**Discussion on noise issues of BESIII tracker system**

**(Dec.2, 2024) 14:00 - 17:50pm (Beijing Time)**

* Indico page: <https://indico.ihep.ac.cn/event/24374/>
* Participants:
  1. Invited experts

Huayi Sheng, Peiliang Wang, Jinfan Chang, Wang Zheng, Yuanbo Chen, Kejun Zhu, Xiaoshan Jiang, Yunbing Zhao

* 1. Participants from the project team

Gianluigi Cibinetto, Giulio Mezzadri, Michela Greco, Qun Ouyag, Mingyi Dong, Yunhua Sun, Jing Dong, Liangchenglong Jin, Zhi Wu, Linghui Wu, Gong Wenxuan, Xiaolu Ji, Liangliang Wang, Fei Li, Yinhong Zhang, Dai Hongliang, Si Ma, Tingxuan Zeng

**Mingyi Dong, on behalf of the project team, introduced the current noise issues in the stepped part of the outer drift chamber and the tests in the past two weeks (**[**Slides**](https://indico.ihep.ac.cn/event/24374/contributions/174983/attachments/85725/109784/Noise%20issues%20of%20MDC%20after%20installation%20of%20CGEM%20IT_20241202.pdf)**)**

**Summary of the slides：**

1. **In the joint testing of CGEM and MDC, both detectors can work well with nominal voltage, but noise was found in MDC during the joint test.**
   1. The noise is in the step part of the MDC
   2. The inner layers are larger, and the outer layers become smaller
   3. Noise mainly impact on Time measurement, almost no impacts on Charge measurement
   4. Noise has a larger impact on the even layers of MDC (readout electronics is at the east end)
   5. Even if CGEM is powered off, there are still some channels with noise.
2. **Lots of tests have been done in the last two weeks**
   1. Grounding tests:
      1. Different grounding connections of CGEM
      2. Different grounding connections between CGEM and MDC
      3. Disconnecting the preamplifier of MDC from the “tower” ground
      4. Removing the patch cards of CGEM from one or two “tower”
   2. Shielding tests:
      1. Adding shielding boxes for MDC preamplifier boards
      2. Adding shielding layers for the end of CGEM signal cables
      3. Installation the final shielding plates for CGEM and MDC
   3. Noise waveform tests:
      1. Testing the signals from daughter board of MDC MQT with a oscilloscope (good channel and noisy channels)
   4. Threshold scan:
      1. Measuring the noise count rate with different MDC time threshold
   5. On the morning of Dec.2, powered off accelerators and other related equipment one by one to search for the base line noise sources，but no related noise source was found (everything was powered off, baseline noise still existed )
3. **Test results**
   1. The grounding and shielding that have been carried out so far have no significant effect on reducing noise
   2. The ground the CGEM is separated from MDC at the front end (the resistance between them is about 350 kΩ when the crates of the CGEM is disconnected from the ground)
   3. As each device in the CGEM system is powered off and disconnected from the ground one by one, the noise of MDC becomes smaller and smaller
   4. Compared to the case before CGEM installation, there is baseline noise because even if CGEM is powered off, there are still some channels with noise present, but the baseline noise is not serious.
   5. The baseline noise does not seem to come from CGEM, as it disappeared between 14:00-16:00 on Nov.19. No operation related to this change was found (SCQ testing system, SSM, interlock door).
   6. When CGEM is powered on, the noise become very serious, and even if the T threshold is increased by 2.5 times, the noise count rate is still very high.

**Discussion and comments:**

After discussions among the expert group regarding the preliminary experimental test results, it was confirmed that the noise source was closely related to the CGEM detector. To solve the noise issues, the proposed solution is as follows: First, completely remove all the patch cards of the CGEM detectors which are mounted on the preamplifier “towers” of the MDC, and then conduct noise testing experiments. Next, the Italian group need to design shielding covers to fully shield the patch cards when they are reinstalled, while the Chinese group also need to consider improving the shielding for the preamplifiers in the stepped part of the MDC. This solution was unanimously approved by all the experts, who agreed it was the clearest and most feasible option.

The expert group also recommends that the Italian group quickly finalize the removal plan and required time, and provide complete design drawings of the shielding covers, while the Chinese group would provide full support in the manufacturing of the shielding covers and dismounting and reinstalling of the CGEM patch cards.

**Additional tests on Dec.3**

In the test on Dec.3, the baseline noise disappeared again between 13:00-16:30. We checked the cryogenic system, superconducting magnet system, and utility system, but did not find any noise sources.

In the absence of baseline noise, when CGEM was powered on, there was still significant noise in the stepped part of MDC. Therefore, it can be determined that the noise comes from two sources, one is CGEM and the other is other devices. The former is very serious and affects normal operation.