Shiftcrew instructions – FPS

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What is the Forward Proton Spectrometer (FPS)?

The FPS is a device designed to detect protons that leave the interaction point at very small angles (< 0.5 mrad), and at very high energies (> 400 GeV). It currently consists of four stations, located at $z = 63\,, 80\,, 81$ m and 90 m in the HERA tunnel. At each station there is a movable plunger vessel — the first two ones are horizontally movable, the latter ones vertically — (a so–called "Roman Pot", which is why the FPS is often called "Roman Pots"). It can be moved very near (to a few millimeters) to the beam under stable (i. e. lumi) conditions, and is retracted during injection by about 50 mm.

The interior of the plunger vessel is filled with dry nitrogen under atmospheric pressure, and contains a scintillating–fiber hodoscope. The hodoscope consists of a total of 20 layers of 48 scintillating fibers with a diameter of 1 mm each, resp. 20 layers of 24 fibers for the horizontal detectors, and measures the tracks of scattered protons with a position resolution of approximately 70 μm. The scintillating fibers are read out by four position–sensitive photomultipliers (PSPMs) with 64 channels each, resp. micro–channel–plate multipliers with 124 pixels each for the horizontal detectors.

Additionally, there are 16, resp. 4 for the horizontal detectors, bigger scintillators, so–called "trigger tiles", which are read out by conventional PMs. These tiles are necessary for triggering purposes, and for the vertical stations to resolve ambiguities that arise because four scintillating fibers are read out by one PSPM pixel to save readout channels.

If a proton is detected in at least two stations, the four-vector of the proton at the interaction point can be reconstructed by using the bending magnets of the HERA beamline between the interaction point and the FPS stations as a magnetic spectrometer.

The movement of the plunger vessels is steered by a PC in room 307, which is also used to move the synchrotron radiation collimators that are controlled by H1.

What to Check

Status of the C.A.E.N. HV Supply (Checklist Item 1.03)

The HV supplies (2 C.A.E.N. crates) of the forward proton spectrometer are located in room 101, rack O1. It should be checked that these crates are powered. If not so first find out why it is off either by asking the shift leader or run coordinator. If there is currently access to the tunnel, the crates may be off on purpose. Otherwise turn the crates on. Make sure that the "HV Enable" switch (at the C.A.E.N) is set to "On".

This check is part of the normal checklist (item 1.03).

Pot Electronics Temperature (Checklist Item 1.04)

Also in room 101, but rack O2, a display is located indicating the temperatures in the interior of the electronics box attached to the plunger vessels. The electronics uses its own cooling system, and an unusually high temperature (above 39 °C) would probably indicate a water leak in this cooling system. In this case, inform an expert!

This check is part of the normal checklist (item 1.04).

Trips of HV Channels

When a HV channel of the FPS trips, it causes a BBL3 alarm in the "Rates/HV" section. The trip is at the same time indicated by the Argus message `FPS/FNC_HV_POWER_BBL3__CAEN_status`.

If a trip has occurred, follow the instructions in section "What to do in case of BBL3 Alarms?" at the end of this note on how to restore the tripped HV channels.

Status of the FPS "Sense Voltage" LED in Room 301

The state of the FPS HV (more specific, of channel `P8VPSPM1` of the first C.A.E.N. HV supply in room 101, rack O1) is monitored by the slow control system. If the `P8VPSPM1` channel is off, then the "sense voltage" LED marked "FPS" in room 101 turns red. This LED also turns red if the channel `monitor` of the second C.A.E.N. HV supply is off, which partly serves the FPS and the PRT. To sort this out, go to the Argus Mac, and look into the "FPS" menu. Channel `FPS/FNC_HV_POWER_BBL3__voltage_p-tagger_NOT_ON` indicates the state of the FPS / proton remnant tagger HV, thus crate 2, and channel `FPS/FNC_HV_POWER_BBL3__voltage_FPS_NOT_ON` corresponds to the FPS HV, crate 1.

The "FPS / p-Tagger HV" Switch in Room 307

In room 307, rack B19, there is a panel with a switch labeled "FPS / p-Tagger ", which can be set to "Full HV" or "Reduced HV". The state of the switch is additionally indicated by two LEDs, the green one indicating full HV, and the red one reduced HV.

