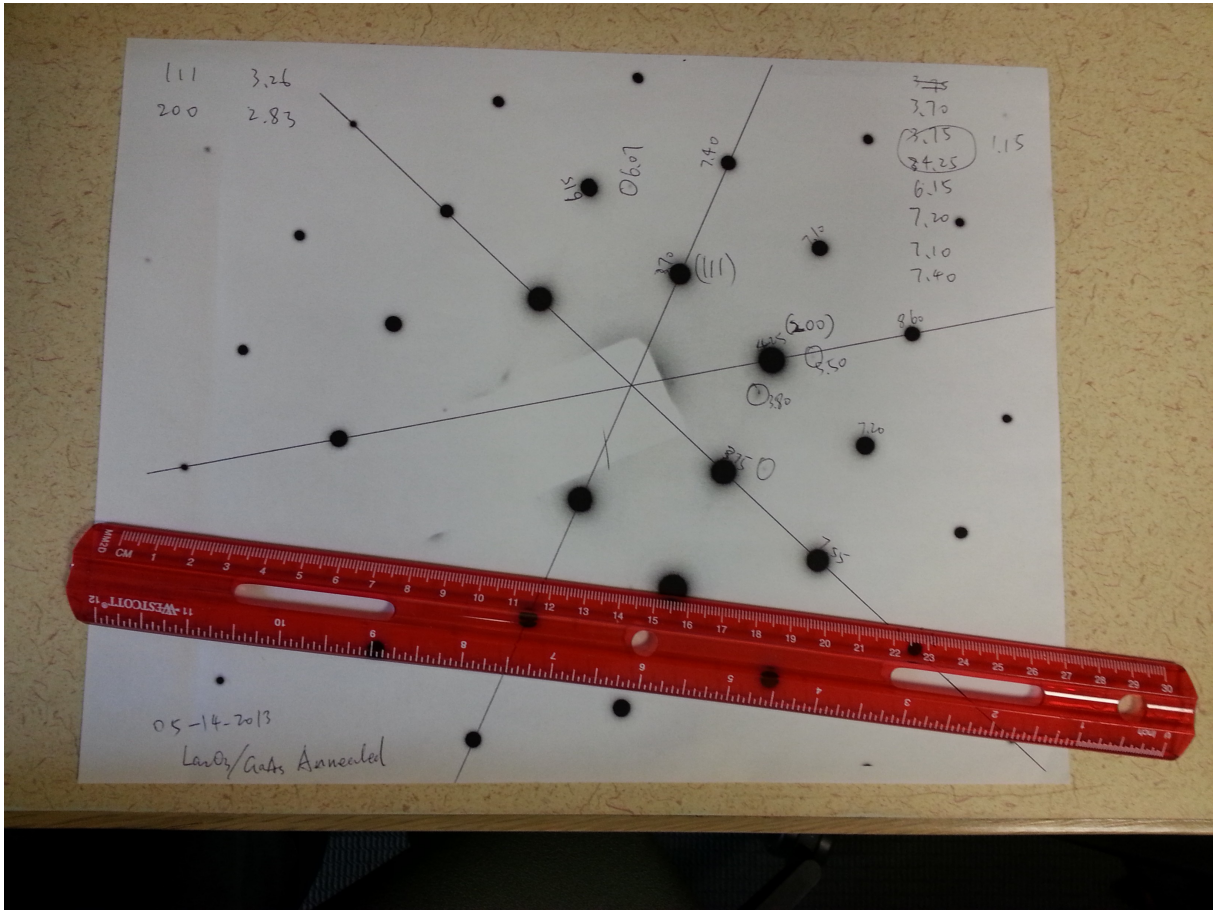
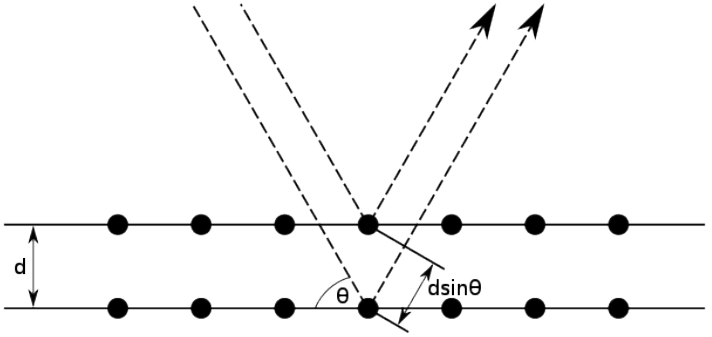
TEM Diffraction Analysis Program(TDAP) Manual



