RDR Management
Accelerator Design Towards the RDR

Nick Walker

ILC-GDE

RDR Goals

- **Produce a detailed (conceptual) design for the ILC based on the Baseline Configuration, evolved through the design process**

- **Produce a cost estimate good enough to give best estimate and bound the costs**

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This process continues as we refine the design (focus of latter part of this talk)

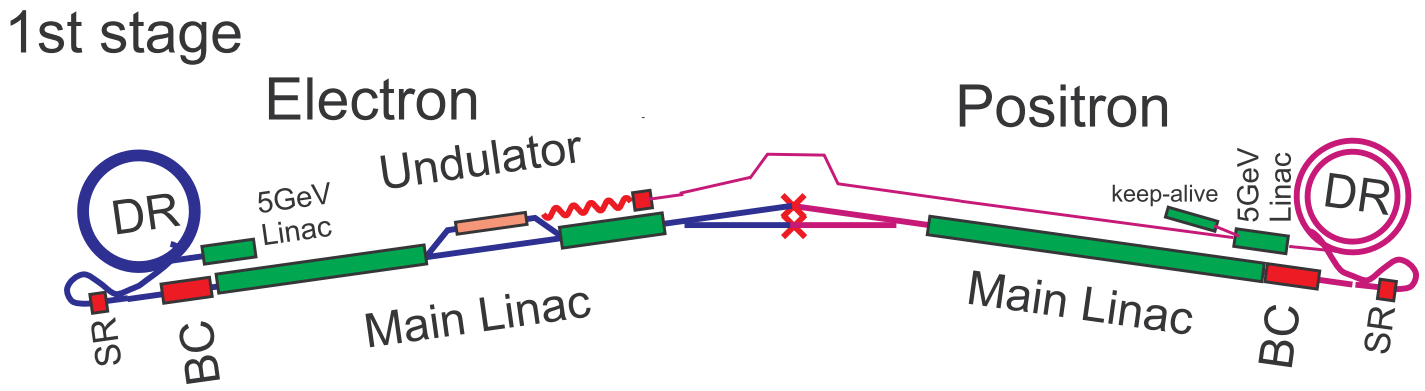
RDR Goals

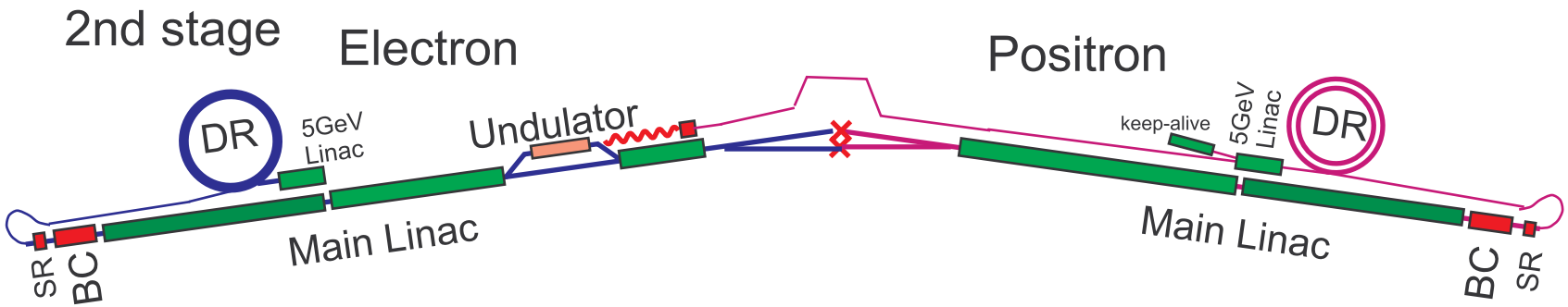
- **Produce a detailed (conceptual) design for the ILC based on the Baseline Configuration, evolved through the design process**

- **Produce a cost estimate good enough to give best estimate and bound the costs**

Expected cost is used to set our priorities (for this year and the RDR)

