Lecture - 53
ERP extraction demonstration

Hi, welcome to the continuation module on ERP analysis. In last module, we have seen the introduction of ERP analysis and what are the applications, where you can use the ERP experimentation. We have also seen three different blocks; how to generate the stimuli, how to acquire the data, and how to extract the data? We have shown you one actual experimentation which is being happening, a glimpse of that.

So, the same experimentation we have recorded some data. So, in this particular short module we are going to see how we can use MATLAB to record that particular data and make sense out of it. So, if you can see my MATLAB screen.
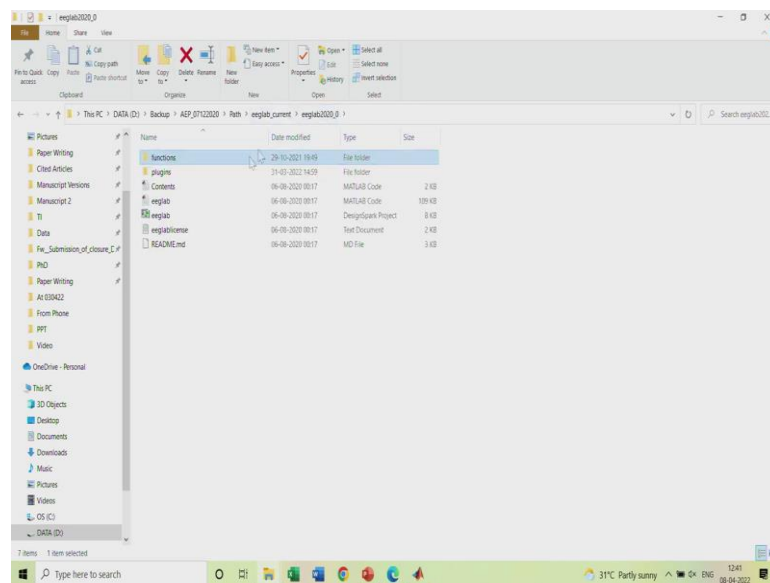
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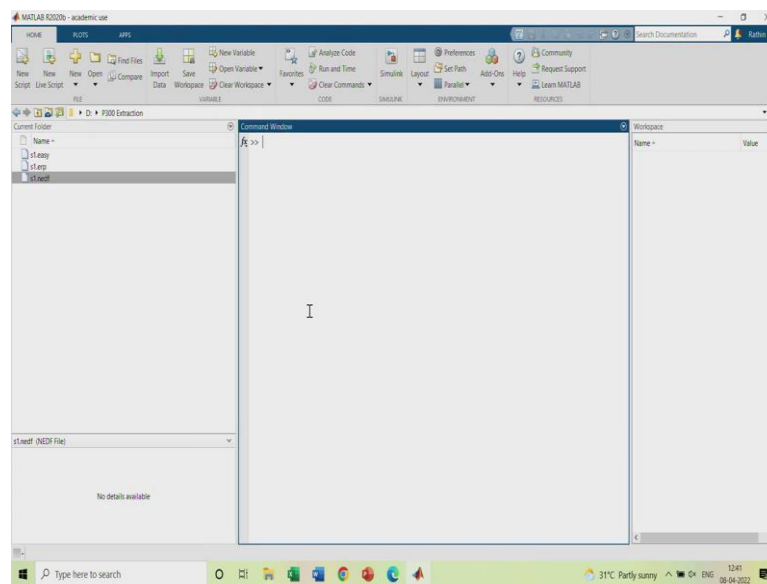
This particular data which has been stored using the acquisition. nedf file as I mentioned using that neuro electrics enobio eight cap saves the data in nedf file and so I ask you to download the eeglab.
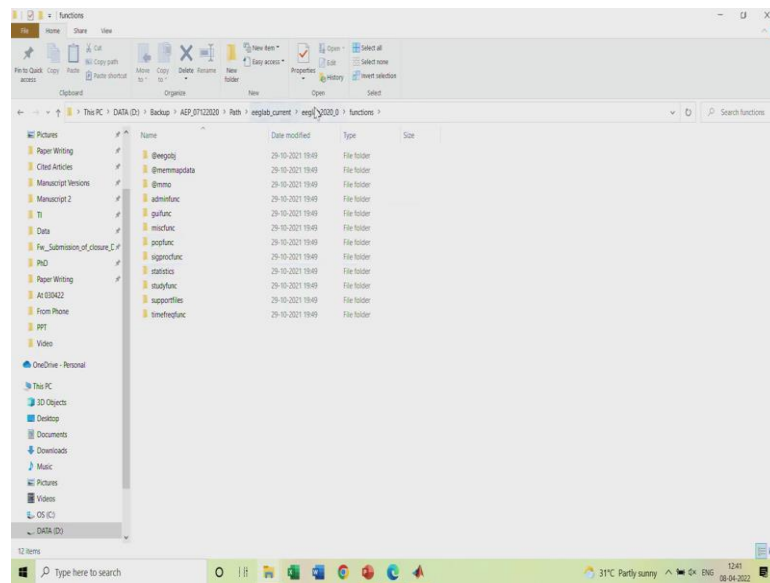
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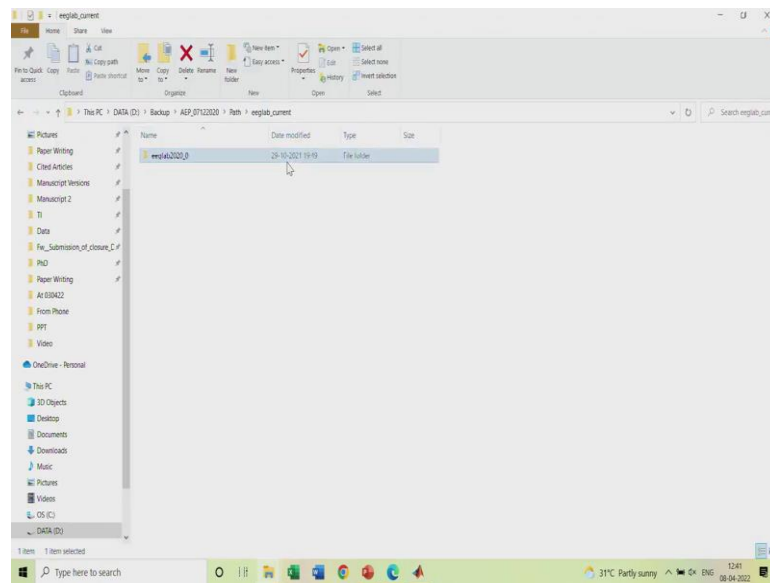
Now, if you download the eeglab, it comes like this.
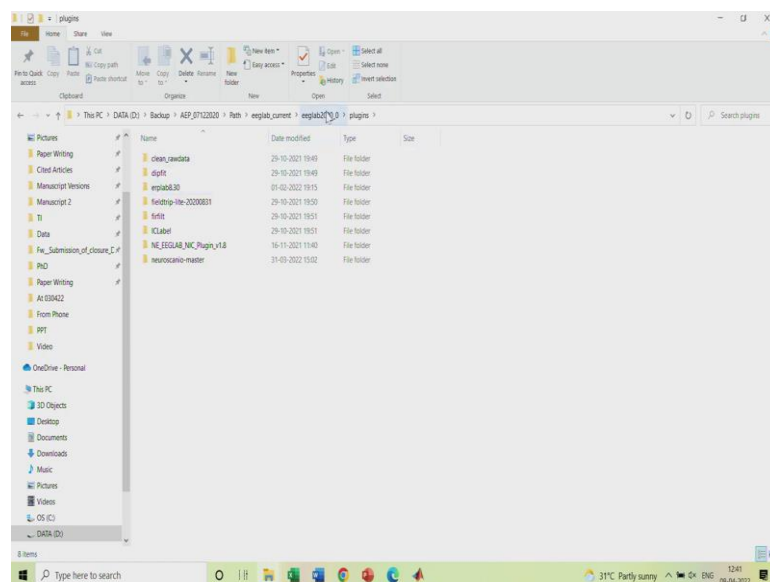
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This is your particular eeglab in which you can see the different functions.