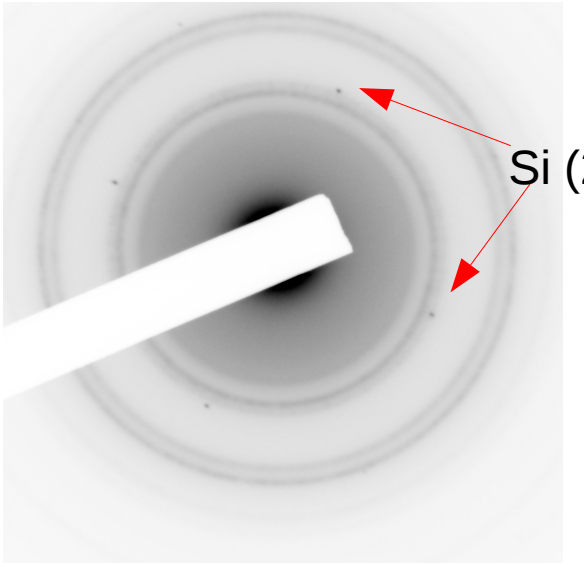


$$n\lambda = 2d\sin\theta\,,$$

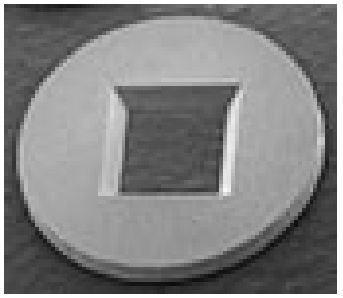
The most frequently used way to index a TEM diffraction pattern is to print the pattern and measure distance with a ruler.

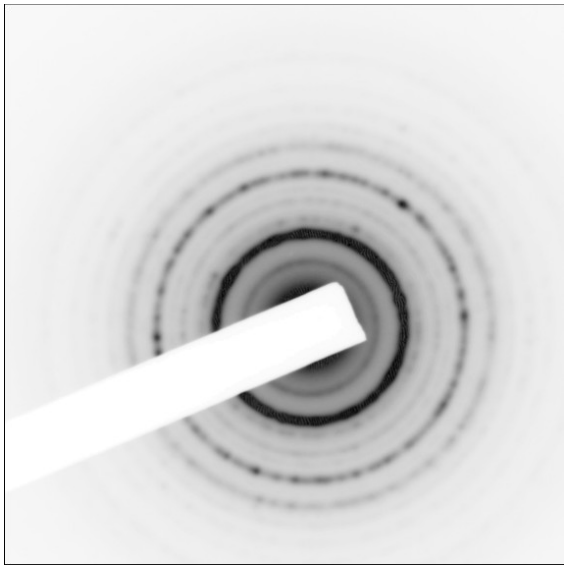
Different types of diffraction pattern in TEM

You have to know what kind of pattern are you going to analyze

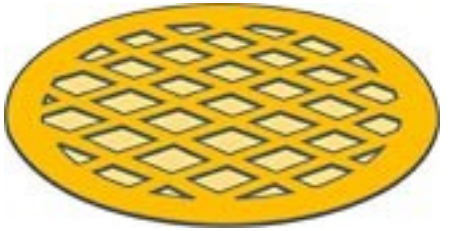


Poly cryrstalline film with single crystal reference

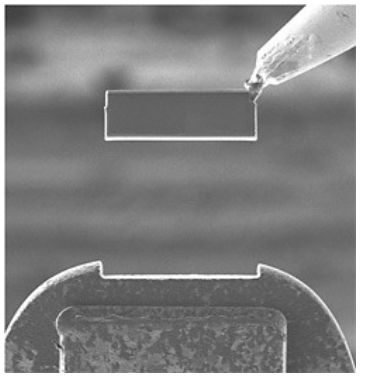




Poly crystalline film without reference



Epitaxial film on single crystal



There are two important aspect you can get from a diffraction pattern:
1. Diffraction symmetry
2. d-spacing

With these information, you should be able to index all the spots. But in reality, you could not specify the symmetry when you have a poly crystalline sample. Thus only the d-spacing information is available in this case

Analysis work glow:

1. Determine the center
2. Measure the reference spot distance to the center(L_{ref})
3. Measure the pattern distance to the center(L_{diff})
4. calculate the corresponding d-spacing with the following equation.

$$d_{diff} = \frac{l_{ref} \times d_{ref}}{l_{diff}}$$

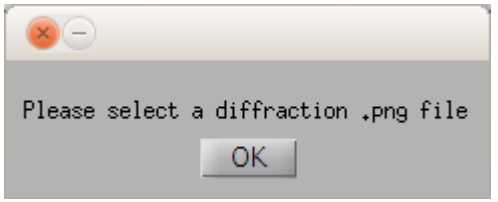
The analysis work can be done very easily by computer as long as the center, reference, diffraction pattern can be accurately selected.

