Biperiodic L-Support Disk and Washer Structure

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A high power model of the biperiodic L-support Disk and Washer structure for electron acceleration is fabricated and under test. Two 1.2m long accelerating tubes are coupled by a bridge coupler, which has an RF coupler, a vacuum port, and three frequency tuners. Each end of the bridge-coupled tube set is terminated by a full-cell endplate for the accelerating mode.

Keywords: linear accelerator/ DAW/ coaxial bridge coupler/ power model

An electron linac[1] has been installed at the Accelerator Laboratory, Institute for Chemical Research, Kyoto University. Its use is mainly intended as the injector for the electron storage ring KSR [2], which is being assembled. Three of 3-m disc-loaded wave-guides are installed as the accelerator tubes, which are operated at 2857MHz. By replacing one of the wave-guides with a new accelerating tube with a higher shunt impedance and the higher accelerating gradient, the output energy can be increased with the same input RF power.

The Disk and Washer (DAW) structure has outstanding features in high stability, good vacuum properties, high shunt impedance, and ease of fabrication.[3,4] Because the stability is related to the square of the coupling constant between cells, DAW, which has about ten times larger coupling constant than that of conventional coupled cell linac structures, should be almost hundred times stable than those. The large coupling constant is achieved by the confluence of the two modes in a cell. (See Fig. 1). They are called as the accelerating mode and the coupling mode. The former has the strong electric field on the axis, which is suitable for the acceleration. The latter has weak electric field on the axis, but has stored energy on the outer

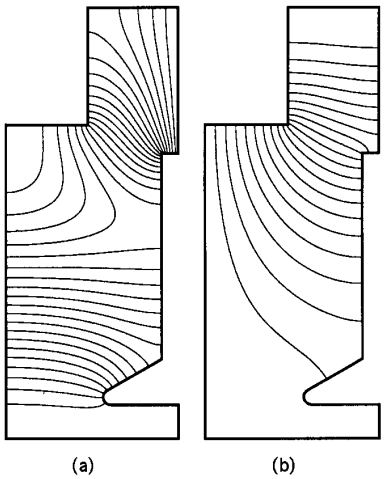

Figure. 1 Flux plots by SUPERFISH
(a) Accelerating mode (b) Coupling mode

NUCLEAR SCIENCE RESEARCH FACILITY —Beams and Fundamental Reaction—

Scope of research

Particle beams, accelerators and their applications are studied. Structure and reactions of fundamental substances are investigated through the interactions between beams and materials such as nuclear scattering. Tunable lasers are also applied to investigate the structure of unstable nuclei far from stability and to search for as yet unknown cosmological dark-matter particles in the Universe.

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region, which acts as the coupling cell.

Because of the extra volume, some of the higher order modes come down and overlap the operating frequency. It was found that the mode overlapping problem can be overcome by the biperiodic support configuration with the careful choice of the tank diameter. There are variety of options for DAW linac structure with such biperiodic washer support. For example, in a large tank-diameter configuration, the operating frequency drops between the two split TM11(-like) mode passbands, and the shunt impedance is higher. When the tank diameter is small, both TM11 mode passbands are above the operating frequency, and the mode density becomes smaller. The basic configuration used here is the extension of the PIGMI[5] geometries, except for the thicker washers and the reduced tank diameter by 20%. This geometry has the smaller density of the unwanted modes and the shorter filling time compared with the large diameter 4-T support DAW. The washer thickness is increased to provide the space for the cooling water channels machined in the washers. Because the L-support configuration has only two supports on the washer, there are only one inlet and one outlet for the water (see Fig. 2). It may simplify the fabrication problem compared with the 4-T support geometry, which has two inlets and two outlets on the washer.

Firstly, the three dimensional electro-magnetic field distributions including the supports are calculated by MAFIA, for the parameter optimization. Then a cold model made of Aluminum is fabricated (see Photo 1). The RF characteristics such as the resonant frequencies and the electric field distribution on the axis are measured on the cold model[6] (see Fig.3). The coaxial bridge coupler is also studied for stable operation[7] (see Fig.4). The high power accalerating tube is being fabricated and under test.