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So, all these functions in different classification, miscellaneous functions are there, gui functions are there, pop functions are there, statistical functions are there, you can go and explore it at your own.
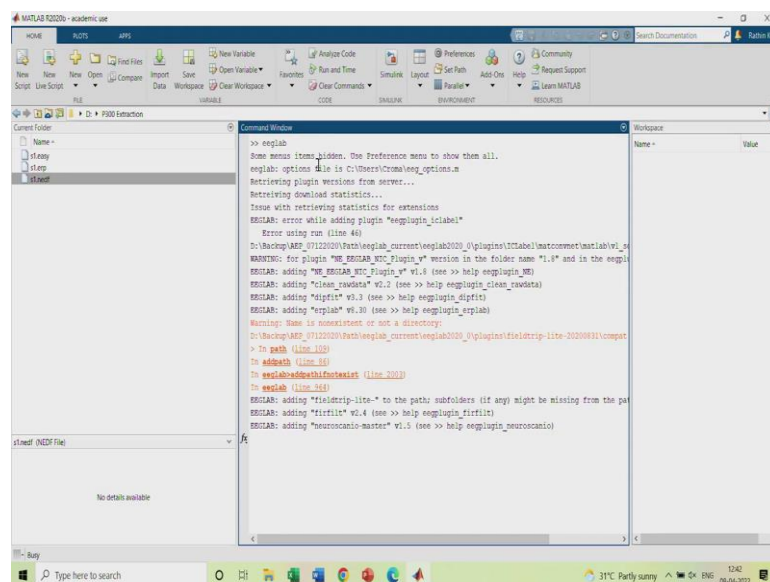
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Also, these are the plugins I mentioned different plugins are there. Now, if you want to operate or you know process the ERP data you should have this erp lab. So, I have currently this latest version of ERP lab 8.30 here, you can check that.
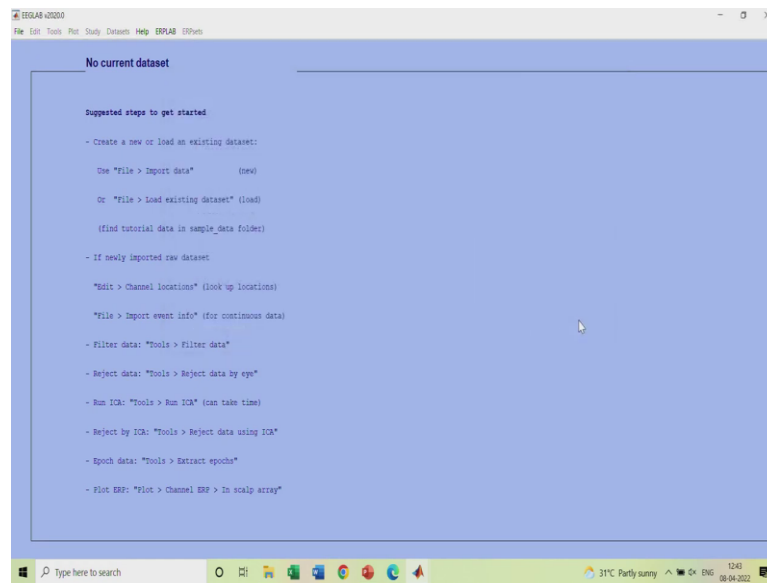
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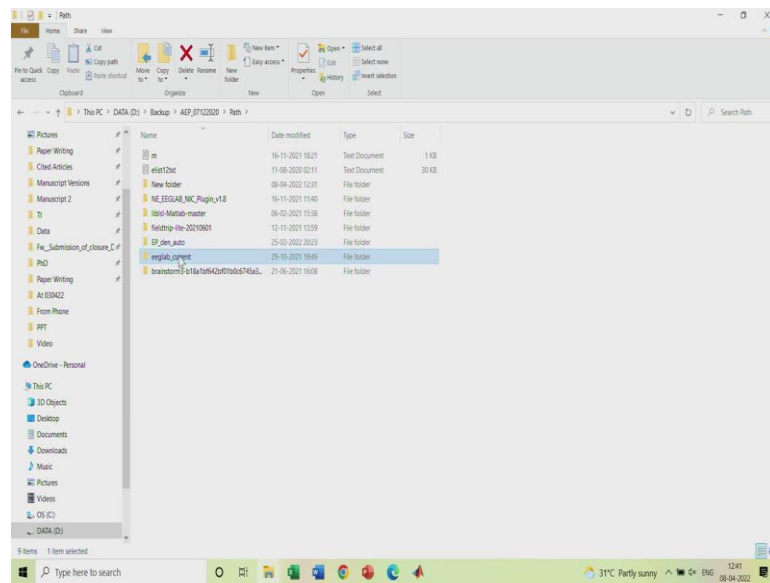
So, basically you everything should be added here, and it should that everything should be added into the path as well. So, which I have already added here in path; so, we will just start the eeglab and try to extract the data, extract the response.
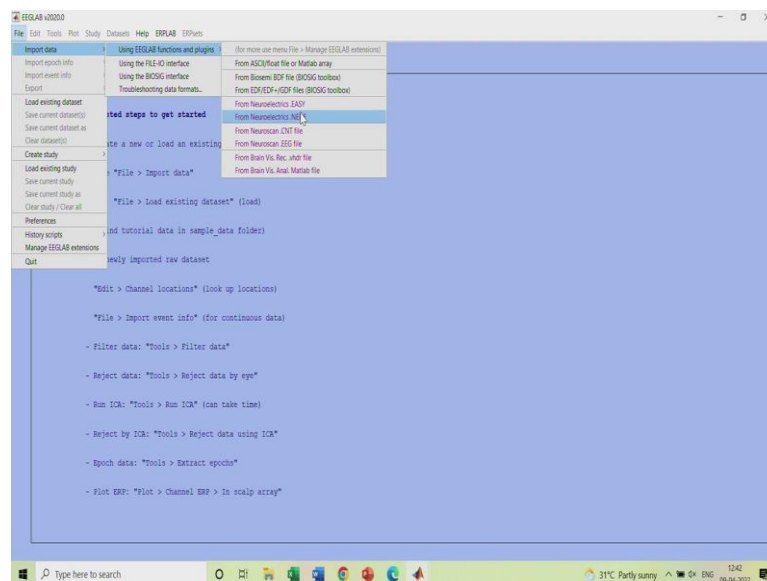
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You can write here in command window eeglab to open it.
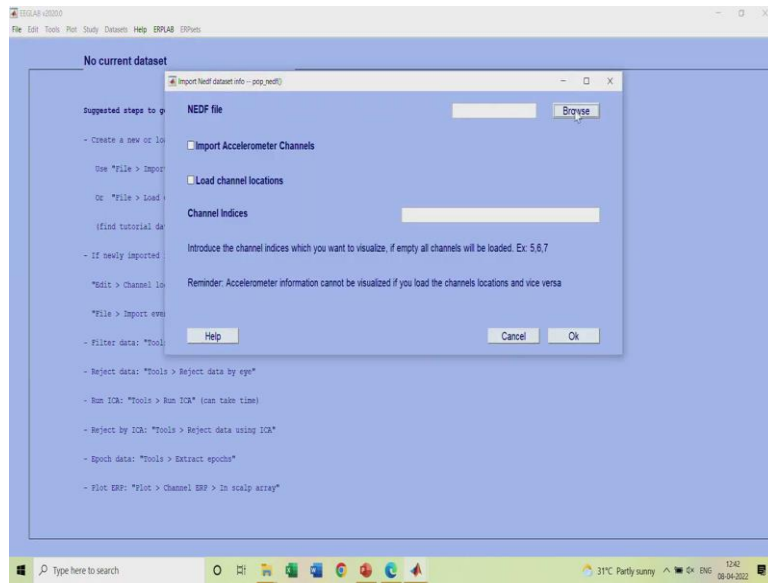
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This is the home screen of eeg lab, once you open your file.
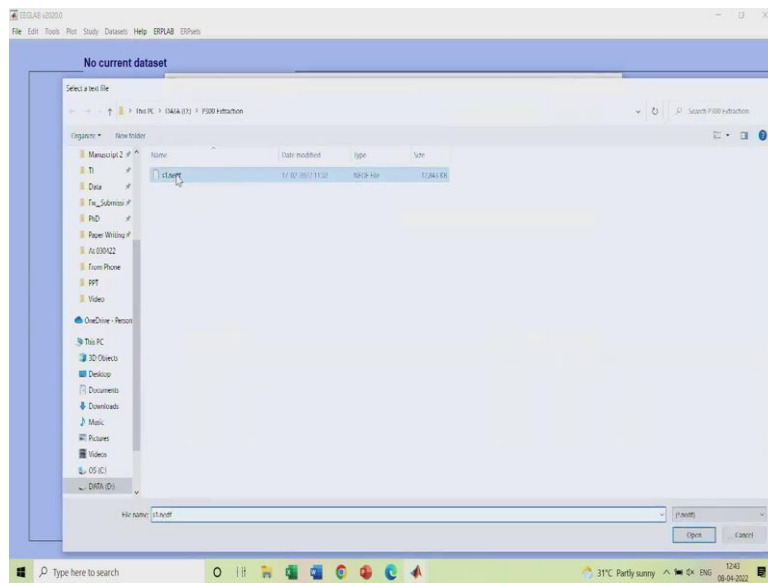
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If you want to import the data you can go to the file menu and based on the plugins you have installed, you will get different formats which you can acquire. If you are recorded using Neuroscan, there is a CNT file you can import. Currently we have used enobio which is from neuroscan file. So, we can either give nedf file or easy file, anything is fine. So, let us acquire the data using nedf file.