Baseline Configuration





The Devil in the (Design) Details

- Baseline Configuration handed formally under Change Control at Frascati GDE meeting (November ’05)
- Basic layout and parameter space of machine established; **e.g.**
  - **RF parameters**
  - **bunch parameters**
  - **IP parameters etc.**
- Critical design decisions agreed upon; **e.g.**
  - **number of tunnels**
  - **location of undulator-based e+ source etc.**

The Devil in the (Design) Details

- However, many detailed decisions still remained
  - **exact layout of RF unit**
  - **detailed lattice designs**
    - component counts
    - real estate requirements
    - Conventional Facilities requirements
- Critical cost-driving systems dealt with first
  - **main linac technology**
  - **Civil Engineering and Conventional Facilities**
- Other ‘design issues’ not cost-critical **e.g.**
  - **exact design of sources**
  - **exact DR lattice**

} ***performance critical***

RDR Technical Management

RDR Management Board

Barish, Bialowons, Garbincius
Paterson*, Shidara, Raubenheimer,
Walker (chair), Yokoya

** integration*

	Area Systems					
Technical Systems	e- source	e+ source	Damping Rings	RTML	Main Linac	BDS
Vacuum systems						
Magnet systems						
Cryomodule						
Cavity Package						
RF Power						
Instrumentation						
Dumps and Collimators						
Accelerator Physics						
Global Systems						
Commissioning, Operations & Reliability						
Control System						
Cryogenics						
CF&S						
Installation						

RDR Technical Management

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Area System Leaders are primarily responsible for the design of their AS

They are also the 'owner' of the costs associated with their AS

RDR Technical Management

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Technical System (TS) regional contacts are responsible for *Engineering, Design* of technical sub-systems and *for estimating the cost.*

Typically one contact per sub-system per region.

RDR Technical Management

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Commissioning, Operations & Reliability		
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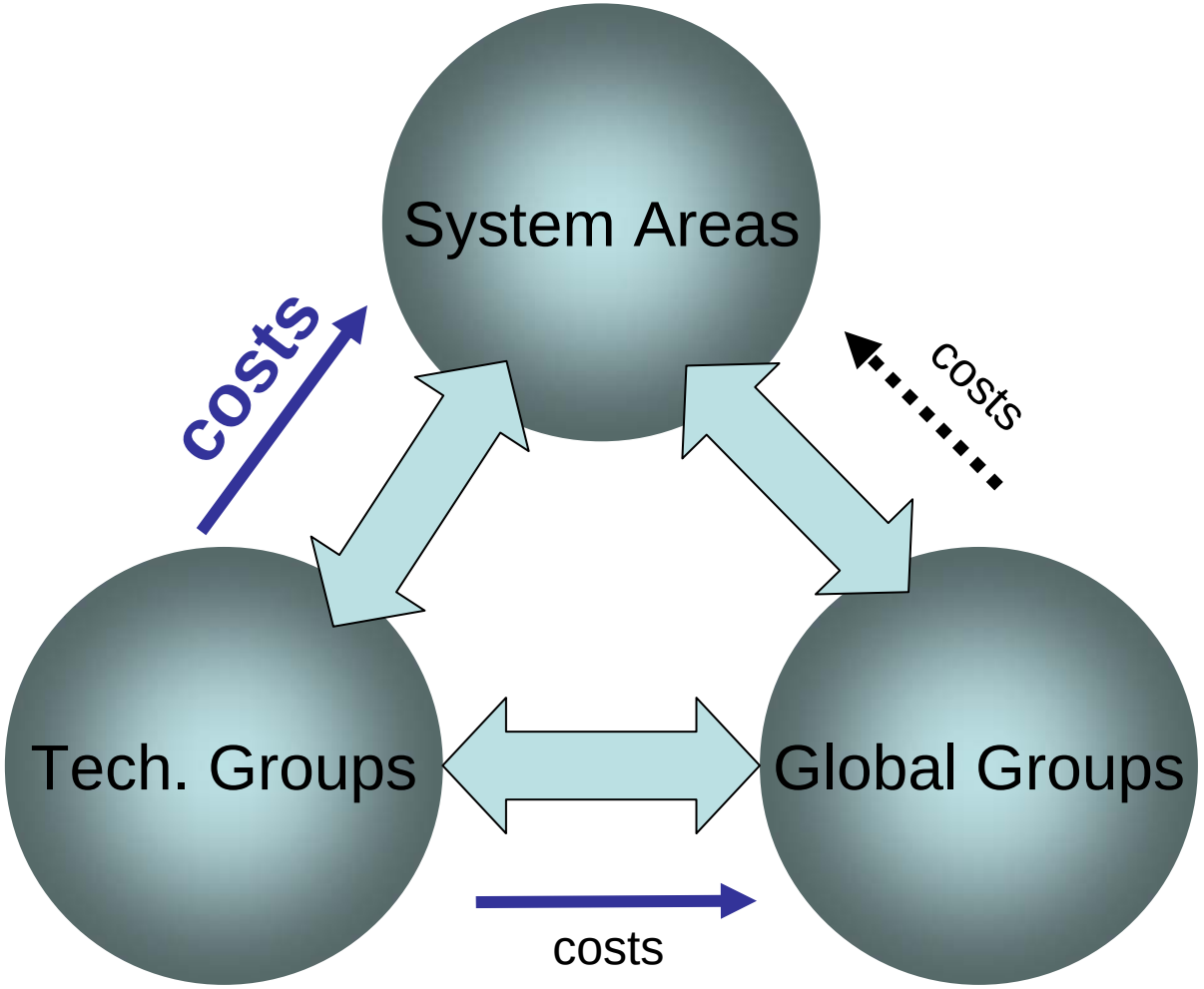
Global Groups (GG) Cover specialist design items which are considered global in nature (i.e. they cross multiple SA boundaries).

