

Status of the CEDAR Upgrade Project

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with contributions from other members of the CEDAR project

Introduction / Remainder

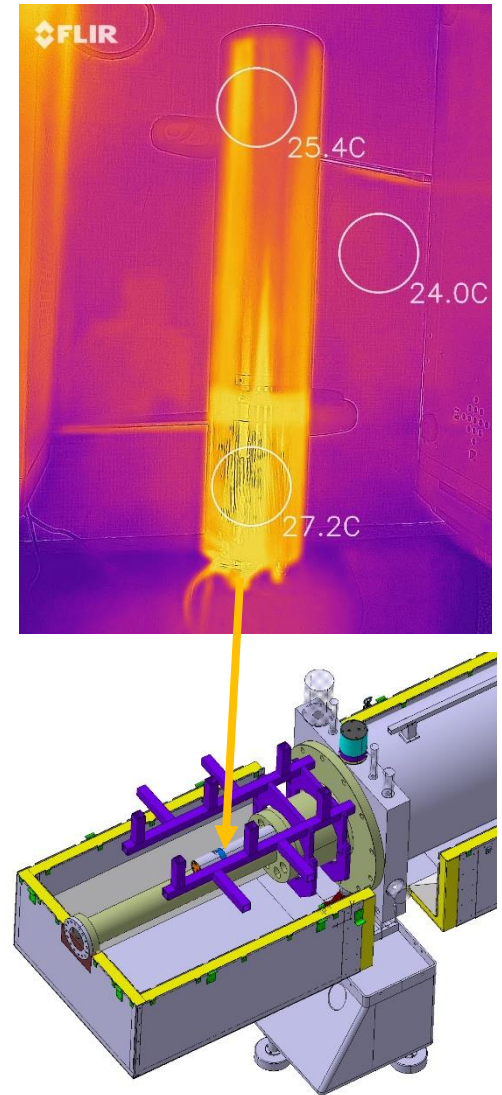
- Purpose of the project:
 - Modify CEDARS to withstand higher rate ($\approx 10^8$ particles/s)
- Project scope:
 - Photomultipliers / voltage dividers / front-ends
 - Readout (funding to be clarified)
 - Thermal system
 - Monitoring of PMT gain stability
- Who is involved:
 - Warsaw University of Technology (WUT)
 - INFN Torino
 - Academia Sinica Taipei
 - CERN

PMT Status

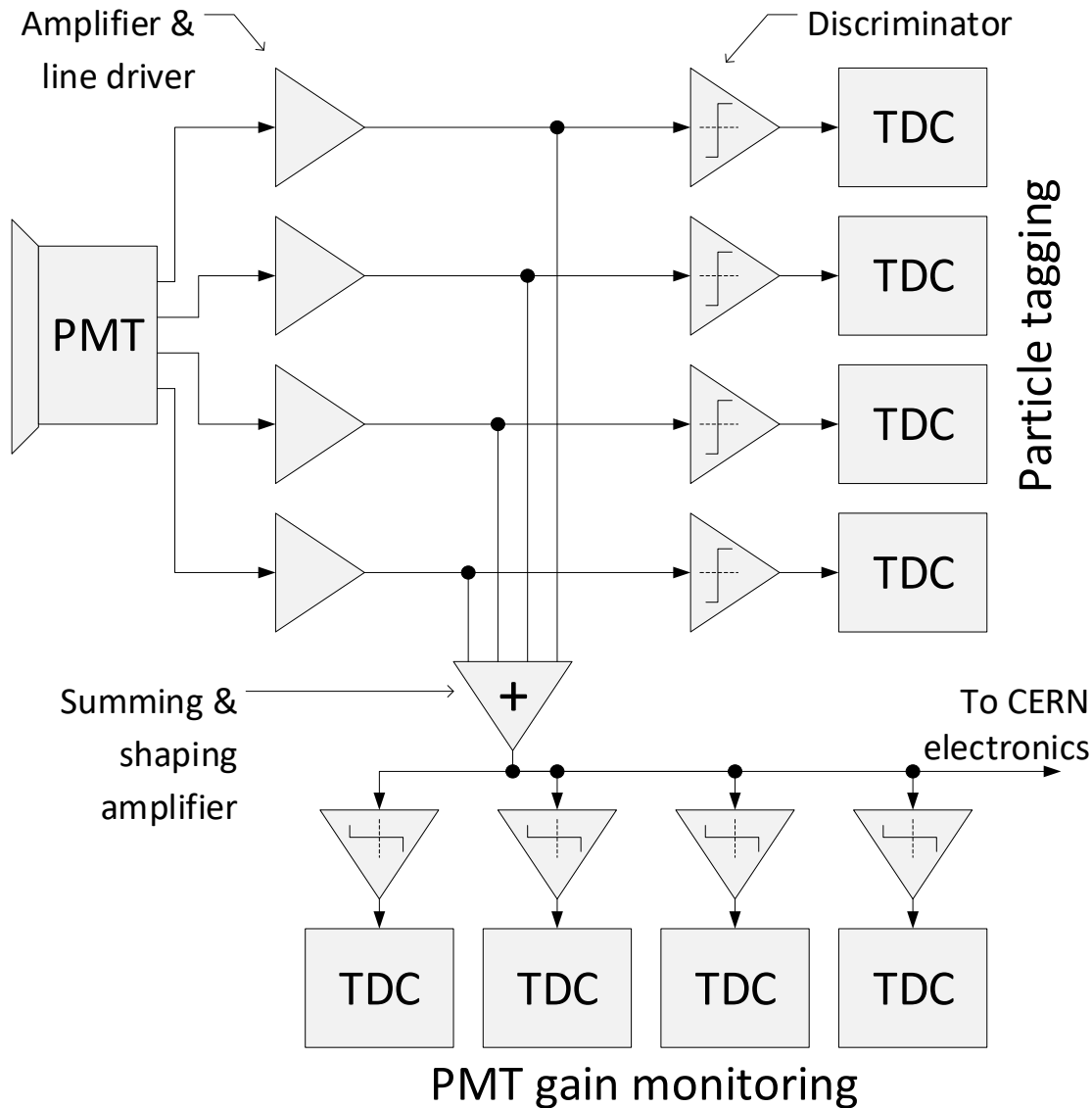
- Delivery
 - 2 units already in Warsaw, waiting for measurements
 - Remaining 16 units to be delivered in December (i.e. this month)
- Measurements & Characterization at WUT:
 - Time Interval Counter arrived at Warsaw, but is damaged
 - Broken potentiometers for threshold control
 - Patched with generic parts, but waiting for original replacement parts from manufacturer (but can measure, just a bit inconvenient)
 - Will fix in place, as no time to send for repair
 - Test stand completed, data taking planned for this week
 - Will test the PMT up to 40 MHz trigger rate, using UV laser (375 nm); surface scan also foreseen to check collection efficiency.
- Voltage divider will be designed once characterization is complete.

