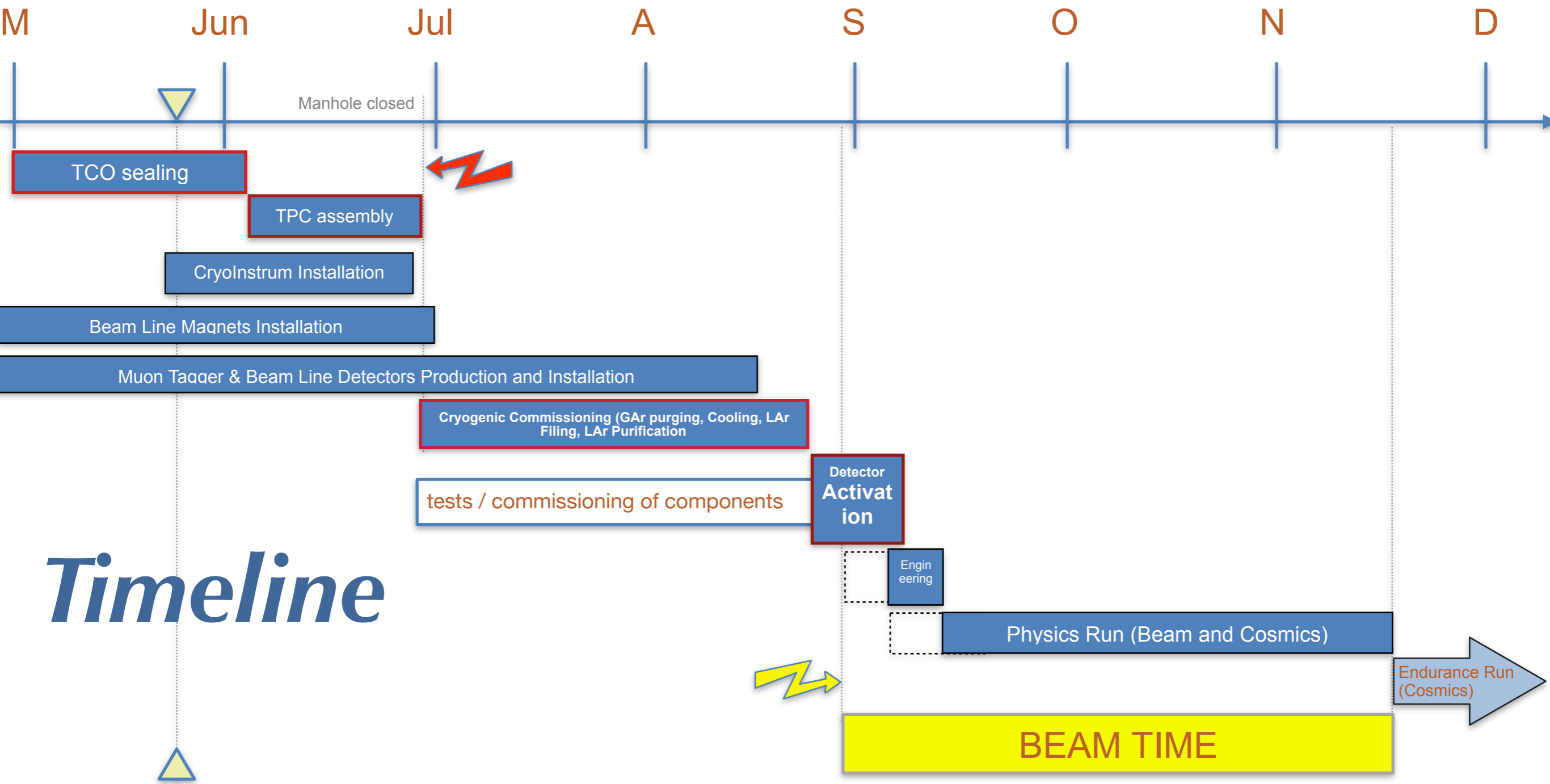


Installation, Commissioning and the 2018 Run



Timeline

ProtoDUNE-SP Commissioning and Operation Plan

The overall plan for the Commissioning of protoDUNE SP system and Operation is subdivided into FOUR subsequent **Periods - Main Tasks:**