In this program, users have to specify an area(rectangular) that contains only one spot(or diffraction line). The program will find the center of this pattern with a improved weighed average algorithm.

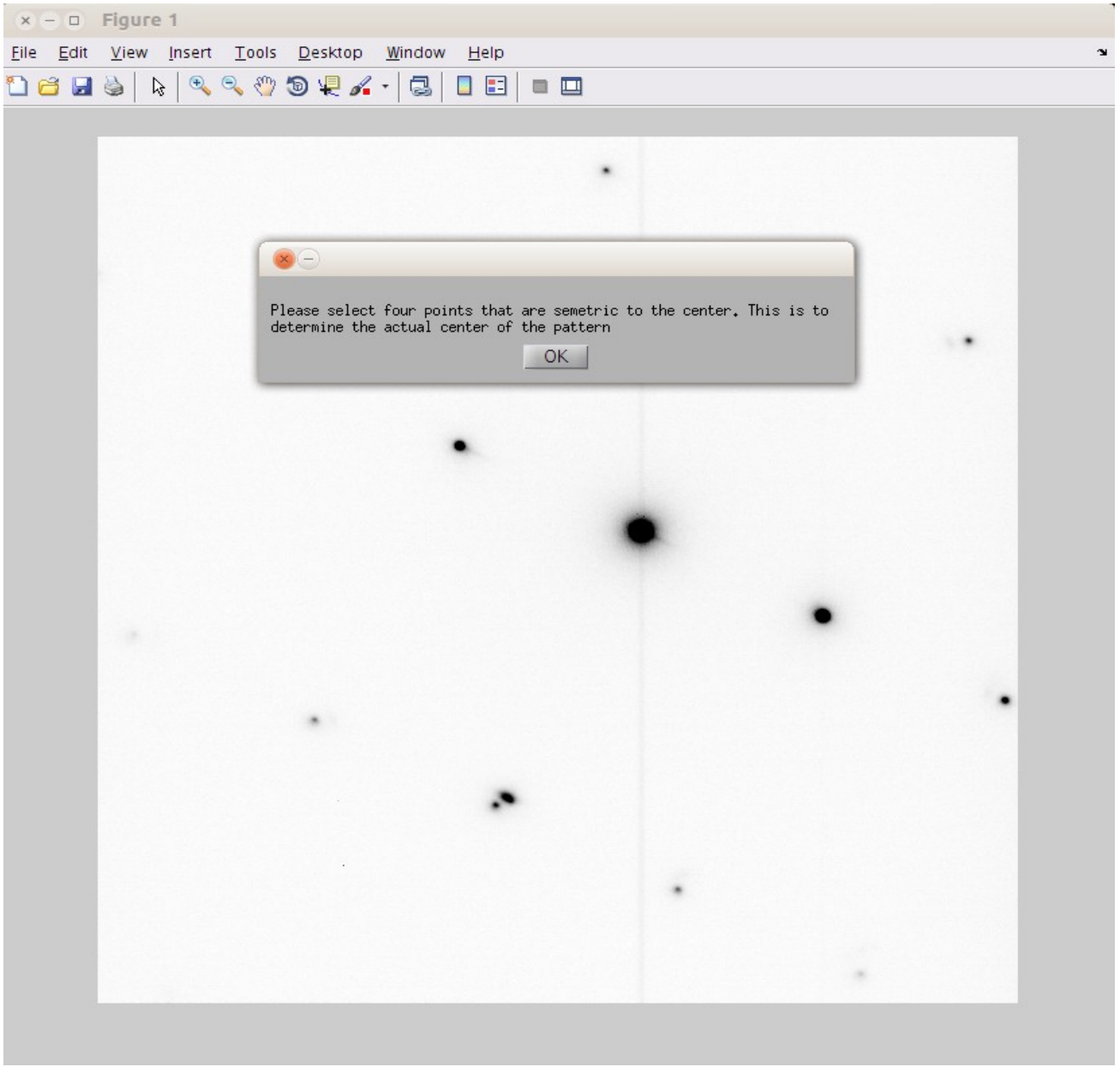
The program contains three files:
TDAP.m
spot_distance.m
Autospot.m