RDR Matrix Reloaded



The “Two Views” of the RDR

- Accelerator Design
  - **focused on layout, performance, accelerator physics, *but nonetheless cost aware***
- Engineering and Cost
  - **design of components (SCRF, magnets, vacuum etc), and supplying unit costs**
  - **Important to produce harmonized cost estimates across regions**
    (*cf Garbincius DCB presentation*)

On-going Accelerator Design

- Main Linac
- Damping Ring
- BDS
- Positron Source
- Global Issues
  - MPS
  - Diagnostics
- Accelerator Physics

Can only touch on examples in this short presentation

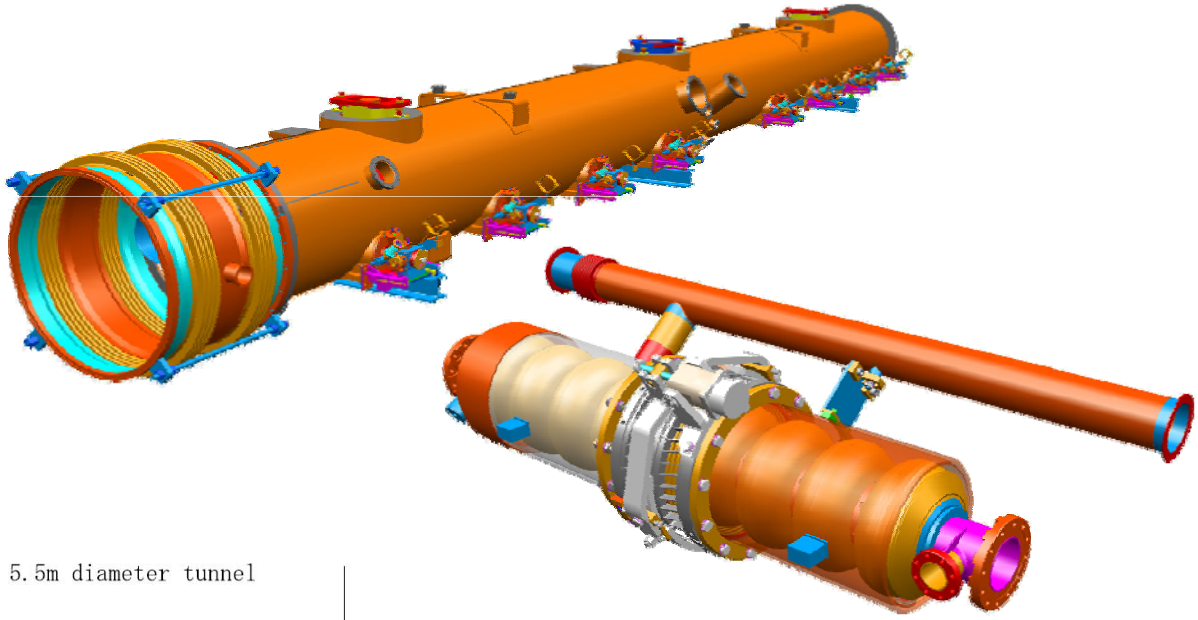
Many aspects presented in previous talks

