QUICK REFERENCES

GPS – πM3 AREA

QUANTUM CRYO – 9505

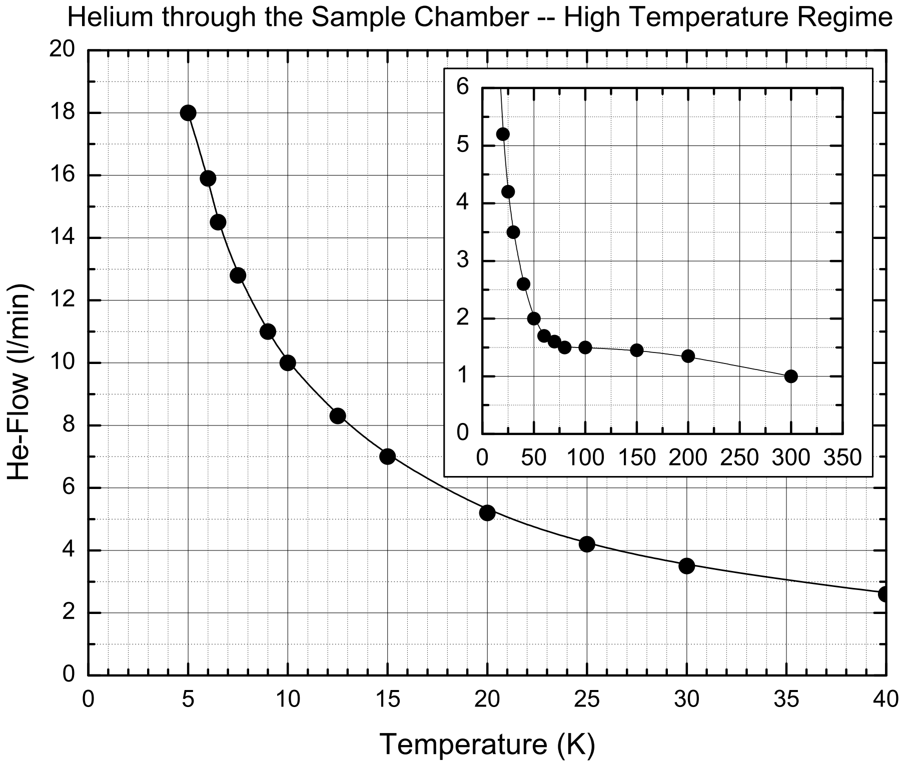
μSR FACILITY 2006

Contents

1 QUANTUM CRYOSTAT – QUICK REFERENCE

High temperature regime (5 K → 300 K):

1. Flow F1 (Transfer Line) at about 13.5 l/min to keep the Phase Separator temperature at about 4.6K (if necessary adjust yellow valve V1).
   Note: this temperature can be slightly higher when $T_{diffuser} = 300$K.
2. Manual valve V2 closed.
3. PUMP2_B switched OFF.
4. He-flow controlled by the electromagnetic valve V3b
   Controller and instruction in Counting Room.
5. Needle valve V4: 0.5 mm open (50 units)
6. 230 mA in Tube Heater.
7. The desired temperature is obtained by choosing the He-flow F2 according to the Figure and by sending the required setpoints to the temperature controller.
   Note that if the needle valve V4 is not enough open, the necessary flow to reach 5 K cannot be reached → open slightly more the needle valve V4
   On the other hand if the needle valve V4 is too much open, temperature oscillations may occur around 15-20 K → close slightly the needle valve V4



Low temperature regime (~2.3 K → 10 K):

1. Flow F1 (Transfer Line) at about 13.5 l/min to keep the Phase Separator temperature at about 4.6K (if necessary adjust yellow valve V1).
2. Manual valve V2 fully open.
3. PUMP2_B switched OFF.
4. No current in Tube Heater.
5. The lowest stable temperature is obtained by gradually closing the needle valve V4. As the valve is closed the pressure P2 will gradually decrease and the sample temperature will decrease correspondingly.
6. Higher temperatures (up to 10 K) are achieved by keeping the He-flow constant and solely changing the setpoints of the temperature controller.
   Note that a temperature scan is only possible once the pressure and flow conditions necessary to reach the lowest temperature are obtained (i.e. F2 $\simeq$ 6.5 l/min and P2 $\simeq$ 30 mbar

Low temperature regime (~1.8 K → 10 K):

