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Installation of Cherenkov detector in TT20 and connection to SPS-BIS

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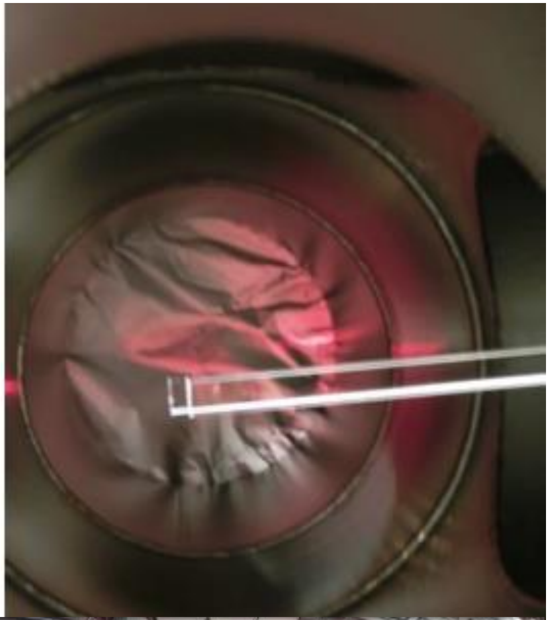
SPS slow extraction

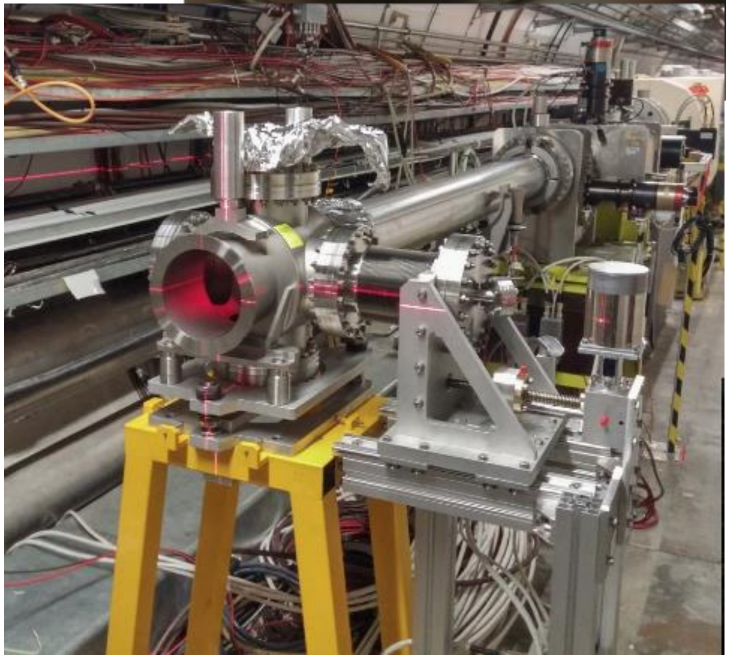
- The quality of the slow extraction spill in SPS is important for experiments:
  - Combinatorial background → Sensitivity
  - Assure design proton density on the target
- Autospill [1]: Iterative feed-forward system on the main quadrupoles to maintain a linear decrease of intensity in the ring.
- Remaining time structure in the spill:
  - from low frequencies up to 200 MHz
  - must be taken into account by the design of the SHiP experiment.

[1] V. Kain, Slow Extraction – Spill control with feedforward

Cherenkov detector

- A particle traversing a quartz bar at relativistic speed emits Cherenkov light
  - “prompt emission” proportional to the number of particles traversing the bar
  - light is collected by a fast PMT (overall time resolution < 2 ns)
- The Cherenkov detector for proton Flux Measurement (CpFM):
  - already used by UA9 to estimate the number of proton extracted by the crystal collimation setup in LSS5 (SPS-BSHV-EC-0001, EDMS 1365265)
  - can be used to monitoring of the time structure of the spill and provide feedback for its optimization (SPS-TQCD-EC-0001, EDMS 1562102)