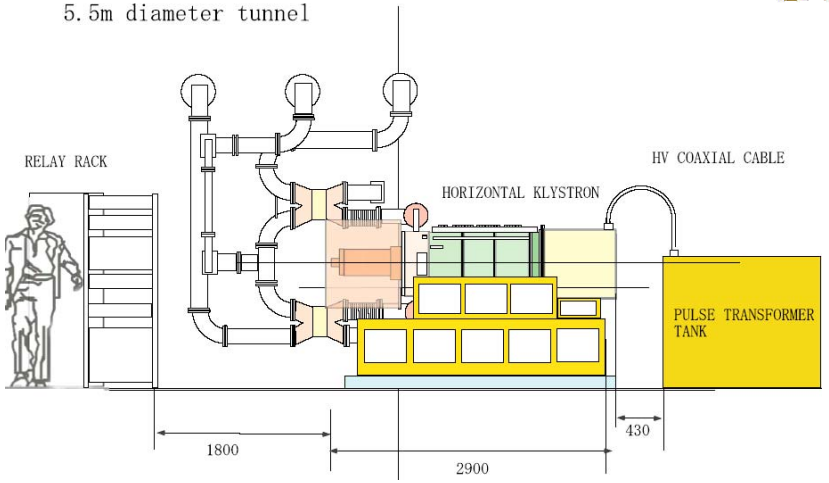
Goal here is to show this effort is on-going

On-going Accelerator Design

SA leads: Adolphsen, Hayano, Lilje, Solyak

- Main Linac
- Damping Ring
- BDS
- Positron Source
- Global Issues
  - **MPS**
  - **Diagnostics**
- Accelerator Physics





Already covered in detail in presentation by Adolphsen

On-going Accelerator Design

SA leads: Gao, Guiducci, Wolski

- Main Linac
- Damping Ring
- BDS
- Positron Source
- Global Issues
  - **MPS**
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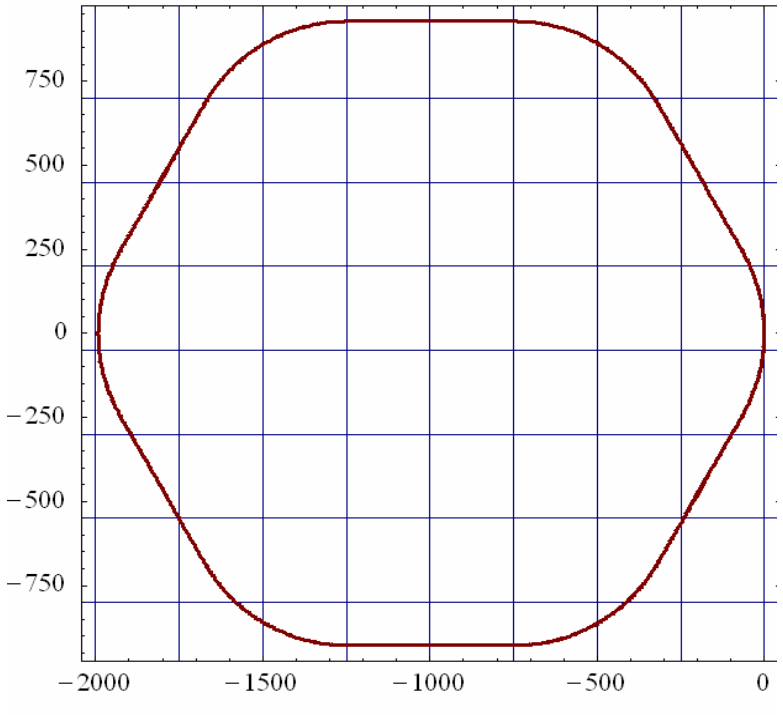
- Accelerator Physics



electrons: 1 ring
positrons: 2 rings (e-cloud)