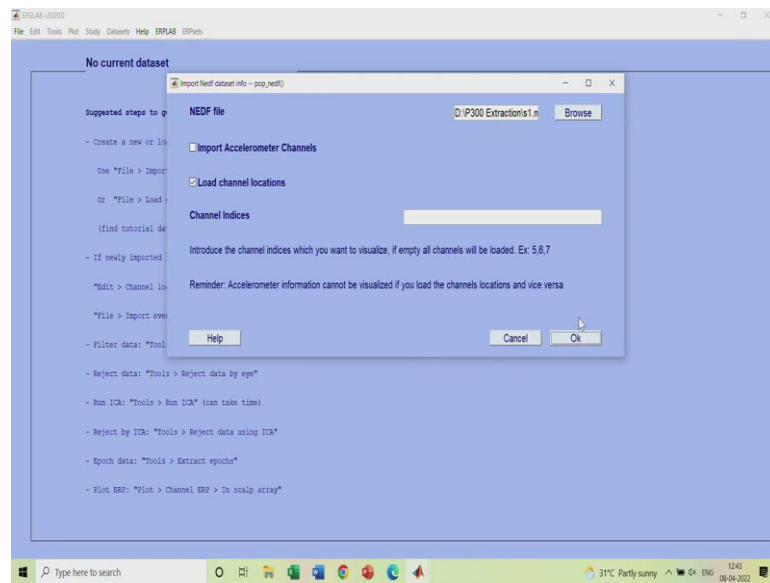(Refer Slide Time: 03:02)

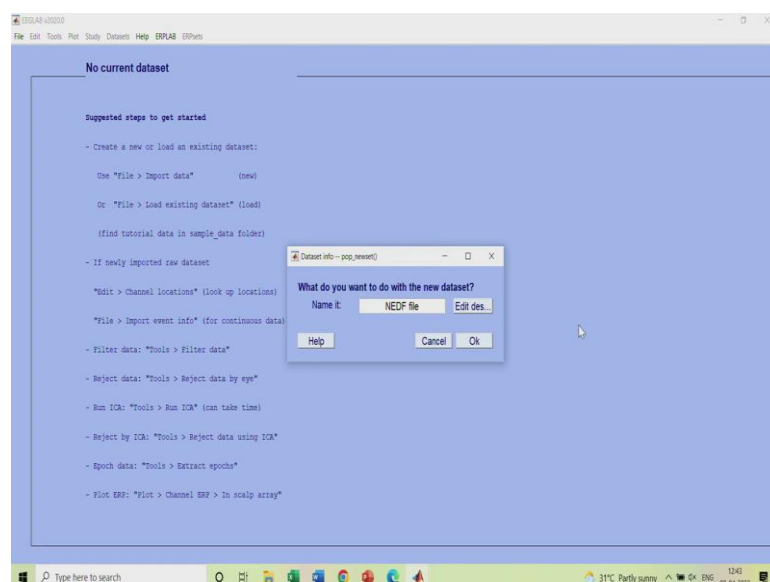(Refer Slide Time: 03:03)

You have to browse the particular data.

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For that make sure that your MATLAB is at that particular level where your data lies. You can load the channel location, during the entire experiment subject who was lying without doing any kind of significant movement. We are not considering accelerometer channels, but we are loading the channel location. And you just press OK it will acquire your entire data, takes some time.

