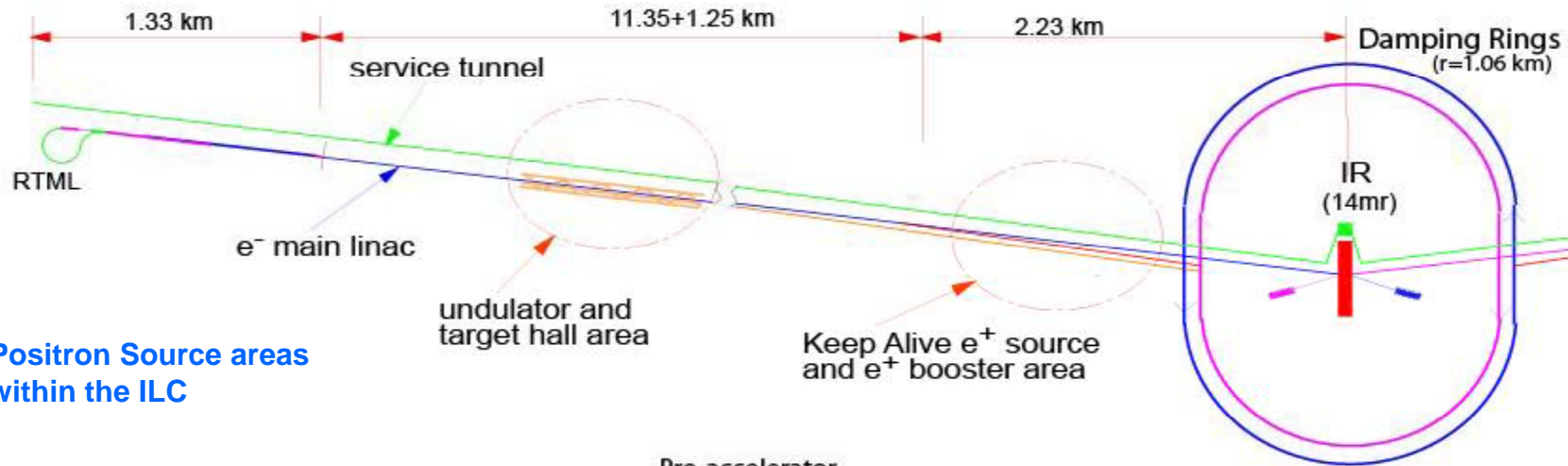


# Positron Source Report

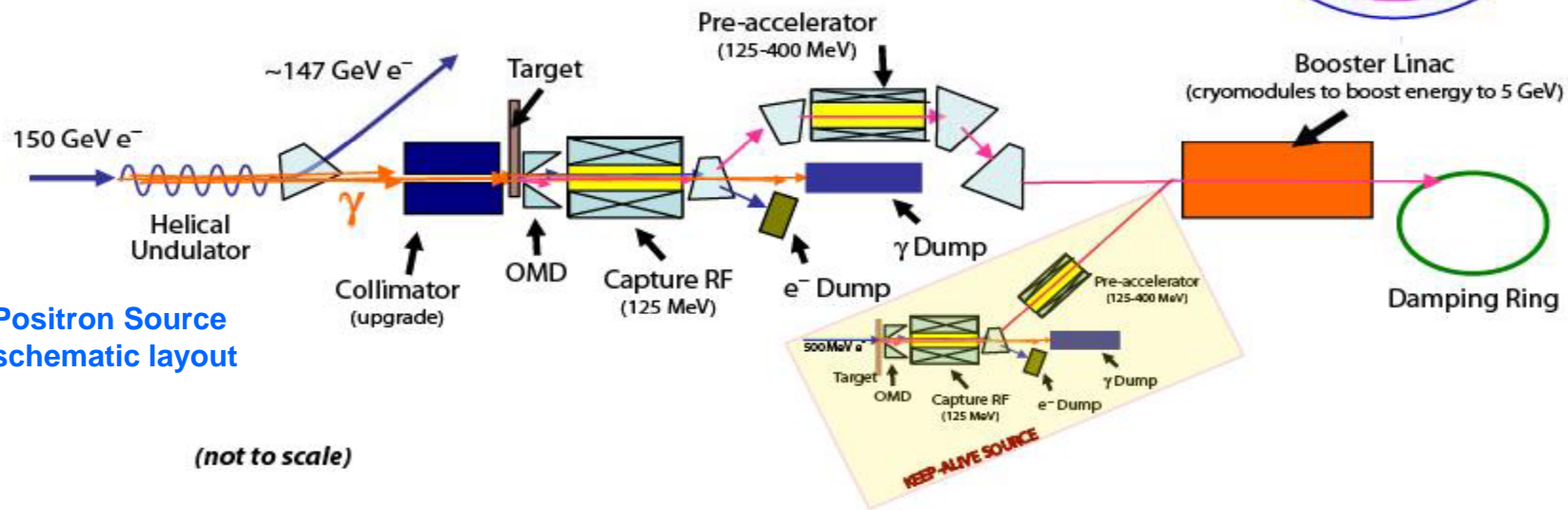
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# Positron Source Layout



