Prototype SSR2 Tuner Procurement and Testing at IJCLab for PIP-II Project

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Abstract

IJCLab is involved in the PIP-II project on the design and development of accelerator components for the SSR2 (Single Spoke Resonator type 2) section of the superconducting linac. Five prototype tuners have been built and are being tested at IJCLab. After a short description of the tuner, this paper reports on the procurement strategy and the performance observed at both room and low temperatures in vertical cryostat test with SSR2 prototype cavities. This paper will also share results on accelerated life-time tests performed in a dedicated nitrogen-cooled cryostat.

Tuner description and procurement plan

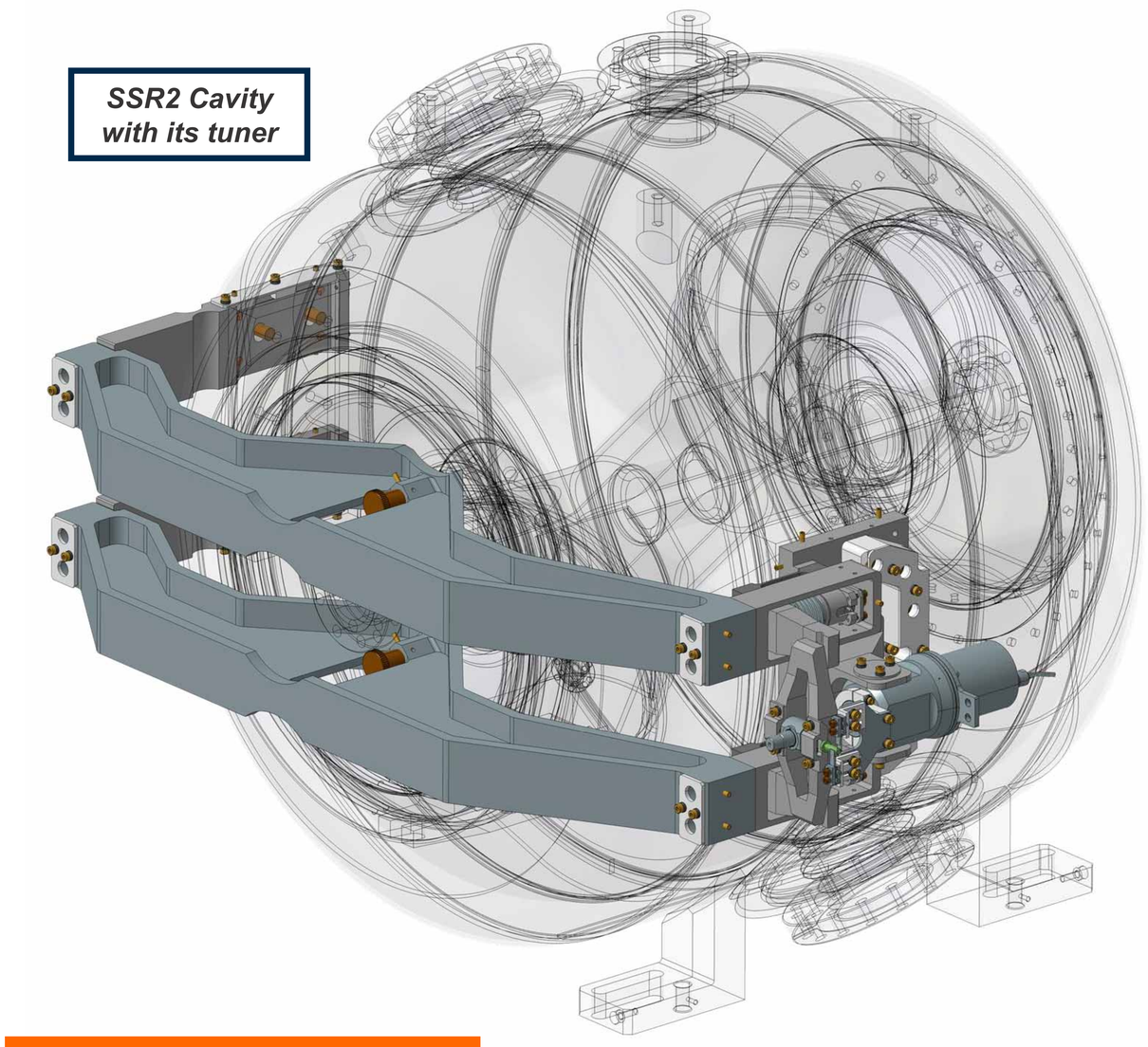
Tuners are made up of three main components: mechanical parts, stepper motors and piezoelectric actuators. They are ordered separately and assembled in laboratory environment. Individual acceptance tests are carried out for the piezoelectric actuators, with capacitance and stroke measurement. Motors are tested immediately after installation..


Linear stepper motor


Piezoelectric actuator


Mechanical parts

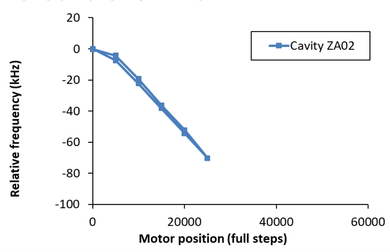
SSR2 Cavity with its tuner

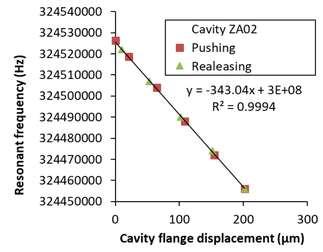


Tuner testing

Room temperature test

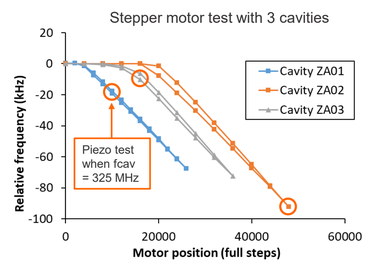
One tuner was verified at room temperature using only the motor actuator and ZA02 cavity and measuring the flange displacement with a laser sensor. Cavity frequency sensitivity was estimated 308 kHz/mm while measured value is found around 343 kHz/mm.