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Because, that particular experiment was repeated for 800 standard, 100 destructor and 100 target.
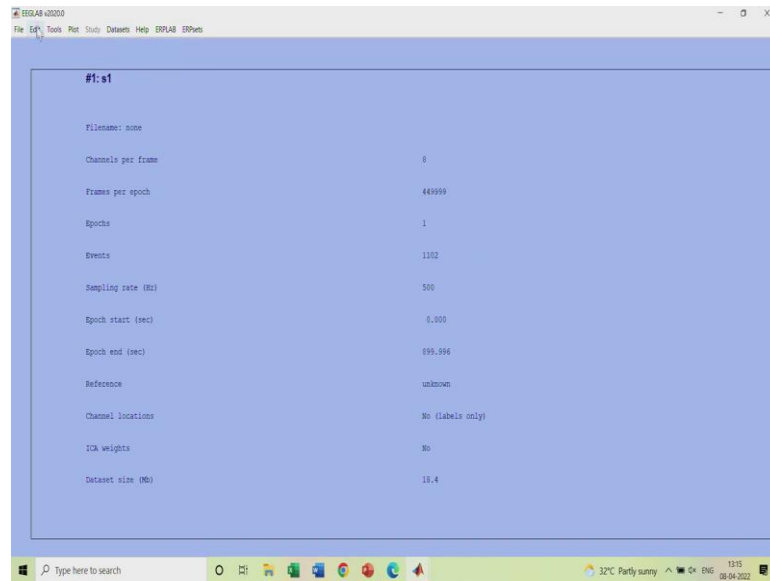
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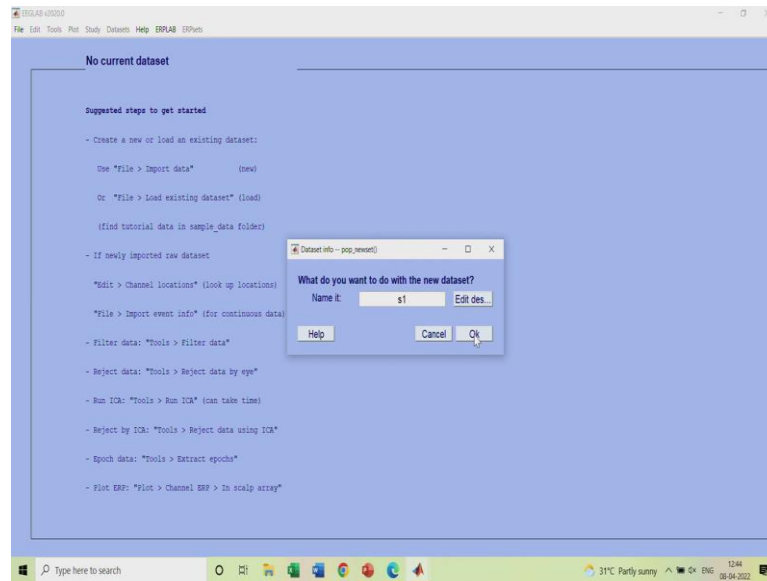
What is standard destructor and target? I told you standard small blue ball, target big blue ball and destructor is checkerboard, which distract you to from identifying target or big ball and subject was asked to click whenever that particular big ball came.

Now just to give a name let us say subject 1 I am writing here s1. Keep this name as short as possible because you are going to do so many operations. So, you can append if you are doing filtering underscore filt, if you are doing binbased epoch underscore bin-based epoch, if you are doing artifact rejection underscore artifact rejection.

Ultimately it will go to a particular you know it will be a very long name instead just keep a small name here we will keep it subject 1 hit OK.

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So, that is no current dataset has been converted into s1. Now, there is a lot of information here, how many, what is first of all most important thing is what is the sampling rate? It is 500, how many events? So, it has detected 1102 event. Now, I told you that 800 standards or small ball, 100 target or big ball and 100 destructors or checkerboards are there. So, sum is 1000. Why this additional 102 events? So, I told you I asked subject to click. So, that also we have considered as event.

So, in response to 100 targets, subject has clicked maybe 102 times falsely clicked there. So, these are the total number of events and how many frames per epoch, and all will come to that as we will keep on going to process. Total epoch starts like currently you consider experimentation starts at 0 ends at 899.996 second. So, it is around 15-minute experiment. And that is why I took little bit time to import the data. So, once you import all these things you can check the data how it looks like or something, it is a row data.
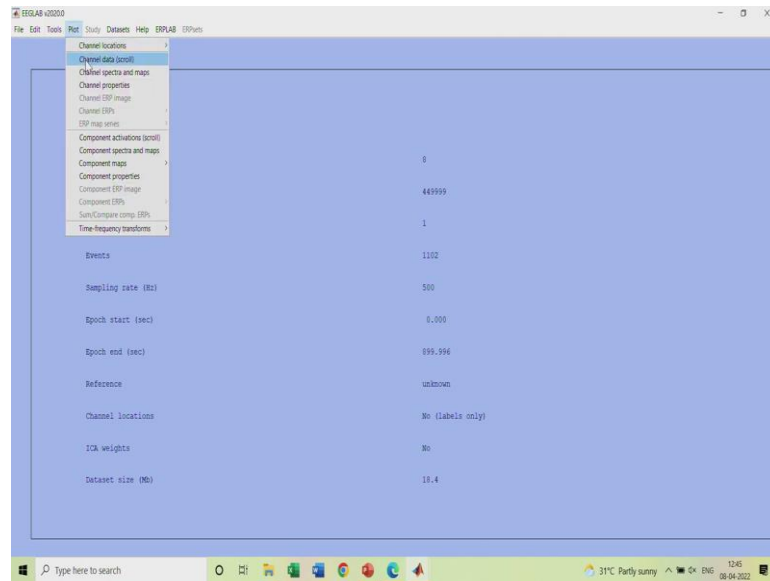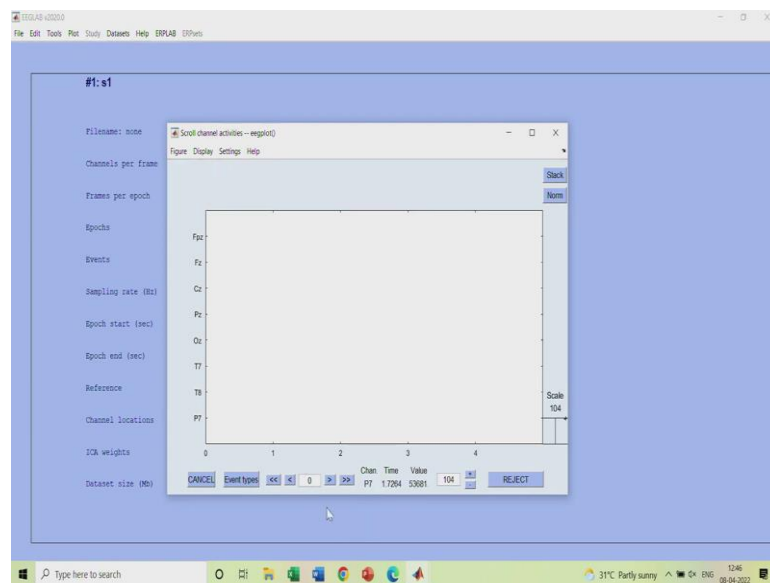
So, you would not be able to make much sense out of it you need to do filtering. But, how to see the data? You can go to plot and channel data scroll I will do it again, Plot channel data scroll. Once you do that, you can see the screen in which 8 electrodes are there. Now, if you have understood the 10-20 system which was taught by Dr. Pandya properly you should know what is FPZ, F Z, C Z, P Z, O Z, T 7, T 8, P 7.

Now, if you can look at myself, I can explain that your FPZ is this particular point on your forehead, it is on midline. Followed by FZ which is there little bit above your

