Maintenance of vacuum equipment for accelerators

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We have been maintaining the vacuum equipment of the accelerators in good condition. We report the maintenance of the vacuum for the accelerators in 2016.

First, the maintenance of vacuum equipment in RILAC is described. In January, the pressure at the X-re-buncher (X-REB) increased to 5 x 10^{-5} Pa after a joint for cooling the inner cylinder was repaired. When the X-REB was searched, leak points were found downstream of the duct of beam. The leak points were found in an O-ring of a Penning gauge, an O-ring of a Pirani gauge, and an O-ring between a rotary pump and turbo-molecular pump. These O-rings were replaced with new ones and no further leaks could be found using a helium leak detector. However, the pressure did not improve. The cause of the pressure increase lay elsewhere and remained unknown until April, when a shaft on a bottom plate of the outer cylinder was disassembled and reconstructed. The bolts and screws of this part were tightened and the pressure improved. In February, a leak was confirmed in cavity No. 5 using a helium leak detector. However, the leak points could not be identified. Because the helium leak detector takes some time to respond after the helium gas has been shot, the leak point could be different from the place where the helium was shot. To identify the leak point, a dye penetrant inspection (color check) was used. A color check is a method for searching scratches and cracks on metal. First, special colored liquid is sprayed on the metal. Next, the liquid is wiped off. Finally, the scratches and cracks appear if they exist. When the liquid was sprayed on a welded area of the RF feeders, red color appeared on the reverse side of the painted area. This indicated that the liquid had passed though the chamber wall. These scratches were treated with vacuum sealing agent. However, the vacuum pressure could not be improved. This indicated other paths that linked outside of the chamber to its inside. If these paths through the chamber wall were the cause of the vacuum leak, the chamber wall should be changed to improve the leak completely. In April, a vacuum leak was found on a part of the welded joint of flanges near cavity No. 6 in an area called e42. However, it was difficult to repair the leak because the access space was narrow. The leak could not be repaired. Because the pressure was kept at the order of 10^{-5} Pa, the vacuum leak did not influence the experiments.

In February, the pressure increased in the AVF cyclotron. The cause of the pressure increase was a vacuum leak. Vacuum leaks in the AVF cyclotron had occurred previously. Leak often happened because of a deformation of the flange. Hence, the flange was supported by pillars so that it would not deform. In this case, the cause of the leak was not the condition of the pillars. Therefore, an O-ring of the flange was greased and the vacuum leak was fixed. In March, a rotary pump used at the AVF cyclotron stopped suddenly. The rotary pump was replaced with a spare. However, the reduction in pressure obtained by the spare was not sufficient. Hence, the spare pump was replaced with the former one which worked normally. The cause of this incident remains unknown.

In March, a cryopump did not work at the SRC. The cause of this problem was a compressor malfunction. To fix the compressor, its head unit was replaced. The cryopump worked normally again.

At the IRC in April, several cryopumps failures occurred. A cryopump failed to work properly. When the circuit breaker was turned off and reset, the pump worked again. However, it soon failed to work again. The pump was replaced with a spare one. Another cryopump also failed to work. After the circuit breaker was turned off and on, the pump was restarted.

At the fRC in April, a cryopump failed to work. After a switch in front of a compressor was turned off and on, the cryopump was restarted.

At the RRC, a bellows connected with RF No. 2 had a leak point. Vacuum leaks from this part occurred frequently. The leak was treated with a vacuum sealing agent. However, the leak happened repeatedly, especially during experimental beam time. In November, the pressure increased during beam time. The ion beam was stopped and the leak point was investigated. The cause of the pressure increase was a leak on the bellows. The leak point was treated with vacuum sealing agent. Then the pressure decreased. To solve this problem completely, RF No. 2 have to be taken apart, and the bellows will need to be replaced. A large-scale repair is needed to solve this problem. It is not easy to solve this problem; therefore, the treatment using vacuum sealing agent will be continued.

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