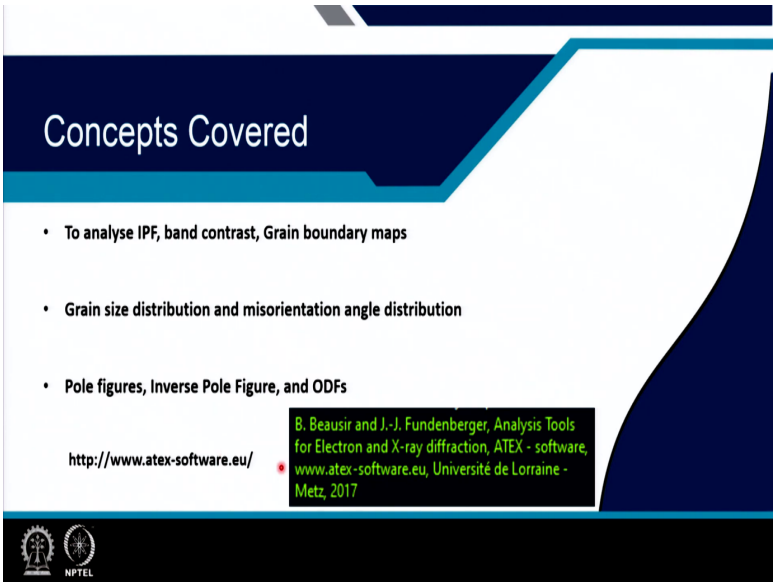
Texture in Materials
Prof. Somjeet Biswas
Department of Metallurgical and Materials Engineering
Indian Institute of Technology, Kharagpur

Module - 06
Microtexture measurements using EBSD technique in SEM
Lecture - 37
Analysis using the ATEX software

Good afternoon everyone, and today is the last class, lecture for the module 6, that is Microtexture measurement using EBSD technique in SEM. So, this is lecture number 37 and we will be analysing the EBSD data using ATEX software. So, before we start this lecture, I would like to say that ATEX software is a software made by two professors in University of Lorraine.

And both these professors belong to Lem Thwa that is Lem 3; laboratory for materials mechanics and mathematics in the University of Lorraine. The name of those Professors are Professor Benoit Beausir and Professor Jean Jacques Fundenberger. This particular software is a freeware available in the internet at their website.

(Refer Slide Time: 01:34)



And, if I go to the next slide you can see, I have given you the link where you can download the software and these are the name of the people who are associated with building this software. And, you can download the software and then you can ask them for the license

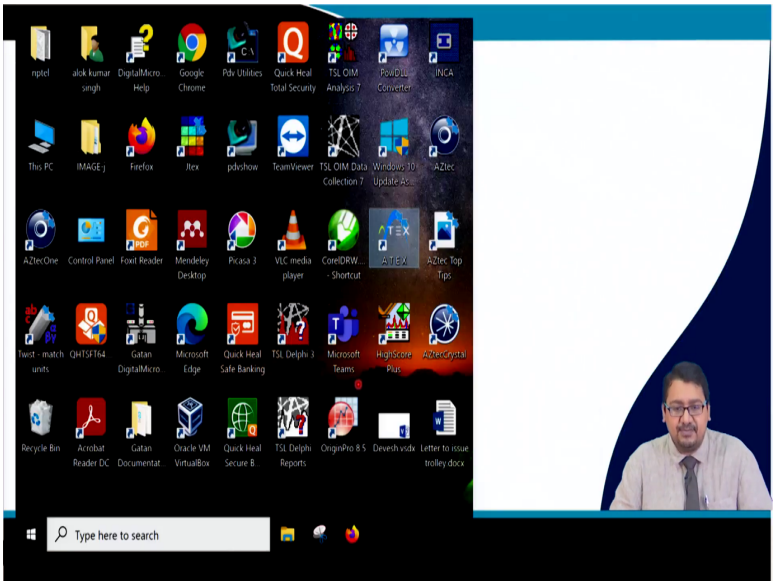
which they will give you for free, only that they will ask you to you know refer their work using this particular name ok.

So, Benoit Beausir, Jean Jacques Fundenberger, Analysis Tool for Electron and X-ray diffraction, ATEX - software, www atex dash software dot eu, University de Lorraine Metz, 2017. So, this particular software as you have seen that it can not only analyse the EBSD data, it can also analyse the XRD data.

The good part of this software is that you can take the data which is obtained from the TSL measurements, that is TSL which is of TSL OIM EDAX ametek and you can that is the dot OSC file and do your calculations here. Then you can also take the data from you know dot CTF data, that is the data from Oxford Instruments and you can use it for analysis here. Now, the TSL data and the you know the Oxford Instruments data both, as if it will be analysed here.

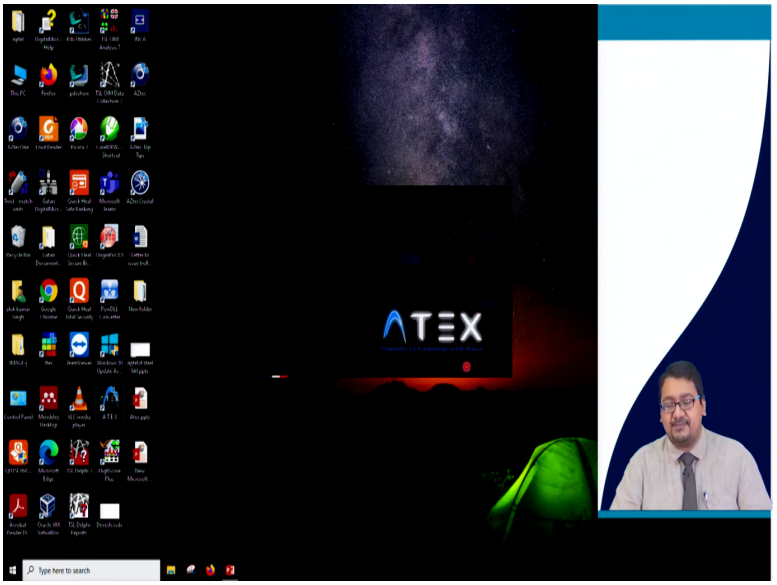
I will be using the dot CTF file for a titanium sample to analyse the inverse pole figure map the band contrast map which is also known as the image quality and the pattern quality map, grain boundary maps, grain size distribution misorientation, angle distribution pole figure, inverse pole figure, ODFs and certain other things that can be done by the other two software's that is TSL OIM software's of Ametek and the HKL channel 5 software which is now ATEX crystal from Oxford Instruments. So, let us begin.

(Refer Slide Time: 04:14)



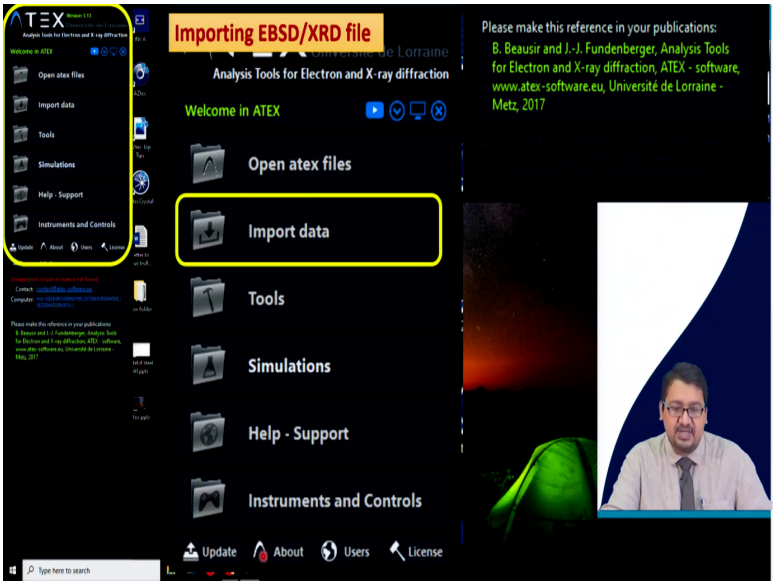
So, if we look at our window after we have got the free license for the ATEX software, it will look like an icon something like this.

(Refer Slide Time: 04:29)



And if you click on this icon the ATEX software will open right.

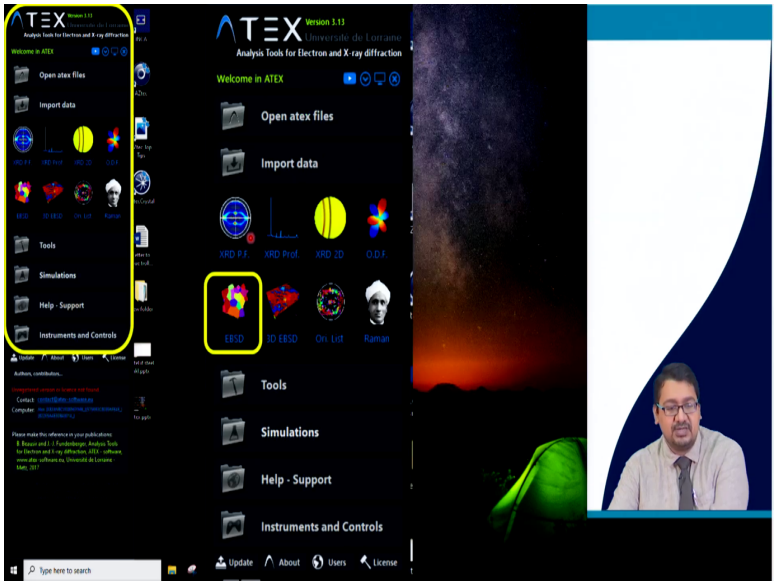
(Refer Slide Time: 04:36)



It will slowly open showing this kind of a pop up window with the logo. And you can see that it will open a very small you know window on the left side of your screen, and this screen if you if we look if you make it big it will look something like this right. So, I have made it you

know magnified, so that we can look into it and see how we do this kind of the analysis. So, let us start with importing an EBSD file ok. So, we will click on the import data.

