A low intensity beam monitor for the CNAO exp. room

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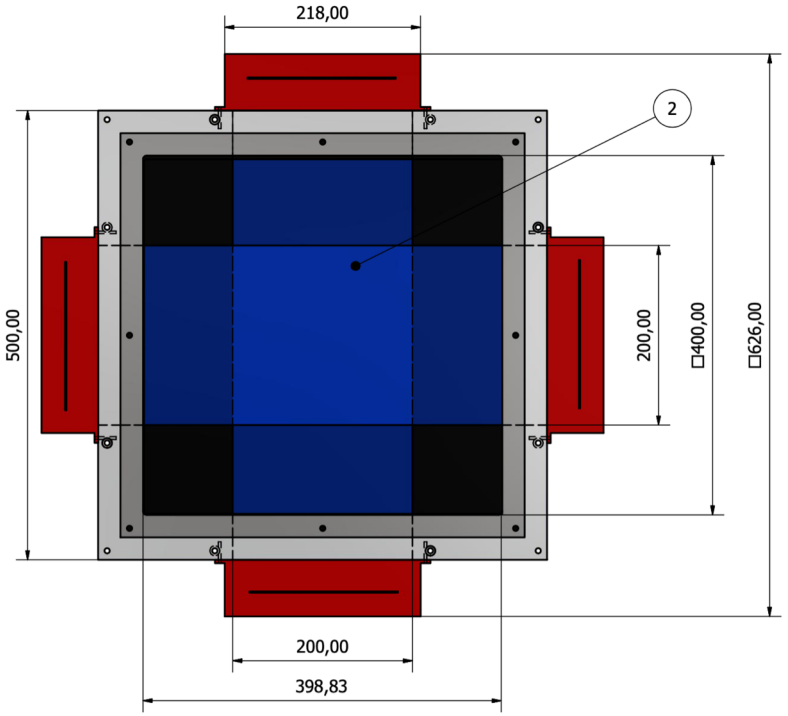
Aim

Provide a feedback to the research teams that are using the exp. room about the beam properties @ low intensity.

- Covering an active area of ~ 20x20 cm^2
- Providing feedback when the beam intensity is < 10^5 particle/s
  - Rate requirements need to be clarified. Current solution should handle rates up to few ten of kHz. Different requirements could be set for the rate monitoring and beam shape monitoring tasks.
- Providing feedback about the beam position with an experimental resolution on both views (x,y) of 1mm

Adopted technology

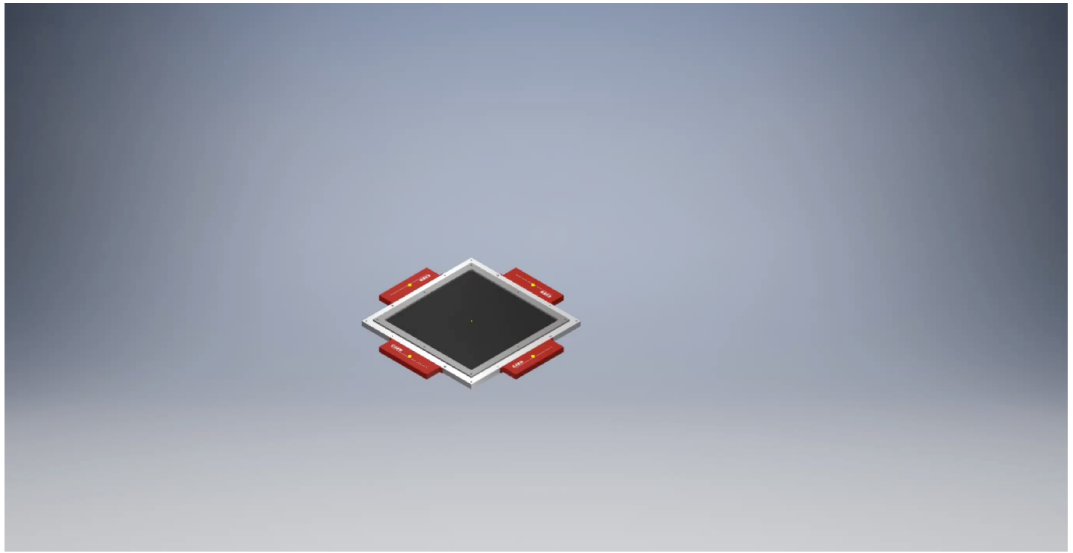
- Plastic scintillating fibers (squared, 500 µm side) readout by SIPMs. The SIPM dimension drives the resolution and the number of channels. Currently a 3x3mm solution is foreseen (resolution of 1mm).
- Active area: 20x20 cm^2
- Aluminum (or whatever else is preferred by RP) frame @ 25 cm from beam isocenter, holding the SIPMs and readout.
- In red the CAEN readout/powering boards are shown. Each board handles 32 channels.



A closer look

The ‘disassemblement’ of the detector is shown:

- Removal of CAEN cards
- Removal of darkening layer/frame
- Removal of aluminum frame
- Exposure of fiber layers



Better resolution could be achieved at the cost of doubling the electronic readout channels (~10/15k€ exp.) and reducing the SIPM dimension.

Readout and integration with room

The SIPMs powering and readout will be performed via a custom CAEN device: the DT5702 board, capable of handling 32 SiPMs, that provides also an embedded readout Front-End Board.

- **Test of rate capability of such device are ongoing @ SBAI**, as well as flexibility in performing trigger logic when daisy-chaining multiple boards. If the monitor needs to be operated at rates larger than 30 kHz or if the board shows unstable behaviour at the needed rates, a different readout technology will be implemented.

The board output is a signal that can be used as a trigger for a full event readout and an ethernet interface that can be fed to a DAQ PC that will implement the DAQ software and counters/ beam shape monitoring.

Materials procurement and time schedule

Next expenses:

- 7.5 k€ (CAEN BOARDS)
- 2.5 k€ Mechanical infrastructure
- 2-4 k€ (depending on the final fibre dimension): fibres
- 2.5 k€ SIPMs boards + dedicated handling of out signals via dedicated boards + interface with DAQ PC

Total: 12.5 – 16.5 k€

Time plan:

- Start material procurement ASAP. Expected 6 months for fibres procurement.
- Mechanical infrastructure and readout/DAQ implementation can proceed in parallel
- 6 more months are needed to
  - Assembly the detector
  - Test the readout and trigger implementation

- Requirements needs to be finalized ASAP (rate capability, resolution) in order to finalize the DAQ / readout scheme and technology.
- Once the details are defined, with ~15k€ [maybe more depending on the final resolution] and 1 year of work a low intensity monitor should be available in the CNAO exp. room