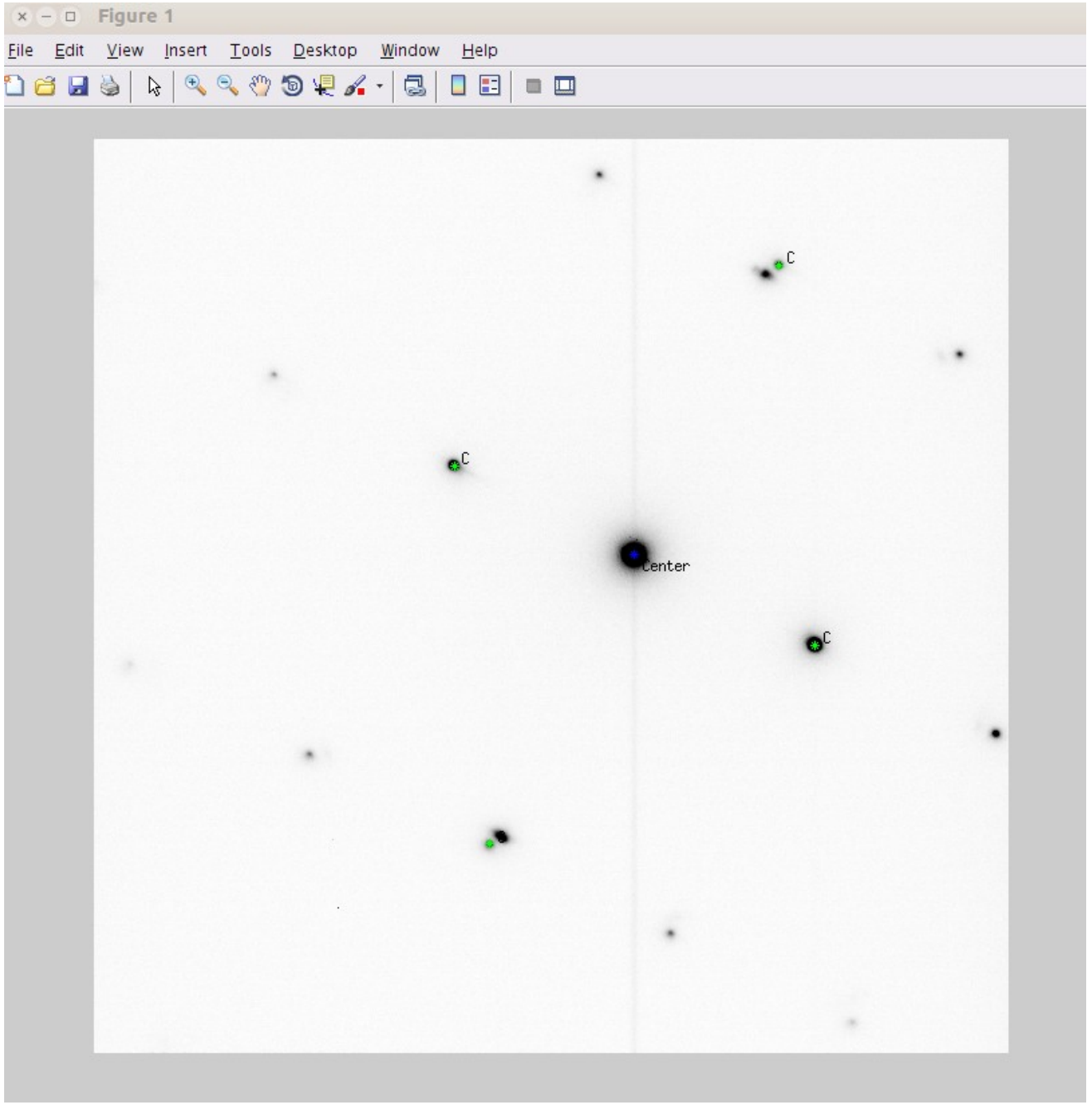
They should be put in the same folder before you run them in matlab.
TDAP.m is the main file and it will call the other two as functions.

When you run “TDAP.m”, a window will come up to ask you select a .png diffraction file. **Remember**, this program can only work with gray png file. The original .dm3 file from the TEM can be converted to png file with “ImageJ” (a free software support all platform). Click OK and a standard file selection window will come up. Just select the file you need and click OK again.



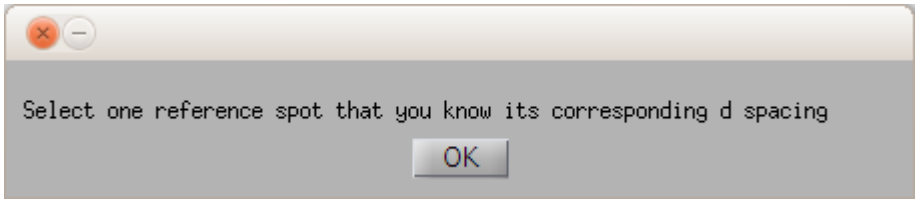
Then the program will display your diffraction file and ask you to select four diffraction spots that are symmetric according to the pattern center to find out the center of the pattern.



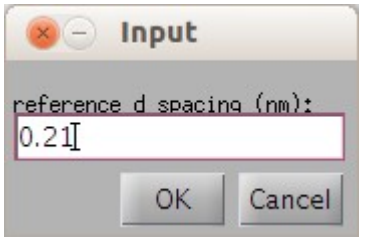


After you select any spot, the program will show the center it found with a green”*” and “c”. After all four spots were selected, it will show the center of pattern it found.

