Light source for the calibration system

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Calibration system is needed to

1. align the unknown PMT time response → use a light source to even out the times of arrival of the detected photons emitted in a short pulse

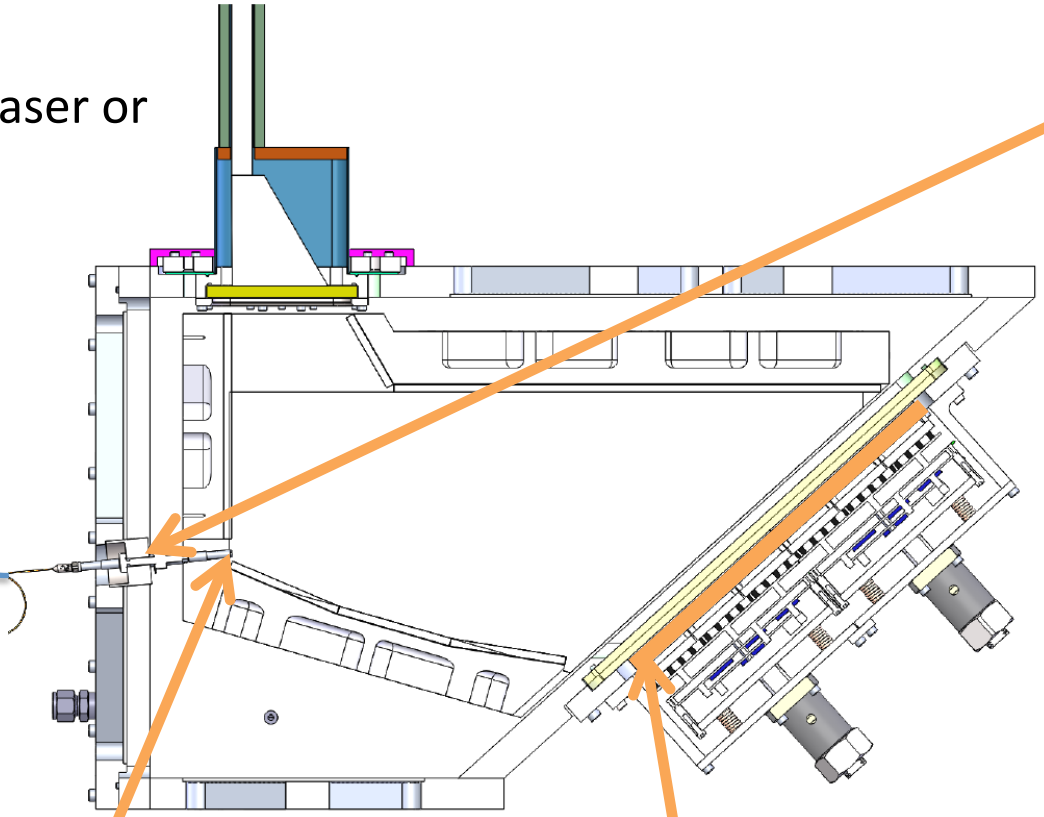
2. align the delays of the front end electronics and the control system → use real tracks to match the single Cherenkov photon timing measured by PMTs to the global track reconstruction