This switch should be used to reduce the HV of the FPS and PRT during injection. It reduces the HV of all FPS photomultipliers by 200 V, and of the PRT PMs by 300 V. Also the voltage of the `monitor` channel of the PRT / FPS crate is reduced from 1700 V to 500 V, which causes the "sense voltage" LED of the FPS in room 301 to turn red, and switches the corresponding bit in the HEAR bank off. When the voltage is reduced in such a way, this should not result in a slow control alarm but only in an informational message.

Make sure that the switch is set to "Full HV" during luminosity running!

L4 Histograms

At the moment there are no L4 histograms for the FPS that have to be looked at by the shiftcrew.

Messages on the CDAQ Message Panel

At the moment there are no CDAQ messages from the FPS.

What Does the FPS Control PC Do ?

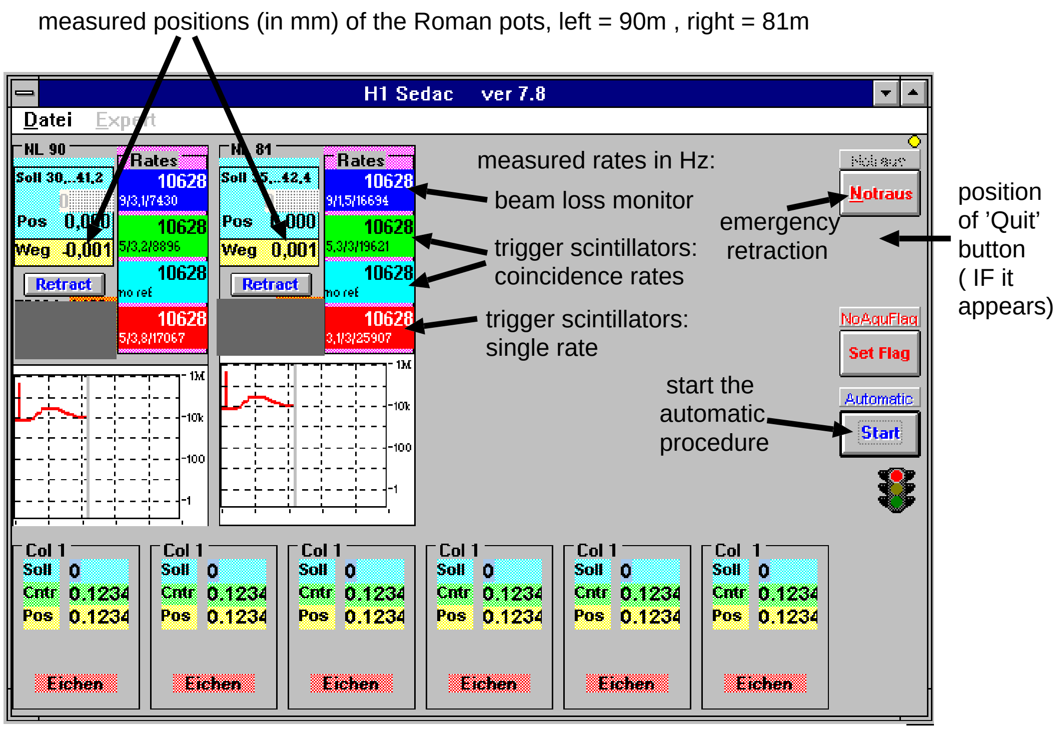
The FPS PC, located in room 307 in rack B19, controls the movement of the vacuum inserts for all four Roman pot stations. With this PC one can move the pots close to the proton beam and in principle also into the beam. So beware of the fact that this is a critical procedure and you should not do anything without being sure what you are doing !

The program which is running on the PC reads out and steers the SEDAQ (= SErial Data Acquisition) electronic, which is installed in room 101, rack O3. In that rack there are three crates. The first and uppermost one houses the 90 m and 60 m pot SEDAQ modules, the next one contains the power supplies for the crates, in the last there are the 81 m and 80 m pot modules. Below these crates one can find the displays of the four position measurement devices. These so–called Heidenhain–devices show how far the vacuum inserts have already been moved into the proton beam pipe. In the retracted position of the pots, the displays should show numbers close to zero. If they are moved in, the numbers will be between 22 and 49.

What Does the Screen of the PC Show ?

On the PC screen one can find the "H1 SEDAC"–window. It is active — means that you can type in something into this window – when the uppermost title bar is blue. If this window is not there look for a yellow–black icon on the screen. Make a double–click on it. The window will then appear. If not, click on the program manager icon, look for the FPS group, and double–click it. There you should find this yellow–black icon. Make once more a double–click on it.