forehead in the mid line. Then CZ, PZ and OZ. Basically this thing covers your entire midline from your forehead to the backside of that. Now, this P 300 is this visual potential. So, it is more prominent in centro parietal or parietal occipital lobe. So, these three are the electrode of our interest we will see that. Now, if you see that, but you cannot see any kind of eeg and all right.
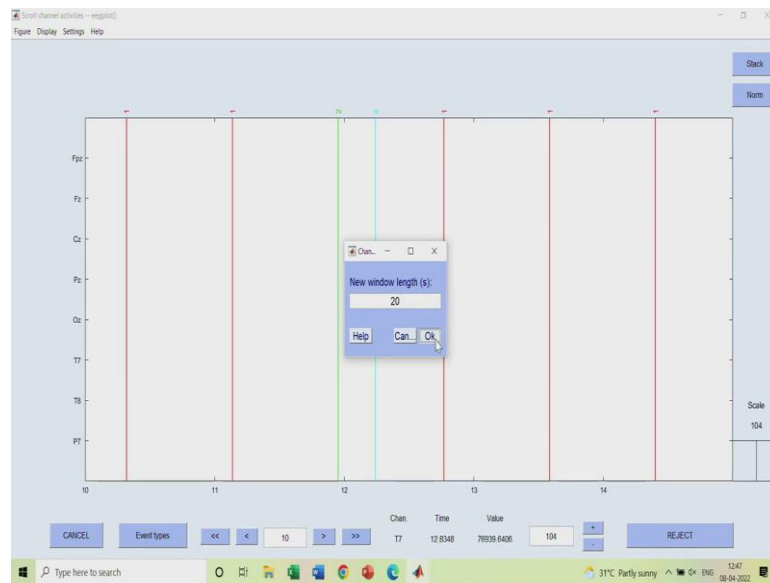
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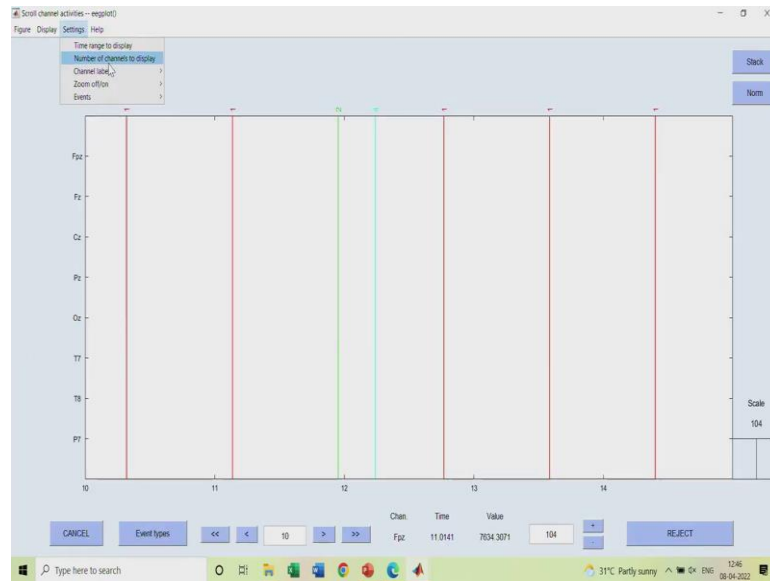
So, where are the responses? But here you can see the events 1, 2 here 4, 4 is your response with respect to 2 is your target. So, you can have an idea if I just maximize it.
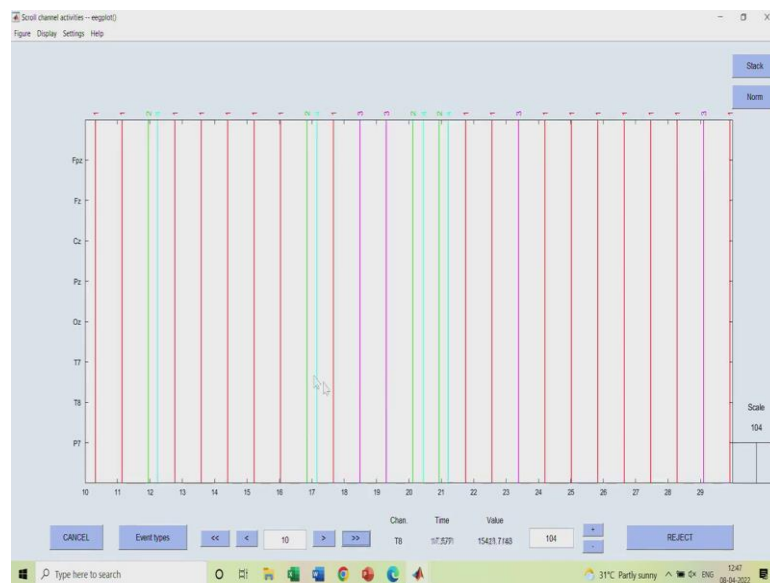
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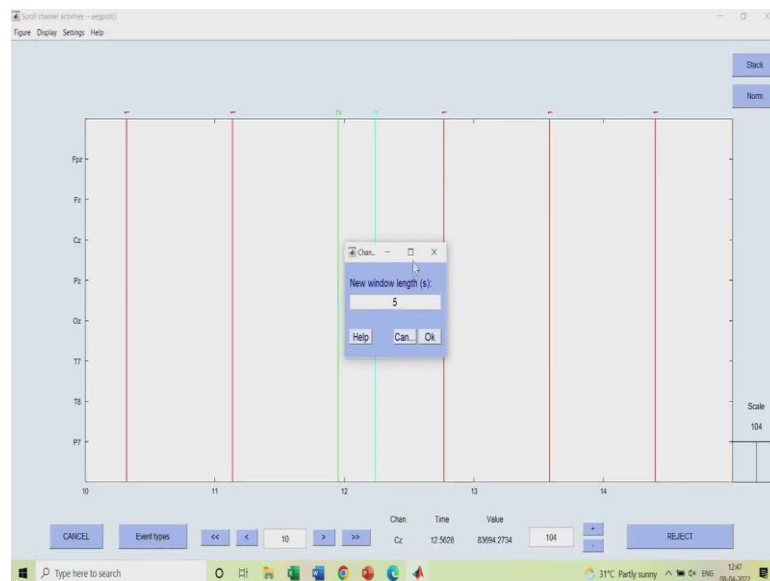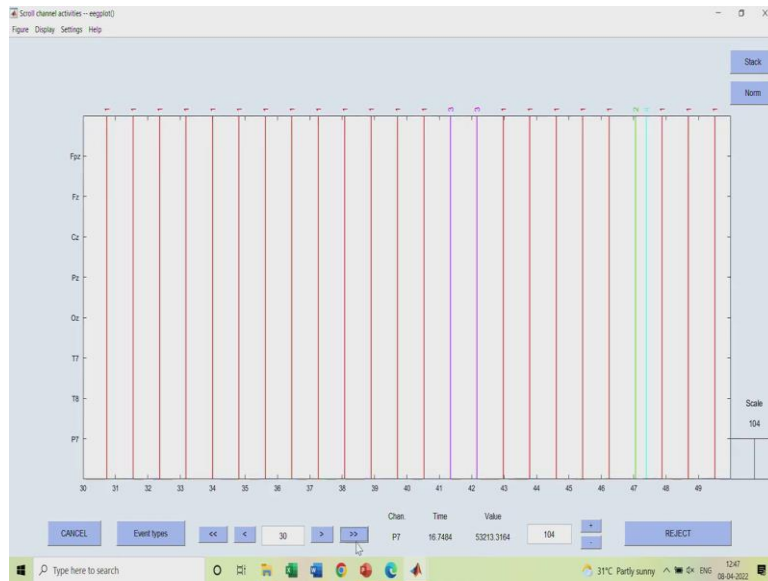
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And increase the time range to display.
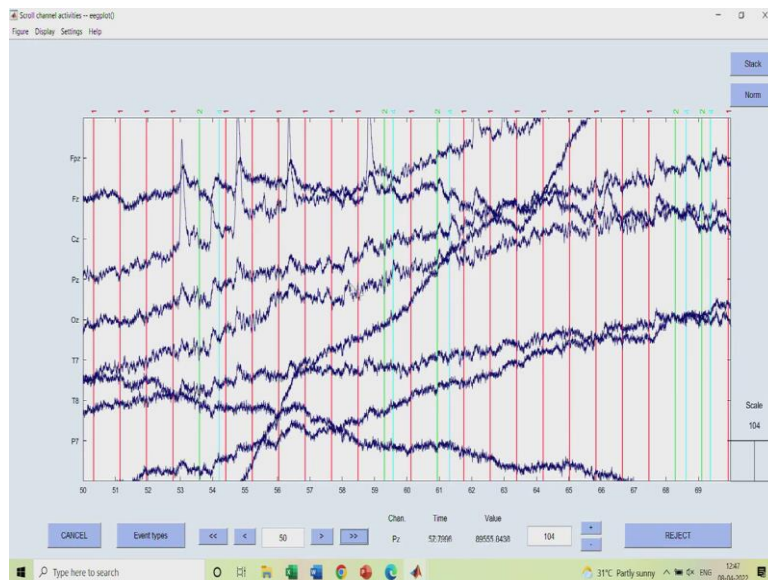
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You can get all this thing. See one appears most number of times, the frequent stimuli which is your small ball 2 is your target. So, in response to that you can see this sand color four responses also there and 3 is your checkerboard. In response to that subject should not click.
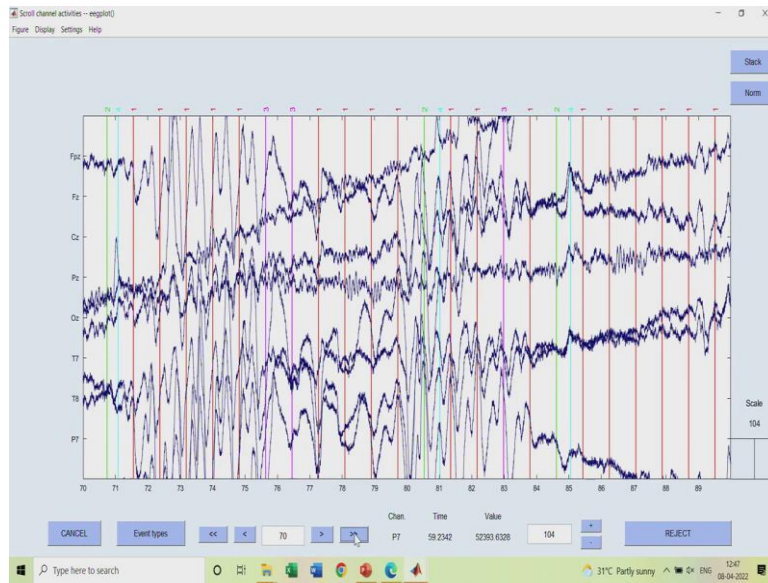
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So, all these are just an event, but where is the data? We can see the event. But where is the data?
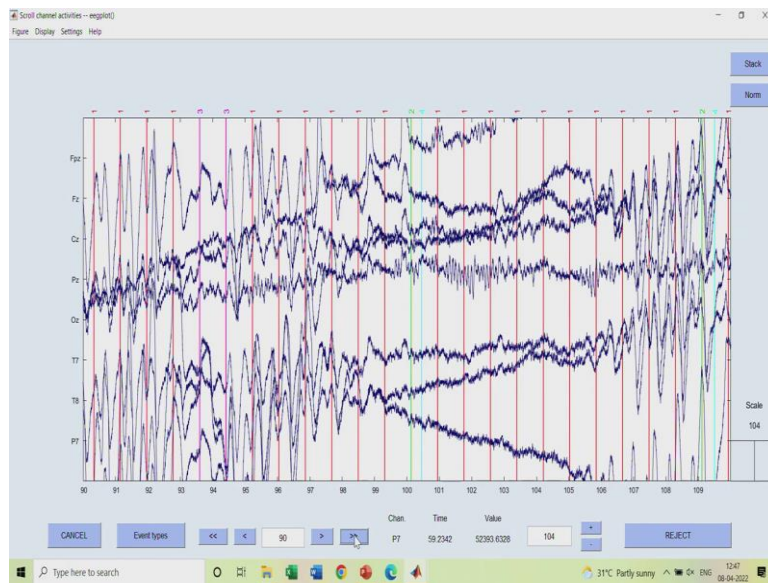
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If you can remove the DC offset, you might be able to see the data. See all these brainwaves are dancing all around the screen.
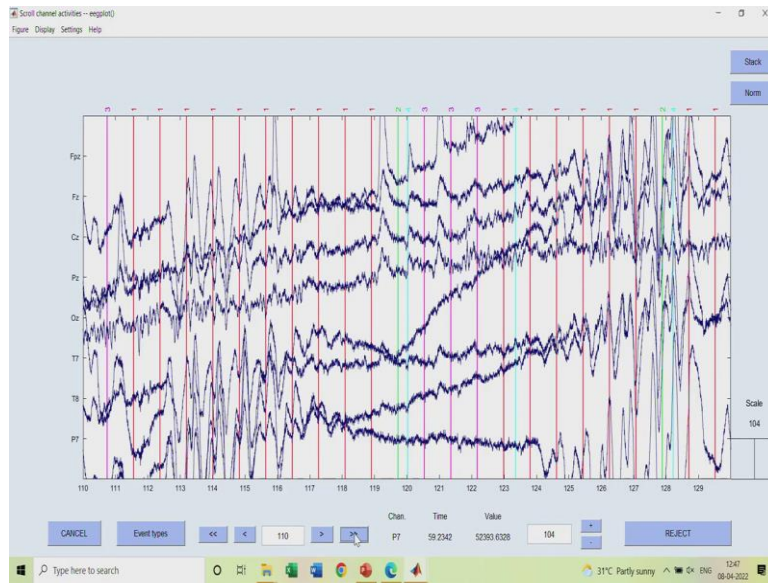
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But the thing is it is not filtered.