If you feel that the center was off to some extent, you can try to start over.(Unfortunately I have not added the function to let users delete selected spots).

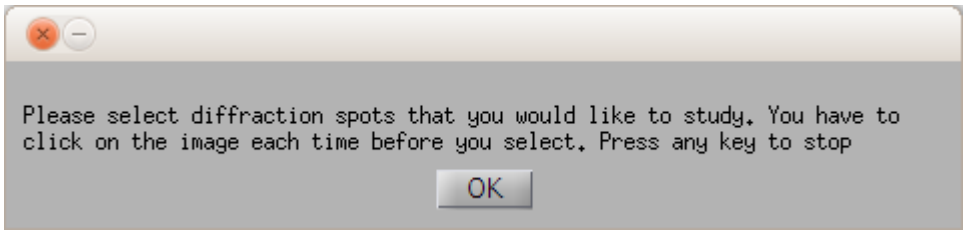


Once the pattern center is found, the program will ask you to select a reference spot. This is the spot that you know its d-spacing.

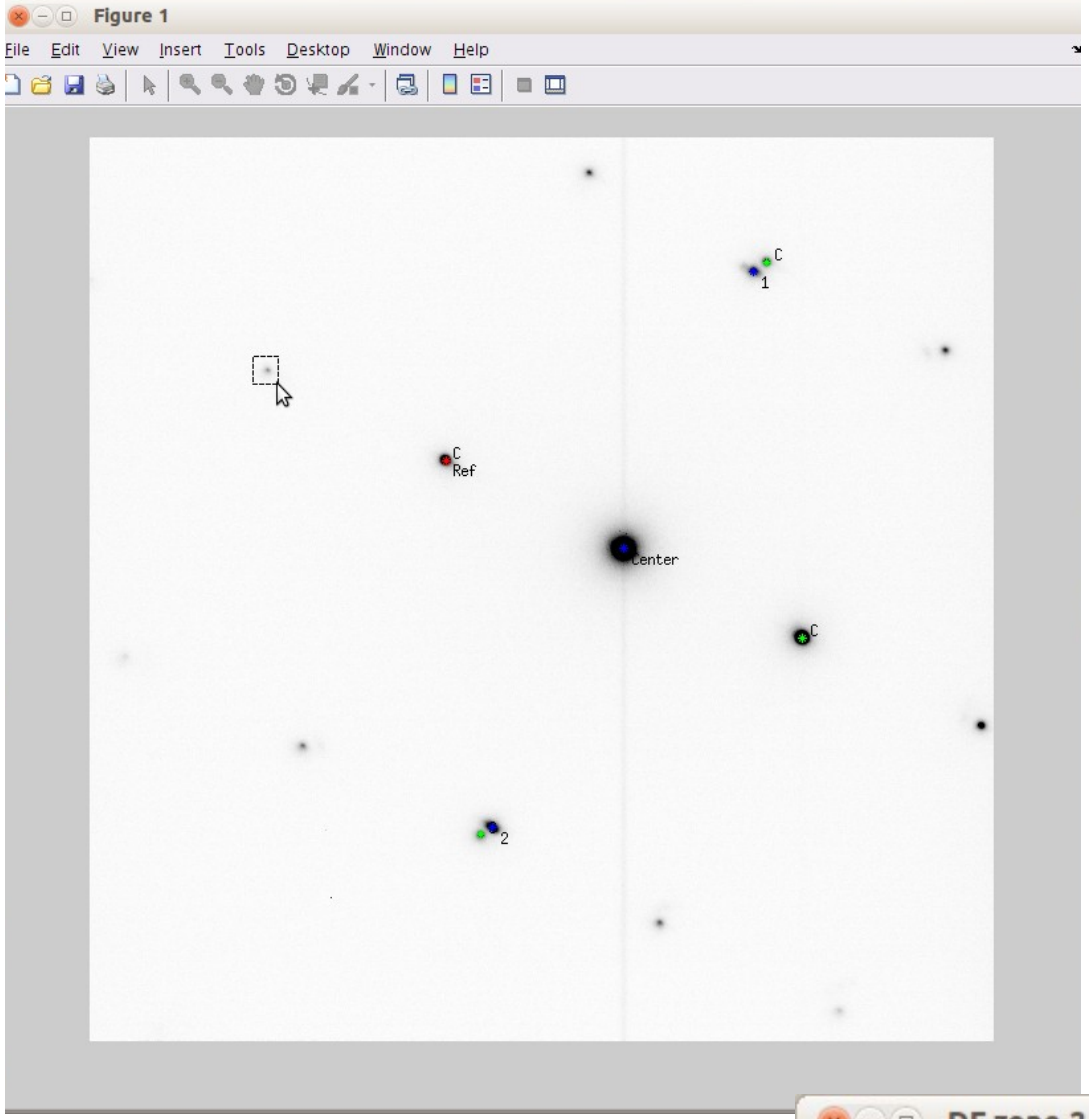


Then it will ask you for the d_spacing of the spot you have selected as reference.