On-going Accelerator Design

SA leads: Gao, Guiducci, Wolski

- Main Linac
- Damping Ring
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- Positron Source
- Global Issues
  - **MPS**
  - **Diagnostics**
- Accelerator Physics

- RF: 500 MHz $\rightarrow$ 650 MHz
  - better timing flexibility (synch. with Main Linac)
  - larger number of available bunch patterns
  - Better suited for so-called Low-Q parameter set (5600 bunches, 1×10^{10} $e^{\pm}$/bunch)
  - *cons:*
    RF system requires R&D
    Tighter inj./extr. kicker requirements

Example of CC request (accepted)

On-going Accelerator Design

SA leads: Gao, Guiducci, Wolski

- Main Linac
- Damping Ring
- BDS
- Positron Source
- Global Issues
  - **MPS**
  - **Diagnostics**
- Accelerator Physics

- Accelerator Design Issues
  - Collective instabilities (under study)
    e-cloud for e^+
    FII for e^- (critical for low-Q set)
  - Low emittance tuning (instrumentation)
  - Inj./extr. kickers (R&D issue)
- Current RDR issues (cost-driven)
  - Location and layout of RF
  - Location of PS and Instrumentation

  } CF&S ($€¥)
- Large international collaboration

On-going Accelerator Design

SA leads: Angal-Kalinin, Seryi, Yamamoto

- Main Linac
- Damping Ring
- BDS
- Positron Source
- Global Issues
  - **MPS**
  - **Diagnostics**
- Accelerator Physics

- Accelerator Design
  - Lattices well established
  - Components counts, specs. etc. available
  - Few AP questions remain (e.g. wakefield effects → impact on vacuum system)
- Current RDR issues under discussion
  - Number of high-powered dumps
  - Location of PS & Instrumentation
  - Civil engineering (location and number of access shafts etc.)

On-going Accelerator Design

SA leads: Kuriki, Sheppard

- Main Linac
- Damping Ring
- BDS
- Positron Source
- Global Issues
  - **MPS**
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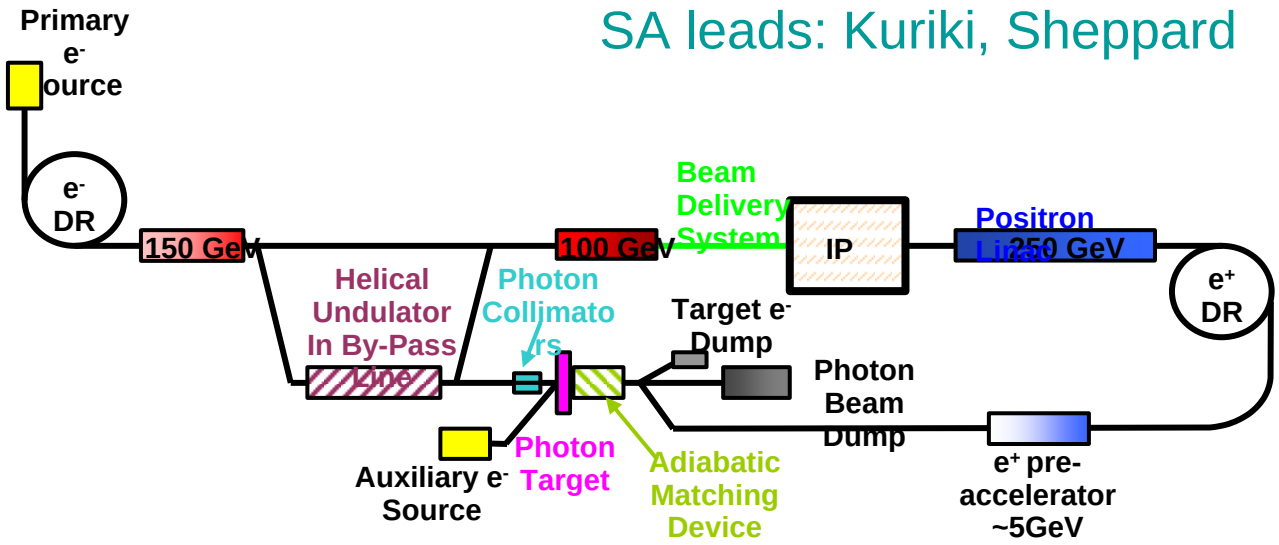
- Accelerator Physics