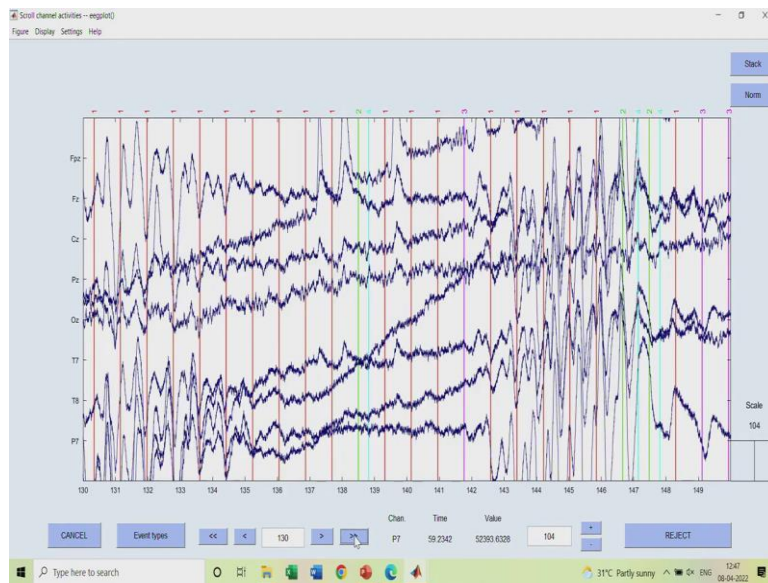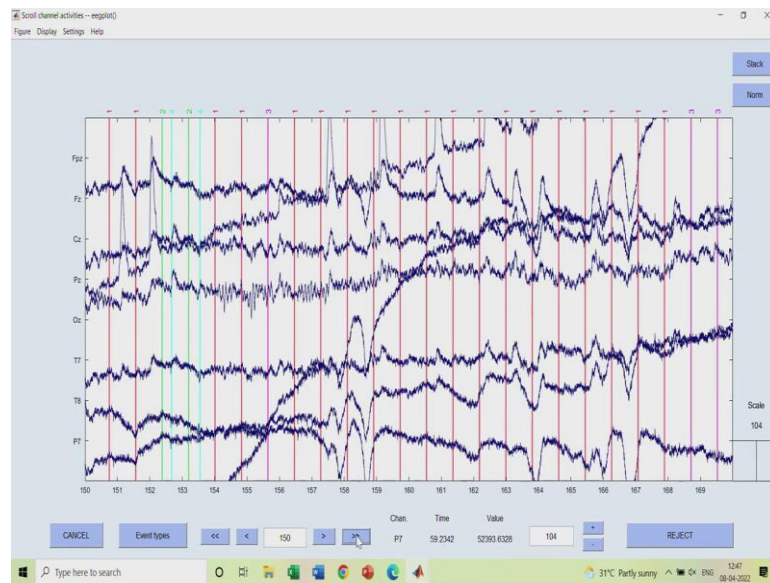(Refer Slide Time: 07:40)