For example, for a silicon 022 spot, its corresponding d_spacing is 0.192nm



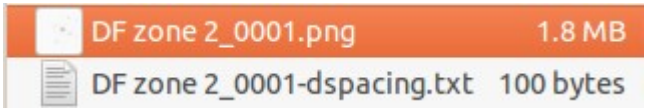
Afterwards, you can start to select the spots you would like to study.

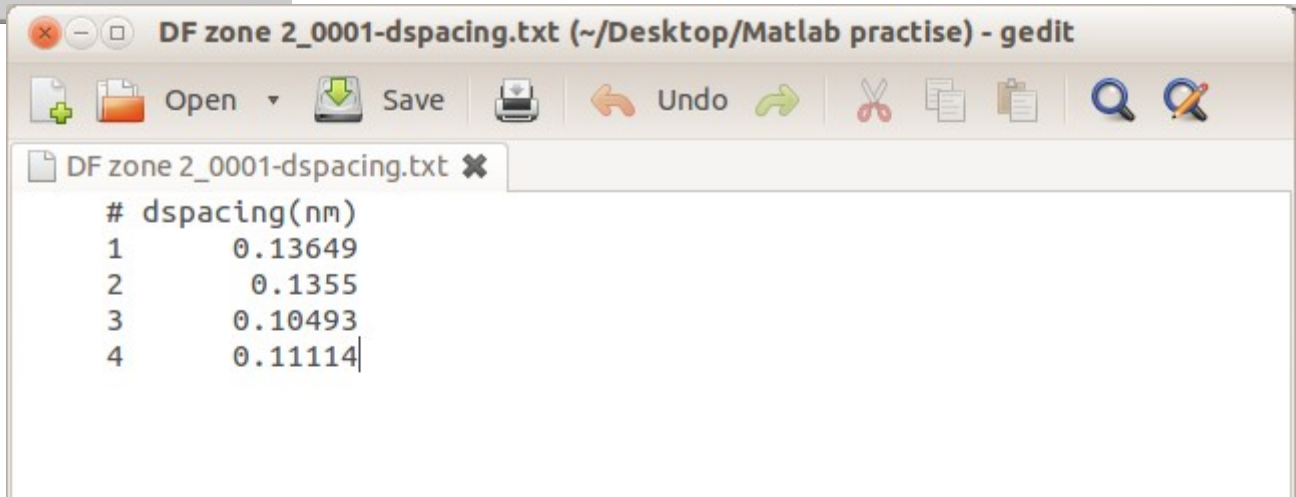


The program will label each spots with a blue “*” and with a number according to your selection sequence.

