3.0 MeV KTF RFQ LINAC

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Abstract

The KTF RFQ that is the first phase of the Korea Multipurpose Accelerator Complex (KOMAC) has been constructed to accelerate an proton beam from 50keV to 3MeV at the operating frequency of 350MHz. The RFQ cavity was made from OFCopper . The KTF RFQ will be extensively tested for pulsed and cw beam current less than 23mA. The present status of the RFQ is described.

1 INTRODUCTION

The KTF RFQ linac [1-3] was designed and has been fabricated at the Korea Atomic Energy Research Institute (KAERI). The KOMAC/KTF RFQ concept is shown in Fig. 1 with the main parameters given in table 1. The RFQ is a four-vanes type and consists of fifty-six tuners, sixteen vacuum ports, one coupling plate, four RF drive ports, ninety-six cooling passages, and sixteen stabiliser rods

In the KTF RFQ, an average RF power is 417kW. And supplied by one klystron, rated for 1MW operation at 350MHz. The output of each klystron is divided two or four ways to create nominally 210kW or 104kW each. We have been completed a Low-Level RF system [4] and are installing the klystron.

Initially KTF RFQ will be operated manually as we bring systems on-line individually.

Table 1. The KOMAC/KTF RFQ Linac Parameters.

PARAMETER	VALUE
Operating frequency	350 MHz
Particles	H^+ / H^-
Input / Output Current	21 / 20 mA
Input / Output Energy	0.05 / 3.0 MeV
Input / Output Emittance, Transverse/norm.	0.02 /0.023 π-cm-mrad rms
Output Emittance, Longitudinal	0.246 MeV-deg
Transmission	95 %
RFQ Structure Type	4-vanes
Duty Factor	100 %
Peak Surface Field	1.8 Kilpatrick
Structure Power	350 kW
Beam Power	68 kW
Total Power	418 kw
Length	324 cm

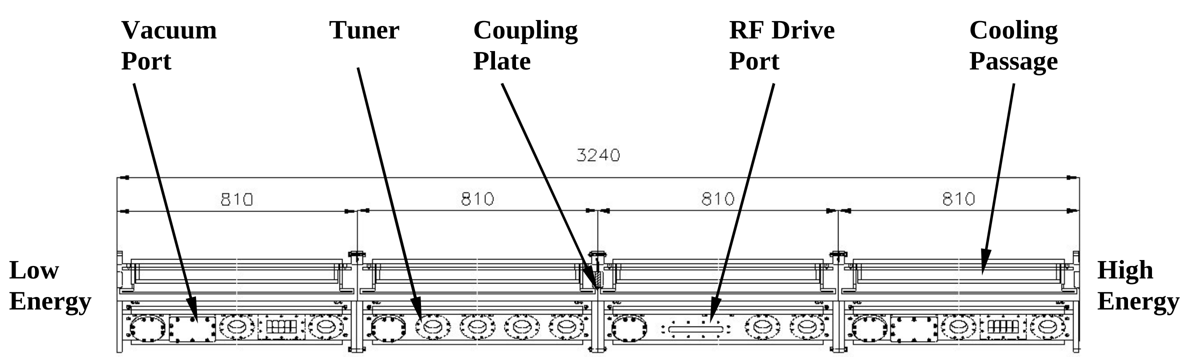

Figure 1. 3MeV, 350MHz, cw KOMAC/KTF Drawing.

2 3.0MeV RFQ LINAC

2.1 RFQ Cavity

The design of the 3MeV RFQ cavity was performed by the beam dynamics codes, PARMTEQM [5] and QLASSI [6] the thermal and stress analysis code , ANSYS, and the cavity design codes, SUPERFISH and MAFIA.

The average RFQ cavity structure power by rf thermal loads is 0.35 MW and the peak surface heat flux on the cavity wall is 0.13 MW/m^2 at the high energy end.

Figure 2. Fabricated RFQ cavity.

In order to remove this heat, we consider 24 longitudinal coolant passages in each of the sections. In the design of the coolant passages, we considered the thermal behaviour of the vane during CW operation, the efficiency of cooling and fabricating cost. The temperature of the coolants on the cavity wall varies to maintain the cavity on the resonance frequency.

The RFQ cavity was machined into OFH-Copper and was integrated from four separate 81cm-long sections which was fabricated by vacuum furnace brazing. Fig.2 shows the RFQ cavity which is testing a electrical characteristics. From the electrical test for the RFQ cavity with a coupling plate and stabilizer rods, the frequency of the operation mode without a tuning is 349.4 MHz and after a tuning one is 350.0 MHz.

