2 HIGH-POWER PROTOTYPES

Two high-power ARES cavities with different HOM-damping schemes have been developed and constructed. The first one constructed in 1995 was named ARES95, and the second one ARES96.

2.1 ARES95

The RF design and characteristics of ARES95 were reported in the previous conference in Europe [2]. The accelerating cavity of ARES95 employs a HOM-damping scheme named Quadrupole Counter Mixing (QCM) choke structure [3]. The HOM characteristics of ARES95 are reported in Ref. [4].

2.2 ARES96

In parallel with the construction of ARES95, another prototype has been developed taking into account the cavity structure symmetry, the HOM-damping performance, and the total cost including HOM loads. Figure 1 shows a schematic drawing of ARES96. Figure 2 is a photograph of ARES96 installed in the TRISTAN AR tunnel. The accelerating cavity has four rectangular waveguides brazed to the upper and lower sides in order to damp monopole and dipole (V) HOM's, where the capital V means deflecting the beam in the vertical direction. The waveguide width was chosen 240 mm, which gives a cutoff frequency of 625 MHz for the dominant TE10 wave. As the HOM load, two bullet-shape SiC ceramic absorbers are inserted at the end of each waveguide. The absorber dimensions are 55 mm in diameter and 400 mm in length including a tapered section. Both beam pipes with an inner diameter of 150 mm are grooved at the upper and lower sides as shown in Fig. 1 in order to damp dipole (H) HOM's deflecting the beam in the horizontal direction. The groove dimensions for ARES96 are 30 mm in width and 85–95 mm in depth, which lowers the TE11 cutoff frequency below 650 MHz. Eight SiC ceramic tiles are arranged in a line in each groove to absorb the HOM power. Details of the HOM loads for ARES96 are reported in Ref. [6].

The coupling cavity structure is almost the same as that of ARES95. A coaxial antenna coupler [7] is installed into the central port of the coupling cavity.
Fundamental RF parameters for ARES95 and ARES96 are listed in Table 1. The first high-power test of ARES95 was carried out at an RF test hall in July 1996. After the test was completed, ARES95 was installed in the TRISTAN AR tunnel. On the other hand, ARES96 was directly installed in the tunnel, and the high-power test was started there about two weeks before the beam experiment scheduled in October 1996.

In high-power testing, the cavity was fully equipped with an input coupler [8], a coupling cavity damper, tuners, and HOM loads. ARES95 was tested up to the design RF power of 160 kW, which generates a cavity voltage of 0.5 MV. The cavity was stably operated for a long time at that power level. However, a slow vacuum pressure rise probably due to local heating was observed beyond ~180 kW. On the other hand, ARES96 was tested up to 240 kW without any problem.

In high-power operation at 150 kW, the RF power leakage to the coupling cavity damper was measured.

Figure 3 shows the $\pi/2$ accelerating mode and the damped 0 and $\pi$ modes measured for ARES96 with $Q_c = 55$, where $Q_c$ is the loaded Q value of the coupling cavity and adjustable from 30 to 100 by changing the antenna insertion. A slight asymmetry of the 0 and $\pi$ modes with respect to the $\pi/2$ mode came from a tuning error, where the coupling cavity frequency was lower than that of the accelerating mode by about 300 kHz. The fixed tuner for the coupling cavity should have been inserted a little more.

The storage cavity is also almost the same as that of ARES95, which is a large cylindrical cavity (1070 mm in diameter and 1190 mm in axial length) operated in the $TE_{013}$ mode. The cavity is a steel structure whose inner surfaces are copper-plated. The storage and coupling cavities are mechanically connected with rectangular flanges, and vacuum seal is obtained by TIG-welding thin flange sleeves.
make a rectangular spare port (240 mm by 28 mm) for the coupling cavity in order to damp the modes C1 and C2 if necessary.

Similar sharp peaks were also observed for ARES95 [4]. One of them is a TM110-like trapped mode in the coupling cavity and has almost the same frequency as the C1 mode of ARES96. That is because the coupling cavity structures of ARES95 and ARES96 are almost the same.

4 SUMMARY

Two high-power prototypes ARES95 and ARES96 with different HOM-damping schemes have been constructed and demonstrated in high-power and high-current beam experiments. Final design of the production cavity based on ARES96 is being in progress.

REFERENCES