

# 70 CM TELESKOP

Title: Instructions to fill with LN2 the  
CCD's dewar

Doc. Number: 002

Issue: 1.0

Issue date: 15.05.2019

Max-Planck-Institut für Astronomie  
Königstuhl 17  
D-69117 Heidelberg





---

Signature and Approval

	Name	Date
Prepared	Werner Laun	30.04.2019
Checked	Conchi Cardenas	15.05.2019
Approved		

---

## REVISION HISTORY

ISSUE	DATE	OWNER	CHANGES
1.0	15.05.2019	WERNER LAUN	Complete document, first version

## ABBREVIATIONS AND ACRONYMS

- CCD: Charge Coupled Device  
KING: Königstuhl Instrument zum in den Nachthimmel Gucken  
LN<sub>2</sub>: Liquid nitrogen  
MPIA: Max-Planck-Institut für Astronomie  
TMP: Turbo Molecular Pump

# TABLE OF CONTENTS

REVISION HISTORY .....	3
ABBREVIATIONS AND ACRONYMS.....	3
TABLE OF CONTENTS .....	4
LIST OF FIGURES.....	4
1. INTRODUCTION.....	5
2. SAFETY .....	6
3. SMALL BLUE LN <sub>2</sub> VESSEL .....	7
4. FILLING THE SMALL BLUE LN <sub>2</sub> VESSEL .....	8
5. PUMPING VACUUM AT THE CCD'S DEWAR .....	10
6. FILLING THE DEWAR WITH LN <sub>2</sub> .....	15
7. SHUTTING DOWN THE VACUUM PUMPS.....	16

## LIST OF FIGURES

· Figure 1-1: Small blue LN <sub>2</sub> vessel location inside the 70 cm telescope dome.....	5
· Figure 2-1: Left: location of the protection equipment. Right: Safety sheets location, on the wall above the small blue LN <sub>2</sub> vessel.....	6
· Figure 3-1: Small blue LN <sub>2</sub> vessel. ....	7
· Figure 4-1: Left: gas valve open and clamp open. Right: cap with extension tube pulled out. ....	8
· Figure 4-2: Left: vessel with heater connected. Right up: power supply for heater. Right down: heater connector.....	9
· Figure 5-1: CCD Maintenance Log table located in the telescope dome. ....	10
· Figure 5-2: Location of the vacuum pump set: at the right of the telescope control console. ....	10
· Figure 5-3: Vacuum pump set. ....	11
· Figure 5-4: <b>Lock valve</b> at the CCD's dewar: left, valve closed; right, valve open. ....	12
· Figure 5-5: <b>Venting valve</b> at the pump set: left, valve closed; right, valve open.....	13
· Figure 5-6: <b>Gate valve</b> at the pump set: left, valve closed; right, valve open. ....	13
· Figure 5-7: Left: switch on roughing pump and mains power. Right: start TMP. ....	14
· Figure 5-8: Left: TMP still accelerating. Right: TMP at nominal speed. ....	14
· Figure 6-1: Exhaust gas hose on the filling neck. ....	15
· Figure 6-2: Filling LN <sub>2</sub> with face protection. ....	16
· Figure 7-1: <b>Lock valve</b> at the CCD's dewar: valve closed. ....	17
· Figure 7-2: Switch off TMP (D), turn off roughing pump (E) and open venting valve (F). ....	17
· Figure 7-3: <b>Gate valve</b> at the pump set: valve closed.....	18

## 1. INTRODUCTION

The KING telescope can be used by any staff member from MPIA.

Because a liquid nitrogen (LN<sub>2</sub>) cooled CCD is used as a detector the handling is not just "plug and play".

To have access to the telescope you must first attend a short introduction in the safe handling of LN<sub>2</sub> and how to run the vacuum pumps. This written procedure cannot replace the personal introduction but can summarize what you should have learned.

The KING Telescope is accessible only via steep stairs. The MPIA standard LN<sub>2</sub> vessels are much too heavy to be carried up to the telescope. Therefore a small blue LN<sub>2</sub> vessel is used. Usually it is stored at the telescope (Figure 1-1).

To fill the small blue vessel, it must be taken to the large LN<sub>2</sub> tank in the main building. Your transponder key will be activated to grant access to the large LN<sub>2</sub> tank and to the KING telescope as soon you have made the personal instruction to the LN<sub>2</sub> handling.



Figure 1-1: Small blue LN<sub>2</sub> vessel location inside the 70 cm telescope dome.

## 2. SAFETY

The CCD's dewar on the KING telescope is cooled by LN<sub>2</sub>.

The handling of LN<sub>2</sub> is not as critical as you might expect but should be done carefully.

LN<sub>2</sub> can be dangerous in some cases. Therefore, following these precautions to prevent any damage:

- Protect your eyes or better your whole face from spitting LN<sub>2</sub>.  
There are protection goggles or face shields available, in the telescope dome (Figure 2-1, left) and in the cabinet of the large LN<sub>2</sub> tank.
- Avoid skin contact as you would do it when handling boiling water.  
Short contact on hands or arms is not dangerous as long as the liquid can rinse away fast. It will harm you much more if the liquid is trapped to you skin by cloth. In case this happened lift the cloth away from your skin. LN<sub>2</sub> will evaporate fast.
- Don't trust the gloves.  
They protect your hands against cold surfaces but the liquid goes through. Take them off fast in case you spit LN<sub>2</sub> over your hands.
- The small blue LN<sub>2</sub> vessel can be under pressure.  
Be aware of this when you open any valve or when you want to remove the head of the vessel for filling.
- Where you have too much nitrogen there could be a lack of oxygen.  
At the telescope there should be no problem with the oxygen concentration but if you work with a lot of nitrogen in small rooms you can easily drop under a critical oxygen concentration. If there is no permanent O<sub>2</sub> sensor in this room ask for a mobile sensor which is available in house.
- You can also consult the safety sheets located above the blue vessel in the telescope dome (Figure 2-1, right).



Figure 2-1: Left: location of the protection equipment. Right: Safety sheets location, on the wall above the small blue LN<sub>2</sub> vessel.

