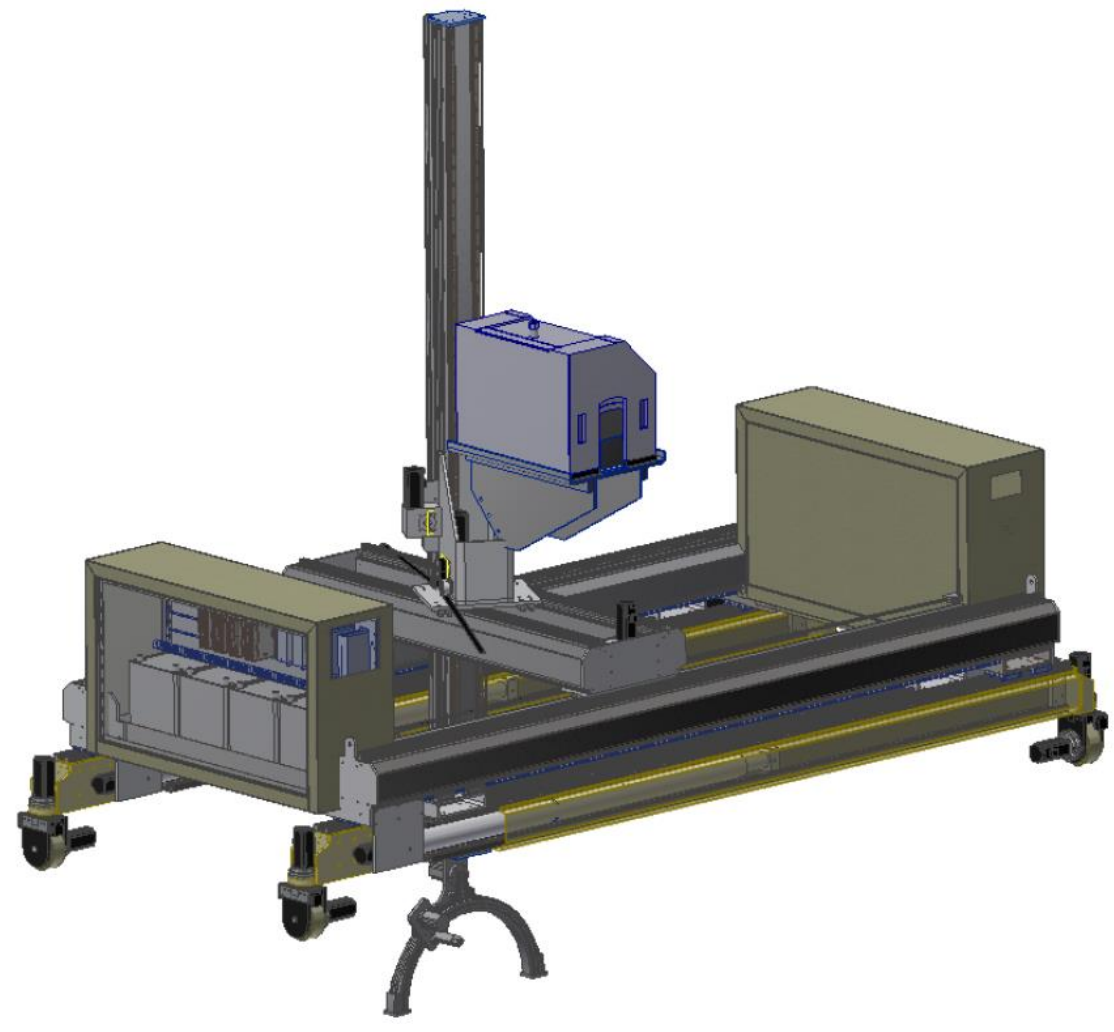
Study of Remote Helium Mass Spectrometer Leak Detection in Accelerator



By

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Abstract

In order to solve the problem that the vacuum system of the accelerator cannot be close to the operation for a long time, a long-distance helium mass spectrometer leak detection system is explored by studying the structure of the conventional round tube vacuum box of the vacuum system, which integrates the online vacuum leak detection, defect diagnosis and process design, improves the digital operation, realizes the accurate and effective detection of the leak location range and leak rate, and provides the technology for the remote leak detection of the vacuum system support..

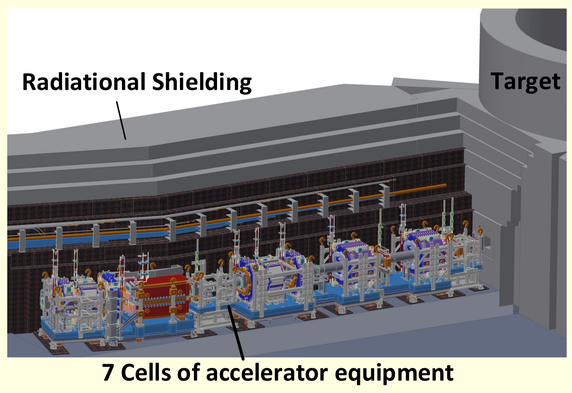
INTRODUCTION

The accelerators Vacuum system of the Particle accelerator has shown a close relation with the beam lifetime and stability. If the vacuum system cannot obtain the intended ultimate pressure, one primary reason is the presence of leaks. but the leak hole is usually invisible to the naked eye, we must find out and repair the leak by some methods. Therefore, vacuum leak detection plays an important role in the steady running of the vacuum system.