1. Flow F1 (Transfer Line) at about 13.5 l/min to keep the Phase Separator temperature at about 4.6K (if necessary adjust yellow valve V1).
2. Manual valve V2 fully open.
3. PUMP2_B switched ON.
4. No current in Tube Heater.
5. The lowest stable temperature is obtained by gradually closing the needle valve V4. As the valve is closed the pressure P2 will gradually decrease and the sample temperature will decrease correspondingly.
6. Higher temperatures (up to 10 K) are achieved by keeping the He-flow constant and solely changing the setpoints of the temperature controller.
   Note that a temperature scan is only possible once the pressure and flow conditions necessary to reach the lowest temperature are obtained (i.e. F2 $\simeq$ 6.5 l/min and P2 $\simeq$ 5 mbar

2 CONDUCTUS TEMPERATURE CONTROLLER

The *Conductus* temperature controller connected to the *Quantum* cryostat is usually utilized in a REMOTE-mode and can be directly controlled from `deltat`.

The following steps describe how to configure and use the *Conductus* temperature controller from `deltat`.

- **Configuration:**
  Each time that you change the configuration of the cryostat (new sample stick), you have to configure the driver controlling the temperature controller.

  In the tab `Modify Devices` choose the temperature controller entry and hit the buttons `Modify` and, on the pop-up window, `Modify Setup`.
  Choose the corresponding sample stick from the drop-down list.
  Hit the `Next` button and choose the corresponding `Entry` for your setup
  Remember that the QUANTUM is usually controlled by the Conductus in a two-loop mode

  Hit the `Apply & Exit` button and at this point the software should automatically detect the PID tables needed and load them into the Conductus temperature controller.

  Remember to put the controller in the CONTROL mode.

- **Setting a temperature:**
  In the tab `Modify Devices` choose the temperature controller entry and hit the buttons `Modify` and, on the pop-up window, `Modify Temperature`.
  On the pop-up window, change for both loops the setpoints and hit the button `Apply Changes`.

- **Autorun sequences:**
  Before writing an autorun sequence, be sure that the *Conductus* in the desired mode (one or two-loop mode).
  In the autorun file, do not forget to give all (6) the arguments in the two-loop mode.
  To change the temperature, you will need an entry like:

  ```
  SET Temperature 100.0 1.0 30 100.0 1.5 30
  WAIT Temperature INRANGE
  ```

  In this example the setpoints are 100.0 K for both loops, the tolerances 1.0 K for the first loop and 1.5 K for the second loop and the waiting times are 30 seconds

3 He-FLOW CONTROL

The He-flow trough the "Sample Space" can only be controlled when solely the Electromagnetic Valve V3b (PFEIFFER EVR116) is used, the big bypass valve V2 is shut and the PUMP2_B is switched OFF.
The control is performed by the Valve Controller PFEIFFER RVC300. The actual He-flow is measured by a flowmeter (HASTINGS HS-50KS) and is also indicated on the center display located at the top of the rack.

- *Setting a flow from* **`deltat`***:*
  In the tab `Modify Devices` choose the flow controller entry and hit the `Modify` button. Enter the new flow value in the pop-up window and close it.
- *Setting a flow in an autorun sequence:*
  A He-flow setpoint can also be included in a auto-run sequence by using the command `SET Flow FLOW XXX` command.

  Example: `SET Flow FLOW 4.3`

  With this example, an He-flow setpoint has been set to 4.3 liter-gas/minute.
- *Manual setpoint (only in case of emergency):*
  Locate the RVC300 device in the area rack.
  Press the button locate below `PARAM`.
  Press the `edit` button to edit the `SOLL` value. Change it with arrow buttons (note that 100 mV correspond to 1 l/min).
  Presse the button locate below `SAVE`

The time needed for the actual He-flow to reach the setpoint value will depend on the PID parameters of the RVC300 controller.

When increasing the temperature, the He-flow should be changed first, if necessary. The temperature controller setpoint, should be changed in a second step. The opposite should be done when decreasing the temperature. If a large change of flow is required, big temperature overshoots can be observed. To minimize the overshoots, the He-flow setpoint should be changed in different steps prior to change the temperature controller setpoint.

Depending on the setting of the needle valve V4 between the "Phase Separator" and the "Sample Space", it is possible that a desired He-flow cannot be reached eventhough the RVC300 controller will fully open the Electromagnetic Valve V3b. To fix this problem, one should more open the needle valve.

4 SAMPLE CHANGE

The following points describe the process of changing a sample in the "Quantum Cooler" cryostat.