### 3. SMALL BLUE LN<sub>2</sub> VESSEL

The blue vessel (Figure 3-1) is equipped with a pressure gauge, two valves for liquid and gaseous nitrogen, a safety valve, a heater to build up pressure and a filling hose.

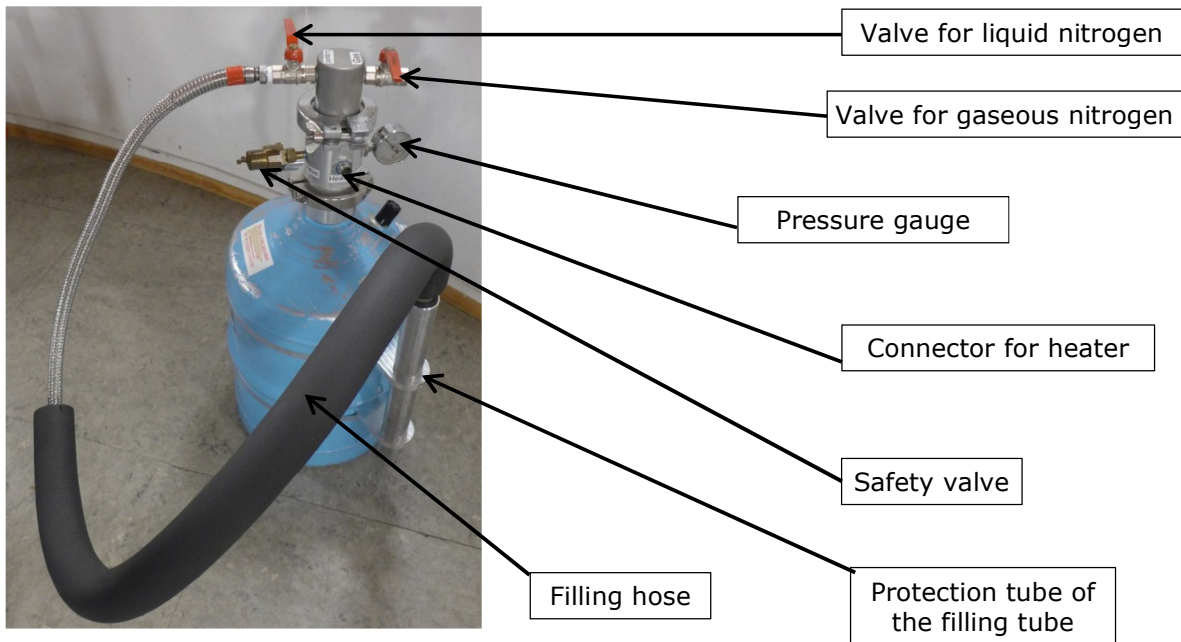


Figure 3-1: Small blue LN<sub>2</sub> vessel.

## 4. FILLING THE SMALL BLUE LN<sub>2</sub> VESSEL

- 1) First, you have to transport the blue vessel from its location at the telescope to the large LN<sub>2</sub> tank in the main building.
- 2) Protection: Put on face protection and gloves.
- 3) Vessel opening: (Figure 4-1)
  - a) **Pressure gauge**: On the pressure gauge one can see if the vessel is empty or if there is any remaining LN<sub>2</sub> inside.
  - b) Release the pressure by opening the **gas valve** until there are 0 mbar.
  - c) When the pressure is gone, open the clamp and pull out the vessel plug with the hose and the extension tubes.

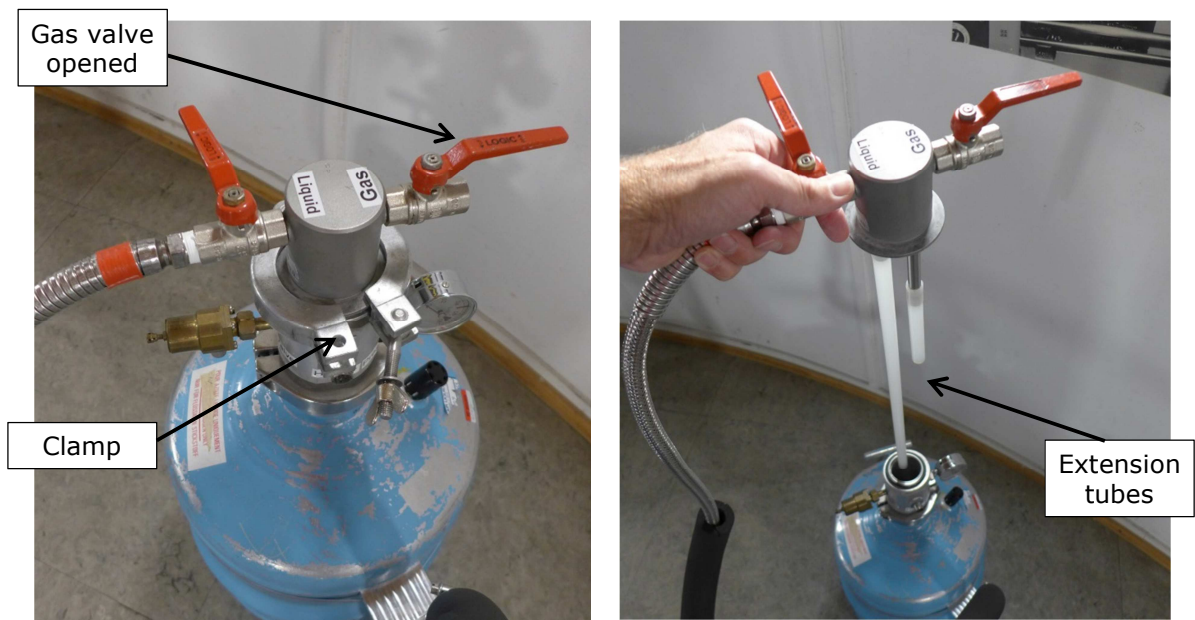


Figure 4-1: Left: gas valve open and clamp open. Right: cap with extension tube pulled out.