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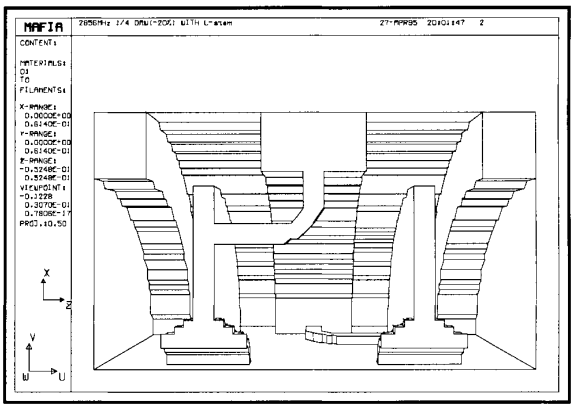

Figure.2 DAW with Biperiodic support

Photo 1 Close view of the disk-support-washer assembly

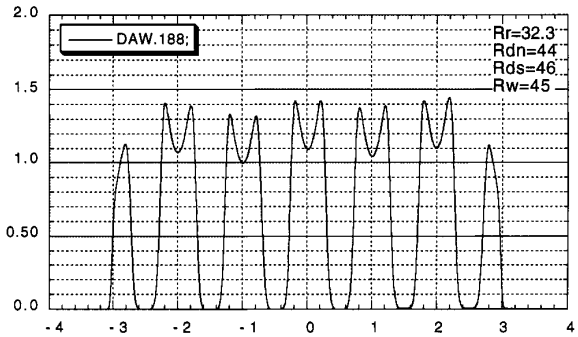

Figure. 3 The typical result of field distribution measurements

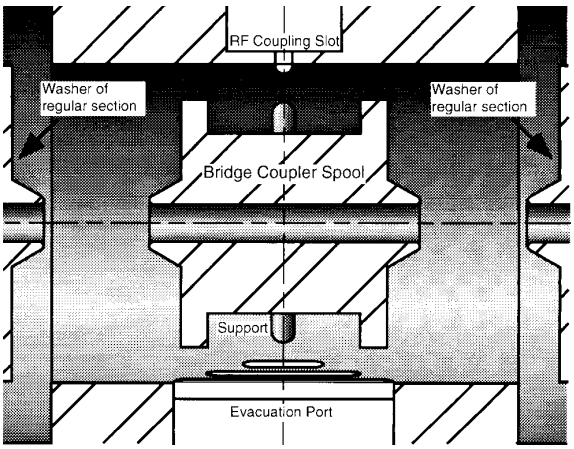

Figure. 4 Coaxial bridge coupler

References

1. T.Shirai, et al., "A 100 MeV Injector for the Electron Storage Ring at Kyoto University", Proc. of the 1995 Particle Accelerator Conference, Dallas, p.1079 (1995)
2. A.Noda et al., "Electron Storage and Stretcher Ring, KSR", Proc of the 1996 European Accelerator conference, Barcelona, in print.
3. R.K.Cooper, Y.Iwashita, J.M.Potter, S.O.Schriber, D.A.Swenson, J.M.Watson, L.C.Wilkerson and L.M.Young, "Radio-Frequency Structure Development for the Los Alamos/NBS Racetrack Microtron", LosAlamos National Laboratory document LAUR-83-95 (Jan. 1983)
4. Y.Iwashita, "Disk-and-Washer structure with biperiodic support", Nucl. Instrum. and Meth. in Phys. Res. A 348(1994)15-33
5. L. D. Hansbrough, Compiler, "PIGMI: A Design Report for a Pion Generator for Medical Irradiation", LANL report LA-8880(1980).
6. Y.Iwashita, et al., "Cold Model Test of Biperiodic L-Support Disk-and-Washer Linac Structure", Proc. of the 1995 Particle Accelerator Conference, Dallas, p.1093 (1995)
7. Y.Iwashita, et al., "Power Model of Biperiodic DAW Cavity", Proc. of the 1996 Linear Accelerator Conference, CERN Geneva, p. 857 (1996)