

Vacuum leaks in accelerators

S. Watanabe,^{*1} Y. Watanabe,^{*1} E. Ikezawa,^{*1} M. Kase,^{*1} N. Sakamoto,^{*1}
K. Oyamada,^{*2} M. Nishida,^{*2} K. Yadomi,^{*2} and J. Shibata^{*2}

The vacuum system for accelerators in RIBF has been running without serious problems. However, vacuum leaks have been observed in the following equipments: (1) resonator of CSM-A1, (2) cooling pipe in resonator #2 of RRC, (3) W-resonator of fRC, and (4) a chamber in the dipole magnet DM-G5.

The vacuum chamber that houses the resonator of CSM-A1 has a leakage of vacuum in its bottom plate, which is made of steel with a thickness of 40 mm and copper-plated inside and painted outside. The precise location of the leak in has been searched but has not been specified yet. Because the response of the helium leak detector was very slow. The route of the leak in the bottom plate would be complicated. Then it took time to respond to helium gas. We will continue searching for the leak point. The vacuum pressure of the A1 resonator was around 2×10^{-5} Pa, which is worse than those of other resonators, by a factor of 2 or 3.

A buildup of pressure was generated in RRC resonator #2 in the spring of 2013. The leak was found in exist somewhere in the cooling pipe of the lower inner conductor of the resonator. The cavity was opened in July, and the inside of the inner conductor was investigated carefully. As a result, water leakage was found in the chamber. However, there is no space around the pipe connection. To solve this problem, a new bypass line was made. The pipe line was cut at two shallow spots, and the spots were connected with a new pipe. The pipe connections were treated with silver braze. This equipment is running without any problems now.

At fRC, a small leak in the W-resonator has been observed for several years. However, with rf power on, the leak was so small that operations had been possible. To investigate the cause of the leak, the upper part of the resonator was removed in June 2013. On doing so, a bad rf-electrical contact was found in a part of the metal C-ring, and the elastomer O-ring seal near to it was damaged. The C-ring was replaced with a new one. To improve the clamping capacity, a long bolt was introduced through an upper flange and the resonator, and the upper flange and the resonator were tightly fastened by a nut. Moreover, the clamping capacity was reinforced by new jigs like a C-clamp.

A vacuum chamber inside a dipole magnet named DM-G5 in the injection beam line into SRC has a leakage of vacuum. The chamber was shaped like a 60-degree arc and had a rectangular cross-sections (58 mm x 86 mm). The main part of the chamber was composed of four aluminum

plates with a thickness of 2 mm. The four edges of the chamber were welded. A rough location of the leak could be determined by keeping the chamber inside the magnet pole gap. For precise investigation, we took out the chamber from the magnet yoke. The first anticipated point was confirmed to be the leak point. However, the leak soon became small enough and was not detected. The cause of this phenomenon was considered. The chamber would be pressed by the magnet. Then the leak would be generated by the deformation of the chamber. To confirm this, we pressed onto the chamber using a C-clamp at a place near the leak point; doing so, a leak was detected at the same time, the vacuum pressure changed by a factor of 10. The leak point of the chamber was determined to be on the welding bead. Additional welding on it will result in another deformation on the chamber. Therefore, the leak point was treated with epoxy resin (Torr Seal). The leak was fixed.

^{*1} RIKEN Nishina Center

^{*2} SHI Accelerator Service Ltd.