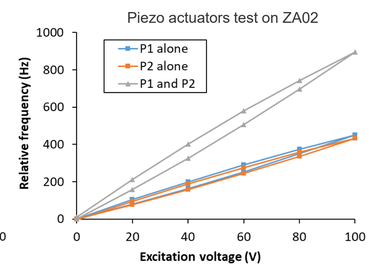


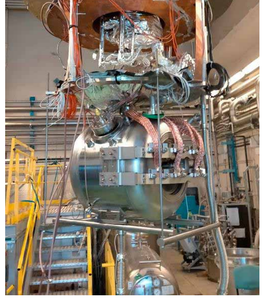


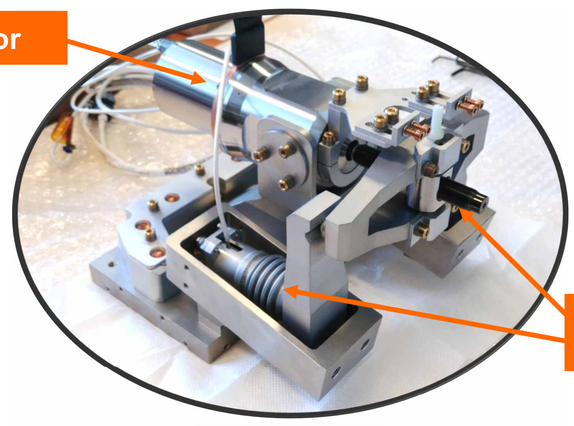
Low temperature test

Three cavities have been tested with three dedicated tuners, motor are tested until reaching. Once the resonant frequency is reached (325.000 MHz), piezoelectric actuators are tested with their nominal voltage range first separately, and then together.





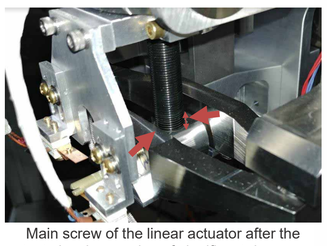




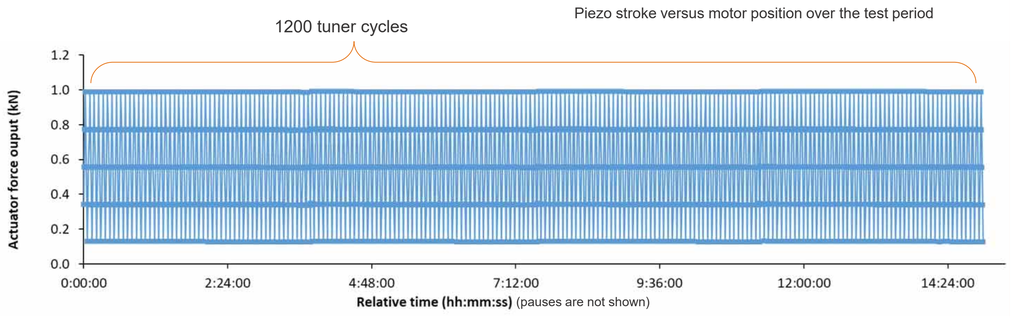
Accelerated lifetime test

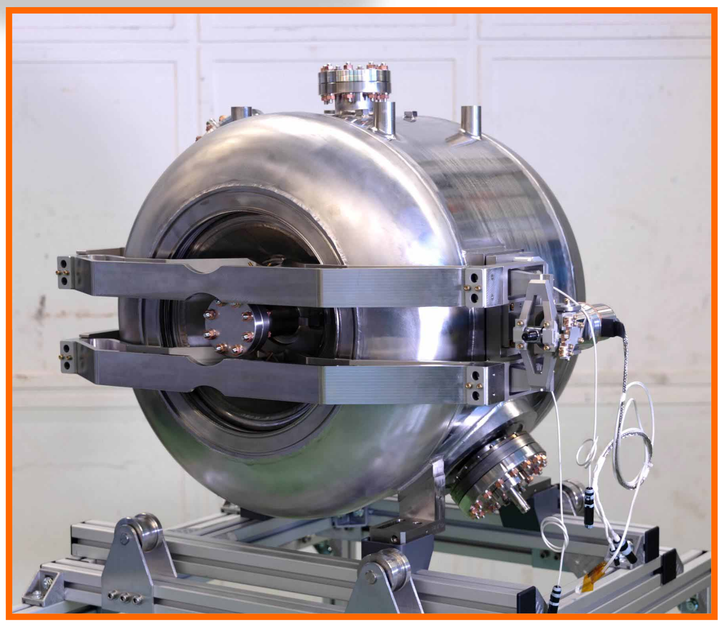

Motor cartridge assembled on the test stand before installation into vacuum vessel

Dedicated liquid nitrogen test stand give opportunity to test over a long period, as the actuators are strongly affected by low temperatures and vacuum.
A total of 1,200 adjustment cycles were carried out, equivalent to the estimated service life of the linac. Performance checks carried out periodically during the tests revealed no degradation in system performance.
Further tests are foreseen to qualify the limit in terms of durability.


Main screw of the linear actuator after the test showing no sign of significant damage

Piezo stroke versus motor position over the test period





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