### 4) Filling with LN<sub>2</sub>:

- a) Take the hose of the large LN<sub>2</sub> tank and lower it into the small vessel until it reaches the bottom.
- b) Open the valve on the filling line by a few turns.
- c) Try to fill the vessel without spitting too much LN<sub>2</sub> around.

For filling it could be an advantage to lift the hose a little from the bottom of the vessel and reduce the flow by adjusting the valve. Try this out.

When much LN<sub>2</sub> is spitting out, close the valve.

- d) Check the level of liquid by using the black vinyl stick.

Put into the vessel and keep it there for 5 to 10 seconds.

When you pull it out you can see from the frost, how high the level of liquid is. About 20 cm are enough for your needs.

- e) Remove the filling hose of the large tank and put it back to the bracket on the wall.



**5) Replace the cap of the blue vessel:**

- a) Close the liquid valve and open the gas valve.
- b) Just wipe away the frost from the top flange, put on the seal ring and put on the cap. Tighten the flange with the clamp.

Please, notice the orientation of the valves, and locate the gas valve opposite to you, since some cold gas will go out through it when you put on the cap.

It can be that the rubber seal did get cold and hard at this time. So you have to try later if you can retighten the clamp when the seal has warmed up.

- c) Close the gas and the liquid valve for the transport.

**6) Transport the blue vessel to the telescope.**

Even the full vessel can be carried up to the telescope by one person.

**7) Prepare the vessel for filling the CCD's dewar.**

When you are up at the telescope the pressure in the vessel has already increased.

If not, connect the power supply to the heater to increase the pressure in the vessel (Figure 4-2). Notice the unique orientation of the heater connector to properly connect it to the vessel.

The safety valve is blowing off when the maximum pressure is reached. The vessel is now ready for filling.



Figure 4-2: Left: vessel with heater connected. Right up: power supply for heater. Right down: heater connector.

## 5. PUMPING VACUUM AT THE CCD'S DEWAR

The vacuum in the CCD's dewar is needed for the thermal isolation of the liquid nitrogen bath.

When the CCD's dewar is warm the vacuum is degrading with time. Therefore it has to be repumped from time to time.

There is a "**CCD Maintenance Log**" table (Figure 5-1 and Figure 5-2) which indicates when this dewar has been pumped the last time. If the last pumping was done more than about two months ago, you should repump the vacuum before filling with LN<sub>2</sub>.

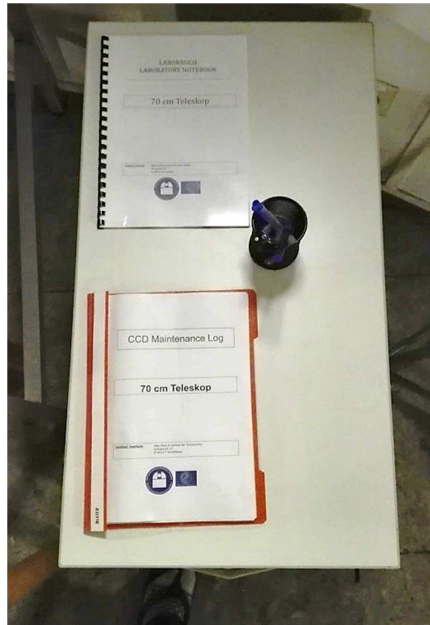


Figure 5-1: CCD Maintenance Log table located in the telescope dome.

The **vacuum pump set** at the KING telescope (Figure 5-2) is placed at the right of the telescope control electronics.



Figure 5-2: Location of the vacuum pump set: at the right of the telescope control console.

The vacuum pump set (Figure 5-3) uses two vacuum pumps in line.

There are a rotary vane pump (**roughing pump**), which can reach a vacuum down into the range of  $10^{-3}$  mbar, and a turbomolecular pump (**TMP**) which can reach into a range below  $10^{-7}$  mbar.

The TMP cannot pump against atmosphere, so it needs the roughing pump in line.