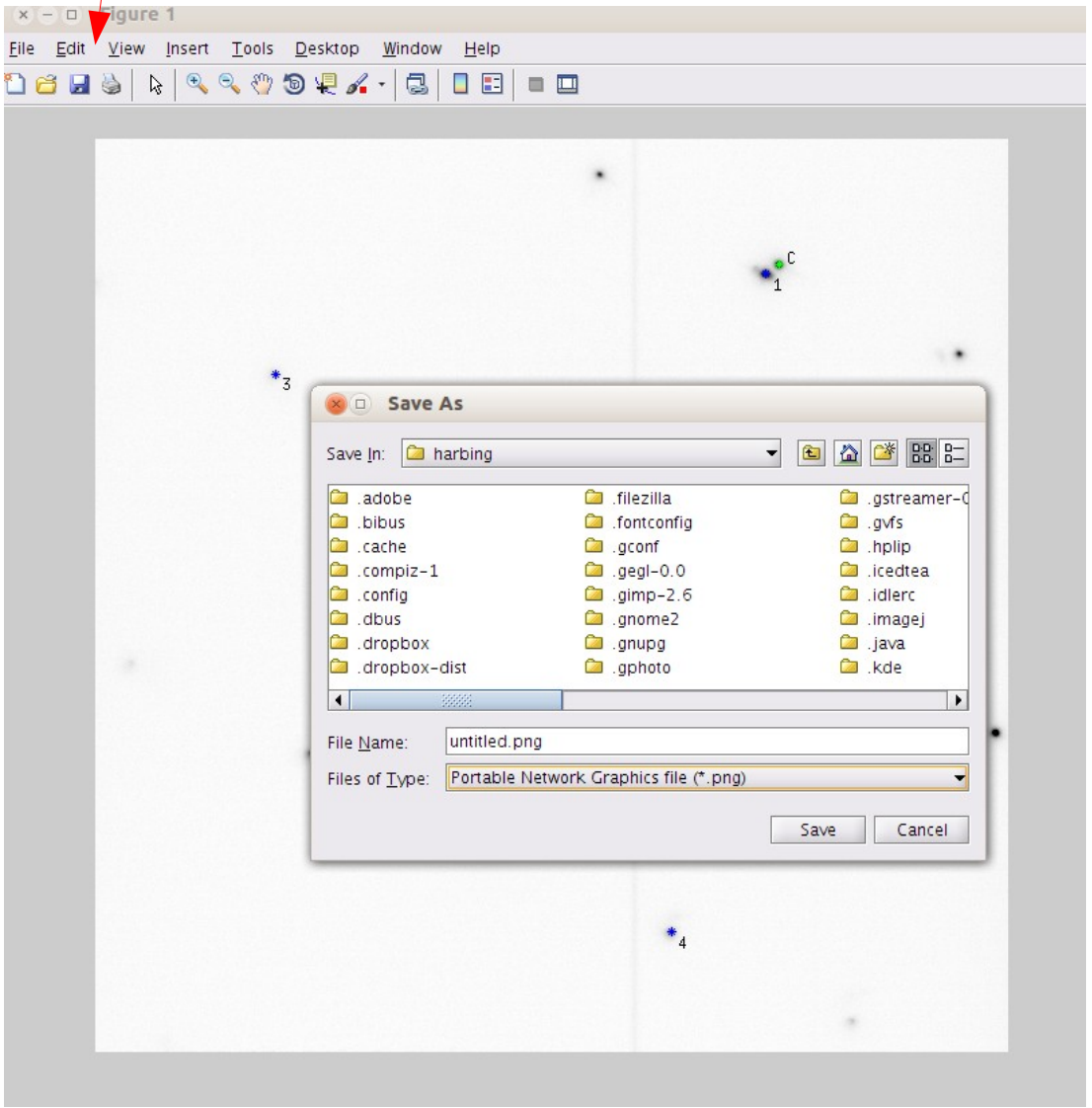
You have slick your mouse once before you select each spot.

Once you finished selection, just press ”Enter” or “Return” to stop selection. The program will output a file with the name “originalfilename-diffraction.txt”.

