Preparation of 2021 Test Beam for HERD Prototype at CERN

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Latest news about TB facilities at CERN

- On 12 June, the new schedule for the activities of Long Shutdown 2 (LS2) was unveiled, compared with last version(released on 2018)
  - four months delay of Run3
  - Run 3 will be extended by one year, until the end of 2024
- Restart of physics runs of TB facilities
  - North Area and HIE-ISOLDE (SPS): July 2021
  - East Area (PS): October 2021

4th beam test at 2021 - Objective confirmed

- PID capability and 5-side sensitive verification
- Solve the problems found at 3rd beam test
  - upgrade the IsCMOS
- CALO trigger definition, redundancy test
  - shell + core pattern
  - chessboard
- TRD performance test
  - standalone test with at EA PS beam line, e- around several GeV
  - combined with CALO prototype at NA SPS

TBD issues (IHEP side)

- Upgrade CALO prototype from 500 (5*5*20) LYSO crystals to 980 (7*7*20) array
  - upper limit of PID capability, TBD by MC
- Upgrade the encapsulation method of crystals
- Fiber routing/splitting configuration
- LED fast calibration for each crystal test

TBD issues (EU side)

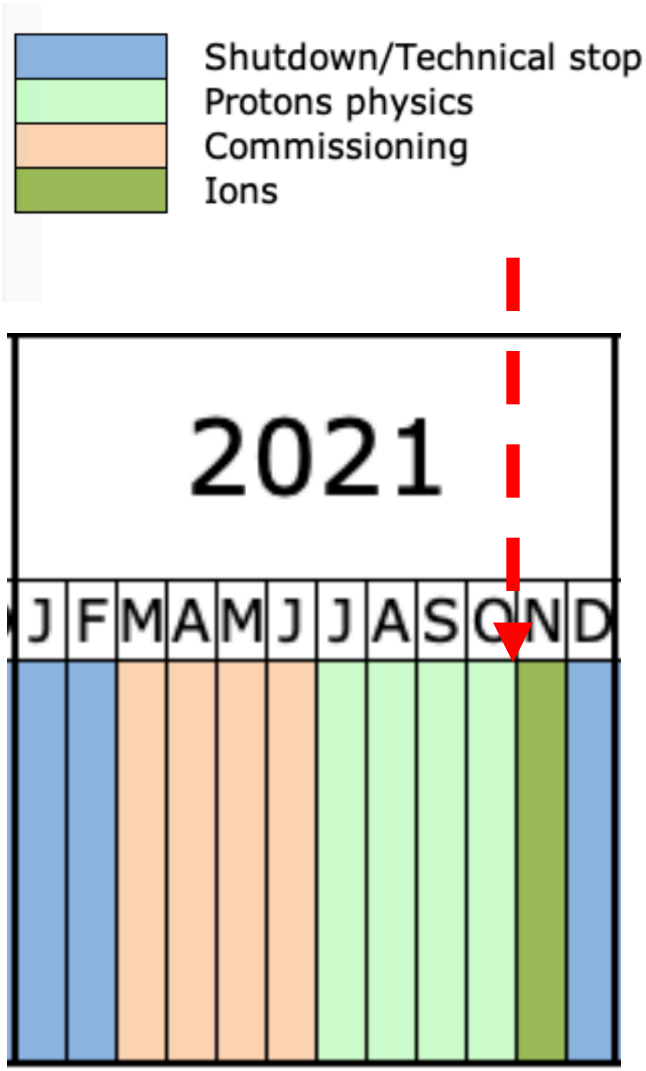
Warmly invite our EU colleagues for Joint test

- CALO dual readout?
- PSD bar/tile
- FIT
- Silicon tracker & SCD
- …

We could organize individual meetings for the joint test, the soon the better for the hardware cooperation, and at the same time to define beam site layout, beam trigger define and synchronization.

Preferred beam time (IHEP side)

- Late October or early November
  - continuous run for both proton and ion at SPS
  - TRD standalone run at PS 1 week before the SPS run
  - beam request will be submitted on October this year
    - competition after two years beam line shut down
    - uncertainty due to the virus

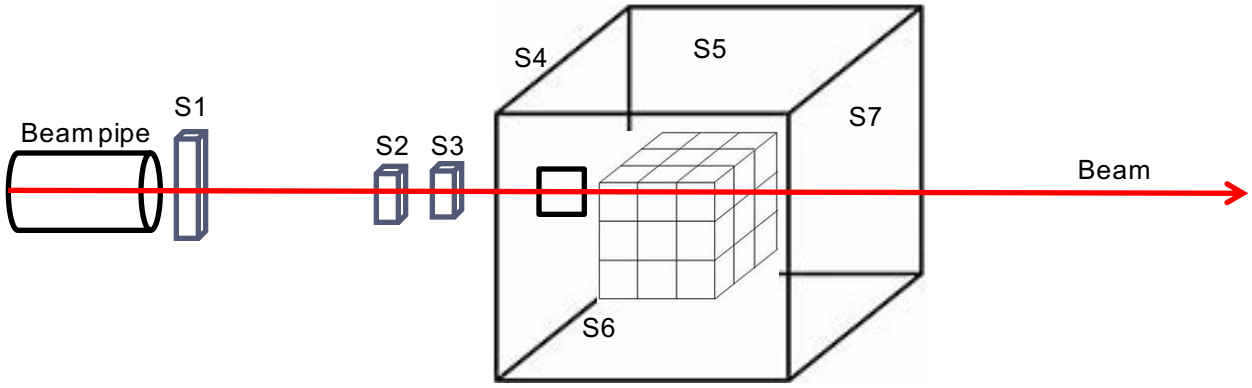


Beam requirement for CALO

- Particle type: electron, proton, charged hadrons; fragmented ions
- Particle momentum: several grid from 20 to 400 GeV
  - proton: primary proton 400 GeV/c
  - electron: 250, 200, 150, 100, 50, 20 GeV/c
  - charged muon: 120 GeV/c
- Beam intensity ~ 2000 particles / spill
- Trigger rate ~ 200 Hz
- Beam size: 1cm * 1cm
- EU colleagues take care of Ion beam coordination with beam line physicist
  - SCD, PSD, FIT

Hardware in site(2018)

Beam trigger



S1-S7 are plastic scintillator plates.
S1 – S3 provide trigger signals.
S4 – S7 provide veto signals
S4：bigger scintillator plate with a hole in front of CALO, veto none beam events
S5-S7, Scintillator plate surround CALO, veto non beam events

- TBD issue, needs carefully design due to shower leakage

The idea is that we keep S1-S3 the same as previous configuration(EU), and IHEP take care of S4-S7 (or S4 only). Or if it's not feasibly for the integrated test at beam site, we could discuss some other way of this scheme.

Trigger logic and synchronization

- Global trigger provided by S1-S7 and distributed by CALO trigger board to each sub system, and prompt veto signal feedback by CALO trigger board
  - 2 ms as the dead time of the camera for now, and adjustable
- All systems synchronized by event number
- IHEP take care of the CALO trigger board, and it'll be necessary we organize separated meetings to fix the technical details