| | | Tasks |
|-----------------|---------------------------------|---|
| Period 1 | June | <ul style="list-style-type: none"> • TPC Completion (Jura side) • Cryo-Instrumentation Installation • Slw Ctrl System activation • HV, APA-CE, PD final tests before manhole closing |
| Period 2 | July (through August) | <ul style="list-style-type: none"> • Cryogenics Commissioning • Operation of cryo-instrumentation for LAr quality and cryogenics parameters monitoring • BeamLine Commissioning • Inner detectors “pre-commissioning” procedures (APA-CE, PD performance tests, pedestal and calibration runs) • DAQ development and Data Quality Monitoring from Control Room |
| Period 3 | August | <ul style="list-style-type: none"> • Cryogenics Commissioning completed • Beam Instrumentation Commissioning • Muon Tagger Commissioning • Trigger System Ready • Detector Commissioning&Activation, |
| Phase 4 | September-November | <ul style="list-style-type: none"> • Engineering Run → Physics Run w/ Beam (and Cosmics) → Detector Performance Data Analysis |

Cryogenic Commissioning Plan

| CRYOGENICS | | | | | |
|------------------------|-------------------------|--|---------------------------|---------------------------|--|
| Task | Duration | Specs | Tech Resp | Shift Resp | Monitoring |
| GAr Purging | 1w + 1w (conting.) | - 20 Vol/day - leaks checks and repairs | CERN-NP | CERN-NP | GAr Purity |
| Safety Clearance | 1d | All documentation ready | CERN-NP | | |
| Cooling | 1 w | - 1 K/hr, $\Delta T \approx 200$ K | CERN-NP CERN TE-CRG | CERN-NP ProtoDUNE-SP | Temp T-Gradient GAr Purity |
| LAr Filling | 3 w + 1 w (conting.) | - ~550 kL - 2 trucks/day into 2x20000 L storage dewars - 40000L/day, 5 days/week | CERN-NP CERN TE-CRG | CERN-NP + ProtoDUNE-SP | Temp T-Gradient LAr Level LAr Purity Visual (Camera) |
| LAr Recirc. & Purific. | 1w (conting.) | Goals: Stable Cryo Cond. $\tau_e \approx 2$ ms | CERN-NP + ProtoDUNE-SP | CERN-NP + ProtoDUNE-SP | T-Gradient LAr Purity |

Start: last week of June

End: last week of Aug.

3+ weeks built-in contingency

ProtoDUNE-SP Commissioning Plan

System Experts and Teams on-site at CERN

Coordination of presence and action items sequence being defined in the **Commissioning Plan and Procedures document**,

July 2018

In parallel to (and within the limitations from) the concurrent **Cryogenic Commissioning operations**:

| Task | Systems |
|--|---|
| Operation of cryo-instrumentation for LAr quality and cryogenics parameters monitoring | <ul style="list-style-type: none"> LAr T-Profilers LAr Purity Monitors Cameras Gas Ar Analyzers |
| Inner detectors “pre-commissioning” procedures | <ul style="list-style-type: none"> APA-CE: monitor noise levels, pedestal and calibration runs PD: monitor single PE rate (?) |
| Trigger Logic Configurations tests | Combinations of <ul style="list-style-type: none"> Beam Detectors Triggers PD trigger Muon Tagger Trigger |
| DAQ development and Data Quality Monitoring from Control Room | <ul style="list-style-type: none"> DAQ DQM (p3s) SlwCtrl/DCS Computing |

August 2018

After completion cryogenic commissioning and LAr purification, and Beamline and Beamline-instrumentation commissioning

| LAr DETECTOR | Commissioning |
|-------------------------------|-------------------|
| Task | Duration |
| Cathode HV ramp | 1 w |
| Wire Planes V-bias | |
| CE activation | + |
| PD activation | |
| DAQ activation | 1 w (conting.) |
| On-Line Mon | |
| DQM | |
| Data Archiving | |
| completed by Sept. 5 - | |

DQM: Data Quality Monitoring

Understanding the detector performance is DRA's top priority.

