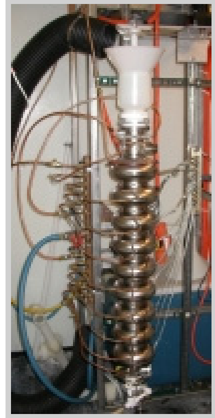
ilc NewsLine

Cornell University Moves Forward on Vertical Electropolishing



The vertical electropolishing set up at Cornell.

Recent results from Cornell University demonstrated that a new method of electropolishing superconducting cavities may hold promise for the International Linear Collider. For the past two years, Cornell scientists have been developing an electropolishing method that treats cavities vertically as opposed to the traditional horizontal orientation developed by KEK. Cornell recently applied this new vertical method to a nine-cell ILC cavity for the first time and achieved positive results. “This is the first step to show the viability of the new method,” says Cornell physicist Hasan Padamsee.

Previously the vertical electropolishing method qualified many single cell cavities to reach accelerating gradients up to 47 MV/m (megavolts per metre). Using a nine-cell ILC cavity that had previously had a limited performance of 26 MV/m, Cornell's Curtis Crawford and Fermilab's Bill Ashmanskas tested the vertical electropolishing method at Cornell's Laboratory for Elementary-Particle Physics. After removing 25 microns with vertical electropolishing, followed by a mild baking, the accelerating gradient consistently showed improvement and ultimately reached a gradient of 30 MV/m.

Results from KEK, DESY and other laboratories around the world have shown that electropolishing followed by a mild baking is a useful method for breaking through to new high acceleration gradients. In the 1980s, KEK developed the standard “horizontal electropolishing” method, which is now successfully used by KEK, DESY and JLab. In this method, the nine-cell cavity is placed in a horizontal orientation and half filled with acid. The cavity rotates slowly around the axis to polish the whole surface. The acid circulates between the cavity and a large acid storage barrel, where it gets cooled with a heat exchanger.

Using the Cornell method, the cavity orientation is vertical and filled with a relatively small volume of acid, gently stirred by propellers mounted from a coaxial shaft. The electrical connections are fixed, and water flows over the outside of the cavity to cool the acid. “The technical complexity of the vertical method is reduced by eliminating rotary acid seals, external acid plumbing, acid flow valves, acid circulating pumps, large storage barrels and heat exchangers,” says Padamsee. “Such simplifications would result in a lower cost for the large number of systems that would be needed to electropolish tens of cavities per day for the ILC.”

While simplifying the electropolishing process has many advantages, Cornell scientists are still tackling some of the challenges with the new method. For example, the acid must be changed more frequently, after about 30 microns of material removal. When removing larger amounts of material, such as 100 microns, the cavity orientation must be flipped after half the removal to avoid asymmetries. There is also a higher risk of hydrogen contamination for large quantities of material removal. Padamsee believes that an 800°C heat treatment as part of the standard protocol should address this risk though.

Cornell scientists will continue to test and treat the nine-cell cavity with the ultimate goal of reaching 35 MV/m. “It is a good sign that the vertical technology works,” Padamsee says. “Much work remains ahead to fully qualify this novel procedure.”

-- *Elizabeth Clements*