

High power RF coupler for the FAIR p-LINAC cavities

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HISTORY

Since some decades most of the UNILAC cavities are equipped with the same type of RF couplers. Studies in the 80th have shown that a cylindrical ceramic as vacuum seal is nearly ideal. Compared to ceramic disks the real surface area hit by X-rays is much smaller. From fabrication issues much more manufacturing steps, including metallization of both tube ends, have to be passed.

A general composition is shown in [Fig. 1].

For applications at different power levels and different mechanical environments the design has just to be scaled.

APPLICATIONS

Beside the operation at the UNILAC at 36, 108 and 216 MHz the same kind of loop is used at CERN Linac3 (Lead Linac) at 101 MHz, at the therapy Linacs in Heidelberg (HIT) and Padova (CNAO) at 216 MHz [Fig. 1] and at BNL Upton NY at 100 MHz. The coupler is not built for a dedicated kind of cavity. A range of applications goes from RFQ, IH, Alvarez, Spirals to CH cavities covering a power range from 10th of kW up to 2 MW pulse (at 25% duty factor). Therefore a big number of flange-oriented types with respect to the dimensions of the used RF power lines as well are available.

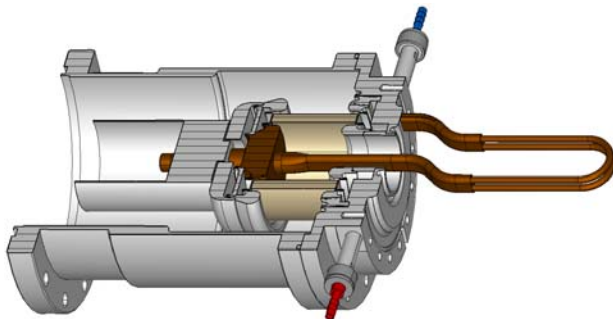


Figure 1: General composition of the GSI RF couplers

HIGH POWER RF COUPLER

The pLINAC providing up to 70 MeV proton beam for the FAIR facility is under construction. The normal conducting DTL of the pLINAC is composed by three Coupled Cross-bar H-mode (CCH) cavities, providing the acceleration up to the energy of 36 MeV, followed by three Cross-bar H-mode (CH) cavities. [1] In order to provide the input power to the CH-cavities a RF inductive coupler has been studied and developed.

The RF power coupler, consisting of a water cooled inductive loop, has to handle up to 3 MW pulsed power at 325 MHz. A dedicated study of the coupling factor and the electromagnetic field for different penetration length of the coupler inside the coupling cell – the intertank unit connecting two neighbored cavities long 2β and hosting the triplet lens - and for different angles with respect to the beam axis has been carried out.

According to the results of the simulations an optimized design of the inductive loop was produced and a prototype of the coupler has been manufactured at the GSI workshop [Fig. 2].

The coupler is vacuum leak tested and low level RF measurements in the build-in condition at the CCH prototype cavity are planned to be performed in March 2015 at the RF test bench.



Figure 2: Prototype of the RF coupler for the CH-cavities of the pLINAC

References

- [1] Technical Report “Proton Linac”, <https://edms.cern.ch/document/994418/1>.
- [2] F. Maimone, G. Clemente, W. Vinzenz, Proc. of LINAC2014, Geneva, 2014