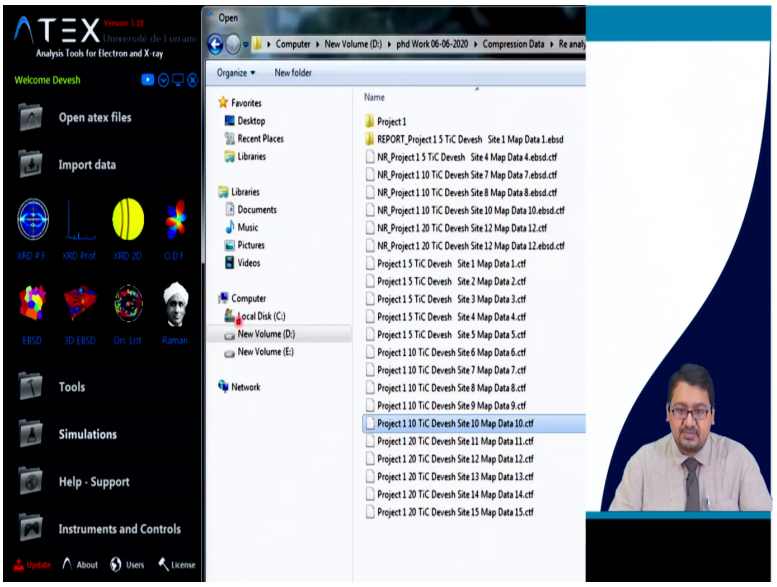
(Refer Slide Time: 05:13)



And once we will click on the import data, what we will get? If we look here closely and the magnified image here, we will get a lot of window right. So, here you will see XRD pole figure. So, if we import XRD data we can directly go and see the pole figure. We can import you know the normal XRD you know theta 2 theta analysis and get the intensity plot.

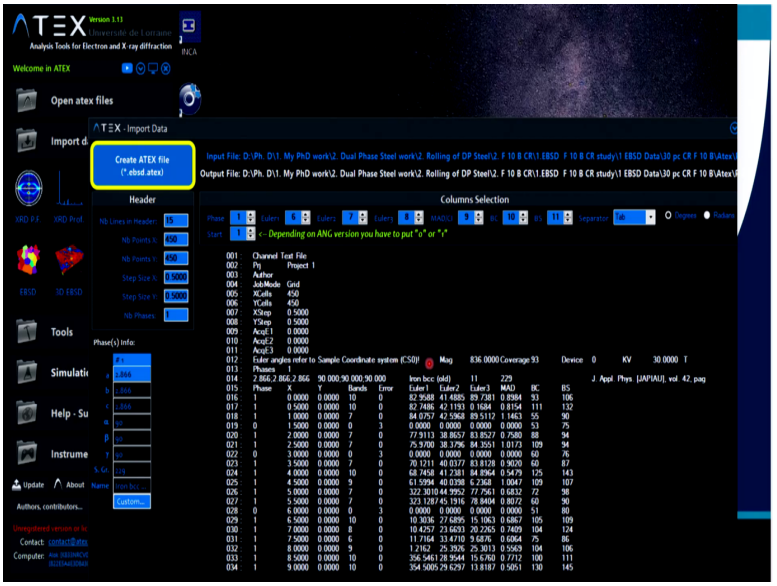
We can do you know click here and input the 2D XRD data, also we can get the ODF from the XRD right. So, in this case we are importing the EBSD data. So, other than that, we can import 3D EBSD data orientation list and data as related to Raman spectroscopy. Now, if we click here to obtain the EBSD data.

(Refer Slide Time: 06:10)



Window something like this will open. And, as I have said that we will be taking the data which is related to you know dot ctf file. So, here we are importing it from one of my PhD student Devesh site computer, so we are importing this particular you know EBSD data which is in dot ctf file right.

(Refer Slide Time: 06:37)



So, let us import and once we import this data we will see the information of this data which is displayed on the screen. So, it will have the phases ok. So, as this is as I let me say that what type of sample it is, it is an alpha titanium, so it has an hexagonal close packed

structure, because it is titanium has an hexagonal close packed structure. And, you see it has only one phase thereby, so all the phase which could be detected have been set 1 1 1 and those which could not be detected has been shown by 0.

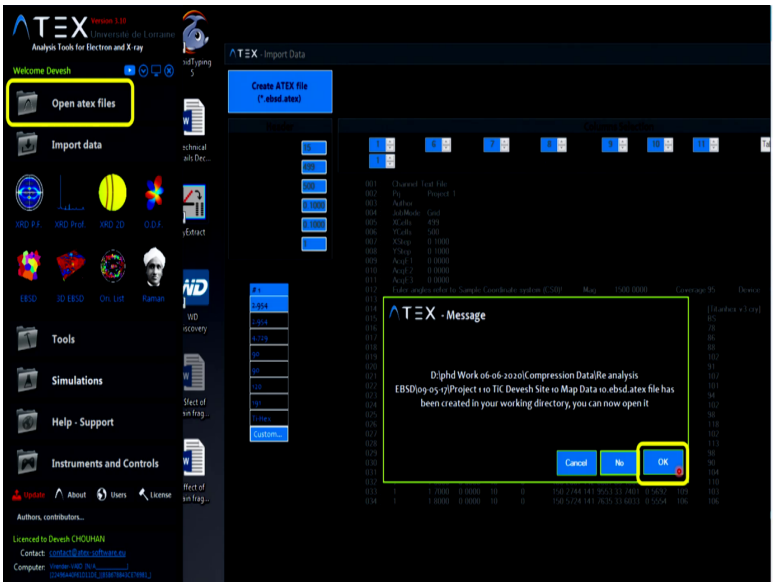
Now, you can see the 0 here. So, X and Y shows the pixel point that is where the incident electron beam basically fell on the specimen, and so we can see that the X increases from 0.0 to 0.5 to 1 to 1.5 and like that; that means, the step size for this specimen is 0.5, and which is specified here right. And, we can also see that what is the number of cells in the X direction and in the Y direction that is 450 into 450 right.

So, we get all the information, we not only get the information about X and Y and the size of the micro structure, we can also get the number of bands which it can actually find out. So, you can see that for the first case it has detected 10 bands for the second 10 and the third 7 something like that what is the error. And then, you can see that I have this particular one is for iron bcc, but we will be doing the analysis for the titanium alpha titanium sample.

So, this is just for demonstration. So, you can see that we can get the Euler angle 1 Euler angle 2 Euler angle 3, the MAD, the BC and the BS values. Now, this these values are enough to calculate the quantitative information from this EBSD data. So, once we get this, we have to click here and we will click here to create an ATEX file right.

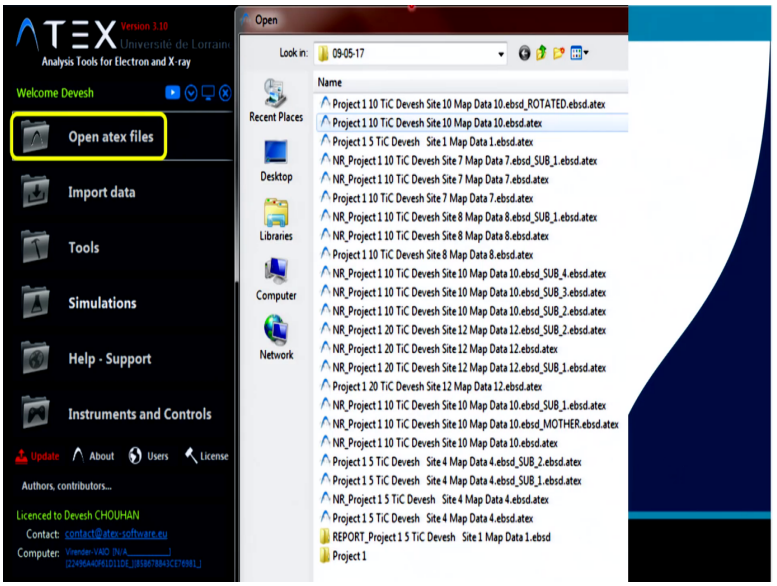
So, let me tell you once more time that, even though we have shown this particular slide which is with respect to the iron bcc, but we will be continuing this particular demonstration here for alpha titanium which is an hexagonal close packed structure right. So, once you click on this you know create a text file so it will create dot ATEX file.

(Refer Slide Time: 09:23)



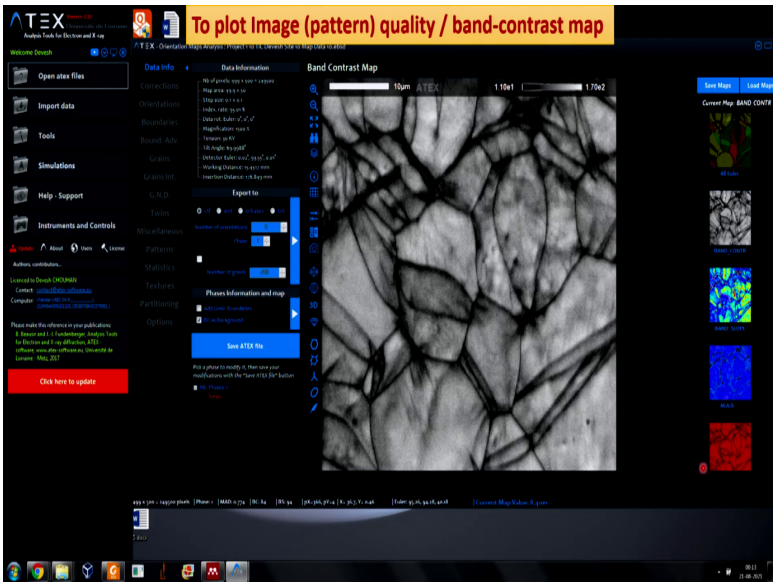
And, you will see this kind of a message will come and it will say, that this file is going to this particular directory and whether you would like to open it. So, we will say of course, we will say ok. So, once we get this you know ATEX file, we can you know open the ATEX file by clicking here and then the message will come where it will say that whether we would like to open this particular ATEX file and we will say ok.

