Discussion on "Surface Processing/Testing of Spoke Cavities for RIA" by Mike Kelly

Kelly presented Q vs E data that showed a surprising improvement of the low level Q just by high pressure rinsing. Pagani and Facco commented that this shows that localized non-BCS related losses were removed. A possible source could be residue from chemical polishing.

Kelly also presented a change in their vacuum system approach. While for their single spoke tests they had a common cryostat and cavity vacuum (like in ATLAS), for the new multispoke cavities they intend to switch to separate vacuum for the cavity and the cryostat. They have three ports available on the new cavity. Tajima suggested that from the contamination point of view it would be advisable to use a bottom port for pumping.

The power coupler used for testing the new multigap spoke resonator is not identical with the final coupler for the accelerator. Nevertheless, it has some important features of the final coupler that are demonstrated on this model.

The rest of the discussion focused on electropolishing in general and in the ANL multigap spoke resonator. Delayen asked about the effects of the hydrogen gas that is created in the polishing process. Kelly pointed out that the cavity is wide open during the polish, as the endcaps are not welded yet, so the H_2 can escape. He agreed that orientation is important to avoid trapping of hydrogen that could end up in the niobium surface. He further clarified that the electropolish process happens in about 200 steps. During each step the cavity/electrode-system is stationary. Every 50 cycles the cavity orientation is flipped to have a more even polishing effect. The polish is only done on the inside of the cavity, to maintain the overall material thickness.

Kelly reported that the downward facing surfaces are polished faster than the upward facing ones, this led them to the change in cavity orientation every 50 cycles.

There are contradictory observations on details of the EP process. Tajima and Pagani reported that KEK/TESLA have seen a clear distance effect to the electrode that determines the speed of the polishing. The irises are polished more strongly than the equator regions of their cavities. Also, both slowly rotate their cavities during the polishing procedure. Kelly reported that they observed (and found published in the literature) that the distance to the electrode is of lesser importance. The polish and its speed is determined by the boundary layer to the surface. The boundary layer must not be disturbed to maintain the layer, thus any agitation of the liquid during a polishing cycle should be avoided. Kelley asked if the"stationary"bath does work better on the downward facing surfaces due to a slow gravity-driven circulation. The issue was not resolved and needs further investigation.

As the EP process gives smoother surface, it was pointed out that polishing should be the last surface treatment. Shepard pointed out that this is not an option for spoke resonators without large demountable flanges. He reiterated that this is the reason for doing only a light BCP at the end of the cleaning process to maintain as much as possible of the surface quality.

The next question was, if EP is really needed for the field levels, where spokes are used. While Shepard agreed that operation in the field-emission dominated part of the Q-E curve is not an a problem, he believes that electro-

polishing helps with the low-field Q-slope seen in measurements.
The final point of the discussion was related to the surface smoothness as a function of the speed of the electropolish. Kelly reported that faster polishing gives smoother surfaces, which again is a surprising result that needs more investigation.