Positron Source areas within the ILC



Positron Source schematic layout

(not to scale)

# EDR Planning

- September 07
  - Positron sources group meeting at ANL
  - Work package structure & allocation discussed
  - Status reports given
  - Action items agreed for short term technical goals
  - <http://www.hep.anl.gov/ILC-positron/>
  - **EOIs requested**
- October 07
  - **Kick Off Meeting at Daresbury**
  - WP structure discussed & amended
  - Cost drivers discussed
  - Major technical issues raised and action items proposed
  - <http://ilcagenda.linearcollider.org/conferenceDisplay.py?confId=1859>

# Work Packages

1. Undulator system
2. Target System
3. Capture Magnet
4. RF Systems
5. Photon & positron collimation and dumps
6. Polarisation specific issues
7. Auxiliary positron source (keep alive)
8. Remote Handling (and target hall arrangement)
9. System Integration
10. Lattice design
11. Compton Source
12. Magnets
13. Power Supplies
14. Vacuum System
15. Instrumentation

# Undulator System

- System design for undulator section (ie not just the undulators but the photon collimators, quads, correctors, etc).
- Construction of full scale undulator prototypes including analysis of the field errors in terms of spectral output and trajectory effects.
- The impact of the undulator on the electron beam will also continue to be studied (wakefields, magnetic errors, jitter, emittance blowup, etc).
- Assess prototype beam tests & progress
- The warm sections between modules will be engineered.

# Target System

- Includes the photon target, vacuum vessel, cooling system, and other associated instrumentation.
- A prototype titanium wheel will be constructed and tested in a magnetic field to benchmark the eddy current simulations.
- Further experiments will assess the water and vacuum seals and feedthroughs.
- A comprehensive stress analysis of the target is essential to confirm the viability of the chosen solution.
- Analysis will also be carried out on the potential use of cooled or uncooled windows as these can ease the design of other parts of the e<sup>+</sup> source.
- Radiation damage and activation levels calculated
- Lifetime calcs cross checked
- Material tests on FLASH suggested

# Capture Magnet

- Solution not yet resolved...
- Quarter wave transformer looks practical (new baseline?)
- Flux concentrator design needed, followed by a prototype if feasible
- Lithium lens is likely to provide the best capture but feasibility needs to be demonstrated.
- Selection of optimum solution
- Impact on yield assessed

# RF Systems

- RF systems are needed to capture and accelerate the positrons from low energy up to 5 GeV.
- NC TW structure captures the positrons and this is being prototyped now.
- SC systems are not standard ILC modules (they have different quad arrangements) so these need to be designed.
- LLRF & HLRF needs to be designed and laid out
- Aluminium cavities suggested as possible method to reduce activation levels



# Collimation and Dumps

- Collimators to be considered:
  - Photon collimators before the target
  - Photon collimators before the undulator (if required)
  - (Photon collimators within the undulator)
  - Positron collimators from the target to the DR
- Dumps
  - Beam abort before undulator
  - Tune-up dumps
  - Photon dump
- Engineering design needed of feasible collimator and dump solutions

# Polarisation specific issues

- Source will be polarised at ~30% and upgradeable to ~60%.
- Spin tracking simulations are required to show that the polarisation can be preserved to the IP and also that it can be reduced to zero at the IP.
- Design of spin rotators needed and consideration of how the positron spin might be flipped at 5Hz.
- A low energy polarimeter (few hundred MeV) will be designed.