(Refer Slide Time: 10:06)



And once we will say ok what will happen? It will show the various ATEX files that it has created while we have done this kind of a similar you know exercise.

(Refer Slide Time: 10:25)

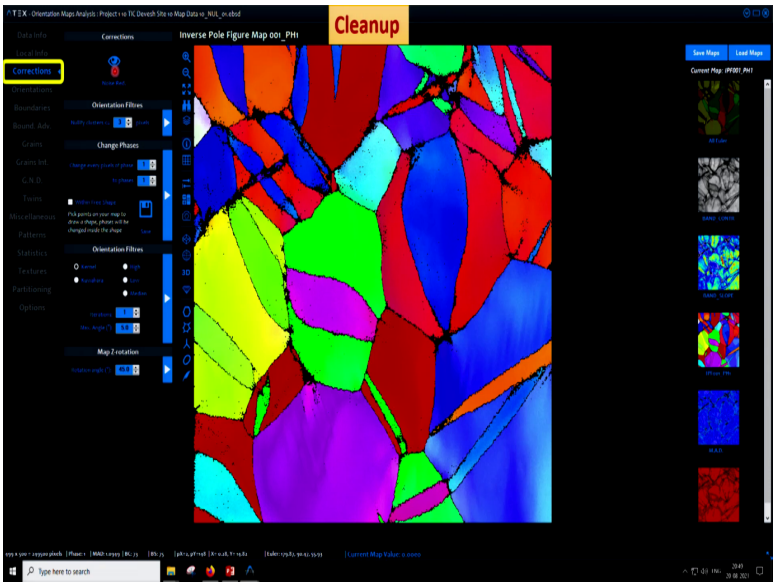


So, we will take the same one, we will detect it with the help of the name and we will click here and it will automatically open the image quality map or pattern quality map or band contrast map. If you look into the right side of the screen, what you will find that there are various kinds of coloured map and uncoloured map present here.

You see the first one, if you look closely it is on all Euler map, the second one as I said is the one that directly comes when you open that window and that is the image contrast map, the third one is the you know band slope map, the fourth one is the misorientation angle distribution map and the fifth one you see that it is the phase map.

And you can see that it has only one phase and the part where the those phases could be detected is shown in red and where it could not be detected is shown in black. And of course, those parts if you look closely are the part near to the grain boundaries where the EBSD scan is unable to rotate to detect it right. So, this is the way it gives the band contrast map.

(Refer Slide Time: 11:38)

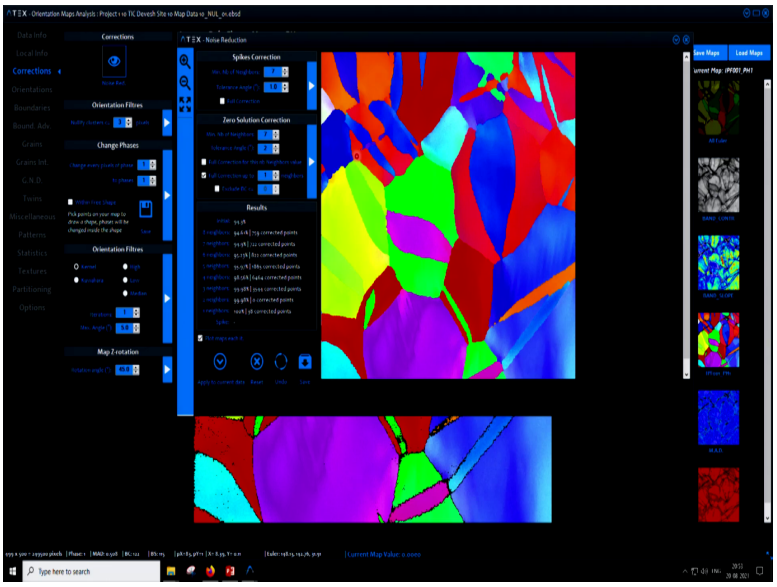


And now, if we see we can do one clean up right. So, as I said that we can click here where my you know pointer is and get the band contrast map, if we click here we can get the you know band slope map, if we click here we can get the inverse pole figure map and like that various maps can be obtained from the right hand side of the screen and let us click here and if you look into the inverse pole figure map.

And, I will also later show you that how actually the inverse pole figure map can be obtained from the left hand side panel and how we can include the grain boundaries and or exclude them. So, we will do a clean up here right, like the others two software's that I have demonstrated, that is the TSL OIM software and the software which is Aztec crystal from HKL channel five oxford instrument. Both of them has their various methods and cleaning procedures ok.

The similar cleaning procedures are also present in this ATEX software. And, if we look if we click on the correction part of the software, you will get a window which something looks like this. And here, is a symbol of an eye which shows noise reduction and if you click on the noise reduction, what will happen?

(Refer Slide Time: 13:07)



A pop up window like this will open, and in this pop up window you will have few you know options, and this options you see that you will have spike correction, so we will not do the spike correction, but yes we will do the zero solution correction and where we will take the minimum number of neighbours and which is default 1.

So, we will say that ok let us take a minimum number of neighbors say 7 or say 8. We can take a tolerance angle 2 degree which is fine. We will tick here if you want to do the full correction for the all the neighbours you know neighbor value Nb values and we can tick here if you want to do the full correction up to how many neighbours.

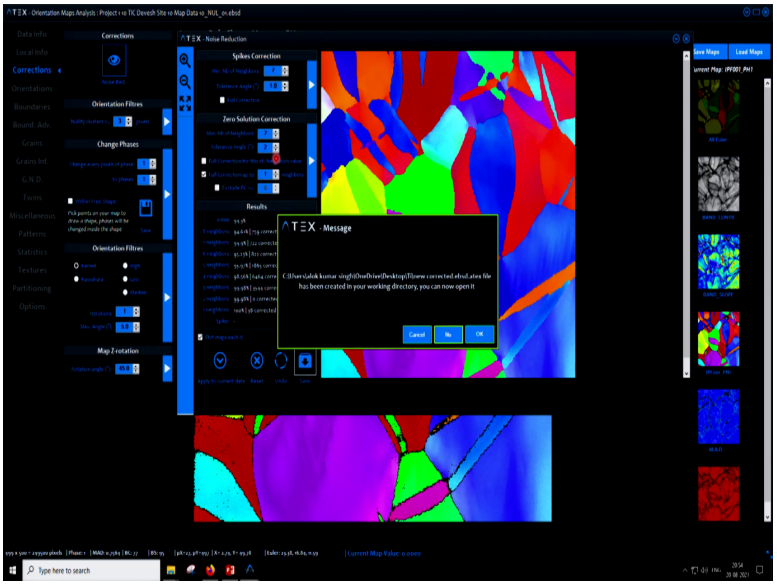
So, here it is 4, but we can do it for the 7. So, I am sorry that I said here we will take minimum neighbours so 7 we can take minimum neighbour from 1 to 7 based upon your you know how much you know correction you want to do or how much clean up you want to do for your EBSD data.

So, if we you know click here in this arrow then what will happen it will slowly do you know 8 neighbor correction 7 6 5 4 3 2 1 neighbor corrections you will see, as I said that we have done a 7 neighbor correction and we have done a full correction up to the 1 neighbor, and therefore, you see you will get a fully cleaned IPF map and this is without boundaries and you can see that there is no areas with dark contrast or black contrast which indicates that those places were not you know detected, the kikuchi bands were not formed during the EBSD scan.

So, a simulation of this sort can clean up the area and most of the time there are you know most of the time I have seen that the clean up gives a very nice result which is very near to the real life scenario. Yes, sometimes grains which are very small and which could not be detected may go away during the cleaning process.

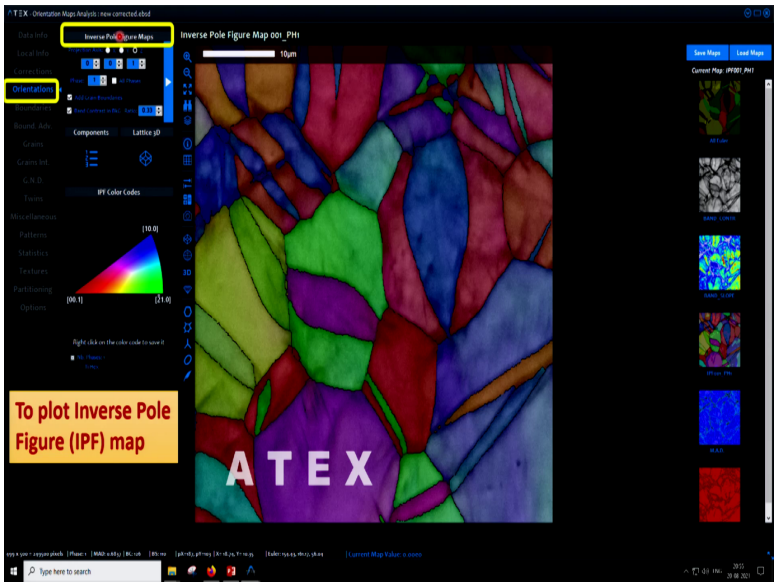
So, there could be various cleaning procedures which are given in these three different softwares. One can use you can use different ones to see which one is most favourable for your case. Whether you would like to do a full correction or you would like to do a little correction, a single correction or some corrections up to 3 or 4 times. So, it depends upon your material, it depend upon the quality of the index pattern during the EBSD.