The method of Helium mass spectrometer leak detection is the most widely used qualitative methods in engineering. Form 1940s, the helium jet method first appeared, then the cover-helium leak detector, accumulated method of sniffer prob or vacuum chamber, and the method of back-pressure emerged one after another. Right now, the helium jet method is most highly applied based on accurately identifying the leaks. Actually, manual identifying the leaks in the underground accelerator tunnel is a hard task when the beam is operating. Meanwhile several workers cooperate simultaneously, which reduce greatly the overall accuracy and efficiency.

Overview of RTBT INTERFACE

China Spallation Neutron Source (CSNS) is a national scientific project. The first phase of CSNS facility mainly composed of a linear accelerator, low energy beam transport (LEBT), a rapid cycling synchrotron with proton energy of 1.6GeV, ring to target transport (RTBT), a spallation target, three neutron line stations. The interface between RTBT and target included accelerator equipment whose beam length was about 18 meters, as shown in Figure.



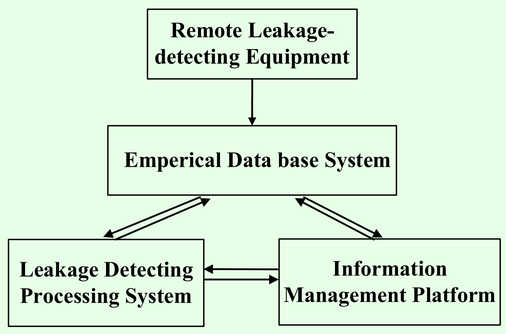
The Development of helium mass spectrometry leak detection

- **With the rapid development of helium mass spectrometer leak detector, its sensitivity and stability have been improved. The helium leak detection by suction gun method has been used in nuclear power plants, spacecraft, satellites and other practical projects [2]. The principle of suction gun leak detection method is as follows: the helium gas with specified pressure is poured into the object to be tested, and the special suction gun is used to explore outside the object to be tested. If there is a leak in the object to be tested, the helium gas will spill out with the national leak. When the suction gun is facing the leak hole, helium gas is sucked into the leak detector together with the sur-rounding air, and the output indication is generated, so as to achieve the purpose of leak detection.**
- **The vacuum system of accelerator often contains a lot of equipment with many sealing and welding seams and narrow space, or the radiation effect endangers the personal safety area, so it is very difficult to shut down or close leak detection. As the vacuum pipeline is long, it often takes a lot of time to seal up the leak with vacuum sealing mud until all the leaks are detected one by one. How to take measures to reduce labor intensity and protect personal safety is of great practical value.**
- **The development of computer technology leads the development of measuring instruments to automation and intelligence. In the past 2-3 years, the helium mass spectrometry leak detection technology in China has made a breakthrough, mainly from the traditional industry covering a wider range of industrial sectors, from a single conventional instrument of oil diffusion pump system to the main product of molecular pump [3]. In China, we should absorb foreign advanced technology, accelerate localization, move forward to automation and high level, and launch high sensitivity instruments. For example, the scope of leak rate can be increased, the communication interface can be in-creased, and the modular design of hardware and soft-ware can be realized. For example, zaj2291 instrument of the science and instrument center of the Chinese Academy of Sciences can switch the measuring range automatically, process the data automatically and connect the printer to realize the one key control of the leak detector to complete the leak detection. However, the development of automatic and intelligent leak detection still has a long way to go.**

Exploration of leakage detection data system

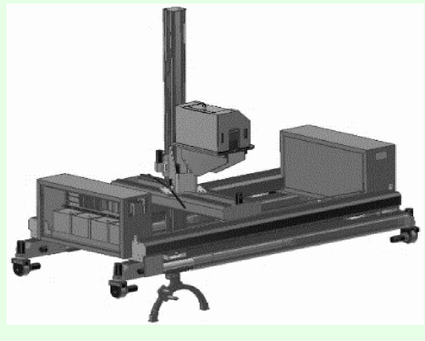
During Remote control, mobile automatic scanning suction gun in the current application is not much, people use more traditional manual operation means, but the traditional manual operation is to occupy the working space, heavy workload, low security. It is a challenging task that the suction gun of leak detector can scan the tested components stably and reliably. These problems must be solved in practical design and application.

The remote positive pressure suction gun leak detection method is used in the environment of high radiation, dust pollution and complex structure of the tested components. Its technical indicators not only complete the leak detection, but also involve the remote control-ling movement and so on. Therefore, remote positive pressure suction gun leak detection is composed of terminal leak detector and automatic mobile suction gun. Based on the leak detection database platform and process design system platform, the leak detection information management platform realizes the online management and control of the leak detection process.



Sketch of leakage detecting database system

Research and design the adaptive spray path of helium for conventional pipeline vacuum box [6], as shown in Fig. 2. The universality and systematization need funds to conduct in-depth research, establish mature leak defect judgment and solutions, improve the automation level of helium injection leak detection technology, realize remote leak detection diagnosis and data sharing, reduce labor intensity, and ensure personal safety.



Design of remote leakage detector

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