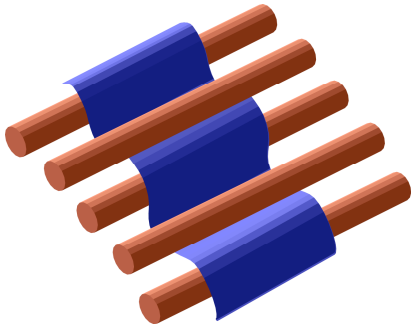
FY07 ILC Statement of Work – WBS 3.10.7 Direct Wind superconducting magnet Quench Threshold determination

The current baseline design for the large crossing angle final focus magnets calls for in excess of 10 MW of beam power traversing a 2 cm bore superconducting direct wind magnet system. Typically superconducting magnets are sensitive to beam losses in the mW range i.e. a 10 order of magnitude difference. No information exists at this time regarding the quench threshold for energy deposition into any direct wind magnet. An accurate measurement of the energy induced quench threshold information is crucial in the beam loss simulations in this region.

Work to be Accomplished in FY07

Building and test of a small multilayer quadrupole magnet with the inclusion of a heater to test the quench threshold of a small diameter direct wind magnet as a result of high speed transient heat pulses of low duty cycle. Quench inducing spot heaters are typically incorporated in direct wind magnets by positioning them on top of a layer of wire. This placement requires the heat pulse travel through coil material, which is not an effective heat transfer mechanism if speed is required. By embedding a thin stainless heater within a wiring layer during the winding process, it is possible to achieve a faster transient response to heat pulses. A depiction of the heater pattern to be tested demonstrates the higher fraction of wire surface which will be in intimate contact with the heater.



Embedment of this heater will require wiring process R&D to establish the methods needed to incorporate a strip heater within a coil block. Once a complete multilayer quad has been fabricated, cold testing will be performed to establish the thresholds for the generation of a quench of the conductor. This will be performed using first a steady state heat input, and then with much higher energy pulses of low duty cycle. Steady state quench onset is determined by the ability of the structure to remove heat to the helium environment, while transient quench onset will be affected by the local heat capacity of the conductor as well as the amount of helium in the local area.

Relevance to the FY07 goals of the ILC Global Design Effort

Beam loss calculations for the final focus quads provide initial estimates of the thermal load within the magnets. No data exists in regard to the quenching characteristics of

direct wind multilayer magnets such as those proposed for the final focus magnets. Given the pulsed nature of the losses, standard quench heater elements cannot provide heat pulses of short duration, but rather, more of a steady state input. By embedding a low thermal mass heater within the coil pattern of a direct wind magnet, faster transient energy pulses can be provided to the superconducting wire. The transient heat pulses desired are consistent with Mokhov's beam loss simulations for low duty cycle high peak energy losses.

Key Milestones/Personnel

Short coil topology design	Oct 06
Short coil winding	Dec 06
Cold test	Mar 07

WBS work package leader John Escallier

FY07 Deliverables

The quenching characteristics of a direct wind coil will be evaluated with respect to the operating current, operating temperature, and background field for transient pulse conditions of varying energy levels and speeds.

Cost

Labor FTE's	Labor $K Direct	M&S $K Direct	Indirect costs $K		Total Costs $K
0.5 FTE	60k	8	41k		109k

Labor consists of 0.2 FTE's elec eng, 0.1 scientific, 0 .2 electromechanical tech