In this window you find all information about the positions of the pots and counting rates and you can control the movement of the pots.



In the menu bar, below the blue title, you can find from left to right the menues "Datei" and "Expert". Normally the last item is disabled (grey shadowed), when black the corresponding menu item is enabled. One can enable this menu only with a password.

The "Datei"–menu allows you to save the history of the last 10 minutes for all the values shown on this screen. Also you can retrieve already stored data with the sub menu "Oeffnen". These actions should be done by the FPS–experts.

The upper left panels below the menu bar represent the 90 and 81 m station. Not shown in that exemplary graphic are the right panels of the 80 and 64 m station. The entries for these stations are the same as for the 90 and 81 m stations: On the left side of each panel some position measurements are given, light blue underlayed. The **SOLL**–position of which the first number is the limit (32 mm for the vertical 90 m, 45 mm for the vertical

81 m, 30 mm for the horizontal 80 m, 22 mm for the horizontal 60 m station), from which the pots can only moved in 100 micron steps. The last numbers, 35, 48, 40 and 29,5 mm, are the maximum distance one could move in the pots. These are total limits very close to the beam and, depending on the beam position, the pots could scrape the proton beam at these positions!

The value below **SOLL** is not labeled except if the pots are out. Then a green label with **ENDA** should appear there. This means the pots are out and have reached the outer end switch.

The third line, labeled **POS**, gives theposition of the pot which you typed in before. This value is the target of the movement after you pressed the "Return"–key.

The fourth line, yellow underlayed and labeled with **WAY**, gives the value read from the Heidenhain indicators and thus the current position of the pots relatively to the retracted position. Around zero represents the retracted position, e.g. for the injection phase, and 37 – 48 mm for the vertical, resp. 22 – 35 mm for the horizontal stations a typical position when the pots are close to the beam under running conditions.

Below these numbers there is a button labeled **RETRACT**. With the **RETRACT** button you can retract the pots in a normal way. This has to be done at the end of a luminosity run, resp. when HERA has lost one of the beams or both of them and the pots have not yet been retracted.

For the 60 m and 80 m station there is written the status for the magnatic valve below this **RETRACT** button. Only these stations are equipped with a hydraudic movement facility. During normal pot movement this valve have to be closed and is only opened when the pots are retracted.

On the right side of each panel are shown four different rates. Reading from the top the first is a counting rate from beam loss monitors (dark blue field). The next green field is a hard–wired 4–fold coincidence rate of the trigger tiles inside the pot. The light blue field is a 3–out–of–4 coincidence rate of the tiles. The last field (red) is the rate of a certain single trigger tile in the pot except for the 90 m station, there you find the neutron counter rate.

Below these four panels there are six further ones. They are representing the positions of the C4 and C6 collimators. This is an expert panel.

In the uppermost right corner of the window is a button named **RETRACT**. This is an emergency button, clicking on this one retracts the pots in a fast mode.

Any time when you think there is something going wrong or the rates are to high, click on this button. Make a note in the FPS–logbook when you retracted the pots !

Below the "RETRACT" button, there are two further ones. The first, named "SET" or "RESET", sets, resp. resets the data acquisition flag. This flag can only be set manually and indicates that the data taken from now on are useful for physics purposes. This should be done every time when one has moved the pots to a final and stable position close to the beam.

The **AUTO** button starts for the automatic insertion.

How to Insert the Pots with the Automatic Procedure ?

Go to the PC screen in room 307, rack B19. Check if the program is running by watching the changing numbers in the data fields, labeled **"Rates"**. If not so, see section "What to do in case of BBL3 alarms or warnings ?", item `FPS/FNC_COMPUTER_BBL3_computer_watchdog`. The measured positions of the Roman pots at z = 90, 81, 80 and 60 m are shown in the yellow fields, labeled **"WAY"**. Usually for

WAY $\sim$ 38 – 49 mm, the 90 an 81 m pot is close to the beam, for
WAY $\sim$ 22 – 35 mm, the 80 an 60 m pot is close to the beam, for
WAY $\sim$ 0 mm, the pot is out.

The Roman pots can be inserted if the following conditions are fullfilled:

- set the HV switch on the panel above the PC screen, labeled "FPS / p-tagger HV", to full HV.

