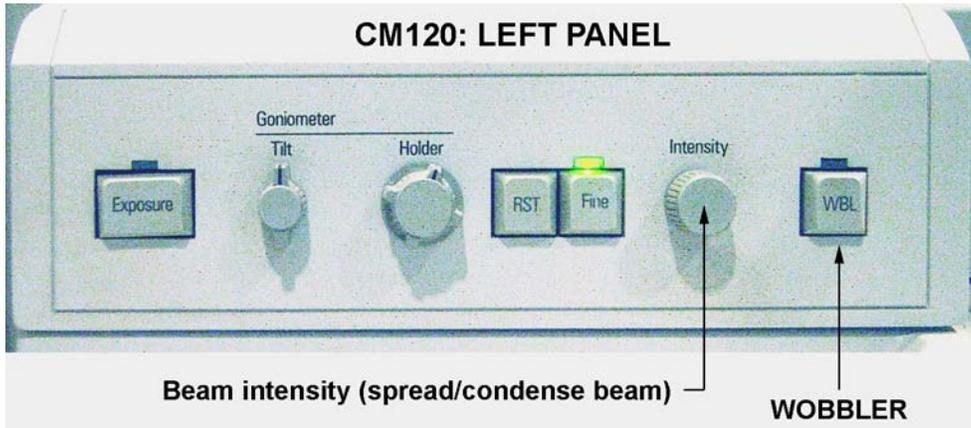


# FEI/PHILIPS CM120 TEM

## Overview.

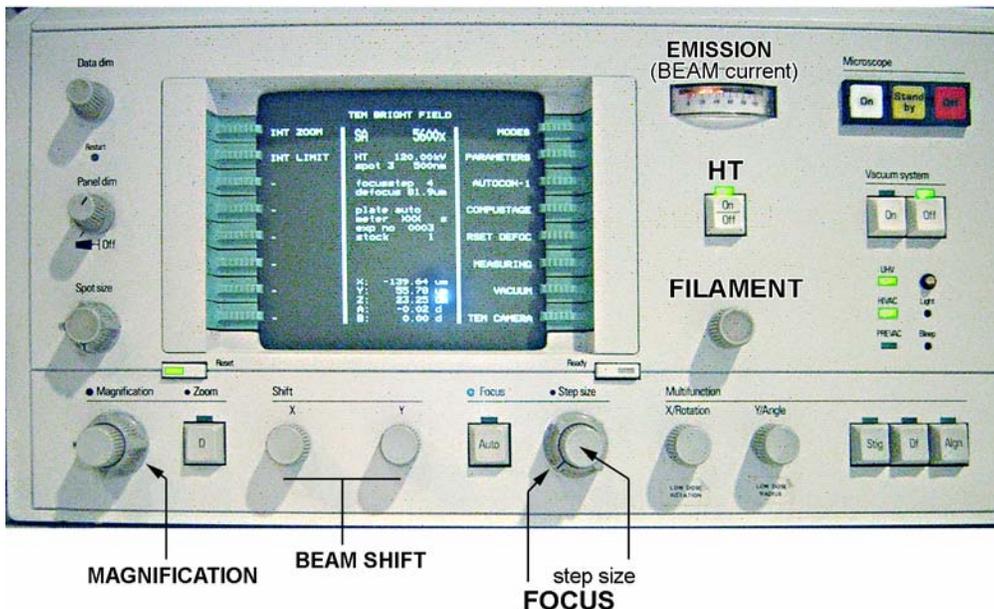
CM120 is a transmission electron microscope with a maximum acceleration voltage of 120 kV. The main microscope controls are localized on the LEFT and RIGHT panels:



The left panel – contains only two controls important for users to know:

- Intensity (beam).
- WOBBLER (for focusing).

