Electron Source Normal Conducting (NC) Accelerator Structures

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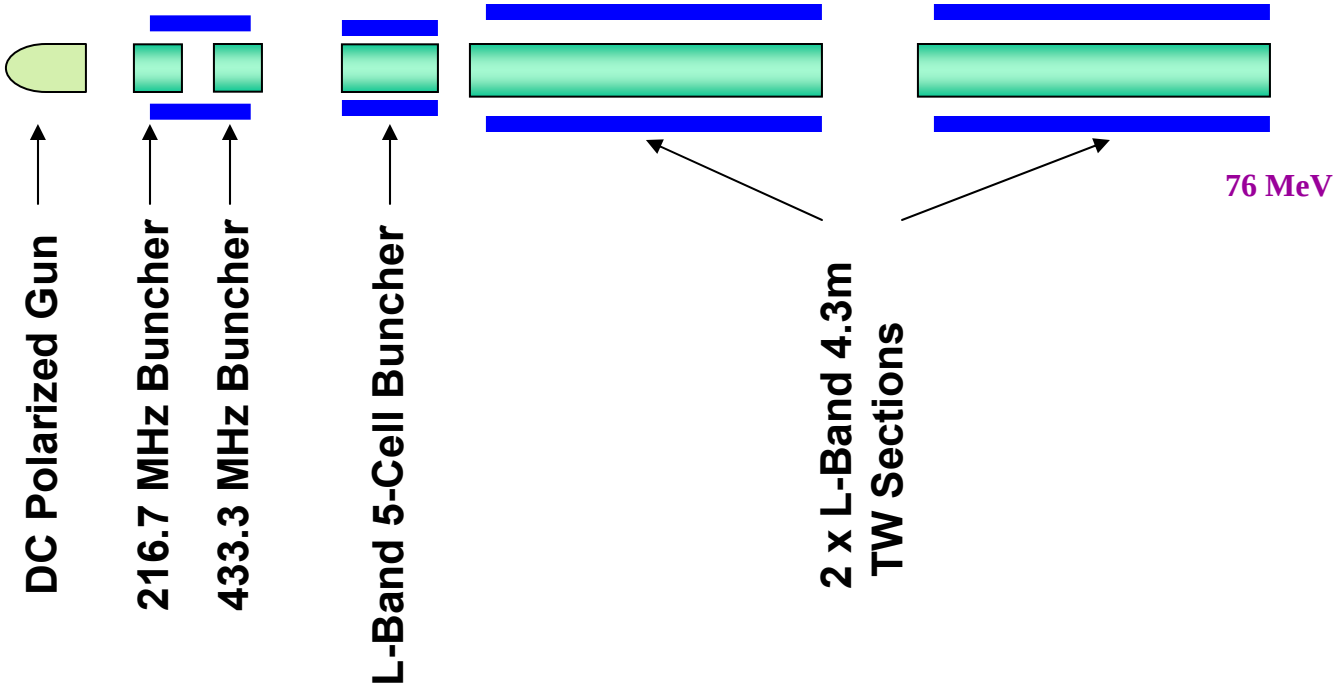
Outline

- System Layout.
- Scope of Work.
- SLAC Expertise in NC Accelerator Structures Design and Fabrication Technology – Some NC Structure Work Applicable to the ILC Electron Source.
- Justification of Funding for NC RF System.

Layout of NC RF System

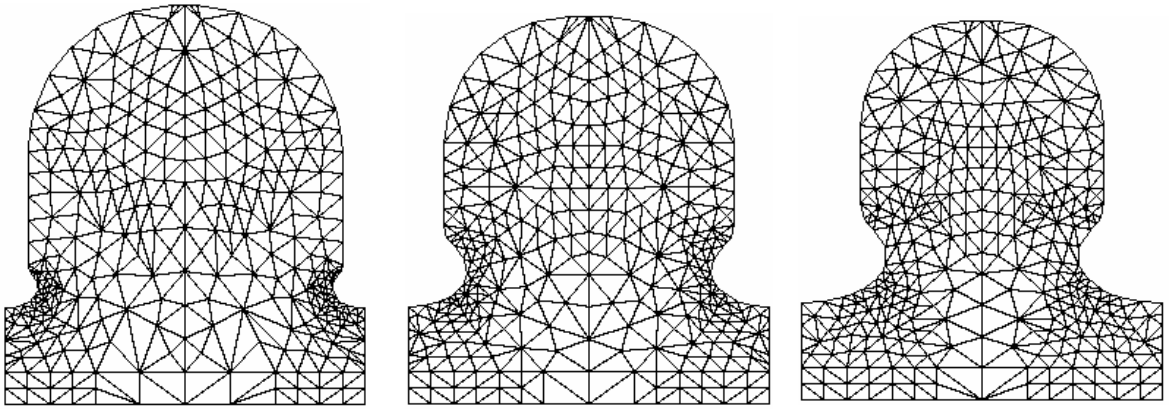


Types of Accelerator Structures and Basic Properties

1. 216.7 MHz Buncher.
2. 433.3 MHz Buncher.
3. L-Band β = 0.75-0.93 5-Cell Buncher.
4. L-Band TW Constant Gradient sections for Pre-Acceleration.

