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Status of PHENIX Muon Identifier Mechanics

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The installation and test of the muon identifier (MUID) for PHENIX detector was completed in 1998. Since then, we have been working on the maintenance of the detectors and the gas supply system for this large scale detector. In this article we will report the mechanical maintenance of the MUID focused on the recovery procedure from a major accident which happened in Jan. 1999 and progress of the gas system design and construction.

The MUID detector is expected to play the important role in the RHIC spin program[1] as well as in the heavy ion program. The system is a range stack made by the sandwich of five absorber steel plates and proportional chambers which are plastic Iarroci tubes[2]. To cover a large acceptance of 10 to 35 degrees in θ and 360 degrees in ϕ at 7m from the reaction point, the area to cover is 10m high and 13m wide. The detector covers the forward and backward regions, so called south and north arm, separately We segmented total of 10 gaps into 60 and made proportional tube array housed in the Aluminum cases, which are called panels. The MUID panels were fabricated and installed on fall of 1998[4)].

A flood happened on Jan. 2nd 1999 in the PHENIX experimental hall. The rapid increase of the temperature melted the accumulated snow on the ground, but not melt the ground ice. The large amount of water rushed into the PHENIX interaction region (IR) with dust and mud where all MUID panels were installed. Though the water went away by the following day, the water level reached about 10cm above the bottoms of the lower MUID panels. In the following paragraphs, we will describe how we recovered the detector from this disaster.

We opened one MUID panel partially and looked into the inside. The flood line reached to the electronics boards which contain the preamplifier and the high voltage distributor. But it did not reached to the lower end of the Iarroci tubes which means that the chamber volume was not soaked in the water at all. 1/4 inch holes were drilled on the side of the bottom rails in order to drain the mud water which was trapped there. After most of the water was drained, nitrogen gas was flowed into the secondary volume which contains the tubes and the electronics to dry up until we finished to check all the soaked panels. The electric connectors which interface between the MUID panels and external electronics were cleaned up by alcohol. The resistance between the terminals of the low and high voltage lines were confirmed as expected before applying the operation voltages. Then the pure CO2 gas was flowed into the chamber volume. The high voltage was applied after flowing the gas for three volume exchange. Then the signal shapes from each tubes were checked by the oscilloscope. The signal rates which is considered as incidence of the cosmic-ray were measured. These data were compared with the data which was taken before the disaster. The detail checking procedure was described in the reference[4]. All the panel test was completed on Feb. 2nd 1999. Two HV channels were found newly sparking under the normal operation voltages. We are expecting they will recover with further conditioning.

The dust and mud, which were carried in by the water, still stay in the secondary volumes. They can not be removed since most of the panels are buried in between absorber steal palates and the secondary volume of the panels are inaccessible position in their installed.

To prevent the further flood the drain pumps in the IR were setup permanently and an improvement of the landscaping around the IR was done to minimize the possible water-flow into the IR.

The outstanding requirements of the MUID gas system are in the followings.

1. Large volume of gas ($50\mathrm{m}^3$) and flow rate ($17l/min$).
2. Large number of segmentation of the gas volume.
3. Widely scattered location of the panels in the PHENIX IR.

4. Need to supply primary gas (pure CO_2, CO_2-iC_4H_{10} mixture which is up to 25 percent flammable fraction) and the secondary gas (dry air or N_2).

Fig.1 shows the schematic diagram of our gas system. The system has two major parts. One is sitting in the IR and the other is in mixing house which locates outside of the building of the IR. The mixing house contains the gas supply and recirculation system. The large fraction of the gas piping is in the IR.

The CO_2 and iC_4H_{10} are fed to the south and north arm chamber through the mass flow controllers which regulate the mixing rate and flow rate.. Up to half of the chamber gas is recirculated through the compressor and purifier. The remains are exhausted into the atmosphere in the safe manner. The gas qualities, which concern the chamber performance, at inlet and outlet are periodically monitored by the analyzers. When the quality of the gas degrades, the system detects it and assert a waring signal. If the degradation is in the fatal level, it will shuts off the HV supplied to the chambers in order to avoid the catastrophic failure.

The purpose of flowing the secondary gas is two fold. One is to keep the volume clean and dry. The other is to dilute and purge the leakage of primary flammable gas. The leak rate from the chamber volume is estimated to be 10 percents of the total flow in maximum even without catastrophic failure. The nitrogen gas is sucked from the secondary volume and monitored its flammability by the nitrogen sniffing system periodically. If the iC_4H_{10} fraction in the sniffing nitrogen exceeds 25 percent of the lowest explosion limit(LEL), the flow of iC4H10 will be shut off as well as high voltage and low voltage power shutting off.

The analyzers, sensors which are pressure gauges, flow meters, and solenoid valves to open/close each gas circuits are remotely controlled by a PC in the mixing house. The PC will maintain the system.

The design of the gas system is reviewed by the RHIC safety committee. The main concern of the committee was preventing the possible fire hazard. The parts in flammable gas flow line and the parts where are close enough to the flammable gas line must not has possible ignition source. The time period for flammability increase in the secondary by the catastrophic leak was estimated. It takes 70 minutes to reach the 25 percent of the LEL. We designed that the nitrogen sniffing interval period for each monitoring points is 30 minutes. The system can detect the leak well before it will be dangerous. The gas flow indicators are monitoring the difference between inlet flow and outlet flow rate and will be able to warn the possible leak. It has been started the construction. The major piping between the mixing house and th IR was completed.

Fig. 1. Fig.1 Schetmatic view of the MUID gas system.

References

1) H. En'yo et al. :*RIKEN Accel. Prog, Rep.*, **30**,

34(1996).

2) Y. Mao et al.,: *RIKEN Accel. Prog, Rep.*, **30**, 36(1996).

3) A. Taketani et al.,: *RIKEN Accel. Prog, Rep.*, **31**, 172(1997).

4) A. Taketani et al.,: *RIKEN Accel. Prog, Rep.*, **32**, 50(1999).

K. Kurita et al.,:*RIKEN Accel. Prog, Rep.*, **32**, 32(1999).

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