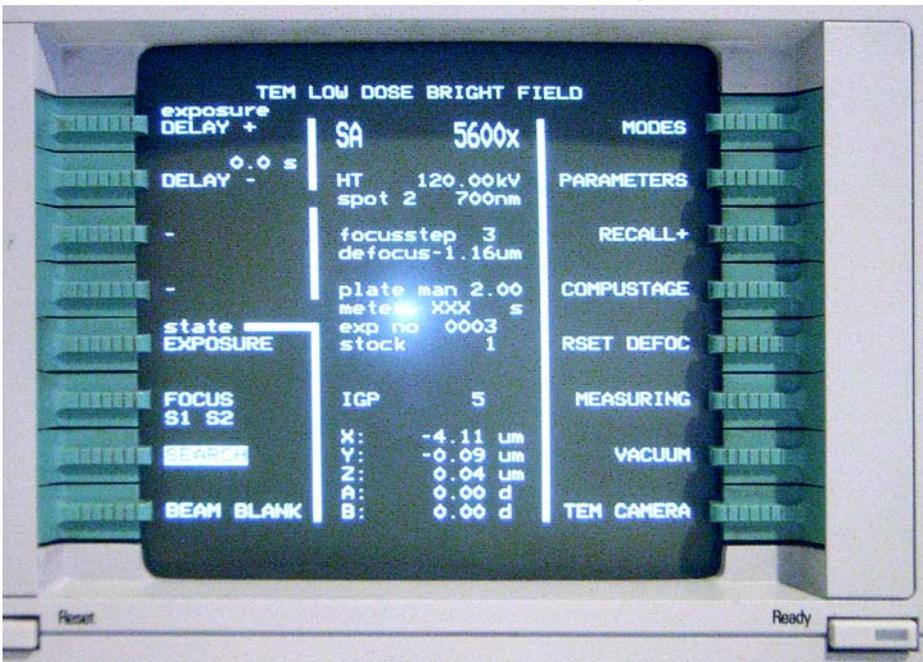
## CM120: RIGHT PANEL



The right panel – contains most of the CM120 controls:

- Microscope ON/OFF switch.
- Vacuum system ON/OFF switch (in normal operation the OFF switch is lit).
- Ultra High Vacuum (UHV) indicator (normally is lit).
- High Vacuum (HIVAC) indicator (normally is lit).
- High Tension (HT) button (normally is lit).
- Filament knob.
- Emission (beam current) indicator.
- Computer monitor.
- Spot size knob.
- Magnification knob.
- Focus knob.
- Beam shift, X and Y.

## Computer monitor.

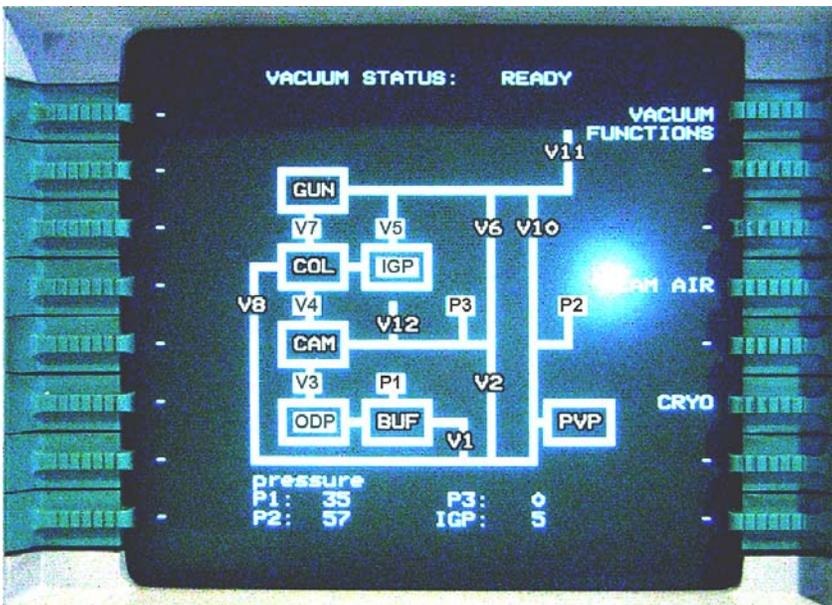


An internal computer controls all microscope functions. The computer monitor on the right panel provides all information about the microscope's condition. Information on the computer is organized into "pages." Computer has no keyboard, but is operated by the green buttons on the left and right sides of the screen. These buttons function in two ways: (1) select/change the page and (2) set/change the parameters. The buttons function differently on different pages depending on the content. There is a *magical* button called "Ready" on the bottom-right side of the monitor. It takes you one

step back in the Menu hierarchy. Sometime it also functions as an "Enter" button. Combine the green and "Ready" buttons to change the screen pages. The hierarchy of the pages is: **CM120**