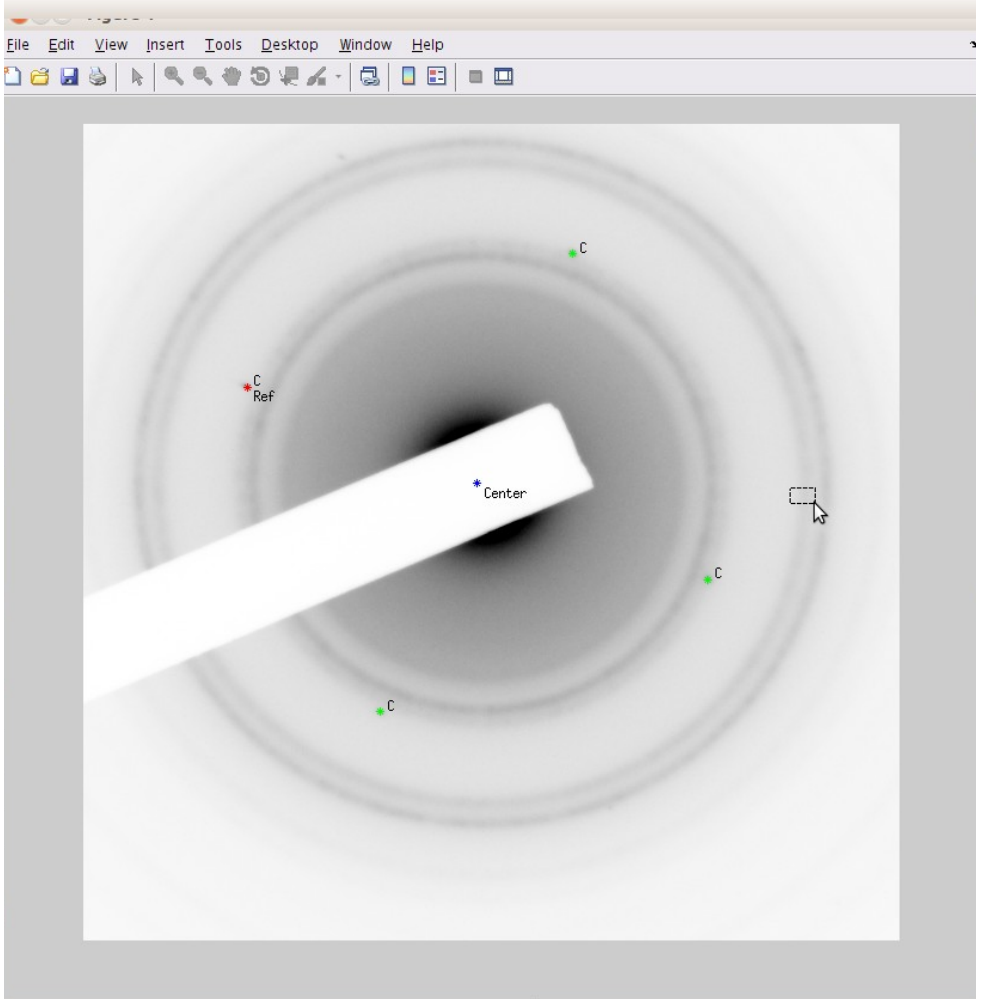


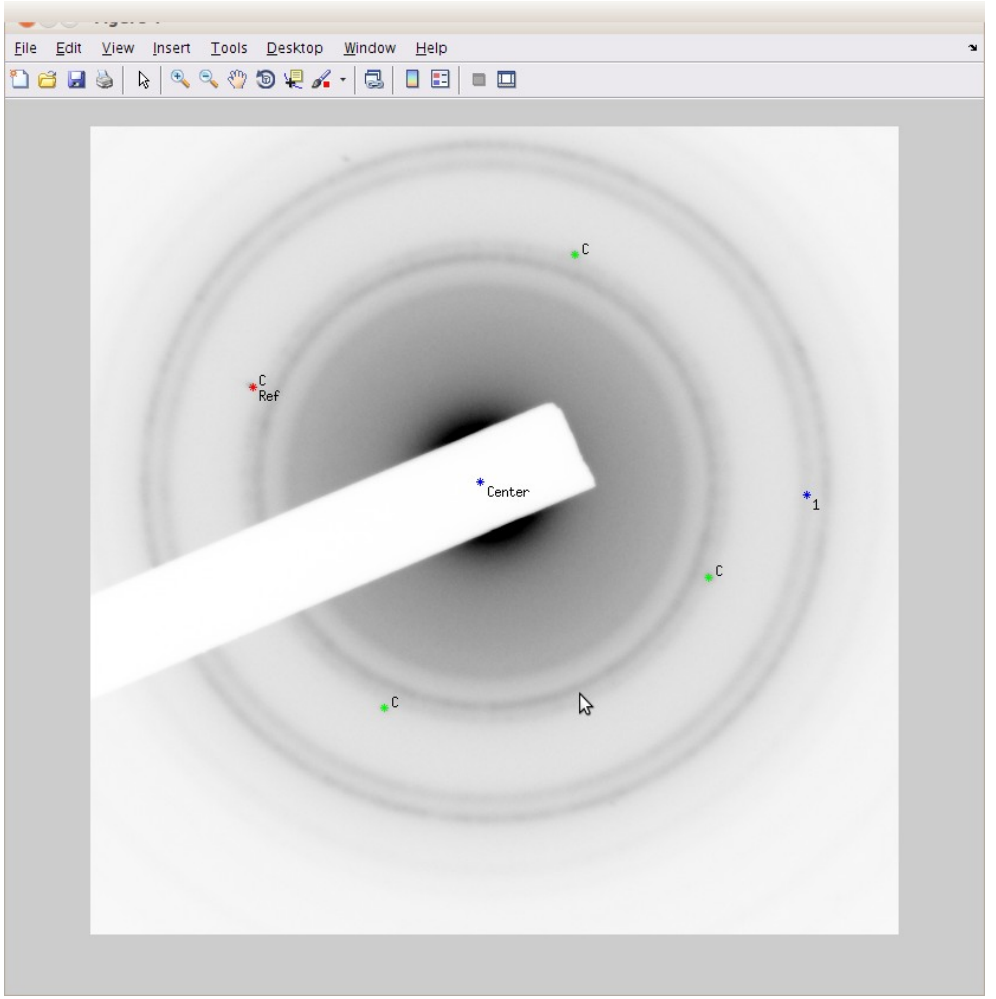


Save



You can save the labeled image by clicking the save button for future reference.





For **poly crystalline** sample with a single crystal reference, it is a little bit more complicated than the single crystalline case.

Still, you have to specify the four spots to find out the pattern center. And also to specify the reference spot(labeled with red “*”).

Then when you have to specify the spot you need to study, you have to select a thin slice with the long edge almost perpendicular to the tangent of the diffraction ring. Moreover, the selection area should only include one diffraction ring. Otherwise the auto spot function would not generate the accurate position.

Hope it is helpful with your research and I hope to hear your advice on it. Thank you very much.

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