# Auxiliary Positron Source

- Plays role of Keep Alive Source & Commissioning Source
- Source specification and operating modes need to be clearly established
- Design to be generated making maximum use of common items with electron source, photon target, remote handling, RF, etc.

# Remote Handling & Target Hall

- The main photon target and also (possibly) the auxiliary positron source will need remote handling.
- The activation levels will be too high for too long to allow for personnel access.
- A scheme must be generated that allows for target replacement and remote maintenance.
- This is likely to include the concept of a facility on the surface as well as at the target itself (is anyone else planning this?)
- An engineering design of the remote handling concept is required to allow for accurate cost estimates and layouts.

# System Integration

- Manage the integrated design of the complete source.
- Bring together all of the separate areas (eg undulator, target, etc) and ensure that a fully self-consistent solution is achieved that is also compatible with the whole of ILC.
- Significant engineering layout will be included.
- Start to end modelling of the positron production from undulator to DR also included.

# Lattice Design

- The optics design for the charged particle transport.
- This includes the electron linac undulator insert region as well as the positron generation to DR region.
- The optics will be toleranced and instrumented to enable an accurate costing for the transport lines.

# Compton Source

- Covers all of the work that relates to the ACD positron source.
- Three drive beam solutions will be studied and the best option selected.
- DR stacking is required for two of these so the generation of a feasible stacking solution is key to the selection.
- The photon stacking cavities (2 and 4 mirror solutions) both require prototyping.
- The alternative CO<sub>2</sub> regenerative laser system requires further design work and will need prototyping as well.
- Unlikely that Compton will be put forward for baselining during the EDR phase so this work will project beyond the EDR and may be considered for baseline later.

# Magnets

- This WP needed to provide designs and costs for the magnets that are used throughout the positron source (except undulator and capture magnet)
- NC Dipoles, quads, correctors
- SC quads
- NC solenoids
- SC solenoids
- Abort kickers & septums



# Power Supplies

- All of the magnets will require power supplies that need to be specified and costed.
- Understanding of the space and utilities requirements for these power supplies must be provided for integration purposes.
- Ideas for power distribution should really be explored for value engineering

# Vacuum System

- Engineering designs and vacuum simulations are required to a level that enables accurate costings to be made for the vessels, gauges, pumps, etc.
- Enough detail is needed so that sufficient space is reserved within the CAD model for a feasible final design.

# Instrumentation

- No special diagnostics (except the low energy polarimeter in WP 6) are anticipated for the positron source.
- Specifications will be generated (eg for the BPM resolution) by other WPs and passed to this one for solutions to be proposed.
- Engineering designs are needed that allow space reservation on the CAD model for the positron source.
- Good scope for value engineering here if resource available



# Issues

- No resource yet in some areas:
  - RF Systems
  - Magnets
  - Power Supplies
  - Vacuum Systems
- Some progress has been made this week but adequate resource seems unlikely
- Balance of resources offered overall not totally matched to needs of EDR
- Scope of work packages/EDR will have to be adjusted for realistic deliverables

# Other KOM Findings

- Undulator chicane with 2.5m offset probably larger than needed
  - Assess smaller offset
  - Assess alternative layout options (eg dog-leg, 3-bump)
- Central injector might imply different optimum source layout
  - Eg Undulator at end of main linac?
  - Analysis of options required (cost/performance)
- Energy upgrade policy needed from PMs
- DR acceptance may be able to be reduced as not presently used by source
  - To be assessed