FABRICATION AND TESTING OF A NOVEL S-BAND BACKWARD TRAVELLING WAVE ACCELERATING STRUCTURE FOR PROTON THERAPY LINACs

S. Benedetti*, CERN, Geneva, Switzerland, and EPFL, Lausanne, Switzerland
*email: stefano.benedetti@cern.ch

REFERENCES:

Introduction
A β=0.38 accelerating structure was designed and built to investigate the high gradient limits of S-band cavities
The RF design [1] followed a Modified Poynting Vector (S_c) model [2], that was experimentally verified by CLIC at 12 and 30 GHz
TERA Foundation addressed the issue at 3 GHz, showing preliminary validity of the S_c model at this lower frequency [3]
The prototype is installed in the test area and about to start the high power test

Mechanical design
An experimental campaign was performed to define the minimum inter-cell wall thickness to withstand the H2 bonding heat cycle creep-induced deformation
Each RF cell has four dimple tuners, following the RF sensitivity and tuning analysis. Diameter and wall thickness of dimple tuners was numerically computed and tested on mock-up cells
The heat dissipation is limited by the peculiar RF design. The maximum acceptable thermal load is 0.75 kW, mostly driven by coupling holes and wall thickness thermal resistance. Four cooling blocks were designed

Fabrication
Ultra-precision machined disks underwent visual and metrological inspection once they arrived at CERN
A LLRF test on clamped structure was performed to verify that the prototype was within the tuning range
The alignment of the disks was ensured thanks to a V-shape support and by using the tuning holes
The disks were joined by diffusion bonding in partial hydrogen atmosphere, following the CLIC baseline fabrication procedure; input waveguides, cooling blocks and vacuum tubes brazing completed the structure assembly

Tuning
All cells were adjusted in frequency. Bead pull measurements were used to determine the electric field profile along the z-axis
The available tuning range per cell is ±3 MHz. Regular cell frequencies were increased of 0.3 MHz on average, output cell of 2.2 MHz, input cell was decreased of 0.6 MHz
Phase advance of 150±1.5 ° under vacuum at 32 °C was reached. The total reflection at the 2.9985 GHz operating frequency is -60 dB