- Primary accelerator design issues involve *integration* of system into the entire machine
- e+ source *co-exists* with other sub-systems
- Location of injector linacs (etc) currently being discussed/resolved
  - interference issues

On-going Accelerator Design

- Main Linac
- Damping Ring
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- Global Issues
  - **MPS**
  - **Diagnostics**
- Accelerator Physics

- *Global Integration* concerns those issues which do not logically fall into any one sub-system
  - overall parameters
  - timing
  - operations (incl. MPS)
  - interfaces
- (Now) the job of RDR management board (and specifically *integration scientist*) to keep track of and resolve these issues.

On-going Accelerator Design

- Main Linac
- Damping Ring
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- Global Issues
  - **MPS**
  - **Diagnostics**
- Accelerator Physics

Example: Global timing constraints

- EC commissioned a 'global timing task force' (**Ehrlichmann, Guiducci Kubo, Kurike, Wolski**) to make a recommendation on a layout of the machine consistent with the timing constraints:
  - main linac frequency, pulse length and current
  - Flexibility in bunch patterns in the DR (need for gaps due to e-cloud and FII)
  - Constraints of e+ production
  - Two IR operation

critical!

On-going Accelerator Design

- Main Linac
- Damping Ring
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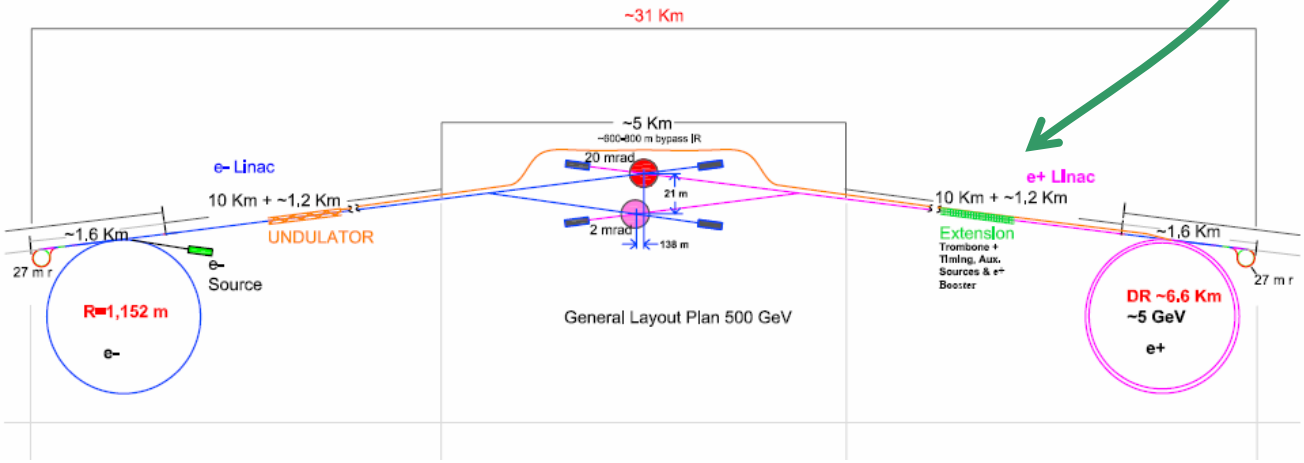
- Positron Source
- Global Issues
  - MPS
  - Diagnostics
- Accelerator Physics