- **For safety reasons, a sample change should only be performed in the "High Temperature regime" with a sample temperature $T > 30$ K.**
- Switch OFF the heaters by setting the Conductus (or Neocera) temperature controller in the *Monitor* Mode [by pressing the *Local* button (if necessary) an pressing the *Monitor* button].
- Switch OFF the Tube Heater.
- Disconnect the electrical plug from the sample holder.
- Dismount the rotation motor.
- Stop the He-flow through the pumps PUMP1 and PUMP2_A by closing:
  - the two valves V2 and V3a on the pumping line of the Sample Chamber (do not disconnect the electrical plug of the electrovalve V3b).
  - the yellow valve V1 on the transfer-line pump (use the closing-ring without changing the actual setting of the valve).
- Pressurize slightly the "Sample Chamber" with He-gas by opening the valve V6 until you reach a pressure P2 slightly above 1000 mbar (check that the He-gas cylinder is open).
- **Check carefully and frequently** the pressures P1 and P2 in the "Phase Separator" and in the "Sample Chamber". (An overpressure in the sample chamber could damage the titanium windows).
- Remove the clamp of the sample holder.
- Remove the sample holder from the cryostat.
- **Immediately** mount a blind-flange on the cryostat opening.
- Stop blowing He-gas by closing the valve V6.
- Restart the He-flow through the He-pumps by opening the valves V1, V3a.

When you are ready to insert the sample holder with the new sample, you should follow an analog procedure as above. Namely:

- Stop the He-flow through the pumps by closing:

  - the two valves V2 and V3a on the pumping line of the Sample Chamber (do not disconnect the electrical plug of the electrovalve V3b).
  - the yellow valve V1 on the transfer-line pump (use the closing-ring without changing the actual setting of the valve).

- Pressurize slightly the "Sample Chamber" with He-gas by opening the valve V6 until you reach a pressure P2 slightly above 1000 mbar (check that the He-gas cylinder is open).
- **Check carefully and frequently** the pressures P1 and P2 in the "Phase Separator" and in the "Sample Chamber".
- Dismount the blind-flange very shortly before inserting the sample holder.
- Insert the sample holder **carefully** (to insert a *warm* sample holder requires more force than to remove a *cold* holder).
- Replace the clamp.
- **Immediately** stop blowing He-gas by closing the valve V6.
- Restart the He-flow through the He-pumps by opening the valves V1, V3a (and V2 if the low temperature regime is needed).
- Readjust the He-flows.
- Reconnect the electrical plug to the sample stick
- When a sufficient He-flow is detectable in the Sample Chamber, set the temperature controller in the *Control* Mode [either through the `deltat` programme or locally by pressing the *Local* button (if necessary) and pressing the *Control* button].
- If you want to operate in the High Temperature regime, do not forget to switch ON the Tube Heater.

5 CHECK-LIST WHEN CHANGING THE SAMPLE

The following points should be checked when changing a sample.

- If your sample is not at the nominal position (30 mm from the back of the sample holder), the brass ring should be displaced accordingly.
- **Using the standard sample holder, the stick can be inserted only 1.5 mm more that its nominal value**.
- Check that flat brass part located on the external part of the stick corresponds to the sample holder orientation.
- Check that you have exactly **one** O-ring before introducing the target stick into the cryostat.
- The positioning of the sample can also be done by checking the external dimensions of the stick (see drawing).
- Check (if needed) that the sample holder is perpendicular to the beam (use the flat brass part located on the external part of the stick).
- The cryostat should be at the nominal X-position 12.0

6 He-DEWAR CHANGE

Should the He-Dewar levelmeter read below ∼15 % (in the case of a 100-liters dewar) or below 100 mm (in the case of a 250-liters dewar), the He-Dewar needs to be changed.

- **For safety reasons, a He-dewar change should only be performed in the "High Temperature regime" with a sample temperature $T >$ 30 K.**
- Stop the He-flow through the pumps PUMP1 and PUMP2_A by closing:
  - the two valves V2 and V3a on the pumping line of the "Sample Chamber" (do not disconnect the electrical plug of the electrovalve V3b).
  - the yellow valve V1 on the transfer-line pump (use the closing-ring).
- Switch OFF the heaters by setting the Conductus (or Neocera) temperature controller in the *Monitor* Mode [by pressing the *Local* button (if necessary) and pressing the *Monitor* button].
- Switch OFF the Tube Heater.
- Lift up slightly (∼50 cm) the transfer line on the He-dewar side
  (the bottom part of the tranfer line in the He-dewar should now be above the liquid-He level).
- Pressurize slightly the "Phase separator" with He-gas by opening the valve V5 until you reach a pressure P1 of about 1000 mbar (check that the He-gas cylinder is open).
- **Check carefully and frequently** the pressures P1 and P2 in the "Phase Separator" and in the "Sample Chamber". (An overpressure in the "Sample Chamber" could damage the titanium windows).
- Disengage the adaptor of the transfer line from the top of the dewar by releasing the O-rings.
- Slide the adaptor upward along the transfer line.
- Remove completely the transfer line on the He-dewar side.
  Replace the plug of the He-dewar to prevent freezing of the He-dewar.
- **Carefully** warm up the transfer line using the available heat-gun.
- Be sure that the sintered end-part is free of any ice.
- Change the He-dewar.

