

Memo: Plan for detector and DAQ preparation on the HRS detectors for fall 2018

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1 Detector Work

1.1 Must

1. LHRS GC PMT 3 investigation

- **Leading Person:** Bogdan, Florian
- **Manpower:** 2-3 people
- **When:** Investigation should be start as soon as possible
- **Funds:** Spare PMT is available, only manpower necessary
- **Description:** The pedestal of PMT 3 (counting from 0) of the Gas Cherenkov detector was very flaky. It is still unclear what causes this behavior. It could be either light leaks, problem with the PMT or something on the cable line to the ADCs. We need to investigate this. Checking the cable and light leaks are easy tasks; the replacement of the PMT is an advanced one.

2. RHRS Installation of Aerogels

- **Leading Person:** Jack
- **Manpower:** Jack and Techs for hardware installation, students for cable installation to DAQ
- **When:** As soon as possible to check aerogel after installation
- **Funds:** Possible investments in cables, aerogels are available
- **Description:** The aerogel detector has to be installed for (e,e'K) on the RHRS. This involved HV cables and HV modules for positive voltage output as well as signal cables. The installation of the cables is an easy task, however the installation itself is more complicated. The detector stack has to be moved out of the hut to the platform.

3. RHRS Modification of GC box

- **Leading Person:** Jack
- **Manpower:** Jack and Techs
- **When:** Before installation of aerogel detector
- **Funds:**

- **Description:** The size of the GC must be decreased to have enough space for the installation of both aerogel detectors for (e'K).

4. RHRS Shower Channels

- **Leading Person:** Bogdan
- **Manpower:** Bogdan, Florian or Evan and probably 1 student for investigation
- **When:** As soon as possible so that replacements can be done when detector stack is out for aerogel installation
- **Funds:** Spare PMTs are available, only manpower necessary
- **Description:** We had two shower channels with flaky and broad pedestals in December 2017. After reducing the HV by 50V these channels were fine through the whole spring run period. However, we don't know what was the root cause. It might come back in fall if the PMTs are slowly degrading. Since these PMTs are in the central acceptance for the calorimeter, we should investigate and maybe replace them.

5. RHRS Removal of Straw chamber

- **Leading Person:** Jack
- **Manpower:** Jack and Techs
- **When:** Before installation of aerogel detectors
- **Funds:** -
- **Description:** The straw chamber on the RHRS has to be removed to have place for the aerogel installation. This task has to be done with the detector stack out on the platform.

1.2 Should

1. LHRS Remnants of EDTM mixing board

- **Leading Person:** Bogdan, Florian
- **Manpower:** 1-2 students + leading person, support from electronic workshop for new splitter, support from Jack and Techs if stack will be put out to the platform for easier installation.
- **When:** Installation when new splitters are produced, possibly together with S2 cable adjustment work
- **Funds:** Build of two new splitter for raw PMT signals

- **Description:** The former EDTM mixing boards are installed next to the S2 detector. Since we removed the EDTM modules in the VME crates, one input of these mixing boards is currently connected to open cables. These cables should be removed and simple splitting boards for the raw PMT signals should be installed.

2. S2 cable adjustments

- **Leading Person:** Bogdan, Florian
- **Manpower:** 1-2 students for analysis and installation
- **When:** Software analysis to determine offsets as soon as possible, installation of extra cables when stack is out on the platform for better accessibility or when new splitter are installed on LHRS (see previous task).
- **Funds:** Short cables necessary, should be available
- **Description:** The cables on the right PMT side of the S2 detector on each arm should be adjusted so that the signals are coming better aligned in time. This reduces jitter on the common stop induced by the difference between the separate paddles.

3. Interconnection Cables between arms

- **Leading Person:** Jack
- **Manpower:** Jack and Techs
- **When:** 3-4 weeks before starting of the run, so that cables can be tested.
- **Funds:** The ribbon cable and two BNC/BNC cables have to probably be made/bought. The costs are about \$500. The cables are the same to the current installed ones.
- **Description:** For the coincidence experiment, we didn't have a spare Ribbon cable for the communication of the Trigger Supervisor on one arm with the crates on the other side. Furthermore, there was no spare BNC/BNC cable left between both arms. Therefore, we should install another Ribbon cable and 2 more BNC/BNC cables between the arms which would go through the Pivot point.

1.3 Like

1. Cherenkov Internal Reflection?

- **Leading Person:** Bogdan, Florian
- **Manpower:** Bogdan, Florian and 1 student
- **When:** RHRS: when GC box is open, LHRS: when GC PMT 3 problem is investigated.

- **Funds:** Only manpower necessary
- **Description:** During the run period, we saw a second time peak in all Cherenkov spectra correlated with low ADC values. The second peak is not vanishing with tight PID and acceptance cuts. These was also observed by GMP. A possible explanation could be internal reflexion of photons on the bottom side of the Cherenkov detector which create another delayed signal. We could look inside the Cherenkov and check if there is a reflecting surface on the bottom side where the detector was extended.

2. Check of delay line connections on patch panels

- **Leading Person:** Bogdan, Florian or Evan
- **Manpower:** as leading + 1-2 student support
- **When:** After hardware modifications and after FADC installation for calorimeter is possible.
- **Funds:** If connectors needs to be replaced it might cost about \$100-200 for spare connectors.
- **Description:** We changed several delay lines for the calorimeter on both arms but we couldn't improve the pedestal width on all of them. Furthermore, we observed changes of "good" and "bad" channels when we played with neighboring channels. We think that most problems are coming from the patch panel connections of the delay lines behind the top electronic racks. This could be checked more carefully and connectors could be replaced.

