Notes from the Wednesday morning discussion session lead by M. Ross.

J.P. Delahaye requested that someone summarize cavity and structure performance to date -vs- frequency. This would include peak field and damage limits as a function of pulse length.

Various people suggested doing a careful comparison of single cell breakdown and damage limits at 3, 11 and 30 GHz. N. Kroll thought it would be better to use a 3 cell TW structure (2*pi/3 phase advance) for this purpose to better represent the actual structures. The main concern with either approach was how to scale the structure and operation parameters so the results would be relevant to the current linear collider structure designs. No conclusion was reached in this regard.

D. Sprehn reviewed his plans to do a systematic comparison of cavity breakdown at S-band and X-band for different pulse lengths. He also listed a number of questions related to breakdown and the experiments that he wants to do to address them.

Sami suggested doing breakdown tests in tapered waveguides instead of cavities since more energy can be made available. He is particularly concerned with the breakdown currently being observed at low peak power but long pulse lengths (> 1 microsecond) at ASTA. J. Haimson said similar tests have been done by Hopkins and Sessler with a waveguide powered by an FEL source.

The lack of a 30 GHz power source to do cavity comparison tests was discussed. Only a few MW would be needed to achieve 150 MV/m gradients if a cavity like L. Laurent's would be made for this frequency. Long pulses at this power level should be available in the early stages of CTF3 (by 2004, 100 MW, 140 ns pulses will be produced). R. Ruth suggested changing the output cavity of an X-band klystron to produce second harmonic (22.8 GHz) power for higher frequency studies. Again, concern was expressed as to what one learns from high gradient operation of cavities that require such low power compared to that needed for the linear collider structure designs.

The need for analytic and numerical breakdown modeling was discussed. People wanted a model that fully described breakdown events, including their formation (as discussed by H. Padamsee), their quasi-steady-state behavior (as P. Wilson addressed) and their interaction with rf. R. Ruth thought the computational tools were available to do the microscopic simulation. However, P. Wilson did not think that the copper surface conditions were known well enough to begin to do numeric modeling. D. Burke suggested that a working group be set up to address these issues.

N. Kroll described his design for a low surface field input (or output) coupler. By reducing the cavity radius of the first cell after the coupler by 0.3 mm, the surface fields on the coupler iris are decreased by about 1/3. This change will be made to the short structures being fabricated by Robertson Machining.

A to-do list complied by C. Adolphsen based on the earlier discussions of improving high gradient performance was reviewed. The list is reproduced below along with comments and additions made during the review.

Surface Preparation

Methods to try with L. Laurent's Cavities

High pressure rinse - L Laurent suggested doing this with coupons first.
Garwin's method (high and low temp bake followed by Ar and He sputtering)
Glow discharge cleaning
D. Sprehn suggested adding particulates to see if this lowers the achievable gradient.

For glow discharge cleaning, it was recommended that one produce 2e18 ions per square cm - the trick would be to make the ion density uniform over the iris surfaces - this technique will remove dielectric particulates but not those made of metals.

Develop a high pressure rinsing process for the short structures being developed - T. Higo thought that this could be done at KEK.

D. Burke suggested that Robertson build two 20 cm structures, one with and one without high pressure cleaned cells .

Try ultrasonic cleaning of structures in alcohol prior to baking.

Try chemo-mechanical cleaning of the cells - B. Kirby said this is basically polishing that would remove hydro-carbon layers but not particulates - Y. Higashi said that such a procedure using SiO_2 and H_2O_2 would remove the oxide and amorphous layer on copper, leaving a surface roughness on the atomic scale.

Understand surface quality -vs- etch depth. It was noted that 200 microns are removed from Ni surfaces for SC cavities (the final roughness was not know). At SLAC, J. Wang said 2 microns are etched off of non-diamond turned parts and 10's of nm are etched off of diamond turned parts. At CERN, the final diamond turning is done dry while at KEK it is done using kerosene, as with all cutting (they measured that the kerosene diffuses 30 nm into the copper).

Handling

Measure particle count of N_2 blown through old and new structures - use standard scattered-light-based particle counters for this purpose.

Use a vacuum furnace instead of H_2 furnaces for bonding and brazing - E. Garwin noted that vacuum furnaces are not necessary clean.

Cavity Measurements

Heat/Cool cavities to see if the breakdown -vs- pulse length relation changes.

Do Auger measurements of processed noses from L. Laurent's setup.

SEM at SLAC surface damage sites on H. Padamsee's test cavities.

Structure and/or Cavity Measurements

Measure temporal and wavelength dependence of emitted light. E. Garwin suggested using sapphire windows and doing broad band measurements to look for the phenomena that P. Wilson suggested might be occurring. H. Edwards thought that we would benefit from examining how cathodes in rf guns are visually monitored. P Wilson noted that at ASTA, A. Menegat sees light emission without any effects on the rf. Finally, R Miller said that we may be able to see into some of the RDDS1 cells though the pumping ports.

Measure HOM power from DDS3 manifolds - C. Adolphsen suggested doing a frequency analysis of the power to try to localize the breakdown.

Measure dark current dependence on pulse length.

Use better gas detectors and do a RGA analysis at different stages of processing. L. Laurent uses extractor gauges with 1e-12 Torr sensitivity, which have a slow response time. Even at this level, she did not do see pressure increases with breakdown in some cases. M. Ross suggested that this may be due to other surfaces acting as getters.

Measure iris profiles and SEM surfaces of processed X and S band cavities.

Processing

Change rf frequency if processing slows.

Use short rf pulse initially.

Use a chopped rf pulse.

Look at dark currents as a breakdown precursor.

H. Edwards and V. Dolgashev suggested using multipactoring to clean the iris surfaces.