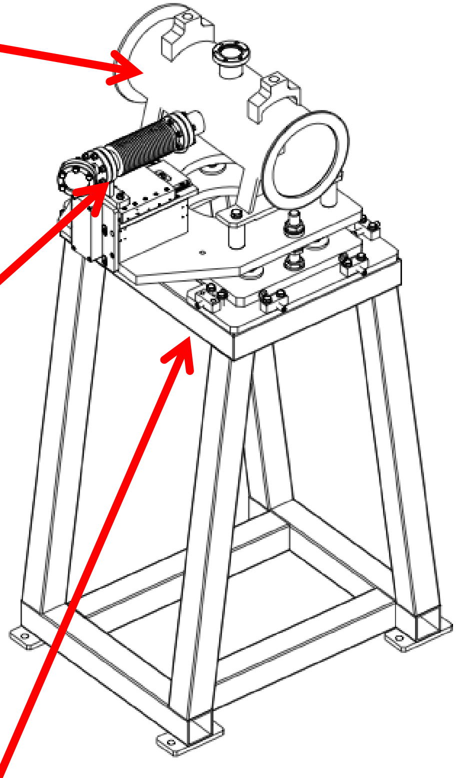


Components of the detector

Tank designed to match the standard SPS beam pipe.

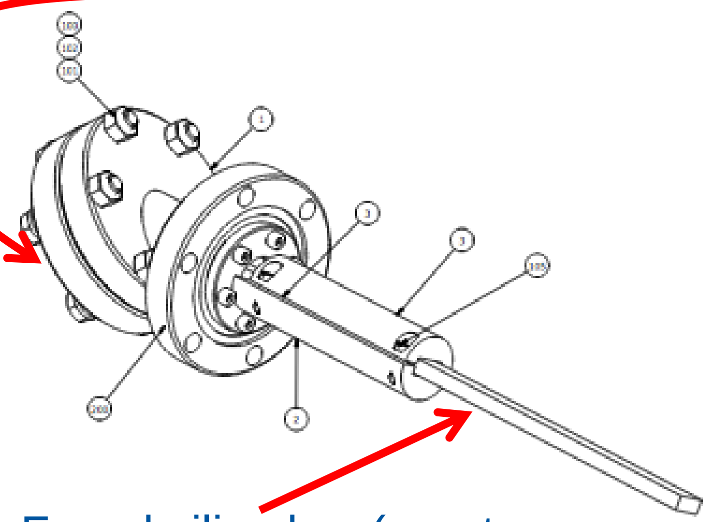
Motorized extensions to move the quartz bar towards the center of the pipe or in “garage position”.

To be connected with the SPS interlock system.



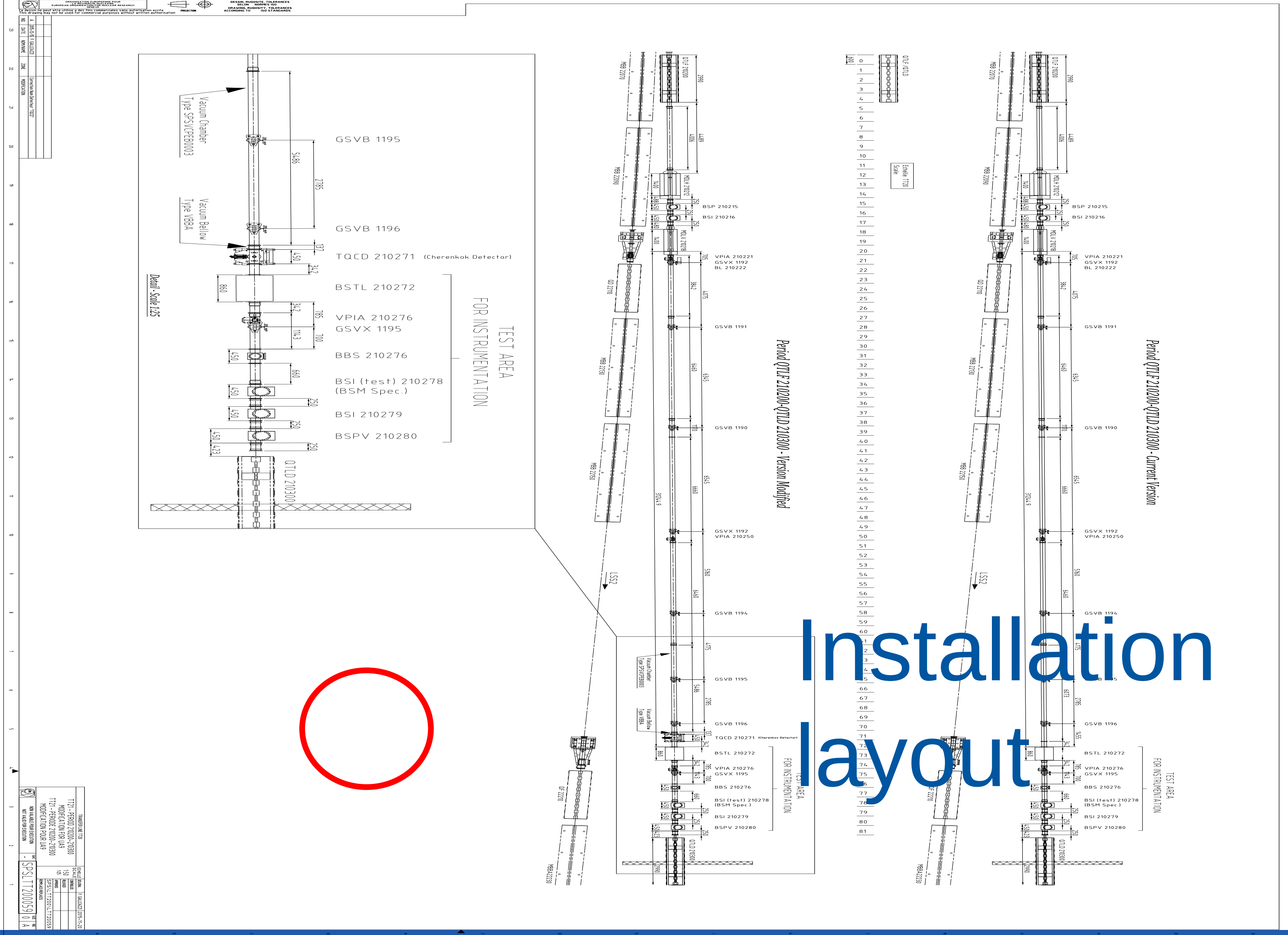
Mechanical support that allows vertical, transversal and longitudinal adjustment of the tank position.