(Refer Slide Time: 16:22)



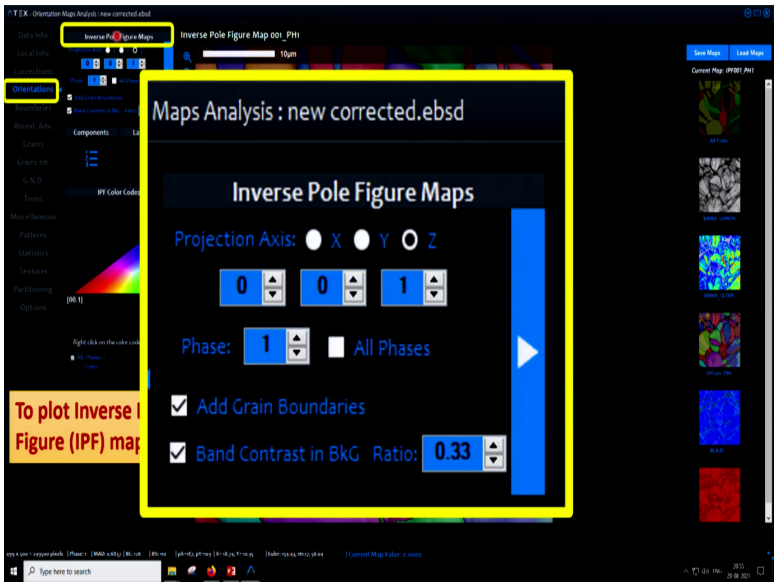
So, one can save this new file also and then you can open the new file using open new file process that I have shown you in the previous slides.

(Refer Slide Time: 16:38)



And, then we will get you know an image something like this. So, this image basically contains the inverse pole figure which is super imposed on the image quality map or pattern quality map or band contrast map and it has the grain boundaries also super imposed on it. So, if we click in order to get the inverse pole figure map, we click we have to click on the orientation and then this window will appear. And, it we can click on the inverse pole figure.

(Refer Slide Time: 17:17)

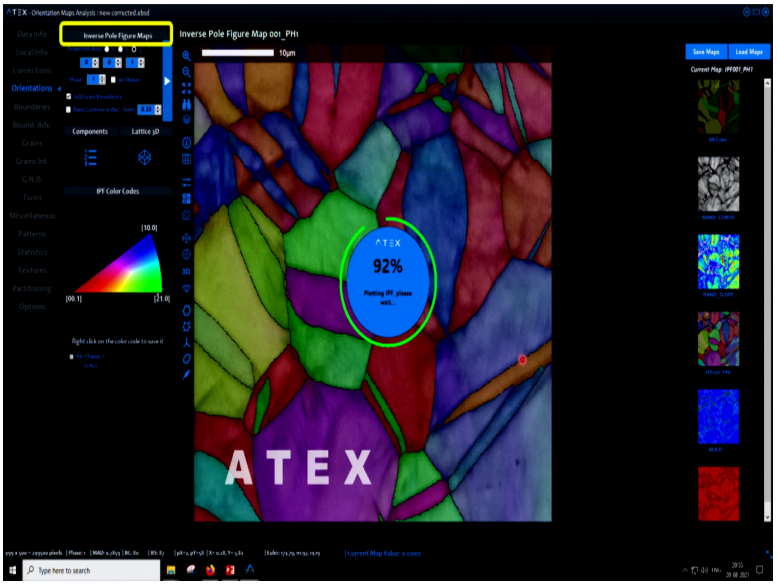


And, let me magnify this one. So, if we magnify this smaller part below the inverse pole figure, we will see that this part and then we will see that there are various options. So, an

inverse pole figure may contain projection axis along X along Y along Z. And, most of the time you see that we see the inverse pole figure along Z right, along the plane normal that we are observing in the microstructure right. So, we look into the plane normal.

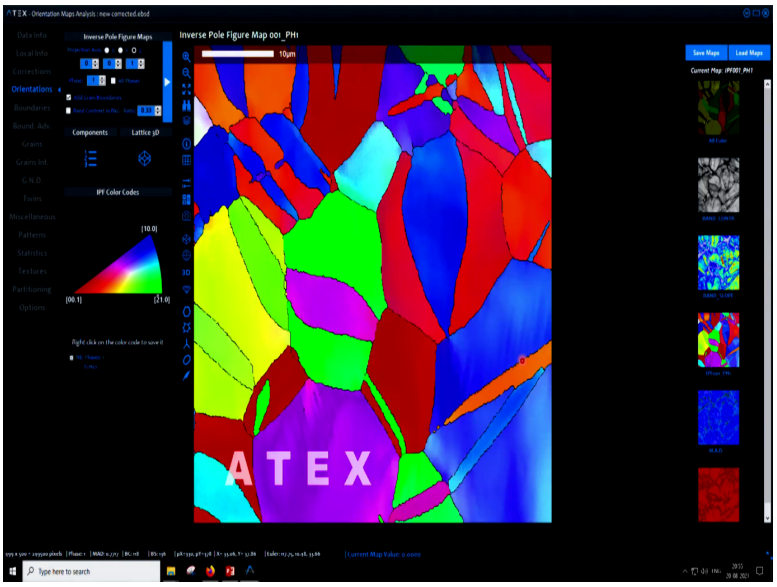
So, we will say 0 0 1 and we will click here, we will have phase 1, because its a titanium alpha titanium it has single phase. So, if we tick it will add grain boundaries, if you untick it will not add, if we tick here it will add band contrast ratio and if we untick it will not put. So, and then we will have to click here.

(Refer Slide Time: 18:17)



Once we click here, it will you know take some time to you know formulate and plot IPF.

(Refer Slide Time: 18:26)

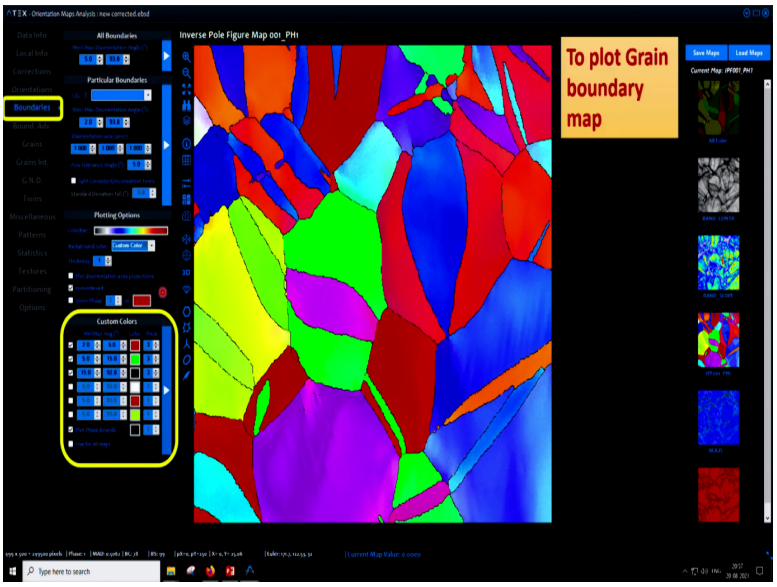


And therefore, after sometime it will eventually plot an IPF. So, you see here what we have done, we have tick the grain boundary and we have unticked the pattern quality or the band contrast map and therefore, the pure inverse pole figure map with the grain boundaries could be visible. Now, we can not only plot the IPF map pertaining to Z, but we can also plot the inverse pole figure map pertaining to X and Y direction.

Though the microstructural feature will remain for the Z axis, but we can observe that what orientation that particular grain or these grains will have if we look into the Y direction or in the X direction.

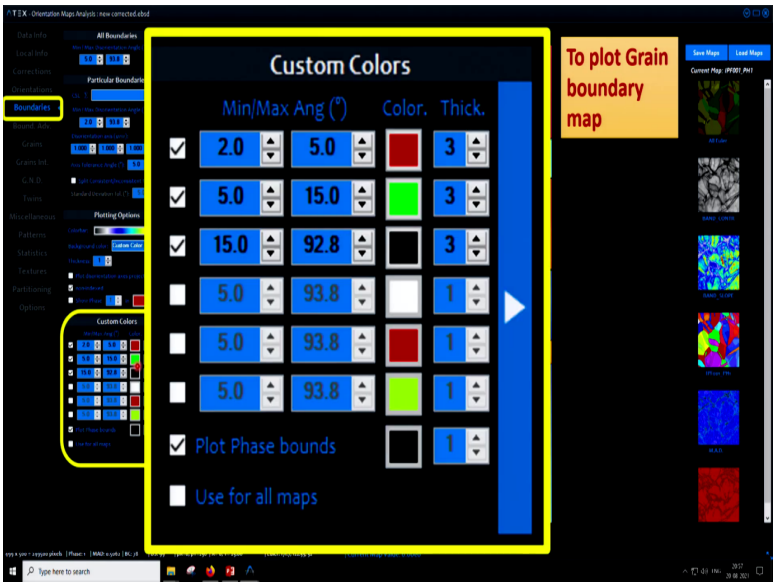
So, that option is also there. Now, as you can see that the inverse pole figure map can be you know correlated with the triangular you know color key code, which is inverse pole figure color key code having you know 3 X's X which is 0 0 1, this one which is 0 0 1, that is 0 0 0 1, this one which is 1 0 0, that is 1 0 1 bar 0 this one which is 2 bar 1 dot 0 that is 2 bar 1 1 0.

(Refer Slide Time: 20:01)



Now, if we try to look into the boundaries. So, a microstructure as I said, will have many boundaries and it will be grain boundary, it will be GNBS, that are those boundaries which have misorientation less than 15 degrees and are known as low angle boundaries. So, if we click on boundaries here and of function opens like this. And, the important function here to look into the boundary are this one which is the custom colour.