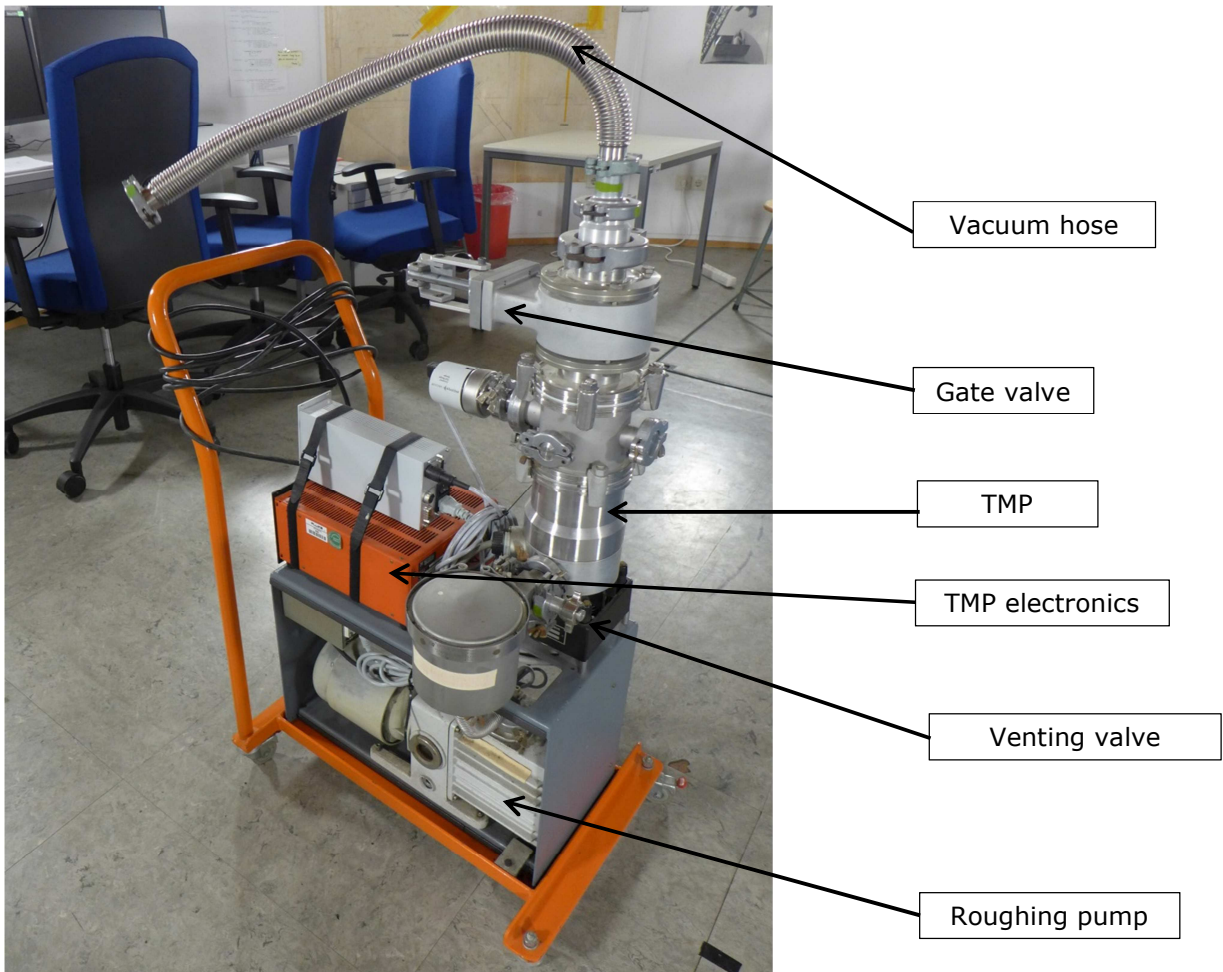


Figure 5-3: Vacuum pump set.

## PUMPING PROCEDURE

### 1) Connecting the pump set to the CCD's dewar.

On top of the pump set there is a **vacuum hose** (Figure 5-3) which can reach up to the CCD's dewar. The end of the hose should be covered by a blank flange which must first be removed.

At the CCD's dewar there is a **lock valve** which should also be protected by a blank flange.

- a) Verify that the **lock valve** is closed (Figure 5-4, left).

To be sure the valve is closed push the handle in before removing the blank flange from the CCD's dewar side.

This prevents to lose the vacuum level that could have the CCD's dewar.

- b) Connect the vacuum hose to the lock valve.

- c) Close the **venting valve** (Figure 5-5).

At the pump set there is a venting valve which should be open. Close it.

TMP won't start otherwise.

- d) Open the large **gate valve** on top of the pump set (Figure 5-6).

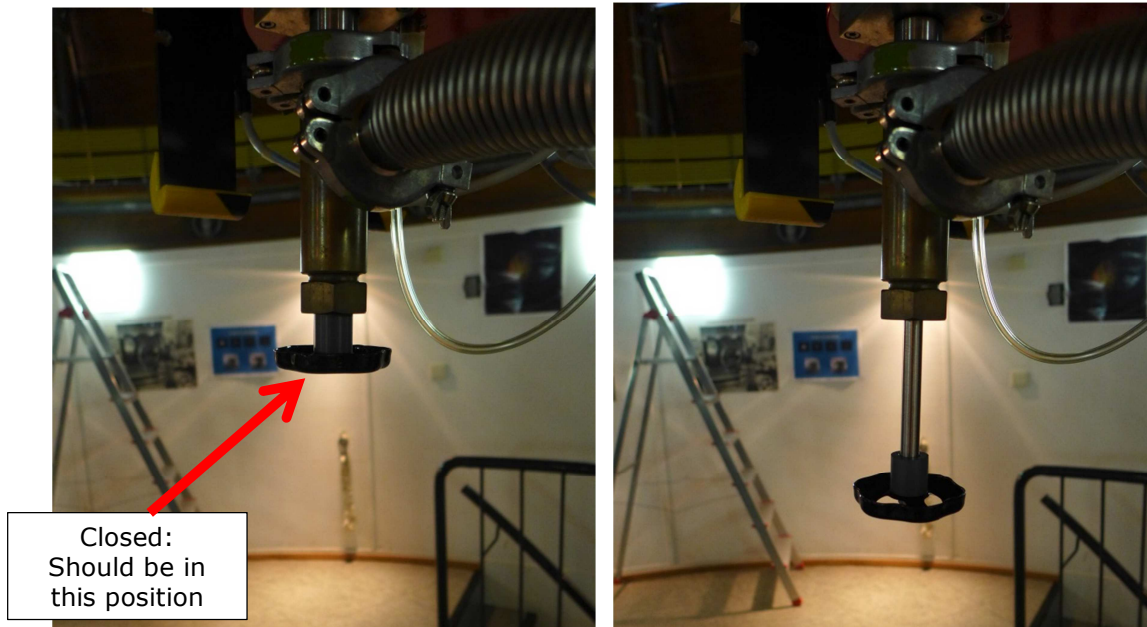


Figure 5-4: **Lock valve** at the CCD's dewar: left, valve closed; right, valve open.

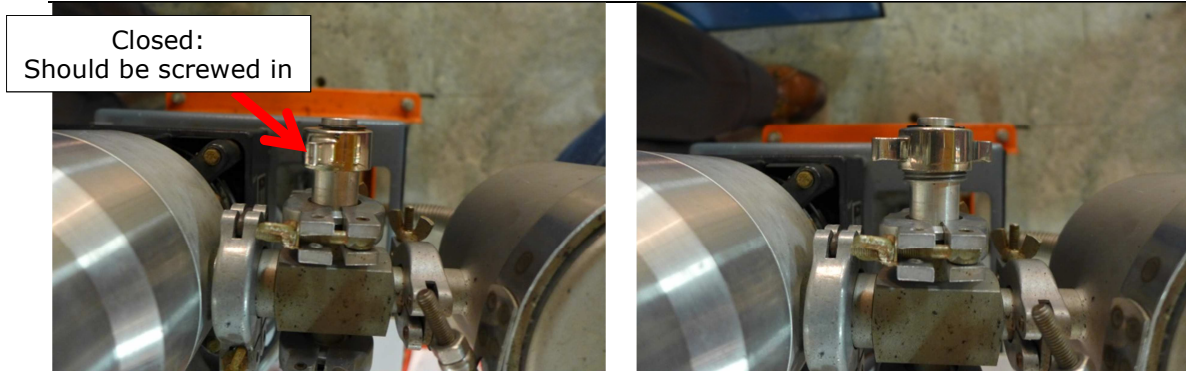


Figure 5-5: **Venting valve** at the pump set: left, valve closed; right, valve open.