A PMT that will be coupled to the optical window in order to collect the Cherenkov light.



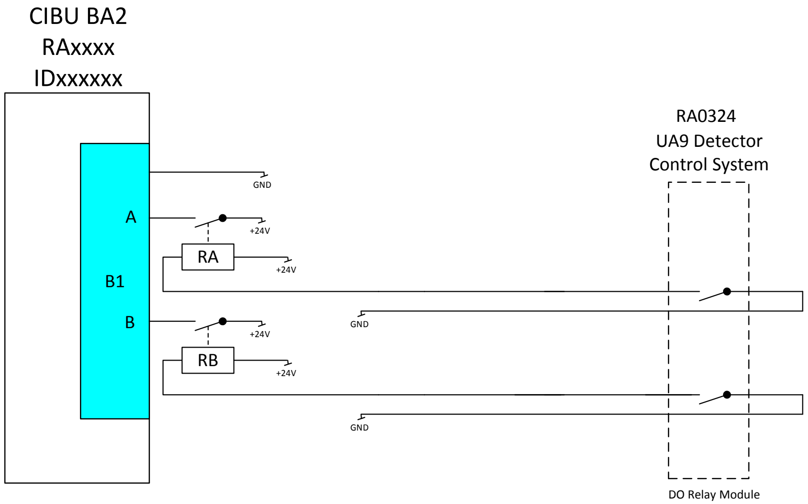
Fused silica bar (quartz radiator) to generates Cherenkov light.

Installation layout



Movable axis

- **The quartz bar is movable**:
  - can pass the centre of the beam pipe by 5 mm
  - nominal speed: 12 mm/s (motor speed: 1 turn/s, screw pitch: 12 mm)
    - will be reduced by ~ 10 times (i.e. to ~ 1 mm/s).
  - Microswitches define the “IN” and “OUT” positions
  - Information about the position of the axis (motor controller + LVDT) will provided to CCC using a FESA class.
- **The new device must be connected to the SPS interlock system**:
  - No beam allowed unless the device is in “out” position.
  - “Maskable” interlock to allow the operation of the device during dedicated runs.
  - The interlock will be modified in case the device becomes part of normal operations



Connection to the SPS-BIS

- TQCD will be **connected to one “maskable” input** of the SPS BA2 BIC
  - there is no dedicated BIS for TT20!
- When **TQCD is in not in the OUT position**, the corresponding “**User Permit**” provided to the CIBU is “**false**”:
  - if the BIC input is not “masked”, the SPS “Beam Permit” will be set to “false” and if a beam is circulating in the SPS, it will be send to the SPS Dump.
- It is **OP responsibility to mask** the TQCD input before moving it.
- It is **OP responsibility to remove the mask** in order to re-enable the TQCD input.

- In case of manipulation error, the beam is unconditionally sent to the SPS Dump.

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