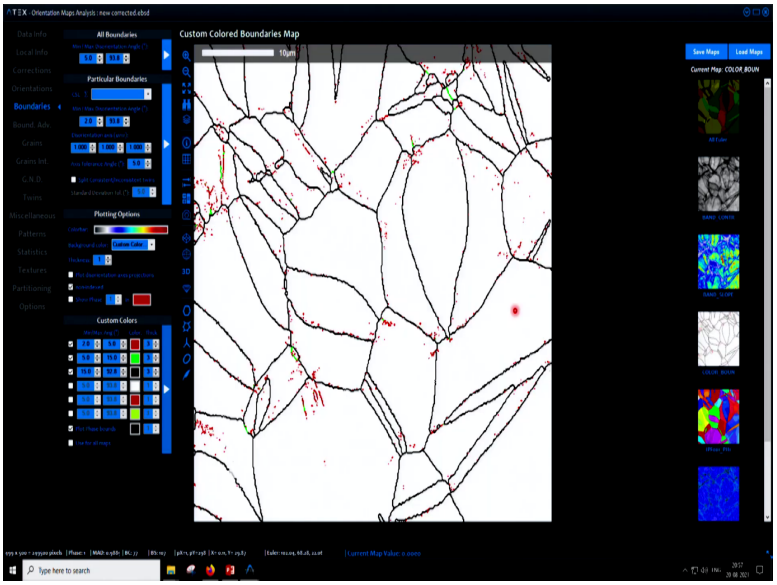
(Refer Slide Time: 20:35)



So, I am magnifying this custom colors portion of this software, and you can see that we can put 2 to 5 degrees we can change the boundaries and put 2 to 5 degrees and say that ok this

color will be red. We can decrease or increase the thickness of this boundary, so we are keeping it 3 here, and then 5 to 15 degree boundaries could be changed into a colour called green and then we can keep the thickness something 2 3 or 6 and then 15 to the maximum angle can be said to be black.

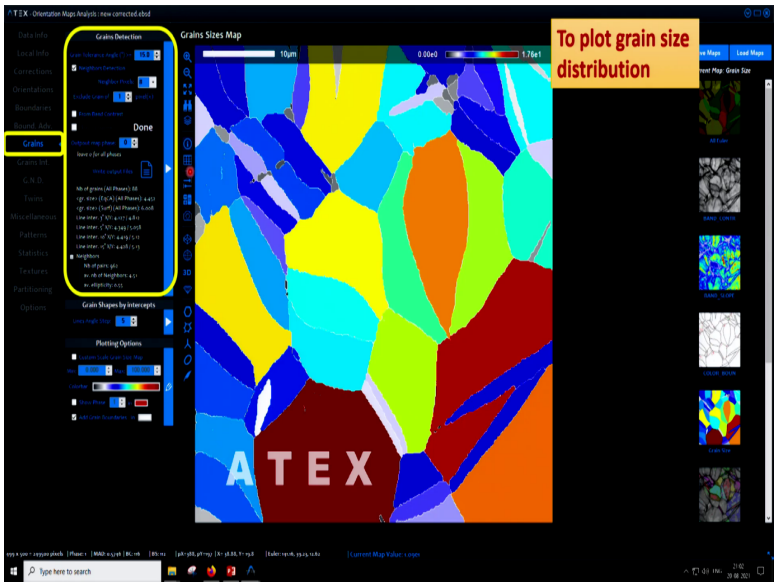
(Refer Slide Time: 21:18)



Now, if we set this three and click here then a grain boundary map something like this will be obtained. You can see the microstructure contains mainly high angle grain boundaries which are mapped in black colour right. There are very few you know green coloured boundaries which are basically 5 to 15 degree boundaries.

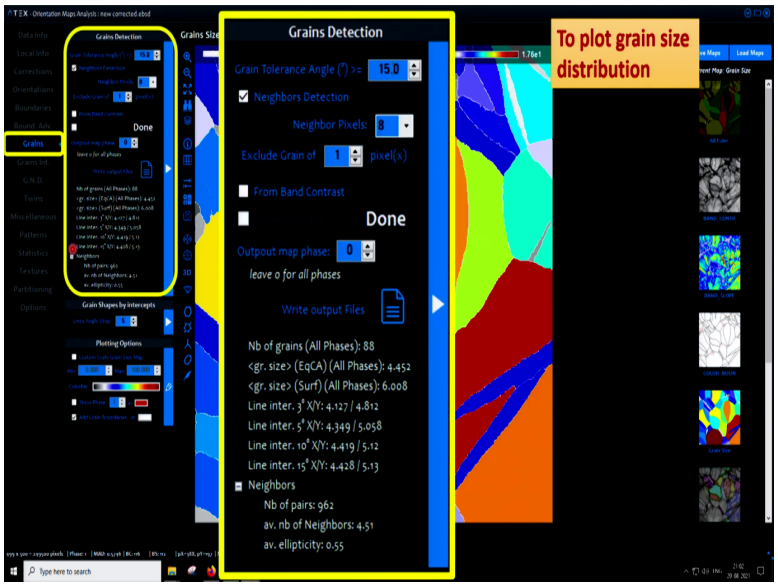
On the other hand, there are few red coloured boundaries which are basically 2 to 5 degree boundaries. Now, this way we can quantify the boundary fraction which can be obtained from right clicking this particular image and to get the data pertaining to this image right.

(Refer Slide Time: 22:01)



Now, if you want to plot you know grain size or see the grain size or want to plot the grain size distribution, we will go to the grain section, and once we will go to the grain section the colour of the map will change something like this and it will get some randomly coloured grains in the map right, something which is you know this one. So, it will open often window like this.

(Refer Slide Time: 22:35)



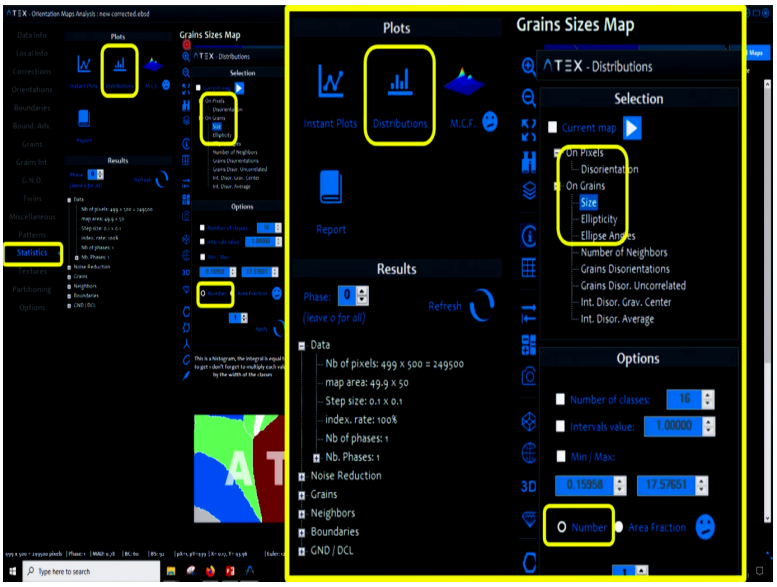
And, let me see whether we have magnified it or not, yes ok. So, if we take a grain tolerance angle like this 15 degree, then the micros the software basically detects that what grains size

we want and the grain size related to misorientation angle greater than equal to 15 degrees can be calculated, will be calculated.

(Refer Slide Time: 23:04)

So now, if we would like to measure the grain size distribution then we will after this calculation we will go to the statistics and then we will click on the distribution plot and then we will see that a window something like that has opened and here, we will have more option. Let us see and magnify even it will automatically plot a number fraction, grain size, distribution, where X axis will be size of the grain and the Y axis will be the number fraction, but let us open this particular window to check that what are the different functions.

(Refer Slide Time: 23:52)

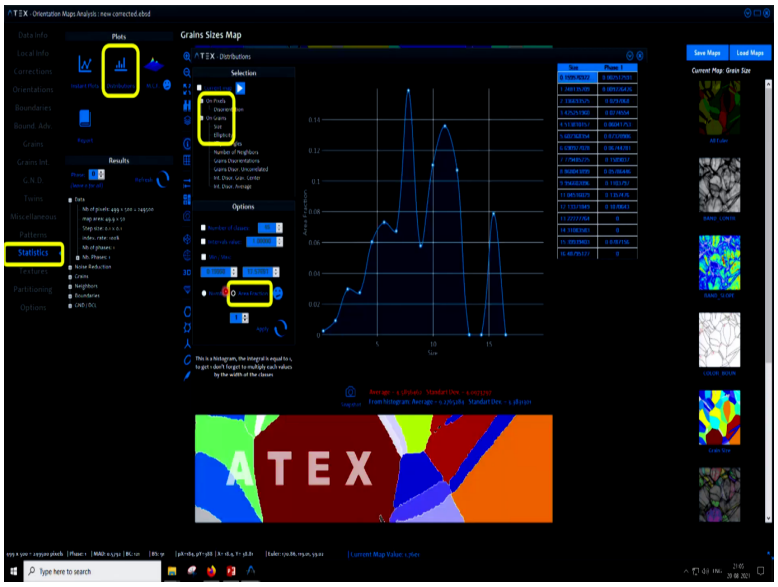


So, we will after clicking on the statistics as I said we will click on the distribution, and once we will click on the distribution, what will happen? We have magnified this portion this small portion of the curve and we are showing here so that we can see it. So, once we click on the statistics and we get this particular window and if we click on the distribution we can get various functions which we from which we can select that either we want to see the disorientation which is basically similar to the misorientation.

And whether we want to see the size of the grain, the ellipticity of the grain, the ellipse angle, number of neighbor, grain disorientation or you know we can also get you know uncorrelated and various kinds of things. So, let us click on the grain size, if we click on the grain size and it will be automatically clicked on the number fraction.