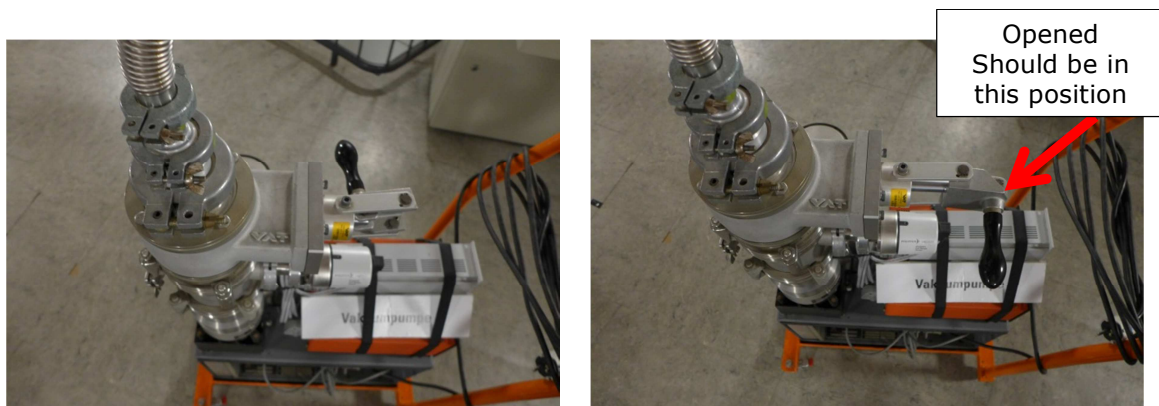


Figure 5-6: **Gate valve** at the pump set: left, valve closed; right, valve open.

## 2) Starting the pumps.

- e) First start the **roughing pump** by turning the “PUMPEN” knob from 0 to 1 (Figure 5-7, A).
- f) Wait until the pressure is below 10 mbar.
- g) Then, start the **TMP** by pressing the start button on the pump electronics (Figure 5-7, B).

The TMP needs some time to accelerate the rotor. During this time the green diode indicating “acceleration” will light until the final rotation speed is reached. Then the yellow light will show “normal operation”. This normally takes a few minutes.

- h) Wait until **TMP** is in “normal operation” (Figure 5-8, C).
- i) Now the **lock valve** on the CCD's dewar (Figure 5-4, right) can be opened by pulling out the handle.

Don't rotate the handle counter clockwise. To pull out the handle slightly rotate it clockwise and then pull it out all the way.

- j) Keep the pumps running until the pressure gauge shows a value in the range of  $10^{-5}$  mbar.

If the dewar was not opened before this, pressure can pretty soon be reached (few min). Otherwise it will take longer.

→ Now ( $P \sim 2 \cdot 10^{-5}$  mbar) you can start filling the dewar with LN<sub>2</sub>.

→ After filling, the pumps can be shut down as described in chapter 7.

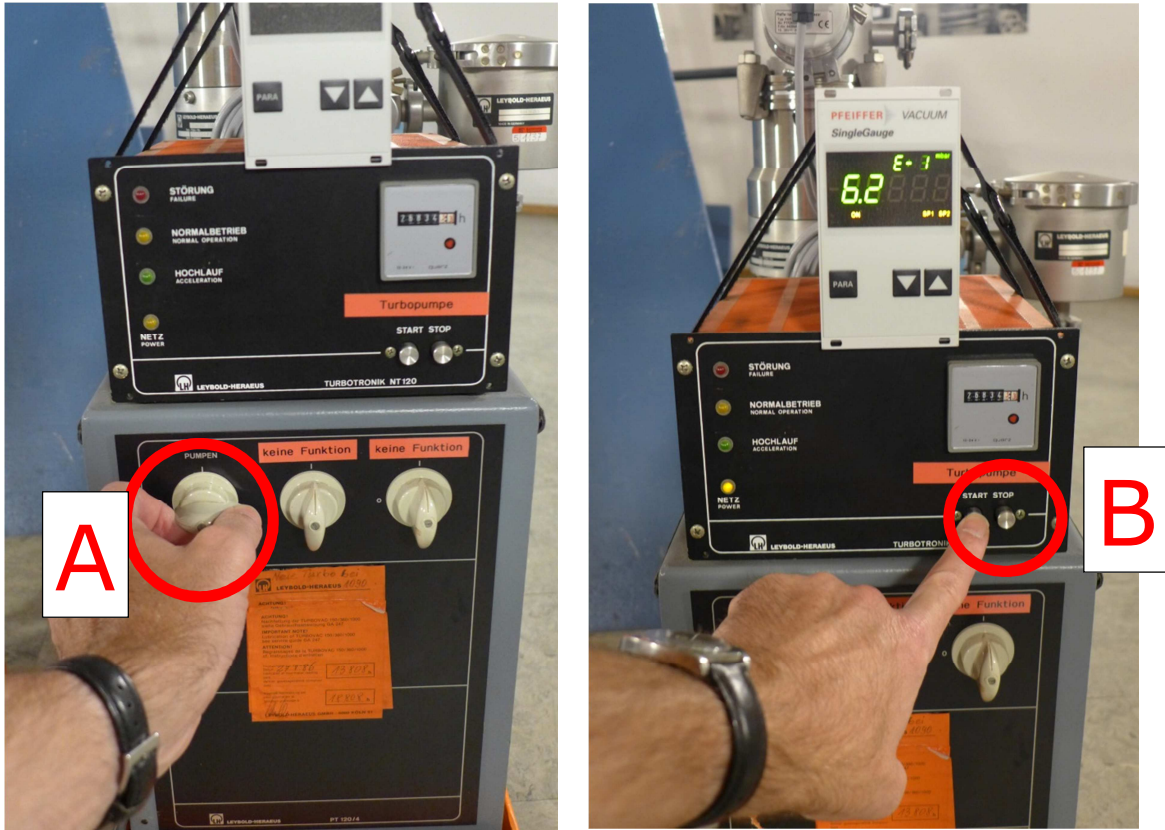


Figure 5-7: Left: switch on roughing pump and mains power. Right: start TMP.

