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Inventory of the R+D Strategy for the ILC-Positron Source.

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1. e-driven Target.

The development of this target serves as a good example for an efficient way of R+D and prototyping of this device.

Initial basic input parameter and specification were provided by ILC-KEK.

Design and performance studies by a qualified engineering firm with in-house experience with FEM studies ANSYS and prototype manufacturing possibilities.

These studies are well under way. Pending issues are:

Leak and outgassing rate and radiation resistance of the rotating seal.

Thermal contact between the Tungsten rim and the water cooled Cu-disk (brazing, bonding, mechanical clamping). Its long term robustness against high temperatures and thermal transients must be verified in laboratory tests.

2. Undulator-driven Target.

Initial basic input parameters and design studies have been launched by DESY.

Following the recent change of input parameters, reduction of energy and number of bunches, FLUKA computations should be updated by DESY.

Thereafter, a procedure, similarly to that for the e-driven target, should be adopted also for the detailed engineering studies to be made by a qualified engineering firm or research institute (RIGAKU, Helmholtz-DESY, Kernforschungszentrum Juelich, or any other). Again, in-house expertise, using simulation codes and having possibilities for making laboratory prototype tests and having manufacturing facilities, are essential.

-Detailed mechanical and thermal optimisation of the wheel (weight, forces and imbalances induced by the beam pulses, thermal transients and deformations of the wheel).

-Impact of the pulsed magnetic field from the flux concentrator to the wheel. Professional codes, like from COMSOL, http://comsol.ch/c/4zgb, are available and should be applied.

-Thermal contact of the Ti-rim with the radiating wheel (brazing, bonding, clamping). Laboratory tests of this contact must be made under vacuum in a non-rotating subsector (a piece of cake) of the wheel. Heat input by electrical heaters and heat removal via water cooled coolers. Long term robustness at high temperatures and thermal transients to be studied.

3. Magnetic Bearings.

Since the rotor is completely, hermetically sealed inside a St. Steel vacuum tank, the vacuum is entirely defined by the cleanliness and outgassing rate of the components of the rotor at the operational temperature. Appropriate materials with good radiation resistance must be selected.

Touch down ball bearings: To my understanding, the wheel will only be supported by ball bearings, when the magnetic support is stopped or not available. In such situations the vacuum is no longer relevant.

The rotating axis is “floating” in a visco-elastic medium, the magnetic field. The controls and suppression of vibrations, pulsed imbalances, etc. at the location of the bearings must be studied and possibly damped or suppressed by active feedback.

Preliminary discussions were held in 2013 with FZ-Juelich. This research institute, with long term experience in building neutron choppers, might agree to make a feasibility study, with initial input specifications from ILC. Such a design study would require about 3-4 man months. This venue was discussed with DESY/University of Hamburg in 2013. However, it was not pursued due to lack of resources at that time.

Similar discussions were also held with SKF.

Thus, a Feasibility Study should be launched now. Thereafter, an engineering specification for a detailed mechanical and electrical design of the complete wheel should be established. This serves as a basis to design and manufacture a first, full sized prototype. Firms or research institutes with expertise in both, magnetic bearings and manufacturing facilities, would be ideal. However, a collaboration among two firms, each with the necessary expertise, could also be envisaged.

4. Photon Dump.

A layout for the water photon dump, including the associated beam windows, has been proposed.

The input parameters, energy deposition in Ti-windows and in water should be reviewed with FLUKA computations by University of Hamburg/DESY with the reduced ILC energy and bunch intensity.

To place the dump at a far distance, close to the main ILC water dumps, would reduce the PEDD in the windows and the water and also the cost for the water treatment plant.

Some more detailed engineering studies for the tumbling window and the water tank should be made. Also, further simulations should be made for the dynamic response to the beam impact in

Ti-windows and in water. Experiments with beam on Ti-foils are under way at present by DESY. Further experience may be available in the next future (XFEL,…).

The infrastructure around the photon dump, like its installation, transport, access, shielding and maintenance should be defined.

5. Flux Concentrator and Cavities.

Taking into account the revised beam parameters, the operating parameters and the layout of the flux concentrator and the cavities should be reviewed. Of particular importance are the ohmic and the beam heating by the 1 ms pulses at 5 Hz, the mechanical and thermal loads and the cooling.

One may profit from the development of the flux concentrator for the KEK- Super K-positron source. Also, initial studies were made by P. Martyshkin-BINP for the flux concentrator of the e-driven positron source. Finally, the power supply for the 1 ms operation at 5 Hz of the undulator driven source may also require specific studies.

Clearly, also the loads in the cavities must be studied. For all these studies FLUKA and ANSYS expertise is required.

6. Infrastructure and Handling of the Target Station.

A scenario for the operation, handling and exchange procedure of the target station has been proposed. It is based on the availability of an overhead crane and a mobile handling device, operated via tele-robotics.

This principle must be validated by a professional engineering study, with solid expertise in remote handling in hostile environment, like around nuclear reactors.

Following this, the shielding, access possibilities, infrastructure, storage of activated components, safety conditions must be defined by ILC.

7. Planning and Resources.

A planning of the above issues must be established which takes into account priorities, still to be defined. Obviously, adequate manpower must be made available, consistent with the time table and the allocated financial resources.