



Fermilab

PBAR NOTE #457

How to install and tune the ARF1 Dampers

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March 19, 1986

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The H = 84 Accumulator cavities must have a low Z/n so as not to excite instabilities in the cooled beam of antiprotons. The cavity was made using lossy material where possible, with a resultant Q of 2000. With an R/Q factor of 170, the resultant shunt impedance was 370 K ohms. To meet the stability requirement the shunt impedance must be less than 25 K ohms.

To lower the shunt impedance, rf mode dampers are attached to the end of the cavity. (This is the middle of the quarter wavelength resonant circuit.) The dampers are attached to the cavity using 50 Ohm carborundum resistors, the intention is that at frequencies higher than 53 Mhz where the dampers look like capacitors, the resistors will effectively terminate the energy radiating out from the gap. When the dampers are properly tuned the maximum fundamental power dissipated in the resistors should be less than 200 watts peak.

The mode dampers are themselves quarter wavelength resonant circuits which are folded in on themselves to minimize the length. They are made largely of stainless steel and have an impedance at resonance of about 10 K ohms. They have a bandwidth of 300 Khz, and are water and air cooled to remove the heat of the damped energy. The rf circuit voltage applied to the damper is 20 Kv, at resonance the current is limited to 2 amperes, and the peak power dissipation of a damper is 40 Kw. (With 200 msec pulses each 2 sec, the average power is 4 Kw.)

Some number of properly applied dampers will lower the gap impedance to below 25 K Ohms. A recommended procedure for applying dampers follows:

- A. Apply the measuring damper with the resistor voltage measuring device, and tune the 4" section for minimum voltage, (Be sure to use only the new version of the resistor clamp which provides better contact and heat transfer.) Keep the cavity tuned to 52.813 Mhz by adjusting and varying the gap capacitance.
- B. Fabricate a damper like the measuring one, and install it in place of the measuring one. Measure and record the Q at 52.813 Mhz and calculate the shunt impedance and record.
- C. Do steps A. and B. above, as you install additional dampers until the required shunt impedance at 52.813 is achieved.
- D. Operate at low duty cycle and measure the Q using the decay time technique. Verify that the power shunt impedance is less than required - 25 K Ohms.
- E. Measure the gap shunt impedance using the measuring cones and the vector impedance meter. (In this case the frequency will not be 52.813 Mhz, it will be several Mhz lower because of the added capacity of the measuring device.
- F. Provide the required water and air flow, operate at 50 Kv and full duty cycle to verify that the voltage holdoff and cooling are reliable.

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