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So, it has so much a non neural burst as well.
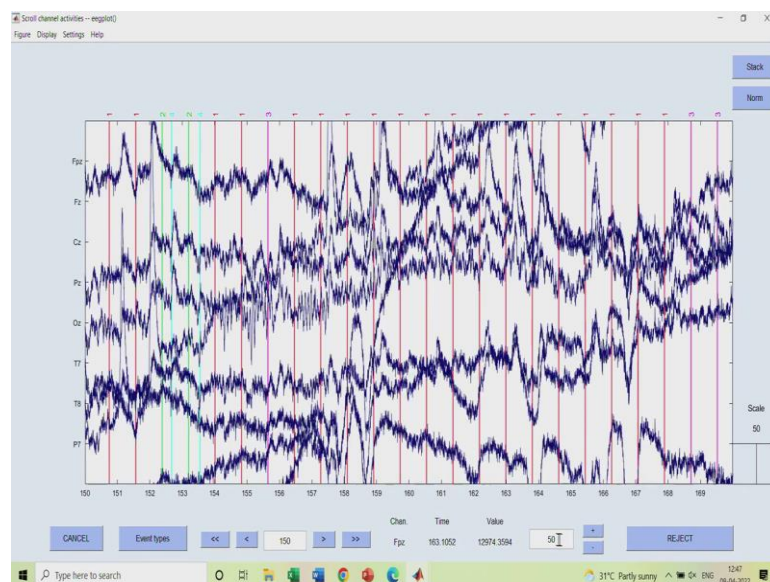
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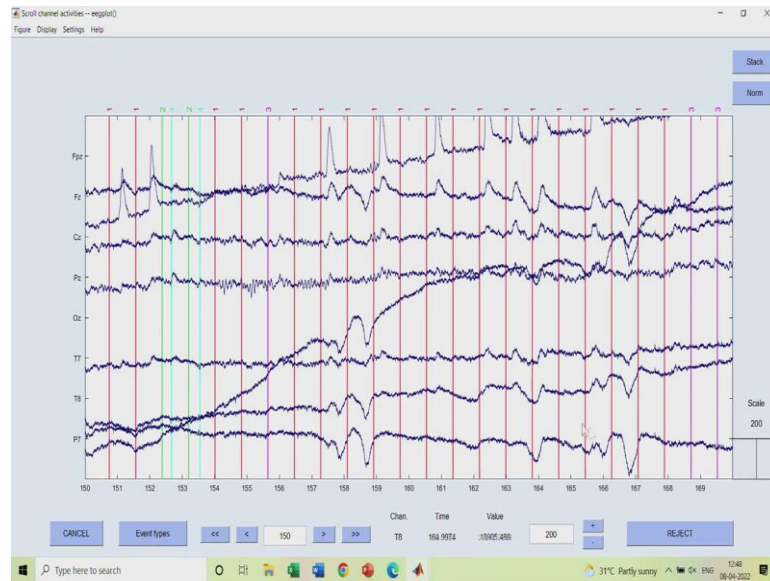
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So, once we see the filtered data, we can make more sense out of it. But you can see here on one fiftieth second to one seventieth second this is the brain wave. Also, you can increase or decrease the sensitivity by changing this parameter.

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See now it is all over.

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If you want to still see the clean data, you can increase the scale of 200 you can see the again clean data. Also, you can see, this can be subjects blink because it is coming higher in the above electrode and here it is getting inverted. You can make more sense out of it once we do filtering, but this is basically how the data has been imported.

The main confirmation is your data is there which we have recorded, and your triggers are also there. So, this is important which you can see here also when you hover over this you can see the time and value, if you want to you know measure a particular value of electrode. So, we got this data as well as figure.

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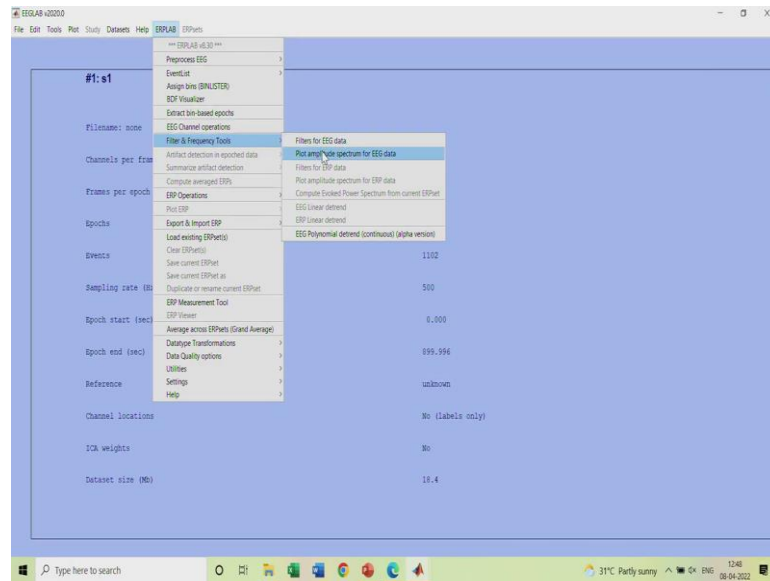
We will now quickly see how it looks like in frequency response. For that, you can go to filters and frequency tool and plot amplitude spectrum of eeg data.