- Accelerating gradient: 8 MV/m
- Using “phase advance per cell” as a knob to optimize the RF efficiency for different length of structure.
- It is simpler and feasible.
- Lower pulse heating.
- Easier for long solenoids solution.
- Easier cooling design.
- Less concern on multipacting and klystron protection from RF power reflection.

4.3 m long 3π/4 Mode TW Structures



Structure Type	TW
Cell Number	50
Aperture 2a	46 mm
Attenuation τ	0.98
Q	24842 - 21676
Group velocity Vg/c	0.62% – 0.14%
Shunt impedance r	48.60 – 39.45 MΩ/m
Filling time T_f	5.3 μs
Power Dissipation	8.2 kW/m
E_0 (10 MW input)	8.5 MV/m

Scope of Work

- Design for RF Parameters and Power Efficiency, Thermal Calculations and Stability Studies.
  - SHB1: single cell structure optimization.
  - SHB2: single cell structure optimization.
  - Buncher: Pro and Cons for SW or TW with smaller aperture.
  - TW Accelerator Structures: ~ completed electrical design.
- RF Distribution System.
- Key RF components: phase shifters, attenuators, circulators, windows…
- Detailed Parts Count and Cost Estimation.

NC Accelerator Structures Work Done for the e^+ Source.

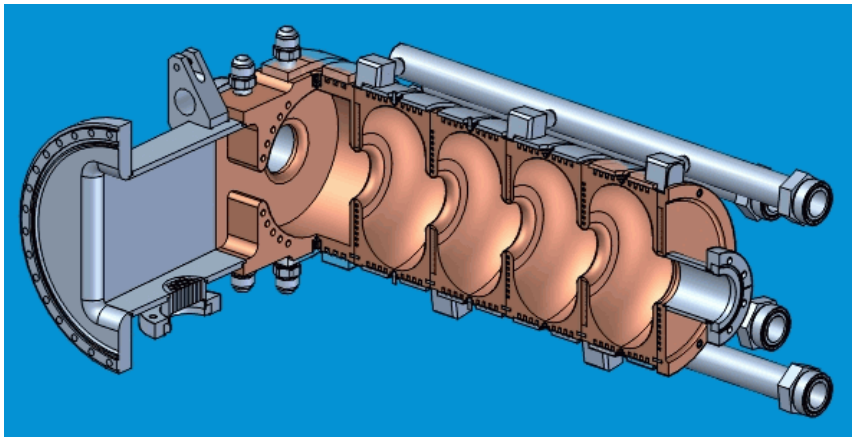
For decades, SLAC has very strong expertise for the normal conducting accelerator structures research and development.

Recently, we have developed several key RF structures like L-Band RF windows and gained some valuable experiences through the L-Band 5-cell SW structure for positron capturing, which is quite similar to the 5-cell L-Band bunch structure.

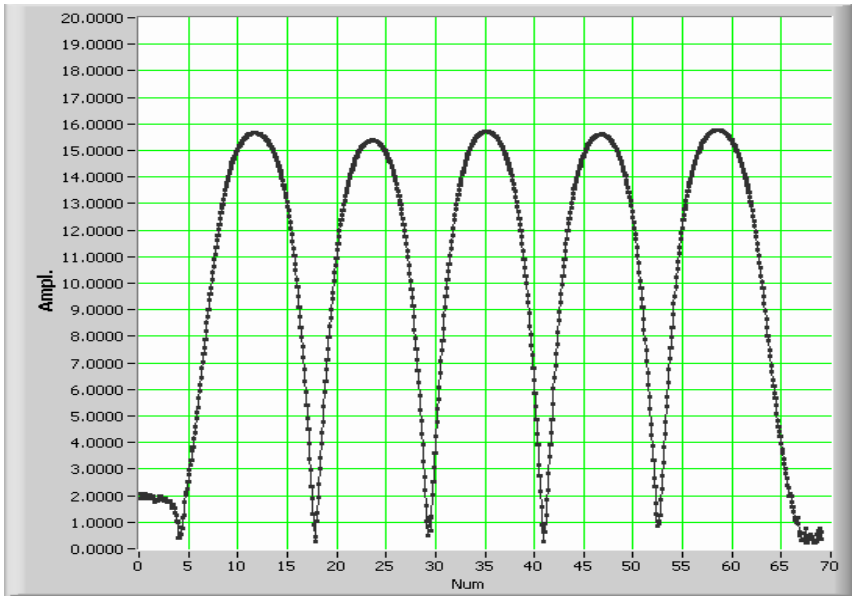
5-Cell L-Band SW Structure for the e^+ Source

f_π=1299.68 MHz at Vacuum 45°C

Q_0 =29000 VSWR=1.03



Cut-off View of the Structure



Field Distribution after tuning

NC Structures under Fabrication

RF Window

A L-Band Structure in Brazing Furnace

We need Funding for the R&D of TW Structures

In order to have a solid design for both positron and electron sources, It is needed to pay a great attention on R&D program for the traveling wave structures. We need to have funding for a short TW structure.

There are many challenges in both electrical, mechanical design as well as fabrication aspects:

- They are long, the balanced cooling and pumping system needs to be carefully studied and inductive brazing technique needs to be practiced at SLAC.
- They have low group velocity (as low as 0.16%c), the impact of big transient effects need to be investigated and tested.
- They work at long beam pulses (1 ms), the operational stabilization needs to be carefully studied and tested.