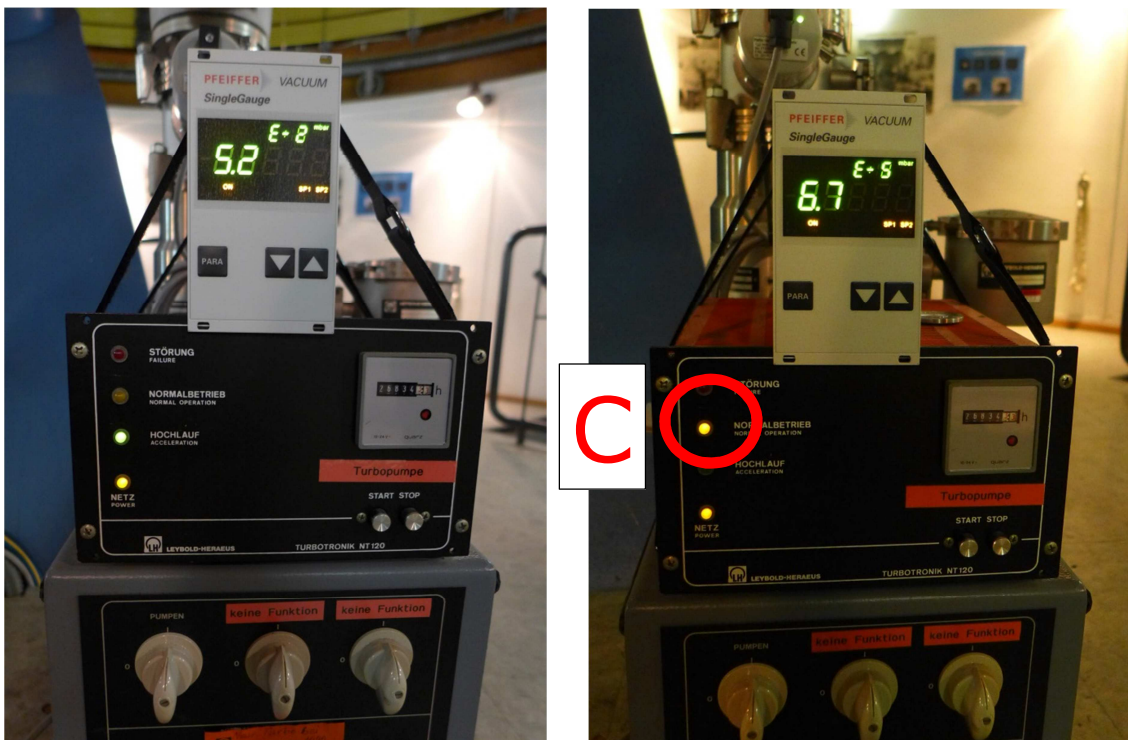


Figure 5-8: Left: TMP still accelerating. Right: TMP at nominal speed.

## 6. FILLING THE DEWAR WITH LN<sub>2</sub>

**During the filling keep the pumps running.**

k) When filling the CDD's dewar the **telescope** has to point to zenith.

The dewar is filled from below.

l) Remove the **rubber hose** from the neck (Figure 6-1).

The **filling/exhaust gas neck** is covered with a rubber hose. This hose leads the exhaust gas to the entrance window. This is done to prevent the entrance window of the dewar from building condensing water.

m) Take on gloves and face protection.

n) Move the small blue LN<sub>2</sub> vessel below the dewar.

o) Point with the **thin tube** into the filling neck as far as you can reach (Figure 6-2, left).

p) Then, open the **liquid valve** on the blue vessel.

If the pressure in the vessel is too low or is dropping too much during filling increase the pressure by heating with the small power supply.

q) When filling, you will fill until liquid is spitting out.

There is no indicator for the filling level.

Wear a face protection when doing this.

r) When liquid is spitting out just close the **liquid valve** on the blue vessel and wait a short moment until you carefully pull the thin tube out of dewar.

s) Then, place the thin tube into the protection tube on the side of the blue vessel.

t) The CCD's dewar is now full and the **rubber hose** can be replaced over the exhaust gas tube to lead the evaporating gas over the entrance window.

→ Now the vacuum set can be shut down.

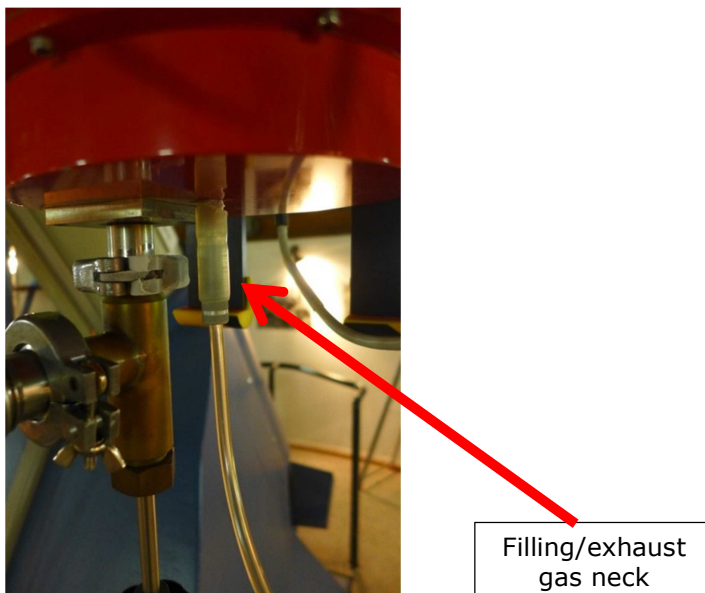


Figure 6-1: Exhaust gas hose on the filling neck.