- **Check that the He-recovery line is connected to the dewar and that the corresponding valves are open. Be sure that the recovery line is not bent and that the He-gas can flow freely.**
- Insert slowly the transfer line in the new He-dewar.
- As soon as the sintered part is enough inserted in the dewar, lower the adaptor and connect it to the dewar.
  Make sure that the adaptor of the transfer line is well inserted in the dewar, and that all O-rings are tightened.
  Leave the transfer line above the liquid-He level.
- Stop blowing He-gas by closing the valve V5.
- Open the valves on both He-pumps (do not forget, if necessary, to reconnect the electrical plug of the electromagnetic valve V3b).
  Open the valve V1 completely.
- Wait 30 seconds.
- Pull down slowly the transfer line in the He-dewar.
  Check carefully and frequently that the transfer line is well aligned with the dewar and that it does not bent; if necessary move slowly and carefully the He-dewar to align it with the transfer-line.
  Be also sure that the transfer line does not touch the bottom of the He-dewar (leave it few centimers above the bottom).
- The He-flow in the transfer line will first show a rapid increase, due to the sudden overpressure in the He-dewar, which will be followed by a decrease. After 1-2 minutes, the He-flow through the transfer line will again increase to its maximum value.
- After a few minutes, the temperature of the "Phase Separator" should drop to the nominal value.
- Readjust the He-flows.
  (For this last point, experience shows that the "Transfer Line" flow F2 should be maintained for few minutes to a high value and gradually decreased)
- When a sufficient He-flow is detectable in the Sample Chamber, set the temperature controller in the *Control* Mode [by pressing the *Local* button (if necessary) and pressing the *Control* button].
- If you want to operate in the High Temperature regime, do not forget to switch ON the Tube Heater.
- Do not forget to tightly close the empty He-dewar and to connect it to the He-recovery line

7 IN-SITU MAGN. FIELD MEASUREMENT USING METROLAB NMR PROBE

- Select the probe according to the desired **field range** and connect it to the Model 1030 amplifier "black" box (Probe 3: 1.7 to 5.2 kG, Probe 4: 3.5 to 10.5 kG as indicated on the PT 2025 teslameter).
- Move the NMR-probe in position by moving out the cryostat on the linear feedthrough to the position **x = 55 mm** (See below how to move the cryostat).
- In MAN mode, use the potentiometer to display a field value close to your actual field value.
- Go in AUTO mode and wait till NMR LOCK is on and TOO HI and TOO LO switch OFF
- When you are finished, put back the cryostat at the nominal X-position 12.0

8 TO MOVE THE CRYOSTAT

On the motor control unit:

- Press the green button corresponding to the motor # 2
  The green LED of the button should now be ON
- Press and hold the "+" (or "-") yellow button to move out (or in) the cryostat

9 SAMPLE ROTATION

The motor control unit EL734 switches automatically to local mode as soon as a local operation is performed.

To rotate manually the sample:

- Be sure that the "+" and "-" buttons are lit (otherwise wait few seconds). Press the green round button corresponding to the motor # 1
  The green LED of the button should now be ON
- Press and hold the "+" (or "-") yellow button to rotate the sample in one or the other direction
- If during this operation, the green square button suddenly lit, it means that the computer has taken the control of the device. In this case, wait few seconds and restart the procedure. The computer connects to the device every 30 seconds..., so be quick...)

To rotate the sample remotely:

- In `deltat`, the tab `Modify Devices` contains the device `Position`. Choose this device and hit the `Modify` button. Enter the new position value in the pop-up window and close it.
- A rotation of the sample can also be included in a auto-run sequence by using the command

  ```
  SET Position ANGLE 100.0
  ```

  With this example, an angle of 100 is requested.

10 COMBI-CONTROLLED POWER SUPPLIES

All the power supplies for the beam magnets are now "combi"-controlled.

All power supplies can now be controlled via the PC (PC125) or the `deltat` application.
They are clients of a server (PC231) which controls the CAMAC crate containing the interfaces to the power supplies. The server is located on the platform above the GPS cabin, in the first left-hand side row of power supplies, near the CAMAC crate.