- HERA has announced a luminosity run and HERA is not steering either beam,
- ZEUS LPS and HERA-B wire target are in stable positions,
- H1 has switched on at least CJC2,
- the monitor rates on the FPS PC screen are all greater than zero and below 20 kHz with the exception of the 4th rate (red panel) of the 81 m station (below 70 kHz),
- HERA (x3700), ZEUS (x2737) and HERA-B (x2750) have been informed about moving in our pots H1.

Click on the blue button labeled **Start** to start the automatic procedure. A confirmation panel will apear. Click on "Yes". If you do nothing, the panel will disappear after about 7 sec. Then the pots will stay out.

The procedure moves all four pots at the same time to the "WAY"-positions of 28 mm, resp. 35 mm, 15 mm and 13 mm which are safe positions far away from the beam. Then only the 60 m pot will continue in steps of 0.6 mm to the beginning of the so called *safety region*, at 22 mm. Inside the safety region the pots are moved in steps of 100 μm. The 60 m pot will stop if the measured rates exceeds a limit. After the 60 m pot did so, the same procedure applies to the 80 m, 81 m and 90 m pot. Their safety regions start at 30, 45 and 32 mm. Please stay and watch the rates until the pots are in.

At each step of this procedure all pots will be immediately retracted if the monitor rates exceeds the emergency limit. (This will also result in a slow control alarm.) You will get a red error message panel "Fehler bei Sedag !!! Rate 1 ueberschritten, Topf 1.". Click first on "Clear Fenster" in this panel and then on the green "QUIT" button on the main panel. This will reset the slow control alarm.

If the pots are thrown out before reaching the safety region, so the "WAY"-values are below 22 mm, 30 mm, 45 mm and 32 mm try again at most three times.

If they are thrown out inside the safety region, try only once again, however if this does not succeed, call the FPS expert.

How to Retract the Pots in Case of Emergency ?

If the **"H1 SEDAC"** program is running, click on the uppermost button on the right side of the screen, labeled **RETRACT**.

If this doesn't work, press the red button **Emergency Retract** on the panel **above** the PC. That will cause a slow control alarm. See "What to do in case of BLL3 alarms or warnings?" on how to react.

What to do during luminosity run ?

Check regularly the positions of the pots. Sometimes they will be thrown out by spikes in the monitor rates. If they are out, move them in again!

What to do at the end of a lumi run or if beams are lost ?

In case of proton beam loss, the pots normally retract automatically because of a spike, ending in a slow control alarm. See BBL3 alarms for reacting on it.

In case of positron beam loss or at the end of a luminosity run, retract the pots by clicking on the button **RETRACT** for all of the pots. Watch the decreasing "WAY"–values and verify that the pots are out after 30 seconds. If this is not the case, use the emergency button.

What to Do in Case of BBL3 Alarms or Warnings?

Message FPS/FNC_VME_CRATES_STCC

This channel indicates that the Roman Pot VME crate is off. Make a note in the logbook and call the FPS expert.

Message FPS/FNC_VME_CRATES_STD1_CDAQ_BRANCH_10/1

Go to room 101, rack O5, and switch the VME crate on again.

After that, probably expert action is needed.

Message FPS/FNC_VME_CRATES_STD1_CDAQ_BRANCH_10/2

Go to room 101, rack O5, and switch the VME crate on again.

After that, probably expert action is needed.

Message FPS/FNC_HV_POWER_BBL3__CAEN_p-tagger

This alarm indicates tripped channels of the **Proton Remnant Tagger** or of the **Horizontal FPS Stations**. It is connected to the BBL3 alarm line "Rates/HV" in group "Other".

Follow the section **"How to switched on channels tripped?"** at the end of these instructions.

Message FPS/FNC_HV_POWER_BBL3__CAEN_status

This alarm indicates tripped channels of the **Vertical FPS Stations**. It is connected to the BBL3 alarm line "Rates/HV" in group "Other".

Follow the section **"How to switched on channels tripped?"** at the end of these instructions.

Message FPS/FNC_HV_POWER_BBL3__voltage_p-tagger_NOT_ON

This warning indicates that channel `monitor` on the PRT / FPS HV supply (C.A.E.N. HV supply 2 in rack O1 in room 101) is on too low a voltage. In this case the LED for the FPS on the "Sense Voltages" panel in room 301 is red.