2.2 RF System

The total power simulated is 418kW, including beam loading and power dissipation by a cavity wall, when an additional 50% of the power is allowed as the difference between the theoretical model of the RFQ and the real device built. This power is delivered by a single klystron, capable of 1MW. The 350MHz klystron and RF windows were supplied by Thomson Co. Ltd at this year. Fig. 3 shows the 1MW klystron.

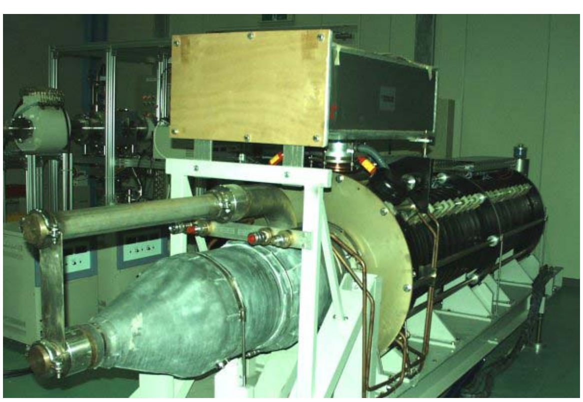

Figure 3. 1MW Klystron.

The power is coupled in the cavity with a set of four coupling loops. Each port will therefore carry an average rf power of 120kW.

RF feed is in the third section. In order to supply the RF power in the RFQ, we studied two types of the input RF couplers which one is a coaxial-type and the other is an iris-type. The coaxial-type RF coupler fabricated is shown in Fig.4. When the RFQ cavity and the input coupler is matched, the S-parameter calculated is 0.008 and VSWR is 1.02:1. Coaxial-type input RF coupler has been fabricated with OFH-Copper. Inner conductor of the coaxial line has cooling channel. The input coupler has a structure that the coupling loop can be rotatable to adjust the coupling coefficient to the RFQ cavity. Helicoflex RF seal is inserted between the RF drive ports and the input coupler to avoid the RF current flow on a vacuum flange surface and to tight a vacuum leak.

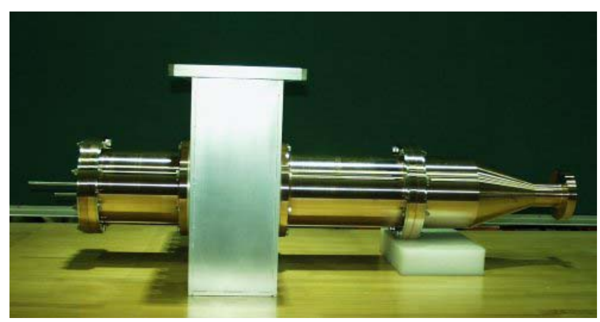

Figure 4. RF input coupler.

Low level RF (LLRF) system constructed include the RF reference, resonance control of the RFQ cavity, klystron control, interlocks, and feedback loop, as shown in Fig. 5. The main function of the LLRF system is to control RF fields in the RFQ cavity and maintain field stability in the range of $\pm 1.0\%$ peak to peak amplitude and $\pm 1.4^{o}$ peak to peak phase. All RF feedbacks loops will use baseband In-phase and Quadrature techniques. Maximum output power of the LLRF system is 200W. The software control of the LLRF system performs with LabVIEW.

Figure 5. LLRF system.

2.3 LEBT System

2.2m-long test Low Energy Beam Transport (LEBT) system which match between the ion source and the RFQ linac was assembled and is being testing. LEBT consists of two solenoid magnets, two steering magnets, and a diagnostic box, as shown in Fig. 6. LEBT will be fitted with a variable iris for beam current control and used a kicker magnet to provide the capability to give a pulsed beam. LEBT system was designed with the codes, TRACE 3D, POISON, PARMTEQM, and ANSYS.

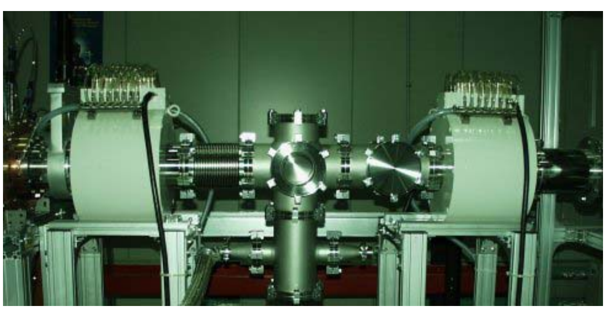

Figure 6. Assembled LEBT system.

3 PRESENT STATUS

The fabrication, electrical test, and vacuum leak test of the KTF RFQ cavity has been completed. We are integrating the RF system for the RFQ and will begin a low-power test at next year.

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