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Introduction of the Alignment of Wuwei Heavy Ion Medical Machine

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Wuwei heavy ion medical machine is the most compact heavy ion accelerator cancer treatment device in the world. The perimeter of the synchronous ring is as small as 56.1m, and the height difference between the high energy line climbing section of the device is about 19m, which is the height difference in the domestic accelerator. The device with the largest span spans tens of thousands of components, and many critical components require sub-millimeter installations. Wuwei heavy ion cancer treatment installations require high positioning accuracy components including beam position detectors, high-frequency cavity, electrostatic deflection plate, peeling film, etc., in which the accuracy of the synchronization ring quadrupoles requirements 0.1mm, part of the oversized, overweight components problems such as narrow installation and installation space and inadequate visibility conditions have caused many difficulties in the installation of collimation. Through the application of new techniques and methods in alignment, the technical difficulties of various alignment installations are solved, and all the components of the device are installed in place with high efficiency and high precision in a short time. The collimated installation of Wuwei's heavy ion cancer treatment equipment began in April 2014 and completed the installation of the global control network, the encryption of local control networks, and the placement and scribing of various beamline components. Completed installation in September 2014, from the ion source to the cyclotron injection system, to the alignment of the medium energy transport line, the synchronous storage ring, to the high energy transport line, and the various treatment terminals. It took more than a year. Through the continuous efforts and cooperation of the staff of various systems of heavy ion cancer treatment devices, Wuwei's heavy ion cancer treatment device successfully emerged in December 2015, enabling the Wuwei heavy ion medical machine to achieve full-line carbon ion beam acceleration and The nonlinear resonance of the synchronization loop leads slowly. The injected energy is 7 MeV/u, the flow intensity is 11uA, and the terminal energy is more than 400 MeV/u, which fully meets or exceeds the original physical design index. This also proves that the basic work of Wuwei Heavy Ion Accelerator is perfect and in place, and the alignment work has also been fully affirmed.

Summary

Wu Wei heavy ion medical machine (HIMM) is the most compact accelerator treatment facility in the world, which includes a synchrotron ring with a circumference about 56.1 m. The height of the high energy climbing segment is up to 19 m that is the highest complex among the accelerators in china. HIMM consists of thousands of elements and some elements require sub-millimeter installation accuracy especially. The devices for higher positioning accuracy are BPM (beam position monitor), RF cavity, electrostatic deflector, stripping film. For quadrupole, the positioning accuracy is less than 0.1 mm. Because some very large and heavy elements need to install hanging in the air as well as the lack of installation space and visibility, the work to mount and align becomes extremely difficult. By using the new technology and method of alignment measurement that solves various alignment challenges, all the elements of this complex are installed with high accuracy efficiently in a short time. The deviation of all the key components is under 0.1mm and the installation error of the vacuum pipe and the diagnostic element is less than 0.5 mm. Currently, Wu Wei heavy ion medical machine has been commissioned successfully and some beam parameters are better than the design target, which in turn verify the reliability and feasibility of alignment and measurement.

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