1 Open Challenges

1.1 Calibration LED

In order to provide ongoing performance monitoring LED's on the sensor boards are meant to be flashed. The resulting signal can be used to determine the time resolution or potential SiPM gain changes. The optimal electric pulse to produce the ideal LED signal was subject to investigation as part of a masters thesis. This project however was never finished and the question of the ideal LED driver remains to be determined.

1.2 Front End Electronics

The Front End Electronics is still to a large part undefined. The base of it is foreseen to be built around the TOFPET ASIC by PETsys. This however would not deliver a complete system on its own. Components of the FEE that would still need to be integrated are the

- Temperature sensor control,
- Calibration LED control.

The temperature sensor can easily be controlled and communicated with by a micro controller or via an FPGA. The internal FPGA of the TOFPET FEB/D would be a suitable candidate to take over these duties if it can spare some computing capacity. The FEB/D already communicates with the temperature sensors in the FEB/A, so it should be possible to extend this functionality towards additional sensors along the Rail-Board.

The LED control seems fairly simple but depends on the implementation of the calibration LED's. If they are simply installed as is, the electronics are only required to provide a sharp electric pulse to drive the LED's for a split second to produce a short burst of light.

1.3 Rail-Board Split

The question whether the split of the Rail-Board is necessary remains to be answered. It was considered an option in order to be able to use RO4003C a low loss PCB substrate material which does not come in sheets larger than about 1 m. The reduced signal amplitude losses are negligible however since the dielectric constant is smaller than for FR-4 we are able to use less material reducing the material budget. It remains to be seen if the connectors between the front and back part of the Rail-Board has any adverse effects on the time resolution of the detector. If no such negative effects manifest the board with RO4003C is to be preferred.

1.4 Sensor-BoardBehavior

While performing measurements with the flexible Sensor-Boards some unexpected behavior was observed. The signal pulse shapes can be distorted depending on how bent the flex board is, with reflections on the line, some of which are stronger than others. These measurements however were done with unoptimized board dimension, since the influence of bending the flex boards and the resulting layout change might affect the characteristic impedance. Test on whether the behavior persists and how to mitigate the distortions are still pending and subject to further investigation.

1.5 Finalize Carbon Frame Design

A prototype carbon frame has been produced and is available however it is not well optimized and it has not been checked for its light tightness. Other designs with more sophisticated parts might be an improvement.

1.6 Implement Cooling Solution

Only a conceptual understanding of the required cooling has been acquired. Once the FEE is finalized and the requirements for the cooling capacity are set, does it make sense to fully work out the cooling solution.

1.7 Build and Operate an (Almost) Fully Equipped Prototype

To make sure all system work the way they are intended it is required to build and operate an almost fully equipped prototype. The last goal of the group in Vienna is to build a system with the components available to date and equip it with five to ten scintillator tiles in order to show the current capabilities.

1.8 Calibration

The calibration of the detector still needs to be performed on a comprehensive level. This can partially be done in the lab with such things as the expected mean signal amplitude or the signal delay between event and time stamp in the FEE, and partially once it is setup in the experiment. The latter case includes the position calibration as an example.