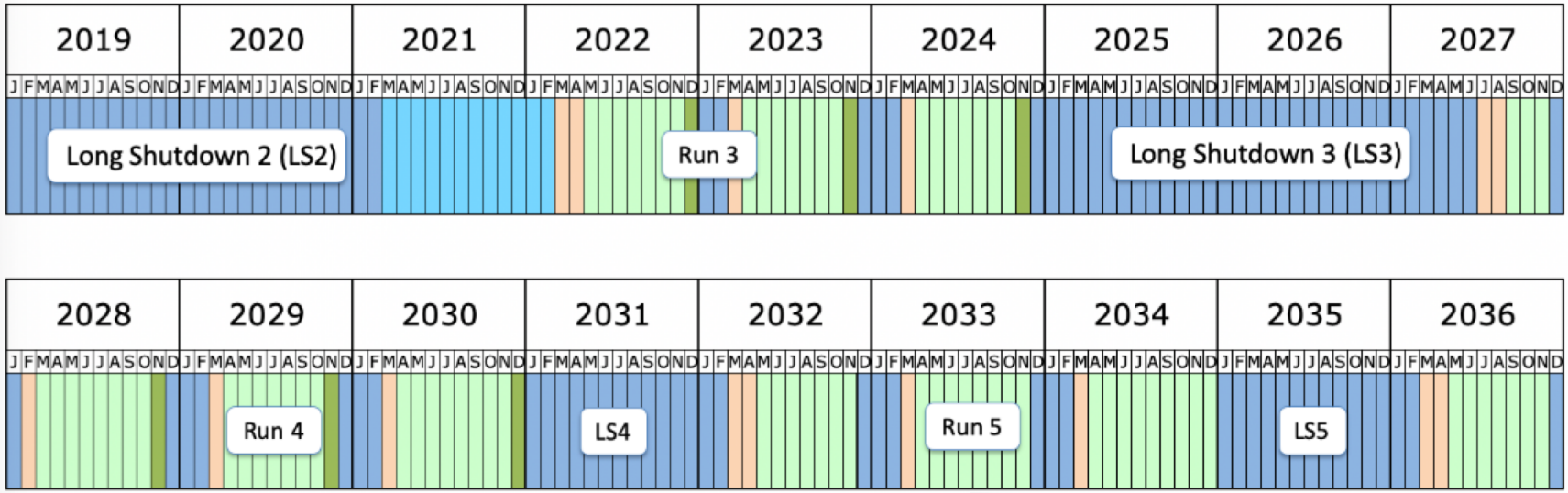
Preparation of 2022 Beam Request for HERD Prototype at CERN

Preliminary injector accelerator schedule



- 2022 PS EA FT proton physics runs
  - start: March 14th (at the earliest)
  - end: December 12th
- 2022 SPS NA FT proton physics runs
  - start: April 11th (at the earliest)
  - end: November 14th
- 2022 SPS NA FT ion physics runs
  - start: November 14th
  - end: December 12th

The deadline for submission is Monday, 15th November 2021. A web based form should be filled to submit the beam request.

Information from latest test beam user's meeting

- Online submission address
  - https://test-ps-sps-users.web.cern.ch/
- HERD beam request draft
  - https://test-ps-sps-users.web.cern.ch/admin/structure/webform/manage/beam_request_2022/results/submissions
  - separated PS(#88) and SPS(#87) submission drafts
  - SPS draft includes both proton and ion beam requests

Purpose of BT 2022

- Individual test beams have already been performed with different CALO prototypes as well as prototypes of other HERD sub-detectors in 2015, 2017 and 2018 at SPS. The novel design of the payload and the basic performances of the detectors were successfully verified in these tests, which also guided the optimization of the HERD instruments.
- In 2021, we have developed prototypes of all sub-detectors and integrate them as a single HERD prototype similar to the flight model, rather than arrange them in a stand-alone way as in the past.
- On one hand the integrated prototype was running successfully under global DAQ and be tested with various beam particles, on the other hand the study was not fully developed by limited beam time, such as insufficient scanning positions and limited parameter configuration.
- Thus in 2022, we prefer to continue the prototype performance test and to complete the payload final design by taking advantage of PS, SPS proton and SPS ion runs.
- The goals of the HERD beam test in 2022 include:
  - the validation and the performance study of the compact payload design.
  - the detailed characterization of the CALO energy resolution, particle ID, five-side sensitive capabilities, dual readout and fast calibration method.
  - the validation of the trigger strategy including the trigger segmentation and redundancy design.
  - the detection efficiency, and the back splash effect study of the PSD with protons and electrons at different energies.
  - the validation of charge Z performance of SCD, PSD and FIT by fragmented ions.
  - calibration and equalization study of each sub-detector.

Geometry layout

- Option 1: integrated prototype by using the same table as in 2021
  - TRD, SCD, PSDs, FIT and CALO mounted on individual scanning structure
- Option 2: a more compact integrated design

hardware upgrading plan,
general DAQ, trigger and
the ‘geometrical’ requirement will be discussed later in regular test beam meetings

Beam time

- 2 weeks of PS proton runs
  - all devices performance study by low energy electrons (0.5-12 GeV/c)
  - all devices equalization and calibration by pions (>= 10 GeV/c)
- 1 week of SPS proton runs
  - CALO performance study by primary protons (400GeV/c) and electrons (20 – 250 GeV/c)
    - CALO PID capability and 5-side sensitive verification
      - huge of pure primary proton sample
      - multiple offset angle scanning
    - CALO trigger definition, redundancy test
  - TRD, SCDs, PSDs, FIT joint performance study
- 1 week of SPS ion runs
  - PSD, SCD and FIT charge Z study by fragmented ions
- Beam schedule request
  - Not before September
  - SPS proton runs with primary proton available, as a strong request
  - PS ahead of SPS proton runs, while keeping the PS and SPS periods as close as possible.
  - No time constrain for SPS ion runs
    - parasitic run with other experiments, if not approved as main user.

Beam particle

- SPS
  - H4 preferred. We have experiences in this beam line, and primary protons and high quality electrons will be needed.
  - proton runs
    - primary protons, 400GeV/c, 100Hz, 4days
    - electrons, 20-250GeV/c, 100Hz, 3days
  - ion runs
    - fragmented ions, a proper A/Z for as much kinds of secondary nucleis, 100Hz, 7days
- PS
  - T9 preferred. We have experiences in this beam line
  - Proton runs:
    - hadrons(pions), >=10GeV/c, 100Hz
    - electrons, 0.5-15GeV/c, 100Hz

Travel issue

- From China, situation remain confused for institute staff, while there is not a strong travel limitation for post-doctor and PhD students
- A ‘baseline team’ will be organized in advance
  - J.J. Wang leads a team (>= 5 persons), include several PhD students of IHEP participant on-site with EU colleagues