← **MODES** ← **TEM LOW DOSE...**

The "TEM Low Dose Bright Field" screen (seen above) is normally used for everyday operation. It contains three fields: **left** and **right** fields label the green buttons (**MODES**, **COMPUSTAGE** and **VACUUM** are commonly used); the **central** field contains information about the microscope status. Most information is self-explanatory: magnification, accelerating voltage, spot size etc. Many options for the green buttons are also self-explanatory. For instance, pressing the green button next to the "VACUUM" will bring up the CM120 vacuum diagram:



On the diagram, a white background indicates that a valve is open (V7), black – closed (V10). For proper microscope operation the following conditions must be met:

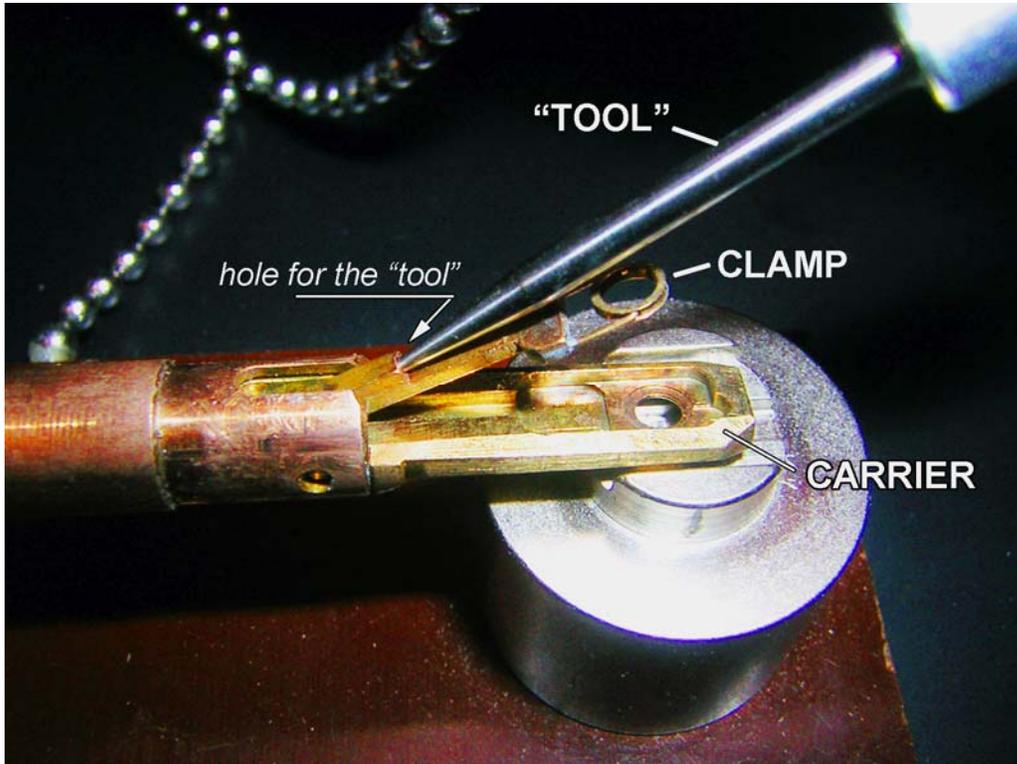
**V3, V4, V5, and V7** valves – open;  
**P3 and IGP** reading (bottom of the page) – **less than 30**.

Abbreviation used on this page: **IGP** – Ion Getter Pump; **ODP** – Oil Diffusion Pump; **PVP** – Mechanical Pump; **BUF** – buffer tank; **CAM** – photo camera; **COL** – column; **GUN** – electron gun.

Similarly, other functions may be accessed by pressing the corresponding green button. Pressing "Ready" returns you to the previous screen.

## Grid-holder.

For those who have had previous experience with JEOL microscopes, CM120 holder will feel very fragile and delicate. It's very true. *Please, pay special attention when handling FEI/Phillips holders – they ARE really fragile and delicate!* Before using, inspect the holder: check the O-ring for cracks or dust, it must be clean; Check conical area next to the O-ring – it must be clean without visual scratches etc; Inspect clamp mechanism, make sure it's not damaged. Report any problem immediately! *Please, be aware: most of the FEI/Phillips holders could hold only one grid!*