3. long term monitoring of gain and time scale of PMT+FEE+DAQ

Calibration system

Light source: laser or LED

Hermetic feedthrough from SEDI Fibres Optiques



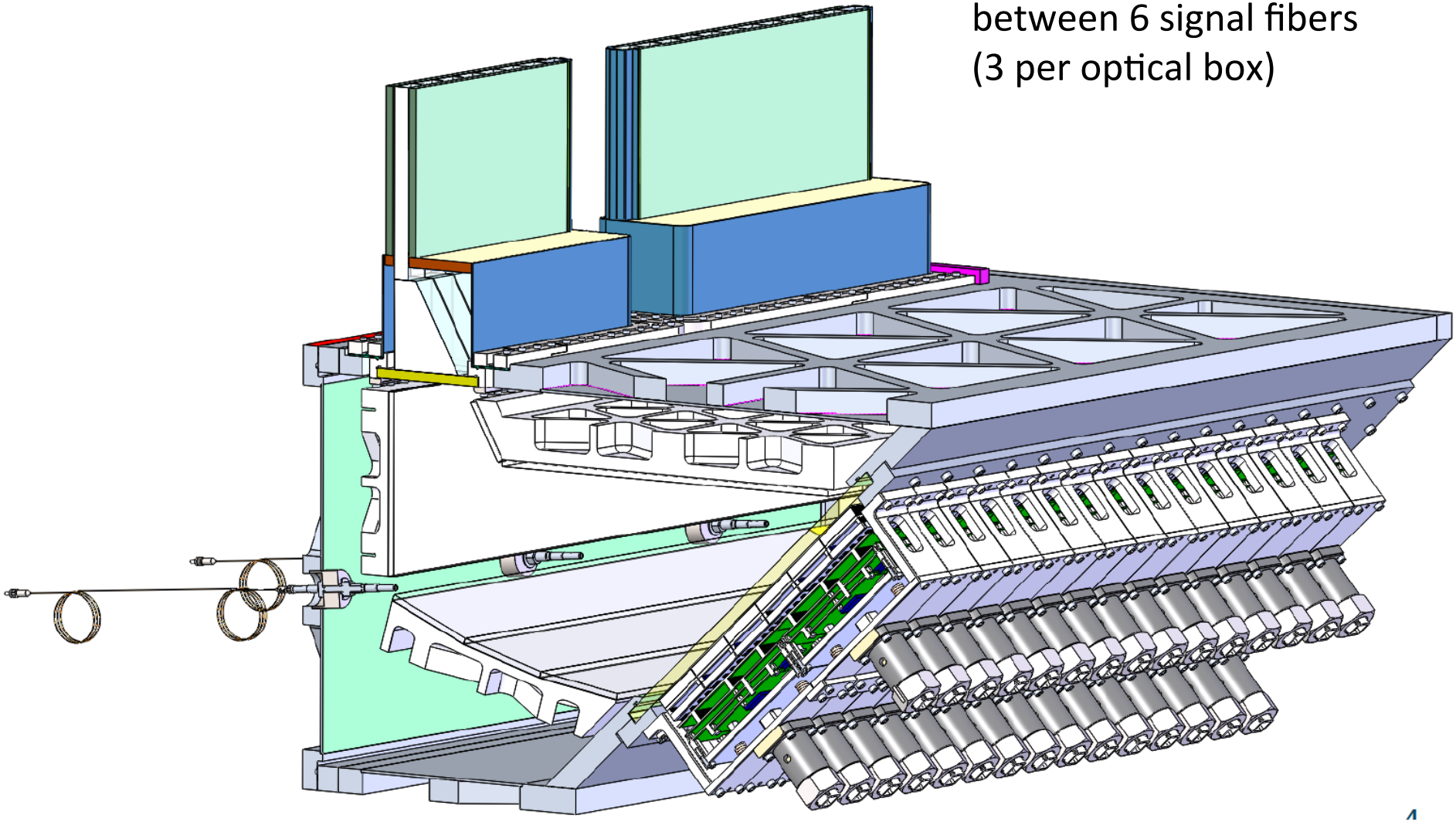
Optical fiber
~ several m

Pixelated photodetection plane
= array of MCP-PMTs

Light is emitted from the end of fiber and illuminating the photodetection plane

Calibration system

Light signal will be split between 6 signal fibers (3 per optical box)



Components of the calibration system

- Light source (laser or LED) with signal generator and slow control
- Optical fiber (several m)
- Light splitter and a diffuser
- GlueX DAQ

Laser (PiLas or PicoQuant) vs. LED (PicoQuant)

- Enough power to illuminate all pixels
- Good timing precision (time uncertainty due to differences in fiber lengths, time jitter, resolution of electronics) <= 1 ns
- Cost ~ 10-12 k

- Power (amount of generated light) can be a problem, depending on what rate we run on
- Large and unknown light loss at LED-fiber connection
- Timing precision ? (Avetik)
- Cost ? (GSI)

Some issues

- Two possible running modes: run continuously with low rate ~Hz (like calorimeters) or perform daily calibration runs. For BABAR DIRC and SLAC fDIRC – monitoring of T0 and occasional gain calibrations, no continuous running. Belle II TOP and ARICH do not plan continuous calibration

- Required timing resolutions (how precisely we have to know the moment of light pulse) can be investigated in simulation (GSI)