First check the "FPS / p-Tagger HV" switch in room 307. If it is set to "REDUCED HV", then everything is OK, forget it. If it is set to "FULL HV", check if there is any BBL3 alarm, concernig FPS or Proton Remnant Tagger. If there is such an alarm, follow instructions in the correponding section. Otherwise call the FPS expert.

Message FPS/FNC_HV_POWER_BBL3__voltage_FPS_NOT_ON

This warning indicates that channel `P8VPSPM1` on the FPS HV supply (C.A.E.N. HV supply 1 in rack O1 in room 101) is on too low a voltage. In this case the LED for the FPS on the "Sense Voltages" panel in room 301 is red.

First check the "FPS / p-Tagger HV" switch in room 307. If it is set to "REDUCED HV", then everything is OK, forget it. If it is set to "FULL HV", check if there is any BBL3 alarm, concernig FPS or Proton Remnant Tagger. If there is such an alarm, follow instructions in the correponding section. Otherwise call the FPS expert.

Message FPS/FNC_OTHER_DEV_BBL3__DETECTOR_OUT_OF_BEAM

This channel is currently not connected.

Message FPS/FNC_SAFETY_HEAT_BBL3__EMERGENCY_OUT_OF_BEAM

This channel is currently not connected.

Message FPS/FNC_COMPUTER_BBL3_computer_watchdog

This channel indicates that the steering program for the pot movement is not in a proper state, (i. e. is has crashed, or is blocked for some reason), or that the pots have been thrown out (either because the rates for moving the pots exceeded their limits or because the **Emergency Retract** button was pressed).

To change the error condition for the steering program:

- Go to room 307, rack B19, to the PC which is marked "FPS Slow Control and Pot Movement."
- Make sure that the program "H1 SEDAC" is running. If not, boot the PC by pressing the "Reset" button on the PC. The program should start automatically. *If it does not start after a few minutes, call the FPS expert.*

  During startup, a message panel appears, saying "LPS eichen und Programm starten?". Ignore it.

  After the program has started, the handle bar of the application window will read "PRESS QUIT IN R101, PLEASE!". To reset this alarm, go to room 101 (don't forget to take the key for room 101 with you), rack O3 (rack labeled "Roman Pots"). In the rightmost slot of the top SEDAQ crate there is a black button labeled "QUIT". Press it. Do *not* press the yellow button marked "Notraus", even though it is easier to spot. Check that the title on the PC screen has changed to "H1 SEDAC" only.
- If the program was still running, but there is a red message panel reading e.g. "Fehler bei Sedag!!! Rate 1 überschritten, Topf 1.", click on **Clear Fenster** in this panel, then click on the green **Quit** button.

If the pots have been thrown out because of rates being too high, see the corresponding paragraph in "How to Insert the Pots with the Automatic Procedure" on how to react.

If pressing the "**Emergency Retract**" button caused this alarm, make a note in the logbook and inform the FPS expert.

Message FPS/FNC_SAFETY_HEAT_BBL3_temperature_crates

This channel indicates that one of the values measured by the FPS temperature monitoring module (room 101, aisle 0, rack 2, uppermost NIM crate) were found to be above the threshold of 39 °C.

Make a note in the logbook and call the FPS expert.

Now the BBL3 alarm should have vanished. If the Roman Pots were moved in at the time the alarm occurred, they are now moved out. Therefore move them in again with the automatic procedure.

How to switched on channels tripped?

- Come up to the FPS DAQ Macintosh (room 307, rack B20 on the left).
- Find a window "shift" with a telnet session.

  If it does not exist, start it from the icon "shift" on the Macintosh desktop, login: `shift`*, password:* `romanpot`*; if you failed to start, reboot the Macintosh and repeat.*
- Type `clearalarm` followed by <*CR*>.

- The program will print out a list of all channels tripped —> write them down in the FPS logbook with the current time, date, your name and the beam conditions (lumi, ramping, injection, dumping the beam, etc.).

  It may happen the message "No channels tripped". It means that there is no problem with HV of FPS/P-Tagger. Try to find out another reason of the BBL3 alarm.

- If there is no evidently bad beam condition try to switch on the channels tripped —> type `hvon` and <*CR*>.

  It may happen that the background rates are too high (some other H1 subdetectors may have also problems then), or you might be informed by HERA that they are moving the beam violently, or something of that kind, please make the corresponding note in the FPS logbook, wait a few minutes, and not forget to switch on the channels tripped —> type `hvon` *and* <CR>.

In case of any problems or questions, please call the FPS Expert on Call!