### How to load the grid?

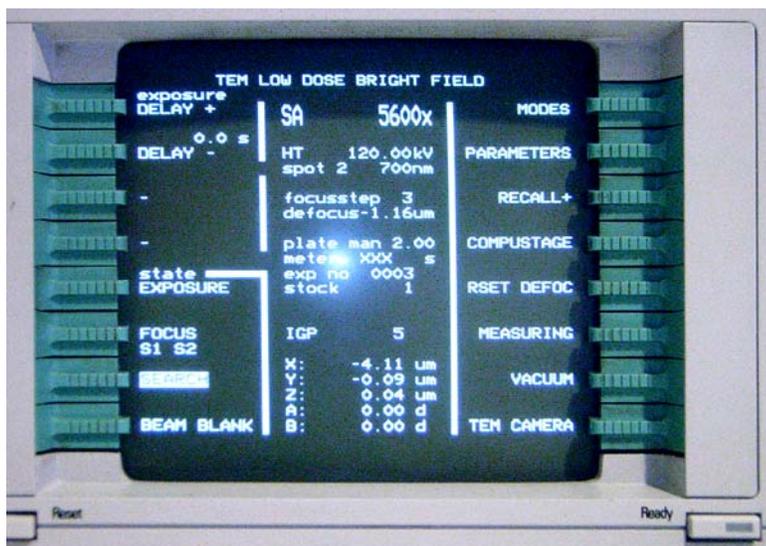
There is a special **"tool"** to open the **"clamp,"** which holds the grid in the **"carrier."** In order to open the clamp, (1) locate the small hole at the base of the clamp. (2) Insert the tool into the hole and slowly move the clamp up into a vertical position (make sure the clamp is secured in this position); do not apply excessive force! (3) When clamp is in the vertical position, load the grid into the carrier; make sure it's centered well and *slowly* move clamp down into the closed position. Control this movement with the tool. Do not remove the tool from the hole unless clamp is completely closed. The normal orientation for the grid is sample down. Do not use tweezers etc. to manipulate the clamp. Improper operation will damage the clamp mechanism.

## Using the CM120 Electron Microscope, basic operation.

Remarks: in this Instruction, references to the computer screen page/function associated with green buttons are presented in **BOLD GREEN**. The name of the physical switch/knob/button – **BOLD RED**. Parameters, which operators need to set/change (like magnification) – **BOLD BLUE**.

### *Step-by-step Instruction.*

1. Make sure that **HT**, **UHV** and **HIVAC** indicators on the right panel are lit.
2. Go to **TEM Low Dose Bright Field** page using green/**READY** buttons: **MODES** ← **TEM LOW DOSE** ← **TEM Low Dose Bright Field**.

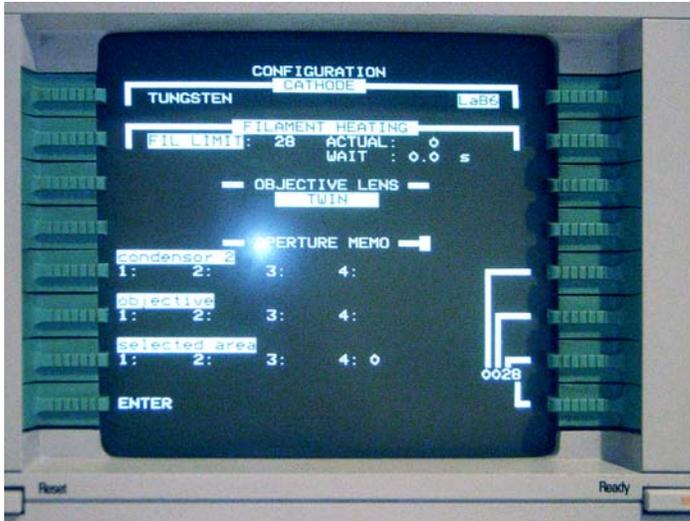


This is your **Main page**.

3. Check the vacuum in the scope: ← **VACUUM**. Make sure that **V3**, **V4**, **V5** and **V7** are opened; **IGP** < 30 and **P3** < 30. Using **Ready**, return to **TEM Low Dose Bright Field** page.