- DQM system is being designed to answer the following questions - within a latency time of "few minutes", by processing 1% of raw data and displaying results on webpage

- What is the noise level?
- Are there dead/noisy channels?
- What is the electron lifetime?
- What is the signal-to-noise ratio?

Do we see tracks in the TPC?

- DQM payloads - T. Junk, B. Baller, D. Adams, G. Christodoulou
- DQM infrastructure (p3s) - M. Potekhin

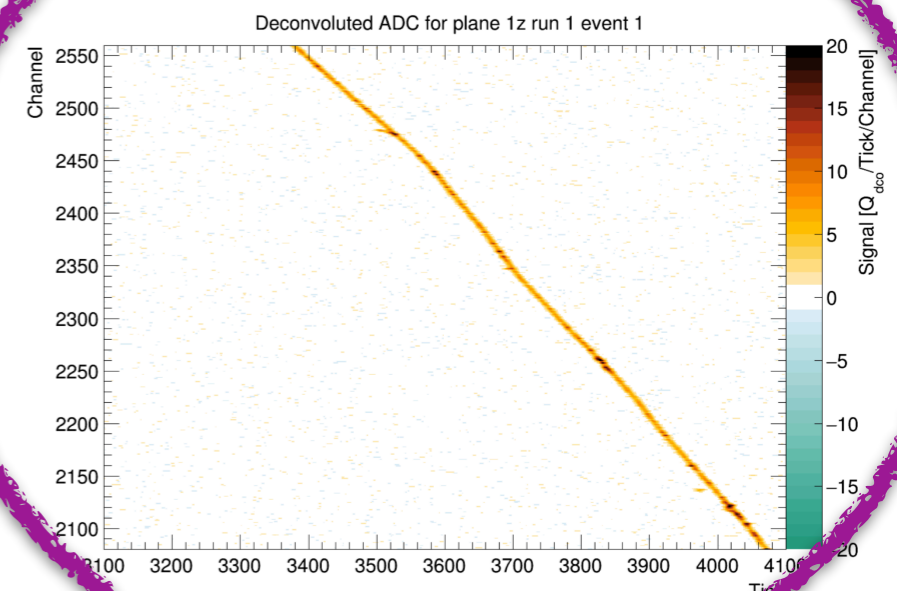
- ★ all algorithms have been implemented
- ★ Testing tools on cold box data

DQM Infrastructure
(Data Quality Monitor)
M. Potekhin (BNL)

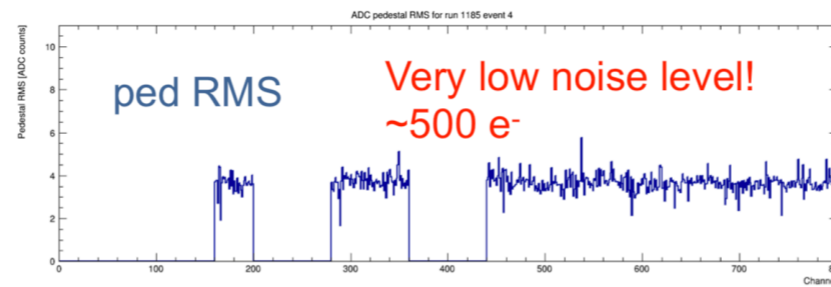
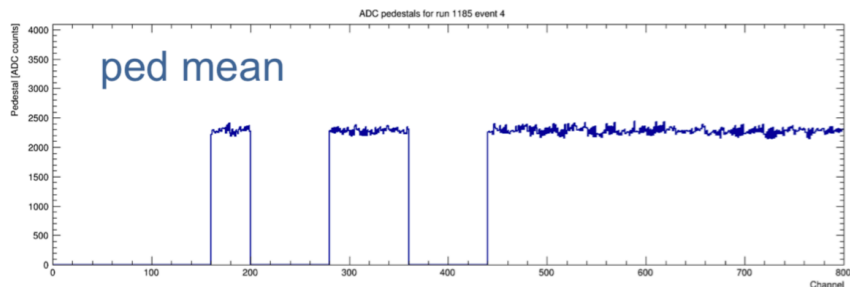
DRA
(Data
Reconstruction
and Analysis)