The advantages of the use of "combi"-controlled power supplies for the users, is that the switching ON and OFF of these power supplies can occur remotely via the PC located in the GPS cabin.
For example, by loading a "set" file, the needed power supplies will be automatically switched ON. Note that this does not concern WED, WEDL, WEP which are switched ON by the `deltat` application.
Moreover a PC-application called *TCP/IP Combi-Control* allows one to directly control these power supplies.
By double-clicking the icon *TCP/IP Combi-Control*, after few seconds, a list of power supplies will appear on a menu. At this point one can switch ON and OFF the power supplies, and read their status.

If a problem is detected on a "combi"-controlled power supply and that the switching ON is no more possible via PC, one should have locally a closer look to the power supply...

The magnets WED, WEDL and WEP are normally set via the `deltat` application (giving a set value in Gauss). The other magnets are normally set via the PC giving a DAC value. With the `deltat` application, the action of setting the power supplies WED or WEDL automatically switches the current cables to the appropriate power supply, switches it ON and switches OFF the unused power supply. In addition, by setting WEP, WEDL or WED to zero the corresponding power supply will be switched OFF.

Examples:

- To switch the main coils between WED and WEDL: just set for the appropriate power supply the desired value with the `deltat` application. This is done in the tab `Exp. Magnets`.
- To switch between the main coils and the small transversal coils (WEP): set the last used power supply to zero; set the WEP power supply to the desired value.
- To switch between the small transversal coils (WEP) and the main coils: set WEP to zero; set the WED (or WEDL) power supply to the desired value.

11 BEAM-LINE SETTINGS

Which settings ?
Some standard settings are normally provided (transverse or longitudinal mode; shared or not shared...). The user will find the name of these settings by looking in the general logbook, where a list of the best settings is regularly reported.
The standard name of these settings is *pNNN_YY.set* ; where *NNN* corresponds to the page number and *YY* to the present year. Look at the page *NNN* to obtain more details about these settings.

How to set the beam-line ?
Load the set-file using the *Setpoint* application on the PC.
Be sure that the spin rotator is working properly (the πM3.1 area should be closed and the green LED of the reset box should be ON)
Due to hysteresis effects, cycle the steering magnets SSK31, SSK32 and SSK33: set their minimum values (either -2000 or -4000); wait few seconds and put back the proper initial values of the file.
By going from transverse to longitudinal mode, it is sometimes necessary to retune the spin rotator value. Note that this retune could be necessary over a long time scale (hours...).

If better settings are found, it is strongly requested to save them (with the standard notation and by doing a proper entry in the logbook) to the benefit of the following users.
NEVER OVERWRITE EXISTING SETTINGS !!

12 TRUE ZERO-FIELD MEASUREMENTS

Extensive tests have shown that a weak remanent field is present at the sample region after that the main field (WED) has been set to high values.
This field has a value of few hundreds of milliGauss and is directed approximatly along the beam direction (angle of about 20 degrees).
High statistic runs have demonstrated that this field can be **completely** suppressed by applying, for a very short time, a small field of 100 Gauss with the auxilliary coils (WEP).

After such a WEP cycling, zero field is dynamically performed (compensation better than 30 mG) by a newly installed automatic compensation device. Such compensation relies on a continuous field measurement realized slightly off-center. The correction due to the off-center position is taken into account and regularly performed by the Instrument Scientist.

When performing measurements in applied (such as Knight-shift measurements), any stray fields created by the major magnets located in (or near) the experimental hall are tabulated and automatically compensated by the automatic compensation device.

13 SWITCHING ON THE "FORWARD" VETO

In the normal mode, solely the "active collimator" (Backward veto) is utilized as a veto for the muons and positrons.
If measurements on small samples (and holders) are mandatory, the center part of the Forward detector can be used as an additional veto (Forward veto).

To switch on the Forward veto:

1. Locate the FAN IN – FAN OUT FO103A (center of the upper NIM Crate). In the normal mode, only the sectors C and D of the FO103A should be coupled and the LED "C·D" between sectors C and D should be ON.
2. To switch ON the Forward veto, one should couple also the sectors A and B (leaving the sectors C and D coupled). This is performed by turning the yellow switch of the FO103A on the position "A·B+C·D".
   At this point, the LEDs between sectors A and B ("A·B") as well as between sectors C and D ("C·D") should be ON.
3. Locate the Coincidence Unit FC104 where the sum between F_l+F_r and F_V is performed (right-hand side of the upper NIM crate).
4. Switch OFF the F_V coincidence (previously on OR).
5. You are now ready to perform measurements with both vetos.

To come back to the Normal mode, the inverse procedures described above should be performed.

Note that on the coincidence units determining the positron stops, the coincidence with the Veto signals should ALWAYS be active, and should NOT be touched.

Holder	Y (mm)
8	84.3
9	86.9
10	
11	86.2