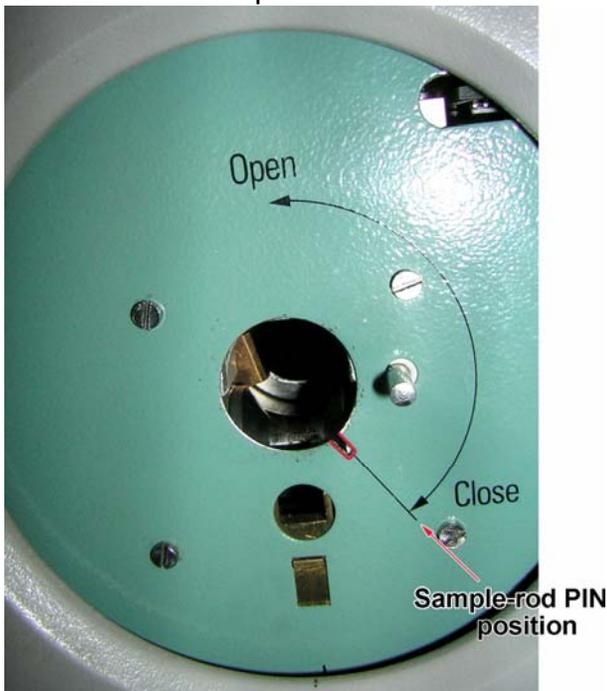
*Note:* you also may see **IGP** readings on the **TEM Low Dose Bright Field** page.

4. If liquid nitrogen is used in anticontamination device, check the level. Add more if necessary.
5. Reset the holder: **TEM Low Dose Bright Field** ← **COMPUSTAGE** ← **COMPUCTRL** ← **RESET HOLDER**.
6. Return to **TEM Low Dose Bright Field** page. Make sure that X, Y, Z, A, B is close to zero.
7. Make sure **FILAMENT** is **OFF**: rotate knob a few turns counterclockwise.



8. Check microscope's configuration: **MODES** **CONFIGURATION**. Make sure that **Cathode** is set to **LaB<sub>6</sub>**; **Filament Limit** is highlighted and between **25** and **30** (**28** currently).
9. Return to **TEM Low Dose Bright Field** page.
10. Please, notice that **CM120** has **High Tension** (high voltage) **ON** all the time (**HT** is lit).
11. Set magnification **SA x5600** using **MAGNIFICATION** (right panel).

12. Turn **FILAMENT ON**: make a few clockwise turns of the **FILAMENT** knob to initiate 2-3 min. long program of LaB<sub>6</sub> filament heating. Progress may be observed in the **MODES** **CONFIGURATION** page, in **Filament Limit, Actual**. Observe, also, **EMISSION** (beam current) increase. It will beep once when filament is ready.
13. Observe the beam on the big fluorescent microscope screen.
14. Using **SHIFT X and Y** (beam shift) on the right panel of the microscope, center the beam. Spread and condense beam (**INTENSITY**, left panel) a few times to make sure it's centered well and symmetrical.
15. Turn **OFF FILAMENT**.
16. Insert the sample holder:



1. Load the specimen (grid) in the standard single tilt holder. Make sure the specimen is properly fastened in the specimen holder.
2. Check that the O-ring and conical surface of the holder is clean.
3. Make sure that the filament is **OFF**.
4. Locate a small pin on the end of the holder closer to the grid.
5. Carefully insert the holder into the goniometer compustage with the small pin on the holder in the 5 o'clock position. The prepumping cycle will initiate and the red indicator light will come on.
6. If necessary, select holder from Menu. Normally, "St Cryo Holder" is used (choose one and hit **Ready**).
7. When the red light goes off (about 1 minute), rotate the specimen holder fully **counterclockwise** until it does not rotate further and insert into the microscope carefully as it will be sucked into the vacuum of the microscope.
8. Reverse these directions to remove the specimen holder from the microscope.

*The filament should be OFF during all these procedures!*

17. Wait for **IGP < 30** (**VACUUM** or **TEM Low Dose Bright Field** page) before proceeding. *Do not use the microscope if the IGP reading is higher than 30 to prevent damage to the LaB<sub>6</sub> filament!*

18. Turn **ON FILAMENT** (see #12).

19. Set **Spotsize** (right panel) to 3-4, find a small recognizable object on fluorescent screen using joystick **XY** control; adjust illumination (**INTENSITY**, left panel).



20. Press **A-WOBLER** in **COMPUSTAGE** page (this will initiate back and forth tilting of the goniometer to +/- 15°). Using **Z** control on the joystick, align Z-High by minimizing the apparent movement of the centered feature.

