

Long-term Stabilization of the magnetic field of the RCNP AVF cyclotron

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In order to obtain an ultra-high quality beam and to supply it for a long period, the stability of the magnetic field for the injector cyclotron is essential. The magnetic field is seriously influenced with the temperature of iron pole and yokes[1]. However, it is very difficult to control the iron temperature: only the method to stabilize the iron temperature is via cooling water for the coils and a room temperature for the cyclotron. There are two important points. 1) the temperature of the circumstance nearby a cyclotron should be kept constant even in hot and humid summer in Japan, and 2) the heat transfer from coils to the iron core should also be kept constant even when the coil currents are changed. This difficult task has been finally overcome in 2004.

We introduced two air conditioning systems to increase cooling power by about 20 % [2]. Figure 1 shows air temperatures at a ventilator in 2001 (before improvement) and 2004 (after improvement) from April to July. In 2004, the temperature was much well controlled even in summer.

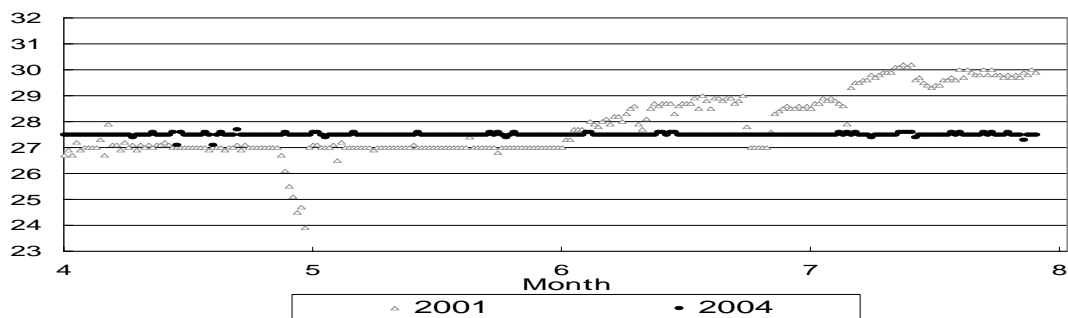


Figure 1 Temperature of the AVF cyclotron room in 2001(open) and in 2004(closed)

Figure 2 shows an AVF room temperature (lower) nearby the iron yoke, a temperature of the yoke (middle) and that of the pole (upper) during 40 days [2]. The return-yoke temperature has an offset of 2 degrees. Sudden fluctuations of the room temperature were due to cycling procedures of the cyclotron, i.e., coil currents were changed from 0 A to 1300 A. The room temperature was totally kept within ± 0.6 degree except cycling procedures.

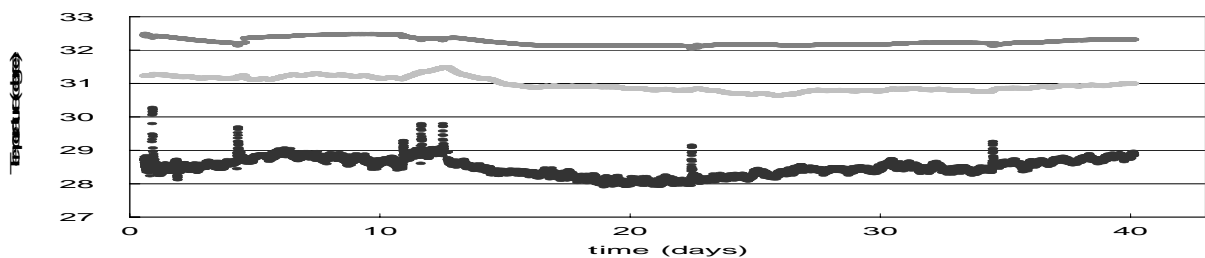


Figure 2 Temperatures of the AVF room (lower), of the iron yoke (middle) and of the iron pole (upper).

At the cycling procedures, the yoke temperatures were increased. The pole temperatures were, however, decreased by excess cooling power of the coil water. During 40 days, those temperatures were kept constant within ± 0.45 degree (yoke) and ± 0.25 degree (pole), respectively. It should be noted that during this period the main coil current of the AVF cyclotron ranged from 266 A to 582 A, i.e., the iron temperatures were well controlled independently of the coil currents.

References

- [1] e.g., S. Ninomiya *et. al.*, RCNP Annual Report 2001 p.148.
- [2] S. Ninomiya *et. al.*, RCNP Annual Report 2002 p.152.
- [3] S. Ninomiya *et. al.*, Cyclotron 2004, in press