RF BOOK

R.F. Note 64

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Vacuum Test Stand for K=800 R.F. System

Introduction. It has been, and still is, difficult to solve all the problems associated with building an rf system for the K=500 cyclotron. It will be even more difficult to solve these problems for the K=800 machine and it behooves us to get an early start at attacking them. R.F. Note 58 and 61 delineate some of the geometry and explain why we should build a 1/2 scale low power model. This model is to fix the goemetry. But the two nastiest problems are whether or not we can hold 200 kV with that geometry, and can we build a satisfactory moving short. I suspect that the former will yield, but that for the latter, a continuous development and modification effort should be envisaged, and that the best we can hope for is that the first effort will "sort of work". Therefore, it is proposed that we build a permanent vacuum test stand! This stand is to only serve the two functions mentioned above, and to minimize space requirements for it, it would be a single dee resonator with a short stem and tunable only from 25 to 28 MHz. It would have no fine tuner.

Test Stand

In the interest of minimizing expenses it is proposed that we use the existing aluminum vacuum vessel, but put a copper lining in it so that no rf sees aluminum. The dee simulator would be a short cylinder with the same spacing to the liner as in the actual dee, and 20% more capacity, so that the short circuit current will be 20% more than the real resonator will require. The stem will have an inner conductor of 8 inch diameter, and an outer conductor of 24 inch diameter. The stem length will be about six feet. See Figure 1 for a general view. The overall height, allowing space for push rods, etc. will be less than ten feet.

Moving Short

Assuming that the piston actuated moving short, using the door spring design, for the K=500 test stand successfully passes its tests, we propose to use a similar arrangement for the K=800 machine. Since we now will have concentric circular pipes, the outer conductor shorts will be the same as the inner. We will have to use pistons suitable for a vacuum environment, and the silicon rubber will have to be replaced by metal springs. But the prinicple is the same.

Then we can have two years to prove it all out before it is needed.

Meanwhile, on with getting K500 working...

Transmitter and Transmission Line

Since the transmission line mode problems will be the same as for the K500 cyclotron, there is no need to get involved with them. Therefore I propose that the transmitter be conveniently close to the test resonator (say within six feet). The line will be a standard 6 inch outer conductor, and the coupling capacitor will be similar to what we have in the K=500. However, I have had a new thought: perhaps it is possible to use a fixed vacuum coupling capacitor and six feet away, on the air side, use a standard vacuum variable capacitor. This is easy to calculate and we will soon do this.

The transmitter would almost be a duplicate of the K500 transmitter except for two things: the tube would be the RCA 4648 (250 kW) and the final grid circuit would be different because of the 1200 pf grid capacity of the 4648 vs the 300 pf of the 4CW100000E. The anode circuitry, blocking condenser, hexagonal outer conductor stem, etc., would be the same. The driver would also be identical (2-4CW2000W tubes). However, the stem would only have to be six feet long.

I recently visited ORNL to be educated about their using a 1.2 kW solid state broadband driver for the 4648 to get 150 kW out at a maximum freq. of 20 MHz. For us, at 220 kW and 30 MHz we would need more than 10 kW to achieve marginal board-band capability at a cost of at least $40,000 for each such driver, so I have ruled it out. A tuned vacuum tube driver will certainly cost less than $10,000. Besides there are self destruct problems with solid state drivers tied to high power transmitting tubes which I wish to avoid. A simple way to resonate the final capacity is to simply use four of our present variable inductors in parallel connecting the driver anodes to the final grid. This is bound to work. But there are simpler schemes abrewing.

To run this test stand it is proposed that we use the 50 MeV Levinthal 450 kW power supply, so that testing can be done simultaneously with operation of the K500 cyclotron.

Schedule

I hope that we can have the following sort of schedule for the implementation of our desired goals:

1. We buy a 4648 (≈20K), design the fixtures necessary to install it in our transmitter box (same size as present, but made out of brass), build the box and have it ready for testing the rf drive circuits by 2/1/81.

2. Build the rest of the transmitter by 3/1/81.

3. Have the vacuum test stand modified and ready by 3/1/81.

4. Design and build the resonator structures by 3/1/81.

FIG 1

K=800 test stand