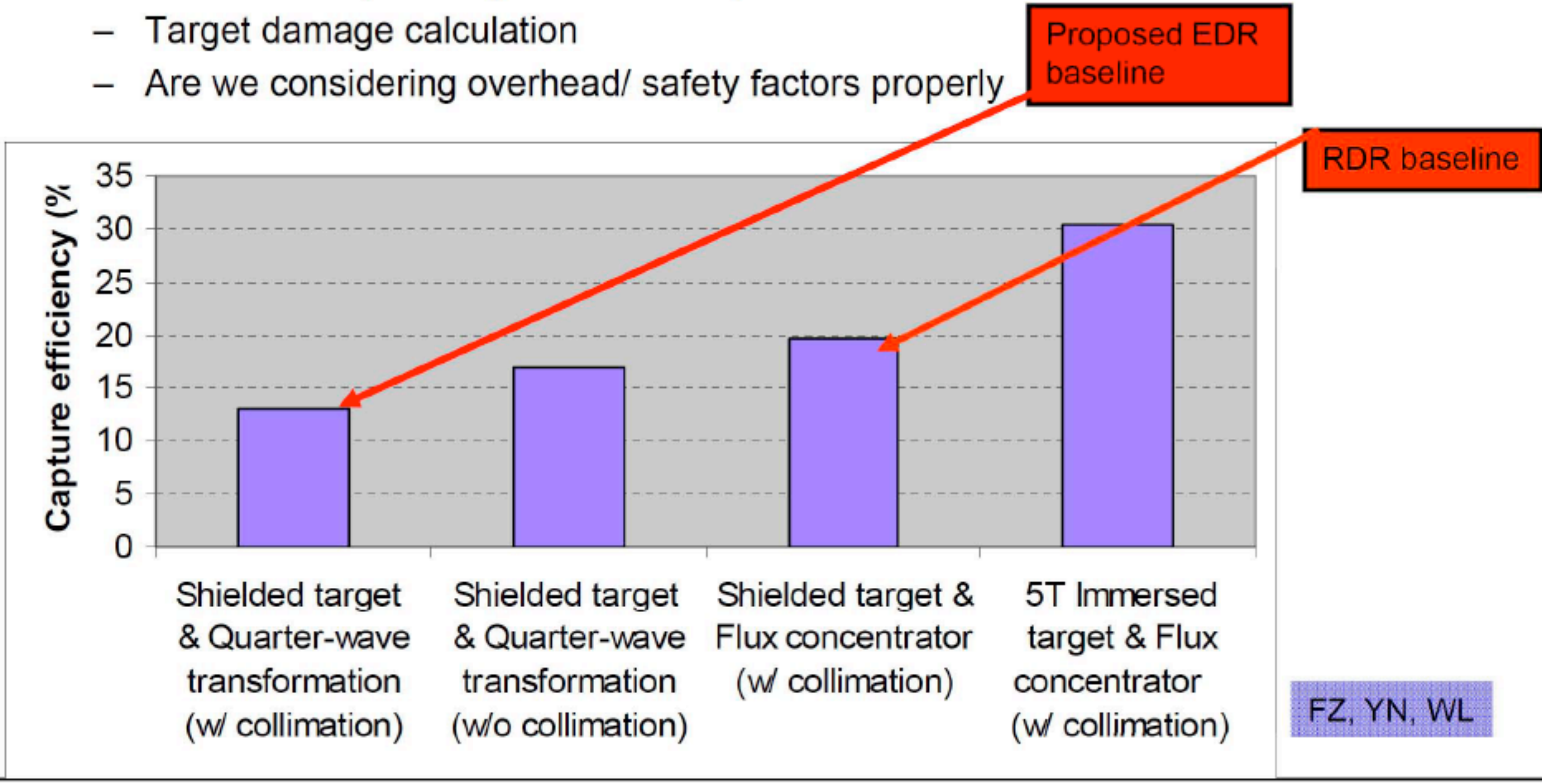
W. Liu



- Ramping from 0T to 1 T in 5cm (no field on target).
- Capture efficiency ~ 15%.
- Technically matured and realizable (actual baseline).

Target & Capture

- Best capture – immersed target & “adiabatic field”
- Target must move to survive
- What is the optimum photon beam spot size
- Target damage calculation
- Are we considering overhead/ safety factors properly