3. LHRS Removing of Straw chamber

- **Leading Person:** Jack
- **Manpower:** Jack and the Techs
- **When:** When left stack is out
- **Funds:** Manpower
- **Description:** Since we remove the straw chamber on the RHRS, we could also remove it on the LHRS to have less material in the way.

2 DAQ Work

2.1 Must

1. Setup of Trigger and Delays for the upcoming experiments
 - **Leading Person:** Florian, Bogdan
 - **Manpower:** Florian + 1-2 students (Shujie and e'K?)

- **When:** Anytime after e'K finalize their trigger design but at least 4-5 weeks before starting in fall
- **Funds:** Manpower
- **Description:** The trigger system needs to be updated for the requirements of the upcoming experiments. Furthermore, the coincidence trigger needs some detailed testing with random pulses and clock.

2. RHRS: Installation of FADCs for Aerogel (total 50 channels)

- **Leading Person:** Jack, Alex
- **Manpower:** Jack, Alex, Florian and students
- **When:** After aerogel is installed
- **Funds:** 3 more FADC boards are required for both aerogels. We have two spares available so one more has to be bought for \$5000. Extra funds might be necessary for HV and signal cables.
- **Description:** Installation of sufficient FADCs boards for the aerogel channels. Both aerogels have a total of 50 channels. That requires 3 FADCs since we have two spare channels.

3. Reference Signal for FADC

- **Leading Person:** Florian, Bogdan
- **Manpower:** Florian and 1-2 students
- **When:** May-June anytime
- **Funds:** Manpower
- **Description:** An intensive test with the reference signal for the FADCs should be done to ensure that we can run with threshold in fall and that the time information from the FADCs are correct.

4. Delay of reference signal for FADCs and F1-TDCs

- **Leading Person:** Florian, Bogdan
- **Manpower:** Florian and 1 student
- **When:** May-June anytime
- **Funds:** Manpower
- **Description:** The current setup should be checked if the reference signal input for the FADCs and F1-TDC comes early enough before the L1A trigger signal to readout the boards.

2.2 Should

1. Check of Scaler Clear signal

- **Leading Person:** Florian
- **Manpower:** Florian and 1 student
- **When:** Before finalizing the DAQ setup
- **Funds:** -
- **Description:** During the (e'p) experiment, we had to exchange the polarity of two scaler gate signals on the LHRS so that the scalers are working again. The main reason for this is not fully understood. The cables should be checked for a wrong polarity.

2. RHRS Scaler ROC

- **Leading Person:** Florian
- **Manpower:** 1 person
- **When:** Anytime
- **Funds:** One cable, should be available
- **Description:** One scaler on the RHRS side doesn't have a sync clock cable connected. We should add this.

3. Fastbus ADC gate only for calorimeter and Raster/BPM

- **Leading Person:** Florian, Bogdan
- **Manpower:** 1 person
- **When:** Anytime
- **Funds:** -
- **Description:** The timing of the FB ADC gate for the calorimeter with respect to GC/S0 was slightly off and required a wide gate. Since we have the GC/S0 signals in the FADCs we can unplug them from the FB ADCs and use only a common gate for the calorimeter which can be well adjusted and smaller. The FB ADC with the raster and BPMs signals will still get another shorter (50ns) gate.

2.3 Like

1. FADCs for all LHRS calorimeter channels (70 channels)

- **Leading Person:** Bogdan, Alex, Florian
- **Manpower:** Leading persons + 1-2 students

- **When:** Before finalizing the DAQ setup, better sooner than later (other tasks could be skipped)
- **Funds:** 5 FADCs are necessary to connect all LHRS calorimeter channels which would be about $5 \times \$5500 = \$27,500$. In addition, we might need cables to connect the calorimeter directly with the FADCs which would be around $70 \times \$40 = \2800 . Thus the total costs are about \$30,000.
- **Description:** We could add 5 more FADCs on the LHRS to connect all calorimeter channels with the FADCs. In this way the old delay lines could be bypassed and the FB ADC crate could be removed from the DAQ to increase the read out speed. Furthermore, the ADC gate alignment for the calorimeter is easier and one could also get additional timing information if necessary.

2. FADCs for RHRS preshower channels (48 channels)

- **Leading Person:** Bogdan, Alex, Florian
- **Manpower:** Leading persons + 1-2 students
- **When:** Before finalizing the DAQ setup, better sooner than later (other tasks could be skipped)
- **Funds:** 3 FADCs are necessary to connect all RHRS preshower channels which would be about $3 \times \$5500 = \$16,500$. In addition, we might need cables to connect the calorimeter directly with the FADCs which would be around $50 \times \$40 = \2000 . Thus the total costs are about \$19,000.
- **Description:** We could add 3 more FADCs on the RHRS to connect all preshower channels with the FADCs. In this way the old delay lines could be bypassed and possibly reused for the shower counter. Furthermore, the ADC gate alignment for the preshower is easier and one could also get additional timing information if necessary.

2.4 Optional, if absolutely necessary by (e'K)

1. RHRS: Aerogel Signal summing

- **Leading Person:** Bogdan, Florian and/or Evan?
- **Manpower:** (e'K) students
- **When:** Before finalizing the DAQ setup
- **Funds:** Needs maybe some investment in required modules and cables
- **Description:** Dependent on the availability of modules and requirements of (e'K), signal splitting and hardware summing of the aerogel signals. Needs maybe some investment in required modules and cables. Otherwise connection of the extra hardware with cables is easy.