T Yang (FNAL),
G. Christodoulou
(CERN)

New APA1 TPC collection after deconvolution



Run 1185 David Adams



ProtoDUNE-SP Beam Time Schedule

August 29, 2018 (Start)

November 11, 2018 (End)

H4 Beam Time Allocation to NP04 by SPS-C:

7.5 weeks (including Beam Commissioning Time) in 4 blocks (2w + 2w + 2w + 1.5w)

SPS user schedule for 2018



schedule issue date: 26-Jan-2018

Version: 1.0

LHC Exp.
 PS/SPS Exp.
 Other Exp.
 INT Exp.

| | | Mar | | | Apr | | | Mai | | | Jun | | | Jul | | | Aug | | | Sep | | | Oct | | | Nov | | | Dec | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|------------|----------|---------------------|----|----------|------------|----------------|---------------------|------------------|--------------|--------------|--------------------|--------|-----------------|-----------------|-------------------------------|---------------------|------------------|---------------|--------------|----------------|-------------|----------------|-----------|-----------------|----------------------|----------------|-------------------|-----------|------------------|---------------------|------------------|---------------------|------------------|--------------|---------------|-------------|------------|----|----|----|----|--|--|--|--|--|--|--|----------------------|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--------|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|----|
| Week | | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 | 32 | 33 | 34 | 35 | 36 | 37 | 38 | 39 | 40 | 41 | 42 | 43 | 44 | 45 | 46 | 47 | 48 | 49 | 50 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Machine | | | | | | | | | | | | | | | | | | | | | | | | | UA9 TS1 Coldex | | | | | | | | | | | | | | | | | | | | | | | | UA9 TS2 Coldex | | | | | | | | | | | | | | | | | | | | | | | | Coldex | | | | | | | | | | | | | | | | | | | | | | | | RP |
| North Area | T2 - H2 | SPS & TT20 Setup 18 | | | NA Setup 8 | HERD FIT 7 | NA62 GTK 7 | NA61 SHINE 14 | | | TIC 7 | | | Calice (Ahal) 7 | ATLAS ZDC 7 | Calice (Ahal) 7 | NA61 K 60GeV/c 7 | NA61 SHINE 21 | | | AXIAL 7 | KLEVER 7 | LEMMA 7 | CMS HGCAL 7 | CMS HCAL 14 | | Calice (Sdhal) 14 | | HERD 7 | NA61 SHINE 7 | CMS HGCAL 7 | NP02 26 | | | NA61 SHINE 28 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | T2 - H4 | SPS & TT20 Setup 18 | | | NA Setup 6 | NA63 9 | CMS ECAL 7 | GIF RD51 14 | | NA64 setup 7 | NA64 35 | | | CMS ECAL 7 | AIDA WP14 7 | SHiP installation 7 | SHiP Muon 14 | | SHiP Charm 7 | GIF 7 | GIF RD51 14 | | DsTau 7 | NP04 setup 7 | NP04 7 | CMS MTD 7 | NP04 14 | | CMS ECAL 7 | NP04 14 | | GIF RD51 7 | NP04 12 | RE29 DAMPE 7 | HERD 7 | ATLAS ZDC 7 | CaloCube 7 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | T4 - H6 | SPS & TT20 Setup 18 | | | NA Setup 6 | Clc pix 7 | CMS Outer Tracker 9 | ATLAS HGTD 7 | ATLAS ITK 14 | | ATLAS ITK Kartel 7 | RD42 7 | ALICE muons 7 | CERF 7 | CMS Outer Tracker / AIDAwp7 7 | Clc pix 7 | ATLAS HGTD 7 | ATLAS ITK 21 | | ATLAS AFP 14 | | ATLAS BCM 7 | Clc pix 7 | ATLAS ITK 14 | ATLAS AFP 14 | | ALICE muons 7 | RD42 7 | AIDA WP7 7 | ATLAS ITK Kartel 14 | | CMS Outer Tracker 7 | ATLAS Strip Tk 7 | Clc pix 5 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | T4 - H8 | SPS & TT20 Setup 18 | | | NA Setup 6 | TOTEM (+UA9) 9 | ATLAS HV-CMOS 7 | ATLAS HV-CMOS 14 | | LHCb 14 | ATLAS Tilecal 14 | | ATLAS HV-CMOS 7 | TOTEM (+UA9) 7 | ATLAS TRT 7 | LHCb 21 | | crysbear 7 | CMS ITK 7 | ALICE FOCAL 14 | | TOTEM (+UA9) 7 | mu-e 7 | ATLAS HV-CMOS 7 | FCce 7 | TOTEM (+UA9) 7 | ATLAS HV-CMOS 7 | CMS ITK 7 | LHCb 26 | | ATLAS Tilecal 14 | | R2E (+UA9) 7 | HNX 14 | | NUCLEON 7 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | T4 - K12 | SPS & TT20 Setup 18 | | | NA Setup 6 | | | | | | | | | | | | | | | | | | | | | | | | NA62 217 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | T6 - M2 | SPS & TT20 Setup 18 | | | NA Setup 6 | | | | | | | | | | | | | | | | | | | | | | | | NA58 COMPASS 217 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| TT41 | | | | AWAKE 21 | | | | | | AWAKE 21 | | | | | | AWAKE 21 | | | | | | AWAKE 21 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |

