Working Algorithm (TEM at Room Temperature)

Note: ***Italic*** – microscope software; CAPITAL LETTERS – microscope buttons

1. Check the log book to find out the status of the microscope
2. Check the status of the microscope:
    - ON/OFF main console – OFF, VAC and HT buttons should lit
    - ***Log in*** and open the ***Tecnai user interface*** (TUI), go to ***vacuum overview*** and check that the vacuum is o.k: Gun < 15; Camera < 30
    - If ***HT*** is off (gray) turn it on (drag the marker on the HT tracker to 20kV, click on the ***free high tension*** check box, change the step size to 10000V (or less depending on the emission jump) and gradually change the HT to 40, 70 and 80kV. Change the step size to 3000V and go up gradually till 100kV, change the step size to 1000 and go up till 120kV. At the end, click to close the *free high tension*).
    - ***Column valves*** V4 and V7 are closed
    - ***Filament*** is off (gray)
    - Cover the projection chamber glass (viewing screen) by the black plastic cover
    - Cover the microscope right control panel
3. Fill the microscope dewar with liquid nitrogen (LN_2) to cool the anticontaminator blades (keep the LN_2 level as high as possible along the session)
4. Check that coordinates (x,y,z,α) are at zero position
5. Insert the holder with your grid

Inserting the holder:

Hold the specimen holder with the airlock trigger pin parallel to the small slit in the CompuStage front plate (at roughly four o'clock). Carefully insert the end of the specimen holder into the airlock cylinder and slide the holder in until a stop is reached (the red CompuStage light will be illuminated). Slowly turn the holder roughly to the left and to the right until it will go in a bit further (the airlock trigger pin now falls properly into its groove). Select the ***type of holder*** (single tilt) and press ***enter***.

When the red CompuStage light has been switched off, gently rotate the specimen about 120° counter-clockwise as far as it will, then allow it to slide in gently (while controlling it with your hand) further into the microscope.

5. Wait for a good vacuum (IGP≤15)
6. Open the **col. valves** (V4 and V7)
7. Turn on the filament
8. Find the beam and make sure the specimen is at **eucentric height** (in the stage tab click on the ***wobbler*** button. Minimize the image movement by changing the Z-Axis up or down in the microscope right control panel).
9. Find an empty area on the grid, take out the objective aperture, check **centering of C2 aperture** by following the movement of the spot when going through focus back and forth with the C2 INTENSITY knob (microscope left control panel). If the position of the spot moves, center C2 aperture iteratively by minimizing beam movement using the ADJUSTMENT SCREWS on the aperture itself and by going through focus repetitively.
10. Go to ***direct alignment*** in the ***Tune*** tab and check the following alignments (spot size 3, first open the beam so that in the cross-over point it will almost cover the large circle (40mm circle) on the microscope screen (~X 26500).

Gun tilt - continuously change each of the multifunction buttons (MF X,Y) until obtaining the brightest beam (minimal exposure time).

Gun shift - center the beam with the MF X,Y buttons: Minimize spot displacement when spot size is changed from spot size = 3 (center with MF X,Y) to spot size = 9 (center with beam shift tracker ball).

Beam tilt PPx and PPy - change both MF X and Y alternatively till only one spot is visible in the image with minimum shake (if the beam moves center with the LEFT TRACKER BALL).

Beam shift - bring the beam to the cross-over point and center it using the MF X,Y buttons. At the end, press ***Done***.

Rotation center - choose an area with sample. Move to mag. X 26500, change with MF X,Y buttons till lateral movement stops (should move only in and out of focus).

- At the end of the direct alignments press ***Done***
- Check (and if necessary adjust with the MF X,Y knobs) objective lens astigmatism: find an amorphous material, start at mag. X 97000, exposure time=1 sec. Open ***Digital Micrograph*** (DM), choose *CCD*, arrange *Preview integration time= 0.1sec*, lift screen, press ***preview***, in the tool bar choose *process-live-reduced FFT*, go from underfocus to overfocus and check if there is an astigmatism (in FFT beam is not round). To fix astigmatism: ***stigmator*** window, choose *objective*, copy 1 to 2, with MF X,Y make the FFT beam round.

Taking images:

- choose a feature you would like to take an image of and roughly focus it
- Open Digital Micrograph and choose the relevant camera (CCD or WAC CCD).

For CCD (bottom camera):

- with INTENSITY knob arrange the exposure time = 1 sec

Arrange ***preview*** integration time = 0.1 sec; ***acquire*** integration time = 1 sec. If intensity value is higher than 5000, reduce integration time or intensity (brightness).

Press ***preview*** and focus the image. Press ***acquire*** to take the image.

For WAC CCD:

- with INTENSITY knob arrange the exposure time = 10 sec

Arrange ***preview*** integration time = 0.05 sec; ***acquire*** integration time = 0.25 sec. If intensity value is higher than 5000, reduce integration time or intensity.

Press ***preview*** and focus the image. Press ***acquire*** to take the image.

Saving images:

After taking the first image: Open ***global info*** (software buttons at the lower right side of the screen) give a name for the images and operator. Do the same in ***image info***. Open a new folder (name _d_m_y) in the film stock folder (Browse – my computer – C- film stock – new folder). Choose image no. to start with. ***Save***.

For the rest of the images of the same sample just press the ***save*** button.

At the end of the session:

1. Put down the screen (and leave the microscope with a reasonable intensity for finding the beam next time)
2. Turn off the ***filament***
3. Close ***column valves*** (V4 and V7)
4. Retract camera and exit ***Digital Micrograph***
5. Reset coordinates (stage workset - ***holder***)
6. Retract the holder from the CompuStage, take out your sample and insert the holder back.

Retracting the holder:

- Always close the column valves before taking out the holder!
- Turn off the filament

Note: **In all stages it is important to give contra on the purple wheel!**

Pull till first stop, turn to right until it stops (here you can leave it), pull out.

7. Cover the projection chamber glass by the black plastic cover
8. Cover the microscope right control panel
9. **At the end of the day**: Activate the ***cryo cycle*** button (should be set for 240 min.). Empty the microscope dewar (put it up side down to dry) and put a plastic beaker under the copper wires to collect the melting frost
10. Burn your images to a CD. It is your responsibility to transfer the images to your own computer.

11. Add notes to the log book (including: Date, Operator name, User name and group, Sample imaged, Holder number, Filament time (to be read from the flap out of filament window), session time, problems in operation of the TEM or other notes.
12. Exit ***Tecnai user interface*** (save changes) and ***log out***.
13. Turn off the lights and leave the room in a state that we would like to find it ☺

Yael, Jan 2012