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Compact tuner designed to minimize the intervals of QWRs for RIKEN heavy-ion linac (10'+8')

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Abstract:
The superconducting booster linac at RIKEN (SRILAC) has ten 73-MHz quarter-wavelength resonators (QWRs) that are contained in three cryomodules (CMs).
Focusing element of quadrupole magnets at room temperature were installed between CMs. In order to obtain optimum beam dynamics, an intervals of QWRs was set as small as 110 mm. Frequency tuning during cold operation is performed by compressing the beam port of the cavity and decreasing the length of each beam gap using a dynamic tuner. The tuning range of the cavity itself is from 0 to -14 kHz. The tuner is used to tune by a few kHz at the beginning of the cavity excitation, and by a few Hz for a long term operation in order to compensate the frequency change by helium pressure.
Since the intervals of QWRs is small, a compact design of the dynamic tuner was adopted. The support plates were welded to the helium jacket, and surrounding wires were attached.
A cavity frequency is decreased by tightening the wires, which is driven by a stepping motor and gears (ratio is 1:64).
In a cooling test at 4K, each cavity was successfully tuned to the design frequency by the tuner, in which the required frequency change was 3 kHz to 8 kHz depending on the cavity.
There is a hysteresis of around 10 Hz, which is caused by a backlash of the mechanical system.
The sensitivity of helium pressure was estimated to be df/dp = -1.91 Hz/hPa by a 3D EM calculation. In a short term (in periods of 2–3 minutes), helium pressure is stable by around 4 hPa (8 Hz) against the bandwidth of 50 Hz. Long term stability test (1 day) is underway.
If the frequency is not stable enough, an automatic frequency tuning will be necessary.
The tuner design and test results with cold cavities will be presented.

Provocative topics:
Compact tuner for QWR, minimal interval of QWR
Performance test of tuner

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