For further information contact the PS/SPS-Coordinator. Email: Sps.Coordinator@cern.ch, Tel: +41 75 411 3845.

Beam exposure and Data taking Plan

• Engineering Run:

- Beam-line detectors activation and DAQ sync,
- Beam Trigger activation/test/debug,
- Secondary (Pion) Beam Intensity Tuning (measure/mitigation Muon Halo in LArTPC) ⇔ StartUp Physics Run

| Beam Setting (Mom, Sign) | Beam Rate | | Beam Time |
|--------------------------|-----------|-------------------------|---------------|
| 2 GeV/c – Negative | 27 Hz | 50% π^- , 50% e^- | 1 week |

| <i>Tentative Plan - to be revised</i> | | | |
|--|------------------------------------|----------------------|-----------------|
| Hadron Beam <i>Cu Target</i> | | | |
| Beam Setting (Mom, Sign) | Accumul. Stat. (goal) | Trig. Rate/Beam Rate | Beam Time |
| 2 GeV/c - Positive | 750 k [500 k π] | 25 Hz / 38 Hz | 1 week |
| 3 GeV/c - Positive | 750 k [500 k π] | 25 Hz / 56 Hz | |
| no beam | - | - | 1 week |
| 1 GeV/c - Positive | 1 M [500 k π] | 25 Hz / 27 Hz | 2 week |
| no beam | - | - | 1 week |
| 4 GeV/c - Positive | 600 k [500 k π] | 25 Hz / 196 Hz | |
| 5 GeV/c - Positive | 600 k [500 k π] | 25 Hz / 200 Hz | 2 week |
| 6 GeV/c - Positive | 600 k [500 k π] | 25 Hz / 226 Hz | |
| 7 GeV/c - Positive | 600 k [500 k π] | 25 Hz / 252 Hz | |
| no beam | - | - | 1 week |
| Electron Beam <i>Pb Target</i> | | | |
| Energy Ramp: 0.5, 0.6, 0.7, 0.8, 0.9, 1., 2., 3., 4., 5., 6., 7. GeV | 75 k per En. setting 900 k Tot. | 25 Hz / 60 Hz | 1.5 week |

• Physics Run

[expected 3000 spill/day]:

➔ Hadron Beam - Goals:

- ≥ 500 k Pion evt per momentum setting
- ≥ 100 k Proton evt per momentum setting

➔ Electron Beam - Goal:

- ≥ 75 k Electron evt per energy setting