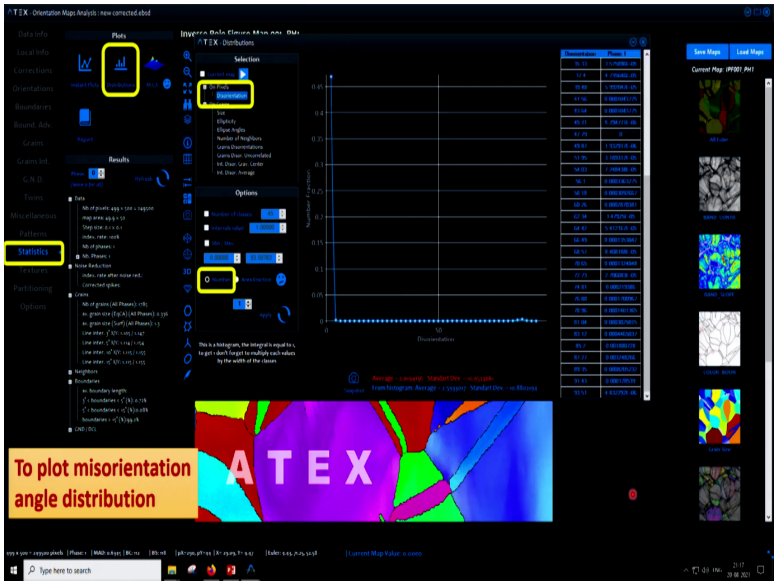
So if we click on the number fraction, we get this number fraction grain size. And, you can see, that the number fraction grain size with the Y and the X axis and we can if we take we have the data here. So, if we right click it and you know take the data in the in a form of a node file or an excel file.

(Refer Slide Time: 25:21)



Now, if we go into the same function and instead of number fraction.

(Refer Slide Time: 25:30)



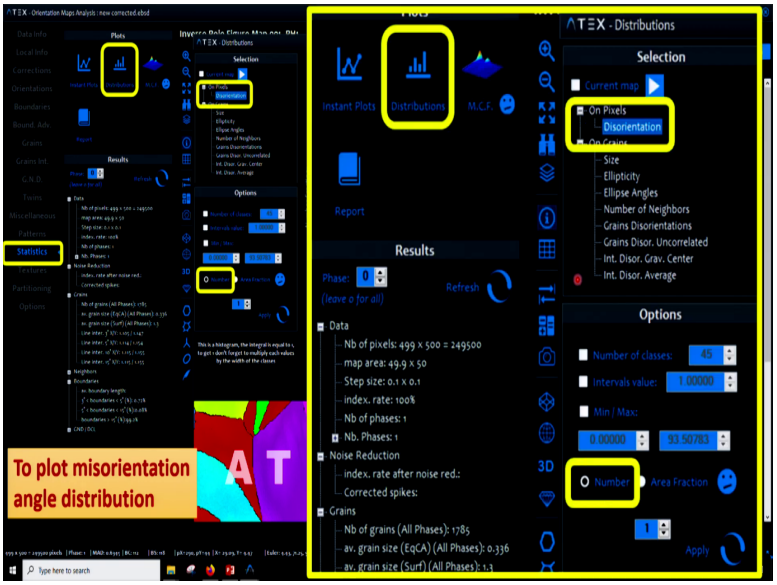
If you click on the sorry area fraction then what will happen? Then, the grain size distribution will be shown in terms of Y axis as area fraction and X axis as grain size. So, you see the distribution has significantly changed from the number fraction. Now, let us go ahead.

Here, we are plotting the misorientation angle distribution from the same function. So, statistics, and then we go to distribution, and then instead of size we go to the disorientation.

And then we click on the number fraction because the misorientation angle distribution is shown in terms of number fraction only in the Y axis, and in the X axis it is the misorientation or the disorientation as it is written in this case.

So, we see that for this particular microstructure we have a peak at the low angle boundary portion and then a very shallow and flat distribution at the high angle boundaries. We can have this data in terms of a you know table which we can right click and take it in form of an excel sheet and then we can also plot it separately.

(Refer Slide Time: 26:52)



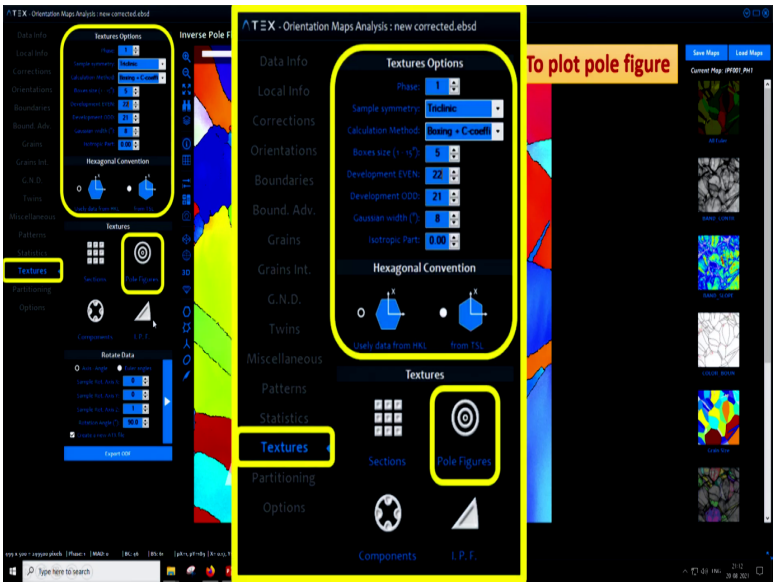
So, this is the magnified image of this left hand window, where I have shown it in a magnified way disorientation sorry distribution disorientation number fraction right and so we get this ok.

(Refer Slide Time: 27:09)

So, that way we have drawn the various inverse pole figure map and image quality map, grain boundary map, misorientation angle distribution, grain size distribution. Now, let us come to plot the pole figure, inverse pole figure, and the orientation distribution function. So, in this case what we would have to do, that we have to click on the texture panel of this left hand panel and then options will be opened right.

And, this option you see it will have that I will show it in a magnified scale and then we will have to click the pole figure. So, we will have you see the ODF sections here, the pole figures here, the components various components present here, the inverse pole figure here, we can click any one of these to obtain the information needed. So, let us magnify this and see.

(Refer Slide Time: 28:07)

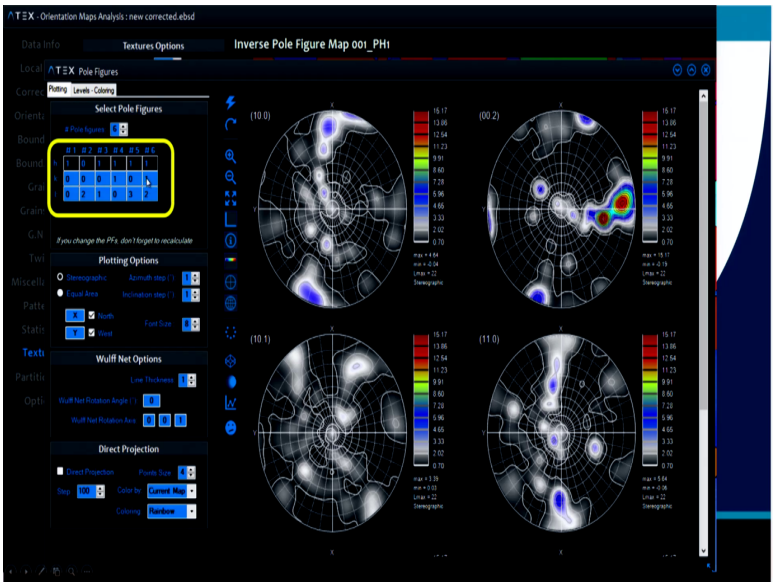


So, if we magnified this after clicking on the texture, this front panel opens. We can see that in our case the titanium sample has a triclinic sample symmetry. So, the phi 1 that we will be plot plotting in case of ODF will be 0 to 360 ok, later we will talk about this one. Now, the various functions the that will be used to iterate the data to obtain the pole figure can be manipulated here.

Now, as we have an hexagonal close packed material and the data is from the HKL, so we will be given 2 options where if we you use this option where X is above and Y is here, that is the X is 1 0 1 bar 0, the Y is 1 1 2 bar 0, when the data is from the HKL channel 5 right.

On the other hand, that is the dot CTF the data that we are using on the other hand, if we have the data in terms of dot OSC that is it is from the TSL OIM EDAX ametek software then X has to be 1 1 2 bar 0, Y has to be 1 0 1 bar 0, because that is the convention that those software's use while they measures the EBSD data. So, we have clicked out here and then we have clicked on the pole figure right. So, once we click on the pole figure various pole figure as default values opens up.

(Refer Slide Time: 29:41)

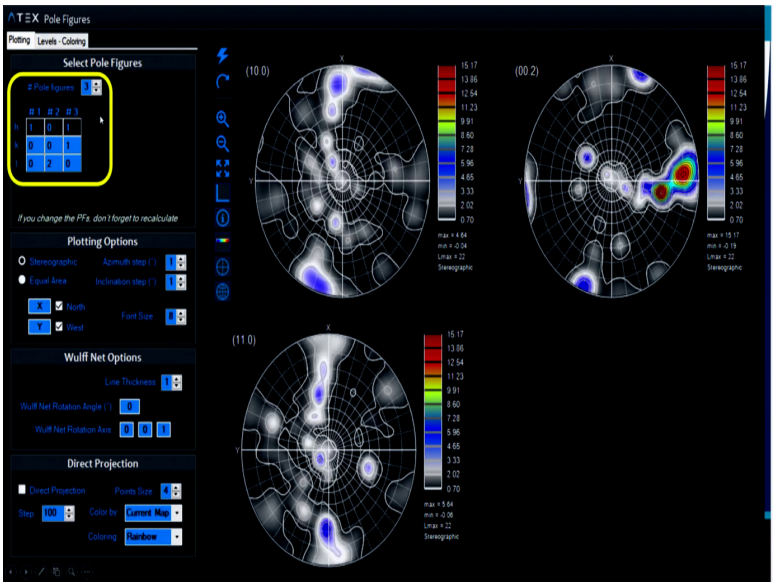


And, you can see that it has given 1 0 1 bar 0 0 0 0 2 1 0 1 bar 1 1 1 2 bar 0 and the other pole figures which cannot be observed, because I have magnified the screen. Now, the various pole figures that can be observed are given here and the number of pole figure is 6 and the various poles figures are given here see 1 0 0 0 0 2 1 0 1; that means, 1 0 1 bar 1 1 1 0; that means, 1 1 2 bar 0 1 0 1 bar 3 1 1 2 bar 2.