Example: Global timing constraints

- Maximum flexibility requires additional ~1.3km to positron path length
  - maintains 1-1 correspondence between ejected and injected e+ bunch in DR
  - maximises future flexibility in choice of bunch patterns
  - cost increment ☹ (but considered justifiable)



On-going Accelerator Design

- Main Linac
- Damping Ring
- BDS
- Positron Source
- Global Issues
  - **MPS**
  - **Diagnostics**
- Accelerator Physics

- Machine protection
  - Overall philosophy (control system)
  - Understanding 'failure modes' and their potential for damage (especially the main linac)
  - example: How many fast emergency dumps are required?
  - Operational *modes* (including recovery from trips)
- Diagnostics (stations)
  - Number of emittance measurement stations
- Commissioning
  - Initial machine commissioning
  - start-up from 'down' (recovery)
  - impact on machine design (# of tune-up dumps, diagnostic requirements etc.)

On-going Accelerator Design

- Main Linac
- Damping Ring
- BDS
- Positron Source
- Global Issues
  - **MPS**
  - **Diagnostics**
- Accelerator Physics (AP)

- Relatively low profile
  - Current design effort builds on 10+ years of accelerator physics
    - TESLA TDR
    - US Options study
    - ILC-TDR & ITRP etc.
  - Current (RDR) emphasis on Engineering and Costs
- Updated AP still required to demonstrate we can achieve goal (luminosity) performance
  - Each Area System has its own unique AP requirements (there are remaining issues e.g. in DR)
  - *Integrated* simulation of baseline machine performance still required (update of existing knowledge)
- There are cost-relevant issues that do require some AP input
  - e.g. MPS, # diagnostics stations etc.

On-going Accelerator Design

- Main Linac
- Damping Ring
- BDS
- Positron Source
- Global Issues
  - **MPS**
  - **Diagnostics**
- Accelerator Physics (AP)

- Lattice (optics) work primarily being made by identified resources within Area Systems
  - this work is close to be (conceptually) finished
- Beam dynamics issues in some specialised areas are also being coordinated within AS
  - DR physics
  - e+ source
  - BDS
- Two important areas that are ‘global’ (inter-AS) in the so-called LET (Low Emittance Transport):
  - Low-emittance tuning (static errors)
  - Luminosity stabilisation (feedback) studies
  - Machine protection ‘failure mode’ simulations
- Goal to produce ‘Start-to-End’ simulations of the machine to answer these (and other) questions.

Interactions

- All of the ILC RDR work requires coordination across many institutes distributed world-wide
  - **Communications and Communication Tools become of paramount importance**
- A heavily web-based collaboration:
  - **information posted to central web sites**
    - www.linearcollider.org
  - **use of wiki sites for information exchange**
  - **CERN InDiCo server for scheduling global meetings**
    - all ILC-related meetings should be posted here!
  - **Document servers and EDMS will have web-based interfaces**

Interactions cont.

- Interacting
  - **heavy use of traditional video- and tele-conferencing**
    - together with InDiCo for posting presented material works OK
  - **Commercial web-based 'virtual meeting' systems (e.g. webex) currently being evaluated**
    - feedback so far very promising, but commercial system costs money.
- No replacement for physical face-to-face meetings
  - **they will always be needed, but we try to minimise them**
- We are still on the learning curve
  - **we continue to monitor effectiveness and improve our approach.**

Final Comments

- RDR ‘matrix’ is in place and functioning well
  - **primary focus is on consolidating baseline with a view to producing cost estimate**
- Accelerator Design work continues around the globe
  - **filling in many of the gaps in the Frascati Baseline Configuration**
  - **Global (Integration) issues now being dealt with directly**
  - **Priorities being set by cost impact**
    - no need to design the machine completely at this stage
- Global interaction (distributed design) remains a challenge
  - **But we are up to it ☺**