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Superconducting Accelerating Cavity Pressure Sensitivity Analysis and Stiffening

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The Soreq Applied Research Accelerator Facility (SARAF) design is based on a 40 MeV 5 mA light ions superconducting RF linac. Phase-I of SARAF delivers up to 2 mA CW proton beams in an energy range of 1.5-4.0 MeV. The maximum beam power that we have reached is 5.7 kW. Today, the main limiting factor to reach higher ion energy and beam power is related to the HWR sensitivity to the liquid helium coolant pressure fluctuations. The HWR sensitivity to helium pressure is about 60 Hz/mbar. The cavities had been designed, a decade ago, to be soft in order to enable tuning of their novel shape. However, the cavities turned out to be too soft due to lack of radial symmetry in their mid plane. In this work we reproduce by a radio frequency Eigen mode and mechanical co-simulation the cavity Eigen mode frequency sensitivity to fluctuation in the coolant Helium pressure- 60 Hz/mBar. In this work we explore that the bending rigidity of the control structure that is used to tune the cavity to the desired frequency has a vital contribution to the cavity sensitivity in our cavity design. It was found that increasing the rigidity of the cavities in the vicinity of the external drift tubes may reduce the cavity sensitivity by a factor of three. A preliminary design to increase the cavity rigidity is presented.

Keywords: linac; superconducting; pressure sensitivity