So, various kinds of pole figure that can be obtained. There are other options like, you can plot stereographic projection that is equal angle projection you can plot equal area projection. So, in case of crystallographic representation in pole figure the equal angle projection is basically used.

So we will click on the stereographic projection and it will be automatically clicked here. So, we will take the azimuth step, the inclined step, as we need to show the you know Wulff Net in the material. Whether, what is the line thickness of the Wulff Net, if is there any rotation axis of the Wulff Net that we can consider or decide right.

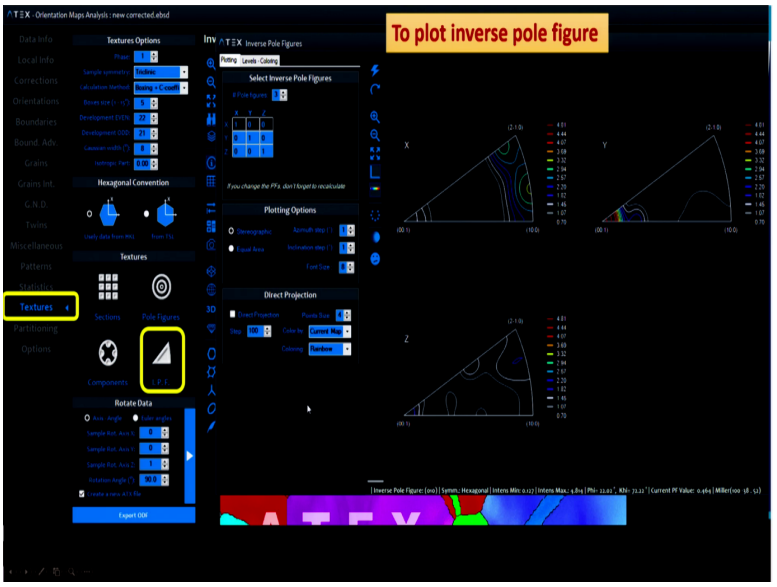
(Refer Slide Time: 31:14)



So, if we look into this, we can click here and select the pole figures that you would like to show. In our case, we would like to show 3 3 pole figure that is 1 0 1 bar 0, so we will put one, rest will be 0 and 0 0 2 that is triple 0 2 right and on the other hand 1 1 2 bar 0. So, here those pole figures could be obtained.

Now, you see 1 0 1 bar 0 the X axis is above the Y axis is here and there are intensity points here 0 0 0 2 the X axis is above the Y axis is here and the intensity points are here right in case of 1 1 2 bar 0 similarly, these are the intensity points. We can vary this values from means it is a default value has been taken, but we can vary this value depending upon the maximum and the minimum intensity we would like to take.

(Refer Slide Time: 32:16)



Now, we can after we plotted the pole figure, we can go and plot the inverse pole figure. So, in the texture column we click on the inverse pole figure tab and when we click on the 1 first pole figure automatically we will get 3 inverse pole figures and that is the X inverse pole figure, the Y inverse pole figure and the Z inverse pole figure. And, you know all about it so I am not explaining it much here.

So, we can even select that how many inverse pole figure we want to see, usually it is 3. So, 1 0 0 means the X pole figure, 0 1 0 means the Y pole figure and the 0 0 1 is the Z pole figure. We will keep it stereographic and we can see we can plot the pole figure in terms of contour or in terms of intensity plots as earlier we have shown right. Now, you can see that if we go ahead.

(Refer Slide Time: 33:13)

And, if we click on texture and then on the ODF section then we get an automatic plot of several ODFs. If we see you know in detail, if we go and see inside these ODF are basically phi 1 sections and the phi 2 is horizontal and phi is vertical. So, phi 2 is 0 to 60 and phi is 0 to 19.

Now, for each of this case, where the phi 1 sections are 0 degree phi degree 10 degree like that up to 360 degree it is possible, why? Because, in this case the sample symmetry that we have taken is triclinic and therefore, phi 1 is equal to 0 to 360 degree. Whereas, the hexagonal close packed material has a 6 fold symmetry, so the phi 2 will basically 360 degree divided by 6 that is 0 to 60 degree.

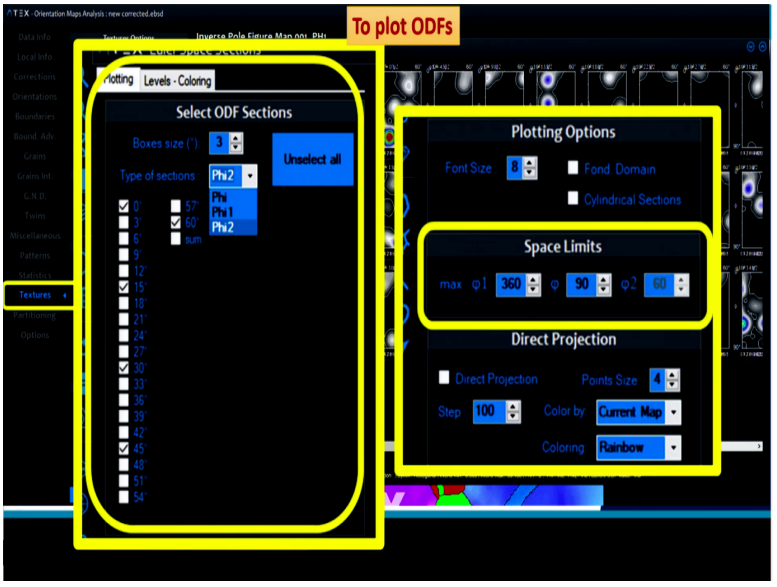
Whereas, the phi which is from 0 to 180 degree for you know the sample without any second symmetry like the mirror symmetry, but see it has a mirror symmetry also in the 0 0 0 2 axis or the Bessel axis, so the phi also gets divided by 2 . So, 180 degree divided by 2 becomes 90 degree. So, phi is from 0 to 90 degree.

Now, in order to plot the ODF sections what we would like to plot? First, you see phi 1 360 phi 90 phi to 60 degree, we have already done it now. Secondly, we go here in this point part and then we select that the you know the type of section that you want to plot. So, phi 5 1 and phi 2 presently automatically phi 1 sections are coming. So, we will click on the phi 2, so that it comes the phi 2 section.

(Refer Slide Time: 35:15)

So, this is a magnified portion of the same thing and then once we get the phi 2 section we know that phi 2 is from 0 to 60 degrees. We can tick on 0 degree 15 degree 30 degree 45 degree and 60 degrees, if we would like to plot this you know 1 2 3 4 and 5 ODF sections from horizontal phi 1 0 to 360 and vertical phi 0 to 90. We are plotting 0 and 30 degrees to show you how the orientation distribution function looks like in case of the alpha titanium alloy, right.

(Refer Slide Time: 35:52)

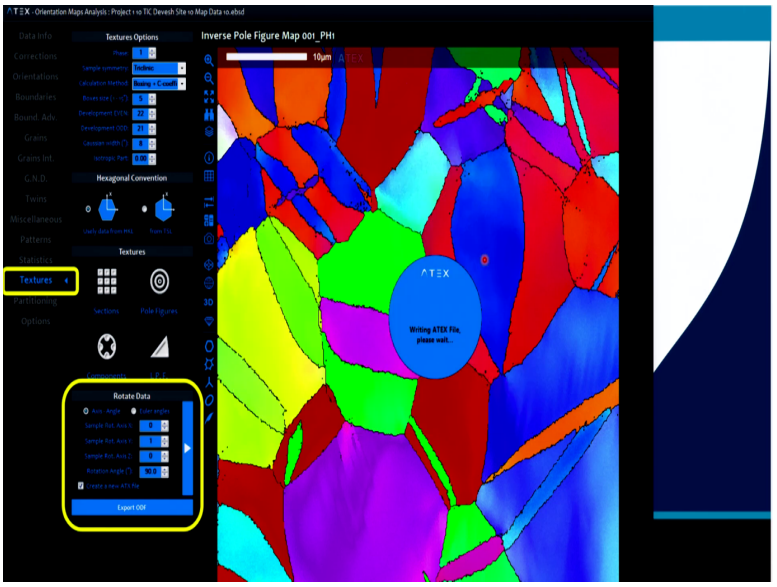


Now, yes this is the magnified portion of the lower area of this you know bar and you can see that phi 1 is equal to 360 phi equal to 90 and phi 2 equal to 60 degree, this has been shown here. We can use different colouring options right and we have used the colouring option rainbow to plot the ODF section that is 0 and 30 degree section.

(Refer Slide Time: 36:23)

And, once we plot it we see that a section something like this will come where the colour code is given here right, we can see the horizontal section is phi 1 the vertical section is phi it is 0 to 360 this is 0 to 90 and phi 2 equal to 0 that is this section and phi 2 equal to 30 degree that is this section has been plotted.

(Refer Slide Time: 36:53)



Now, once we have obtained the different you know texture information in terms of pole figure, inverse pole figure, and orientation distribution function, we can also use to we can also see the data EBSD data by rotating it. So, if you look in this if you click on texture.

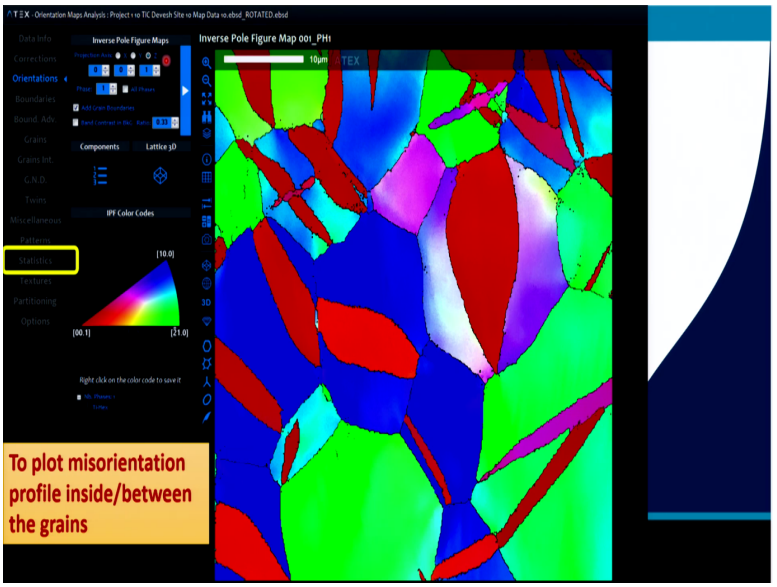
(Refer Slide Time: 37:24)

If you see the below window you will see that rotate data section will come. Here is the magnified portion of it. And, let us say that we want to see the we are observing the Z axis, because this is a plane where Z is perpendicular to the plane and the texture pertaining to the Z axis is being shown right.