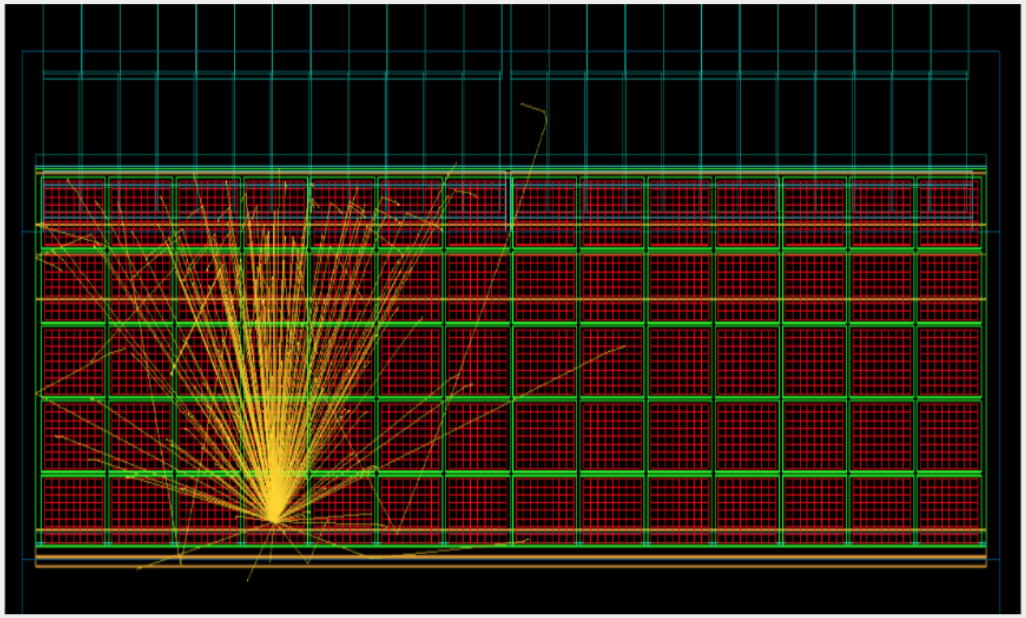
- What rate should we run on (depends on the amount of light per pulse/ second)?

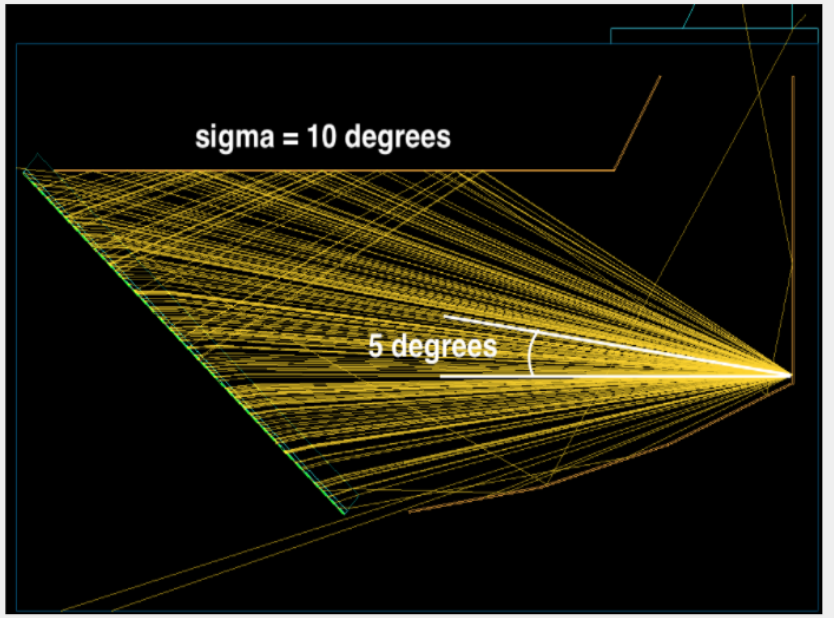
- Intensity stability (check with DAQ expert if there is pulse height/charge/ time-over-threshold info): locate light source in a temperature controlled and low radiation area, use reference counter(s)

- Interface to control the laser from outside (slow control) – Avetik?