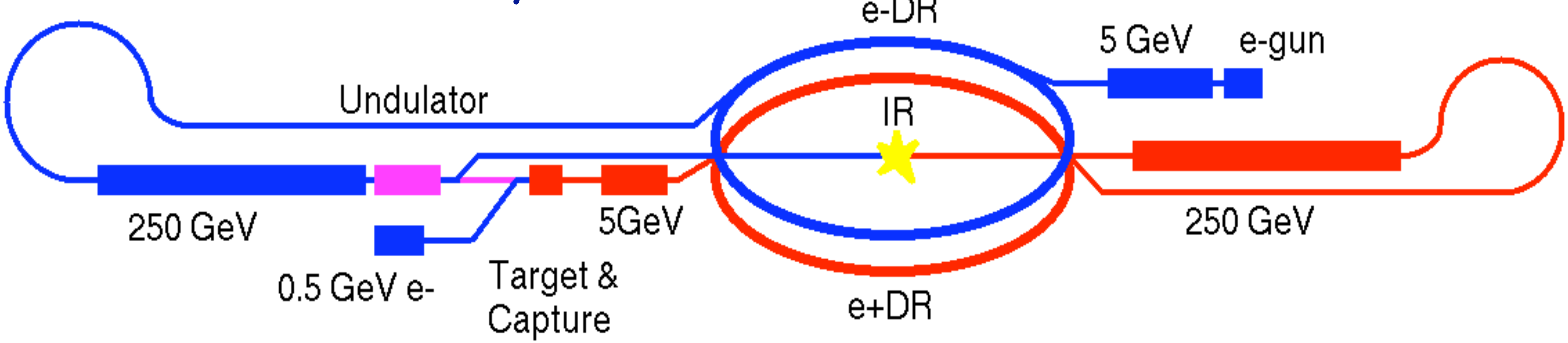


Summary for baseline

- R&D efforts for critical devices are in progress (undulator, target, etc).
- Although Matching device is one of the most important, the R&D is stopped.
- QWT is the only realistic solution at this moment and it should be actual baseline as long as there is no big progress on R&D for MD.

ILC Positron Source:MM

- Undulator is moved to the end of ML (250GeV).
  - Energy scan <100GeV is difficult.
  - Dedicated pulse for e+ generation with $\frac{1}{2}L$.
- QWT instead of AMD, which has lower capture efficiency; The undulator length is 350m.
- KAS share the common target with gamma1 source; yield is only 1% of the nominal intensity.



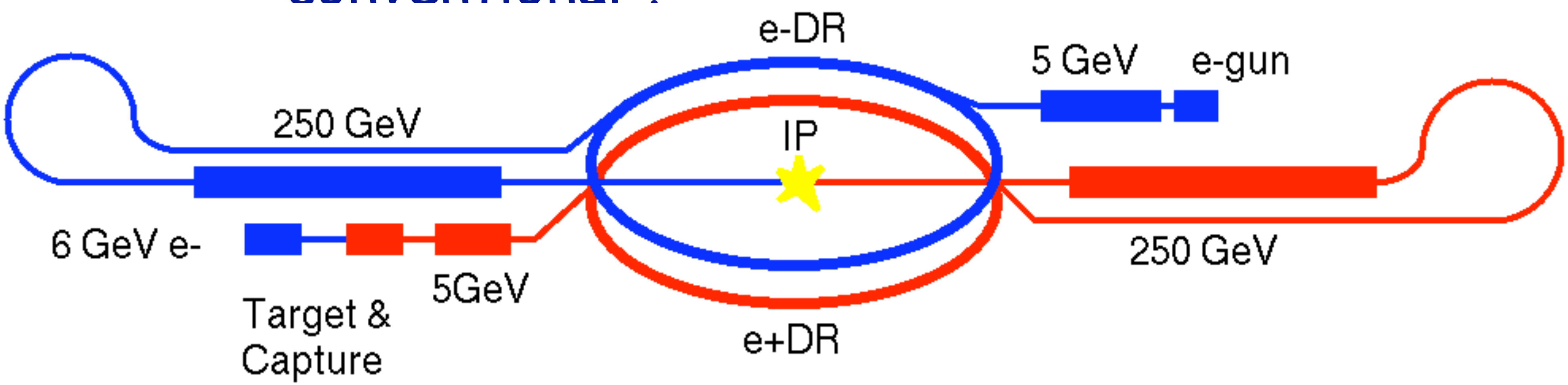
Summary

- Systematic studies of the ILC positron source performed. Various issues addressed.
- Basic-Basic (1/4 wave) scheme may work, but require 300 m long undulator and 3 GeV Linac to compensate the energy loss.
- Challenges and further works:
  - Target design: Mechanical and materials. (Ti, W, Eddy current and radiation damages).
  - Capturing Magnets (Lens): Small R&D investments may yield huge savings.
  - Target Hall: Remote handling target and other beamline components.
  - Undulator: electron beam jitter tracking through the undulator, polarizations, and other errors like undulator and alignments.
  - Electron beam properties after traversing the undulator, anything changes except energy?

赤四角は大森による

Further Considerations on MM

- Improved Low P parameter : half # of bunches in a pulse.
- It is a big fair wind for the electron driven.
  - Potential target damage, which is the most serious issue on electron driven scheme, is relaxed.
  - There are active R&D on noble ideas.
- No doubts that Conventional is really "conventional".



TDP Summary

- Basic R&D is very important in TDP1.
- Re-baseline at the end of TDP-1 is the mile -stone.
- According to the investigation based on the latest technology, the status is:
  - The conventional method is important as a fall -back. Low P parameter and noble target technologies make it feasible and reliable.
  - Technical difficulty forces the undulator system bigger and bigger and it does not seem “mimimal machine”.
  - From the pure technical point of view, the baseline is the electron driven and undulator and laser compton are upgrade alternatives.

Summary

- R&D status of ILC positron source is reviewed.
- Undulator scheme is the baseline design.
  - SC helical Undulator, rotating rim target prototype.
  - Need study for matching device.
- e- driven scheme is important as a backup.
  - There are several active R&Ds based on noble ideas. It is the best scheme for MM.
- Laser Compton is an advanced alternative.
  - Aggressive R&D efforts.
  - Still need more technical maturity.
  - ILC-CLIC collaboration.