Now, if we would like to see the texture pertaining to the X axis, now what we can do is that we can click on the axis angle and rotate the sample along Y axis, so we will keep 1 and the rotation angle if we give 90. Then, if we visualize if we rotate the sample by 90 degree about the Y axis then it will show the texture pertaining to the X axis instead of the Z axis.

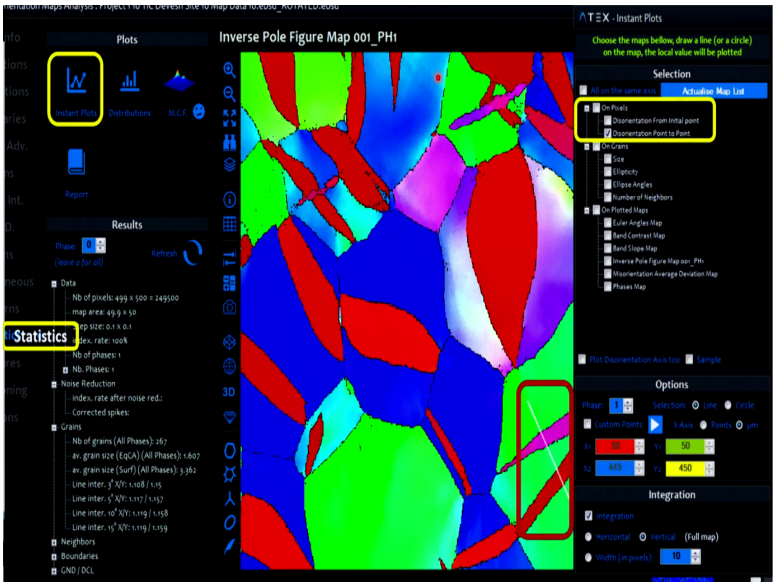
Of course, the microstructural morphological features will remain the same and will remain off the Z axis, but that feature related to texture or the orientation of the grains will be obtained in terms of X axis. So, if we do it and if we click here then what we will find, that it will the file will be calculated slowly and then the texture will change something like this.

(Refer Slide Time: 38:44)



So, this is the inverse pole figure pertaining to the X axis. Now, because we have rotated the sample with respect to Y axis to see the X axis. Now, at this portion, at this time the IPF map though it is showing X axis, but now the X axis itself is Z axis because of this rotation. So, here we can see that the Z axis is actually clicked on. Now, apart from that we can observe the misorientation profile inside and in between the grains.

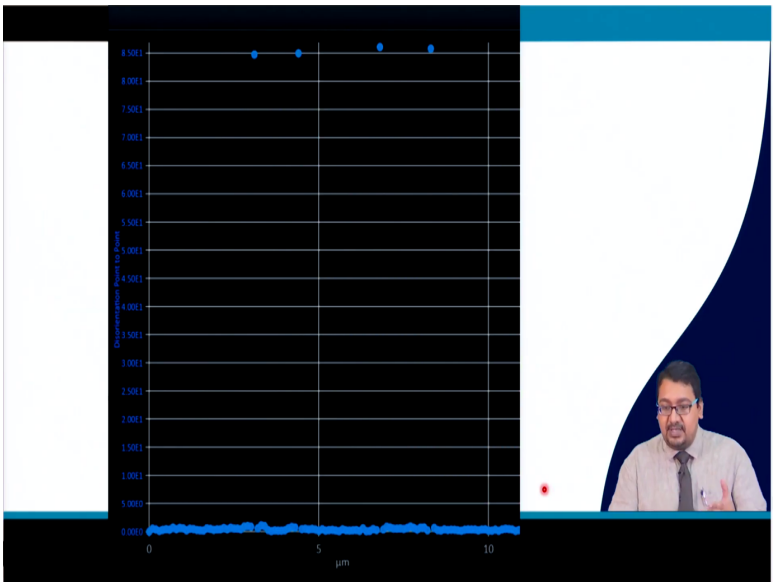
(Refer Slide Time: 39:30)



So, if we you know go to statistics and then if we go to the instantaneous plot and go here in the right hand side window, where there are two option on pixels; that is disorientation from initial point, that is from where we will you know start the line and disorientation point to point like.

So, if we click from here to here, you see this is a window, and if we click here to here we know these are you know these are twins and these twins are basically extension twin in case of titanium. And, these extension twin have an orientation misorientation or disorientation of nearly 86.5 degree and if we have a line something like that.

(Refer Slide Time: 40:31)

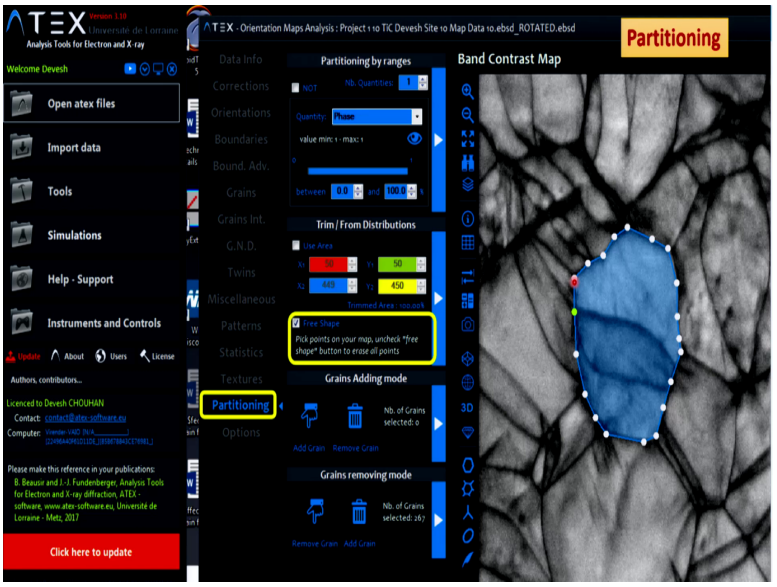


And then if we enter it, what we will find out that there will be a distribution something like this. Now, if we look closely to this distribution, it will have on the Y axis disorientation point to point or point to point misorientation and in the X axis it will have the you know the size in micrometre. So, as we go ahead in the microstructure through that line that is shown in the previous slide, what will happen?

It will after sometime the misorientation is near to 0, but at a certain point you will see the misorientation is nearly 85 degrees. Now, again the misorientation is 0 and then it is again at 85 degree and then again 0 again 85 degree then 0 again 85 degree. So, there are four places where the misorientation is basically 85 degree.

And, this place basically corresponds to this part where a line has been drawn where you can see if I am going from here it is 0 degree, 0 degree it is 0 degree in the misorientation or disorientation and then when it reaches here it is 85 degree, and then again 0 degree 0 degree 0 degree and 85 and 0 degree 0 degree 0 degree 85 0 0 0 85 0 0 0. So, we can get the point to point misorientation, we can get the misorientation from the initial point of that line and therefore, this is the thing that we can analyse using this ATEX software.

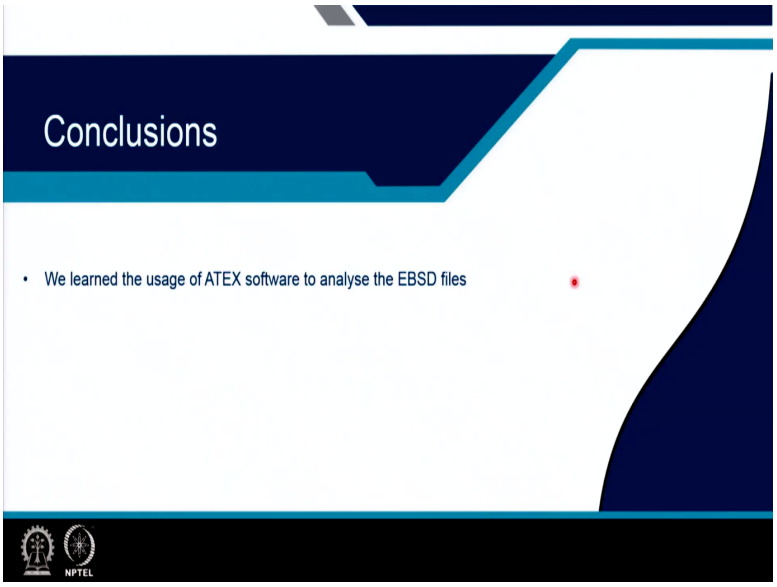
(Refer Slide Time: 42:09)



Finally, we can do the process of partitioning. So, in the window the final you know function partitioning has been shown. If we click here we can get the partitioning range, we can see the phase, we can you know trim it normally and then we have one more option where which we like to trim various grains of interest.

So, we click on the free shape and when we click on the free shape we get points. We can click on a particular grain and various points, and then if we click on it we can just you know partition that particular grain from the microstructure to you know concentrate on that grain and to observe the features of that grain quantitatively using the same software.

(Refer Slide Time: 43:11)



So, we can conclude that from this ATEX software also, we can do EBSD analysis of the files obtained from both HKL channel 5, that is star dot CTF file and you know TSL OIM which is from ametek, and that is star dot OSC file and can get information from those you know texture information from this EBSD data. Thank you very much for the class and for your consideration.

Thank you.