PMT Mechanics Status

- No external radiator needed – for 2.5 W the ferrule itself is a good-enough radiator (tested)
 - Picture shows temperatures without any airflow
 - Max. $\Delta T \approx 3^\circ\text{C}$, expect much less with airflow
- Currently purchasing a small 3D printer
- Intend to print prototype PMT mounting, check and then outsource ‘mass production’
 - Either machining or 3D printing
 - Backup solution – we have both CNC milling machine and professional 3D printer at the faculty – so maybe we’ll do everything in-house
 - Design to be completed by the end of the year
 - Need X,Y and Z movements (no need for motors, once we set up everything the PMT will stay in position forever)



Readout Status 1/3



- Baseline design:
 - Discriminator (fixed threshold) + TDC
- Particle tagging (pulse timing)
 - Fast channel
- Gain monitoring
 - Pulse amplitude/charge measurement
 - Multiple time-over-threshold technique
 - Only off-spill monitoring possible, as pulses need to be stretched and there is a significant risk of inaccuracy due to overlap

Readout Status 2/3

- Estimations of TDC specs (from Igor)
 - Possible to time both leading and trailing edge
 - Time bin ≈ 250 ps
 - Min. pulse width 4 ns
 - ≈ 500 EUR/32 channels
 - 1 unit in Jan 2018, remaining ???
- Discriminator
 - Designed & manufactured by WUT
 - Robert Kurjata almost finished schematic
 - Plan is to make 4-channel prototype and test with single PMT, incl. shaping for amplitude monitoring
 - This is urgent, as CERN people need this for their tests
 - Then replicate layout & schematic to a 32-channel board

Readout Status 3/3

- Discriminator & PMT amplifier
 - Connection via Cat 6A shielded twisted pair cable
 - Will test soon if it is OK; would appreciate advice on connectors.
- Need to decide on connection from discriminator to the TDC
- Need to decide on format and power supplies of the discriminator card (VME, something else?)
- Need information on transmission standard to CERN electronics (50 Ohm cable?)
- Will we be able to handle data rate from TDCs?
- Plans:
 - Prototype discriminator ready & tested with PMT and pre-amplifier first week of Jan.
 - Active divider designed in December, assembled and tested early January.
 - Working prototypes of divider and test discriminator to be sent to CERN for evaluation by BE-BI group.
 - Currently securing parts (mainly HV transistor for dividers and soon Ics for discriminator)

PMT Gain Monitoring

- Measure PMT gain using light pulses of constant intensity, in off-spill time
- Components:
 - Pulsed light source – calibrated 470nm LED flasher, same as used in ECAL0
 - Multimode fiber splitter
- Optical system currently on hold, no manpower to work on this. Will resume once layout of the discriminator prototype is sent for manufacturing & PMT characterization is complete.

CERN Group Status (from Johannes)

- We are preparing at the moment an ECR (Engineering Change Request) to document all planned changes to the CEDAR housing. The ECR will include cost estimates, a risk register and a technical justification. It will be presented at one of the upcoming IEFC (Injector and Experimental Facilities Committee) meetings.
- We are in contact with HSE for the planned Aerogel insulation. The material is not necessarily conform with fire safety requirements, so we need an assessment and possibly a derogation.
- The works on the housing are scheduled to start in January, we are at the moment procuring the necessary materials. Workshops and technicians are booked and all drawings are now available.

CERN Group Status (from Johannes)

- The BE-BI colleagues ask for a specification of the new electronics and PMTs. They are waiting for a prototype of PMT + voltage divider to check compatibility with their equipment. Otherwise they might not be able to commission their systems.
 - WUT working on that, will send in January.
 - Need to finish design of summing amplifier
- EN-CV has prepared the Ventilation System User Requirements document (EDMS 1867803). It includes the specifications for heat loads, circulation, insulation, ambient conditions, stability, normal operation and failure modes.
- A big thank you to Vladimir, Didier and the Torino colleagues for freeing the space on the platform above the BMS barrack. Now EN-CV will start with their preparations on site. There might be the possibility that we have to calculate the load capability of the platform before installation for HSE, to be confirmed.