21. Stop **A-WOBLER** and press the **Auto Focus** knob (right panel, next to **FOCUS** knob). Make sure that stage is not tilted: A and B=0. If not – **Reset AB** on the **COMPUSTAGE** page.

22. Focus desired object using the **FOCUS**. Note: **FOCUS** knob has a “step size” sub-button (smaller one) – step size determines how quickly focus is changing. Normally, step size should not exceed “5”. Step size is indicated on Main page along with

magnification, HT etc.

23. Use joystick **XY** to move the grid. Observe your sample using standard EM procedure.

24. Use digital camera to take the pictures. **EMMENU4** software is used on CM120 microscope. In order to use digital camera, you need to manually lift up a big microscope fluorescent screen.

25. Ending your session:

- Set MAG to 5600x.
- Spread the beam over the viewing screen.
- Turn OFF the filament.
- Reset the Holder (see #5 above).
- Take out the holder, remove your grid.
- Put holder in the desired storage place.
- If you are the last person, who is using microscope for the day and liquid nitrogen was used, please, remove Dewar flask from the microscope, empty it and place it on the microscope console in an upside down position, initiate cryo-cycle on the microscope (**VACUUM** ← **CRYO** ← **START**).

26. Transfer your files to flash-drive, DVD, FTP etc. Do not store your images on microscope's computer – please, clean your directory often. EICN have no responsibility for your files on any of EICN computers – they may be erased without notification.

27. Sign-in the log-sheet, report any problems, abnormalities with the scope.

28. Check CLMS to make sure that your actual timing on the scope is correct. Please, be advised that EICN personnel are not responsible for proper timing of your microscope's usage.

*You are done! Many thanks for your patience and respect for our instruments!*

## EMMENU4 overview.

**EMMENU4** software operates the TIETZ F224HD CCD camera on CM120 TEM. The main element of **EMMENU4** is a “viewport”. It contains the whole interface for the digital camera: controls (photo, video etc), settings (exposure time, image size, binning etc), measuring tools, FFT and a “screen” to see the picture. You may create multiple viewports with different settings. On top of that, every viewport also comes with two sets of settings: Camera 1 and Camera 2. So you may switch between them as well! Because there is only one physical camera, only one viewport may be active (you choose which one). Active viewport is connected to the “buffer” or “slot”. It is just an allocation of virtual memory for the future picture. There are 500 buffers currently available. Every time you take a picture – the camera writes the data to the buffer. **Attention: by default, the camera writes in the same “buffer” and erases the previous picture!** Make sure that you choose the next available slot for the next picture. To avoid this problem, you need to mark “save acquired images on HD” in **Tools** ➤ **Options** ➤ **Image Manager**. Please, specify Directory and establish filename “rules.” **EMMENU4** image format is TIFF. Besides this virtual camera thing, **EMMENU4** has a set of standard features including histogram, image controls, measuring tool etc. We strongly encourage users to study the **EMMENU4** Manual.

## EMMENU4 operation.

1. Click on **EMMENU4** icon, ➤ **START**.
2. Click on the viewport icon – “create viewport”.
3. If you plan to use the camera in many different modes – create more viewports.
4. In viewport, choose the “camera”: 1 or 2, check the settings: exposure time (in milliseconds!!!); camera resolution settings: “2kx2k full” (full resolution, slow), “2kx2k 2xbin” (with 2x binning - relatively fast). Configure all your viewports this way.
5. Obtain an image on the large microscope’s fluorescent screen.
6. Lift up the large microscope fluorescent screen (mechanical handle on the left side of the observation chamber) – it will activate the digital camera.
7. In viewport, choose the viewing mode: single picture, video, FFT etc. Hit corresponding icon to activate the function. Use “Stop” to terminate the current process or switch to another. Pay special attention to the “buffers” - make sure that you write each picture in a separate slot. You may choose “save acquired images on HD” in **Tools** ➤ **Options** ➤ **Image Manager**. To change the size of the picture on the screen use F2-F3 to zoom in and out.
8. When finished with digital imaging, make sure that your images have been saved, lower microscope screen and exit **EMMENU4**.
9. Transfer your images to flash-drive, DVD, FTP etc. Do not store your images on microscope’s computer – please, clean your directory often. EICN have no responsibility for your files on any of EICN computers – they may be erased without notification.
10. Perform usual procedures to end your microscope session.