Figure 6-2: Filling LN<sub>2</sub> with face protection.

## 7. SHUTTING DOWN THE VACUUM PUMPS

- u) Before you shut off anything first close the **lock valve** at the CCD's dewar by pushing in the handle as far as possible (Figure 7-1).
- v) Now you can switch off both pumps.
  - The **TMP** by pressing stop (Figure 7-2, D) and the **roughing pump** by turning the knob "PUMPEN" to 0 (Figure 7-2, E).
  - The TMP will need some time to decelerate.
- w) Open slowly the **venting valve** at the side for about 2 or 3 turns (Figure 7-2, F).
  - The pressure in the pump set will increase and the rotation speed will decrease faster. Wait until the TMP stops spinning.
- x) Close the **gate valve** (Figure 7-3).
- y) Disconnect the vacuum hose from the CCD's dewar.
- z) Put a blank flange on the open flange at the valve and on the flange at the end of the hose.
- aa) Put the pump set back to its place (Figure 5-2).



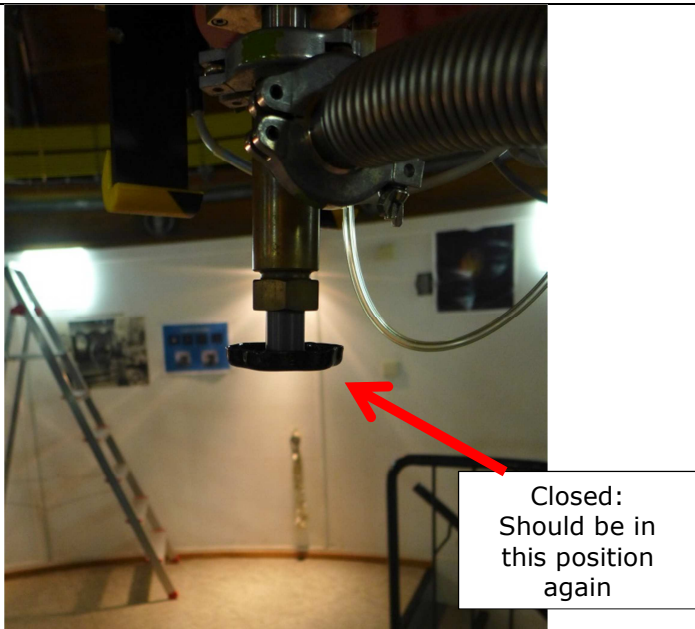


Figure 7-1: **Lock valve** at the CCD's dewar: valve closed.

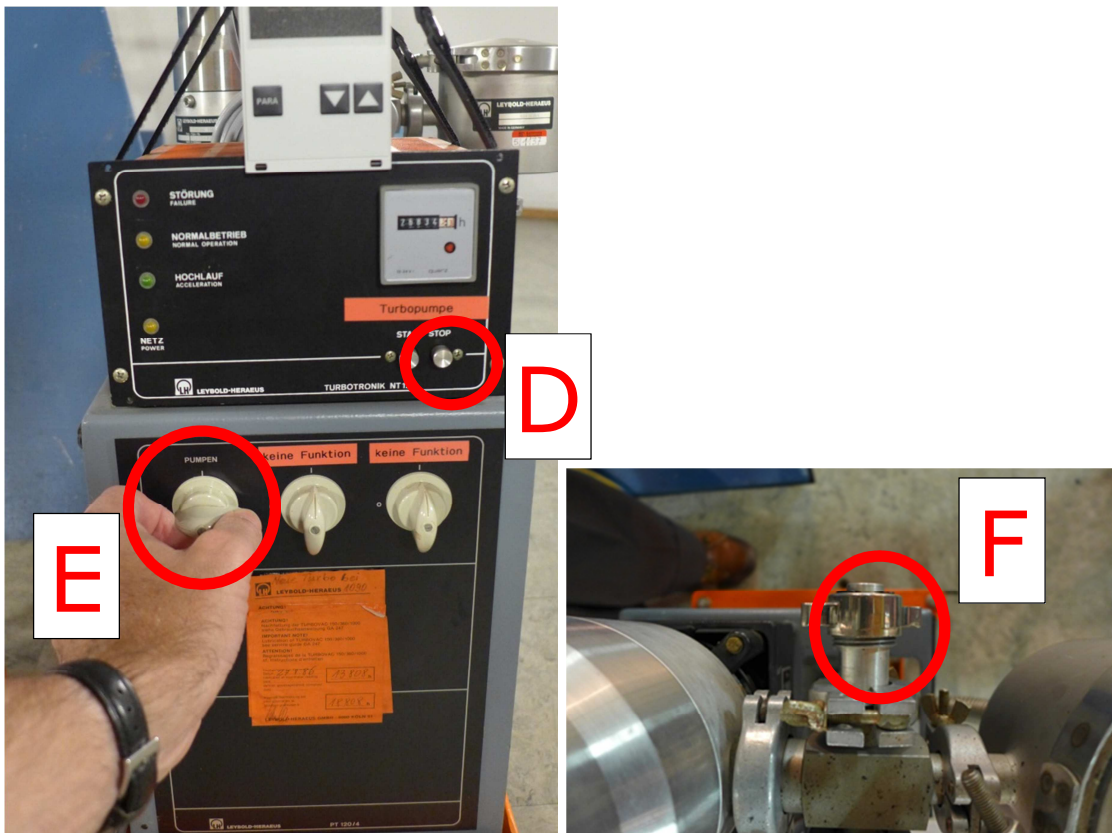


Figure 7-2: Switch off TMP (D), turn off roughing pump (E) and open venting valve (F).