Simulation of the light source

Assuming the light is emitted from the fiber end as a gaussian (sigma)



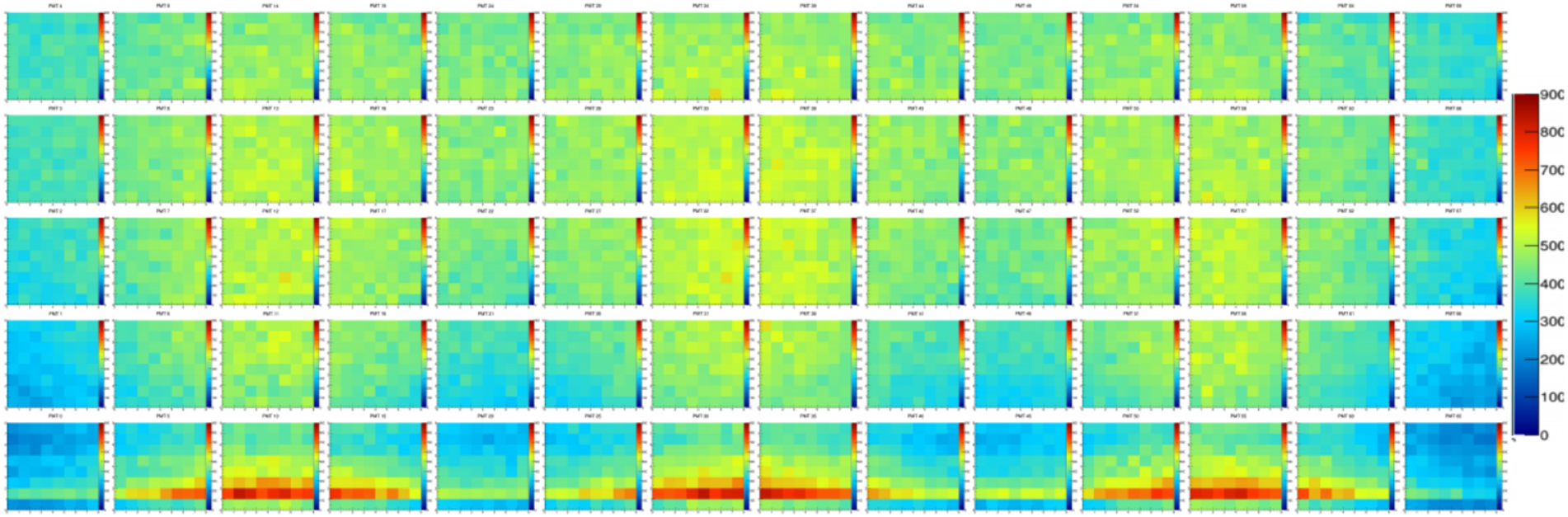


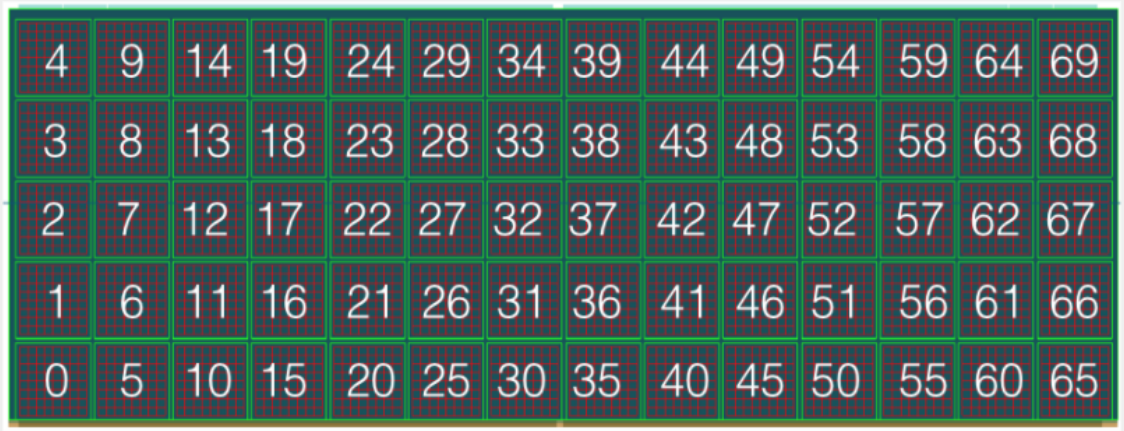
Final configuration:

- 3 fibers / box
- Sigma = 15 degrees
- Inclination = 6 degrees

Occupancy of the MCP-PMT plane

80% difference between the least and the most occupied pixels. 1M photons / fiber.





Update for 17 rows of PMTs!