

# HARDWARE DEVELOPMENT and STUDY for ILC POSITRON SOURCE PARAMETERS

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Some components of the normal conducting Positron Pre-Accelerator (PPA) in the ILC Positron Source will operate [1] in hard combination of high fields, long pulse and strong radiation. This case an experimental verification of operational ability in a conditions, mostly close to operational regime, becomes necessary. Moreover, some particularities of the PPA operating regime and beam structure require more consideration.

## 1 Accelerating sections

The PPA capture sections will operate with an accelerating gradient of up to 15 MV/m in combination with long RF pulses ( $\sim 1ms$ ). Developed in INR and now constructing in DESY, the CDS Booster Cavity (BC) for the Photo Injector Test facility (PITZ), DESY, Zeuthen, will operate at the same conditions and is a full scale, high RF power prototype [2] of the PPA capture cavities. A low RF level test program has been performed to investigate cells production results, to verify RF tuning procedure, brazing procedure and cells parameters change after brazing. All cavity components are produced in industry. Tuning procedure has been established. Both operating and coupling mode frequencies were adjusted to target values for total cavity assembly, without individual cells tuning. Electric field distribution along the cavity axis confirms compensated structures advantage - high stability with respect cells parameters deviations. Cavity RF tuning before brazing is completed, Figure 1. Multi - step brazing procedure in vacuum is now under way. Brazed cavity components are shown in Figure 2. Symmetrical RF coupler, with two input windows, is developed for the cavity. Cavity completion and commissioning will be in nearest future. Start of operation is sheduled for 2008 summer.

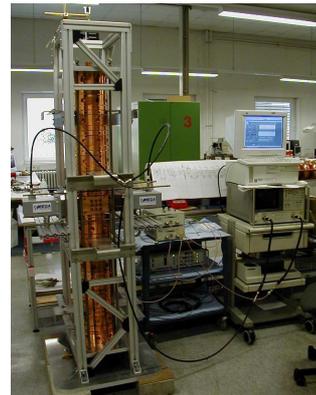


Figure 1: Cavity assembly for RF tuning

## 2 Focusing elements

The solenoid in the first PPA part, together with focusing elements in the part of beam separation and collimation, should withstand against high radiation flux. The special technology is developed in INR for focusing elements, operating in a conditions of high radiation flux.

A special water cooled conductor with mineral insulation is used. The example of dipole coil is shown in Figure 3. There are no organic or plastic components in the conductor and conductor life-time is equal to initial components (copper and insulating oxide) life-time.

### 3 Methodical study

For the total PPA accelerating system the CDS structure has been proposed in [2]. Some particularities of CDS operation were considered in simulations and compared with the same effects in another structures, both standing and traveling wave, proposed in SLAC [3] for the same purpose.

With high accelerating gradient ( $E_0 T \approx 15 \frac{MV}{m}$ ) CDS operation the maximal magnetic field  $H_{smax} \sim 60 \frac{kA}{m}$  at the end of coupling windows will be realized, resulting in power pulse loss density  $P_{dmax} = 1.55 \cdot 10^7 \frac{W}{m^2}$ . These are sufficient for pulsed RF heating effect, values. This effect in CDS PPA options is considered in [4] and compared with the same effect in simple  $\pi$ -structure [3]. Instead of higher local temperature rise in CDS PPA, an effect summary for both structures is the same. Pulsed RF heating effect is not essential for PPA structures in comparison with this effect in successfully operating DESY RF Gun cavities, [4]. Mode danger can be structure non uniform pulsed heating, caused by particle losses.

An average heat in PPA capture sections is  $\sim 25 \frac{kW}{m}$ . Cooling CDS capability, taking into account real RF losses distribution, has been considered in two approached. In engineering approach a prescribed heat exchange coefficient value at the cooling channels surface, estimated from approximate semi-empirical relations, is used. In conjugated approach we start from turbulent flow parameters simulation in cooling channels and solve self consistent heat exchange problem cavity body - cooling fluid. Results of all simulations show - the CDS structure has a sufficient reserve in cooling capability.

PPA beam loading effect, taking into account specific beam pulse structure, is considered in [5]. Our simulations show - for PPA output  $e^+$  energy  $\approx 400 MeV$  standing wave structure saves at least two RF channels.

### References

- [1] ILC Reference Design Report. <http://www.linearcollider.org>
- [2] M. Krasilnikov et al., PAC 2005, p. 1030, 2005.
- [3] J.W. Wang, et al., Pros. PAC 2005, p. 2827, 2005.
- [4] V.V Paramonov, A.K. Skasyrskaya. TESLA-FEL report 2007-04, DESY, Hamburg, 2007.
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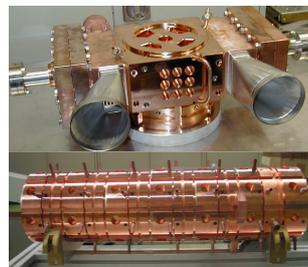


Figure 2: Brazed RF coupler cell (top) and half-cavity part, 7 periods (bottom)



Figure 3: Dipole coil made from conductor with mineral insulation