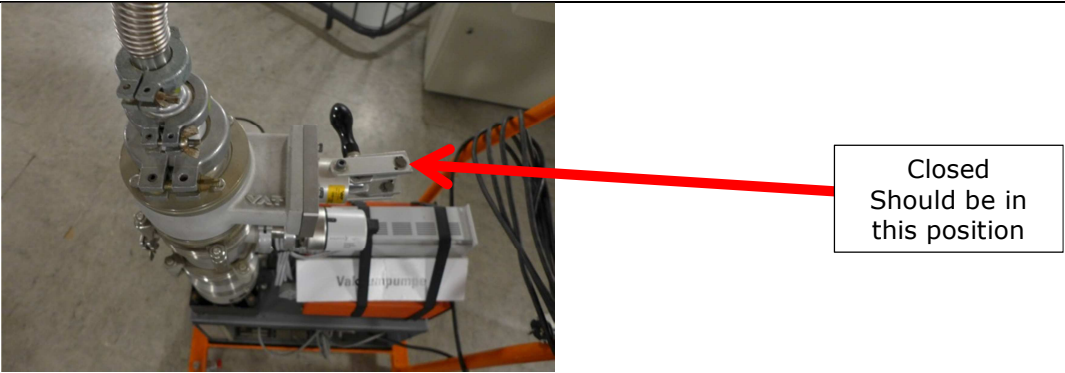
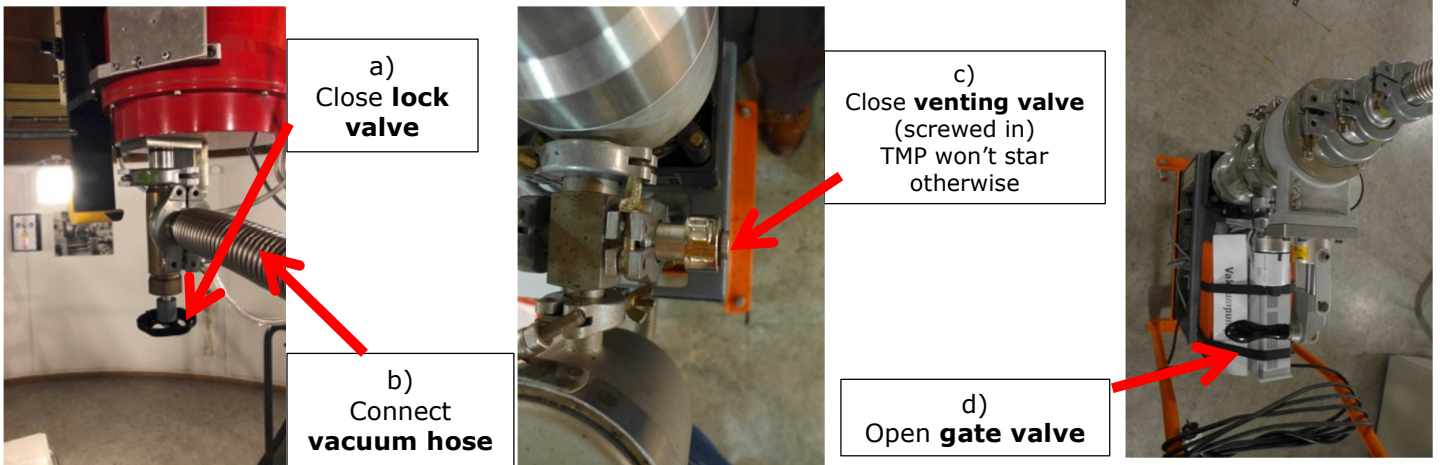


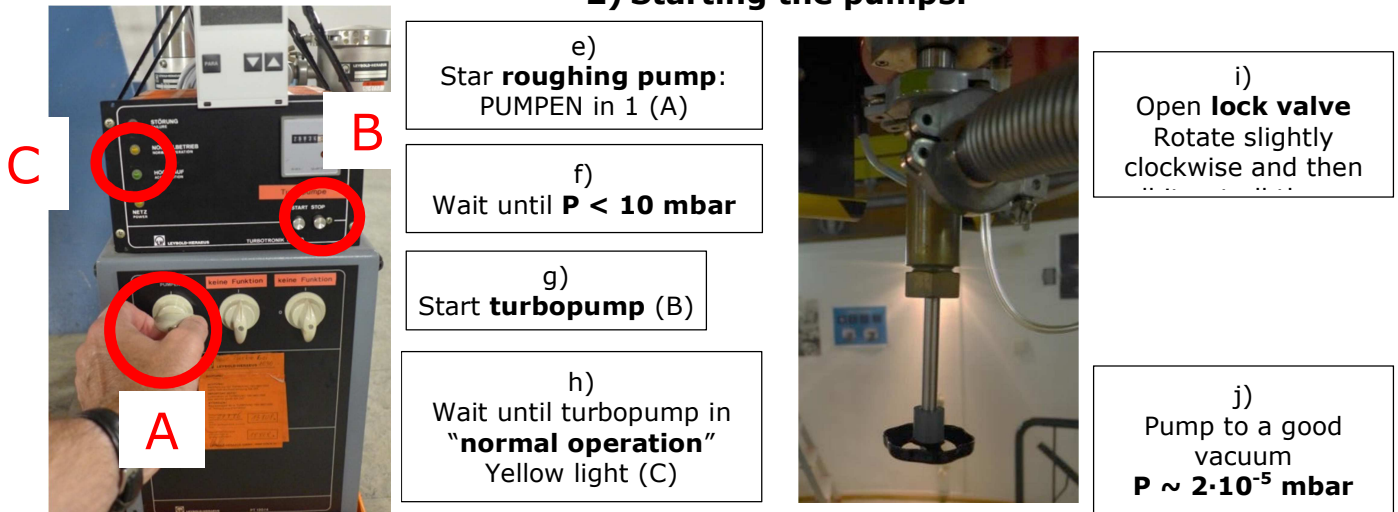
Figure 7-3: **Gate valve** at the pump set: valve closed.

## PUMPING PROCEDURE

### 1) Connecting the pump set to the CCD's dewar.



### 2) Starting the pumps.



### 3) Shutting down the vacuum pumps and disconnect the vacuum hose