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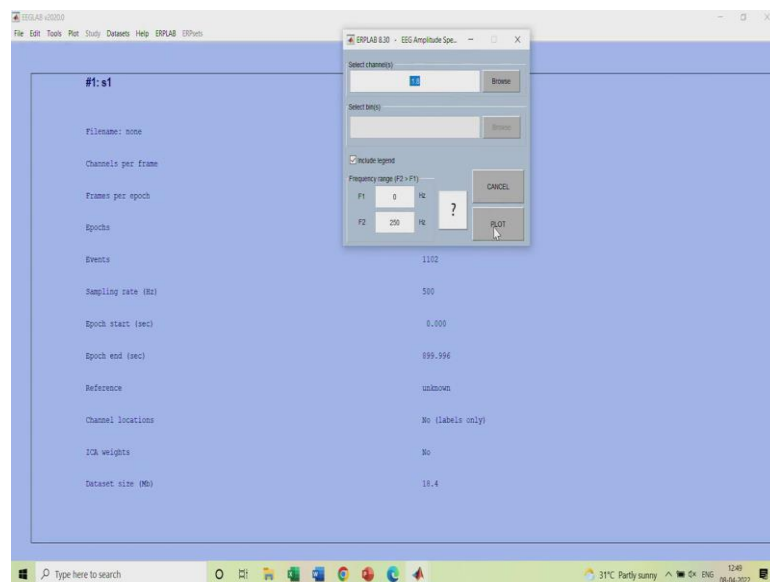
Now, this data will give you an overall idea that whether you have a powerline interference or not and how many electrode. Currently let us consider all 8 electrodes combinedly, it will show you one frequency response.
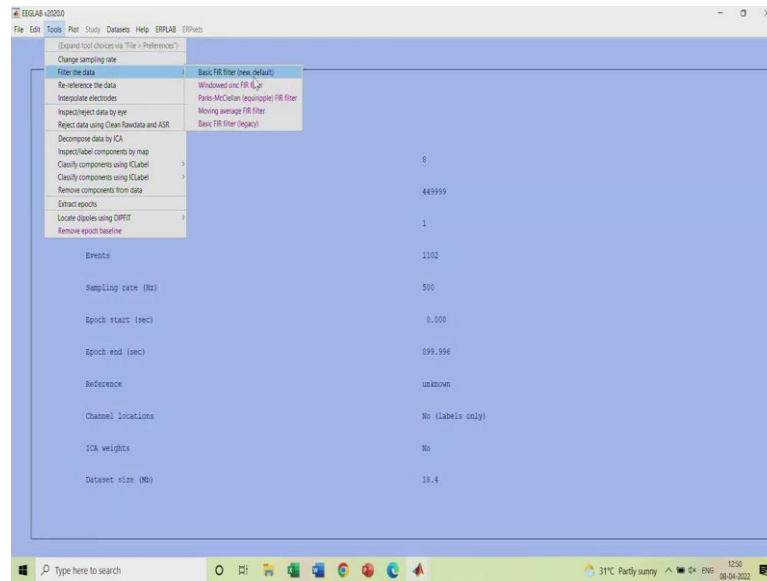
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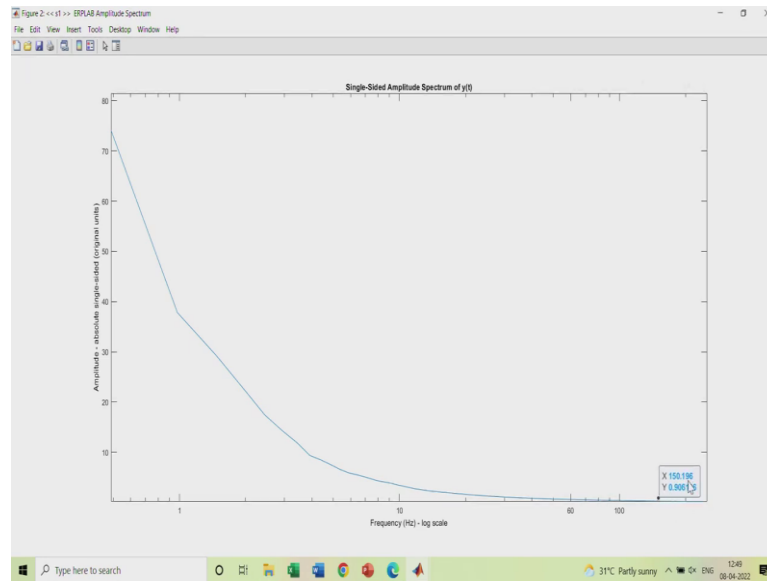
Now, one more thing if you have noticed here it comes in x axis it is a frequency in log scale here amplitude. If you can see this here a lot of DC offset is there. So, which we can remove once we do filtering from 3 to 30 or 1 to 30. And there is a small tip here. So, that is around 150 which is nothing but a multiple of your power line interference which is 50 hertz. One more thing if you have noticed is when I have given the command, I have given the maximum frequency here 250.

Very important thing why I have given this 250 is because if you can see here the sampling rate is 500. So, as per Nyquist theorem if your sampling rate is fs, the maximum frequency which you can successfully obtain is 250. So, if I go here above 250 it shows error. So, it is a very basic thing for signal processing, but you should know that whatever your sampling frequency accordingly you should plot the spectrum. So, currently it is fine, spectrum looks good, but still a small this thing is there, but not that much hazardous.
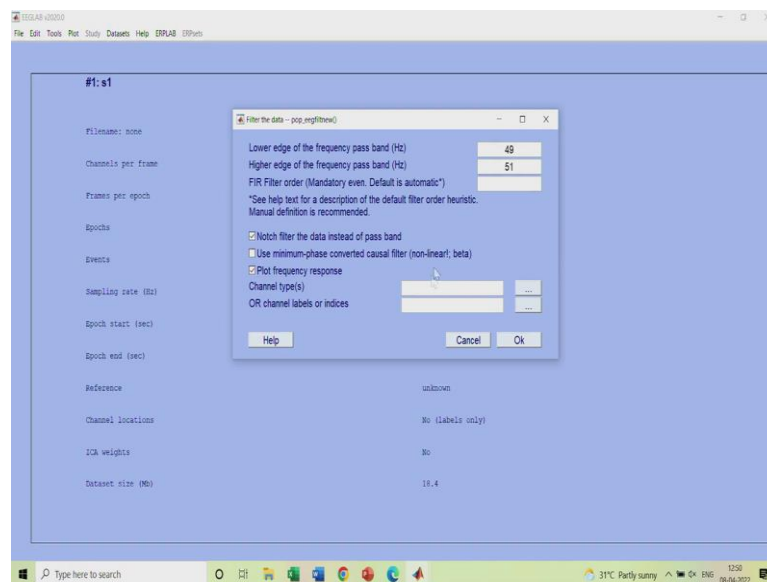
In some of the cases around 50 hertz you will see a big spike, in that time you have to do notch filter. Here it is not required so we can directly go ahead with band pass filter.

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How to do notch filter? How to do bandpass filter? We will see that in tools filter basic FIR filter.

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For the illustration purpose I am just selecting a basic FIR filter. If you want to remove 50 hertz noise you can check this option notch filter and you can give here 49 and 51. What it does is from 49 to 51, it notches the data, or you know it removes those particular frequencies which is basically of 50 hertz frequency. In that case this pass band will become a stop band, if I talk in actual sense, it will become a stop band. It will
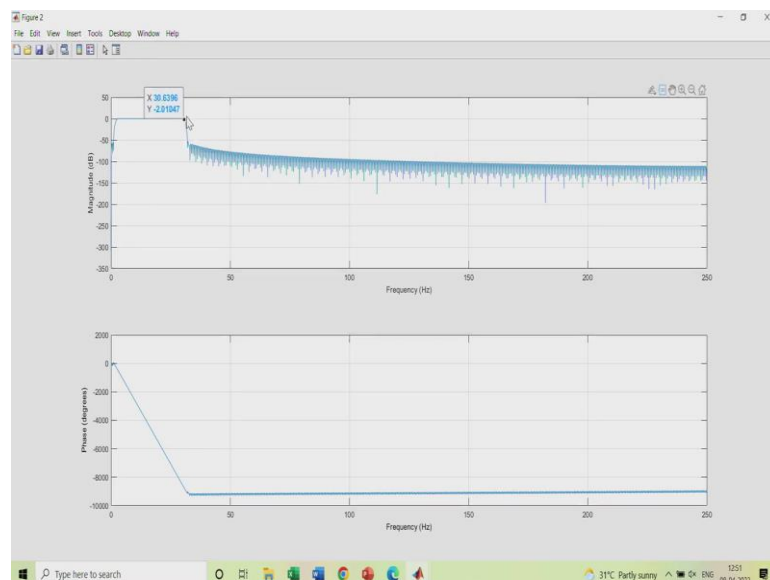
stop the frequency from 49 to 51. Whereas here I will just give, we could not see any kind of power line interference in this data.

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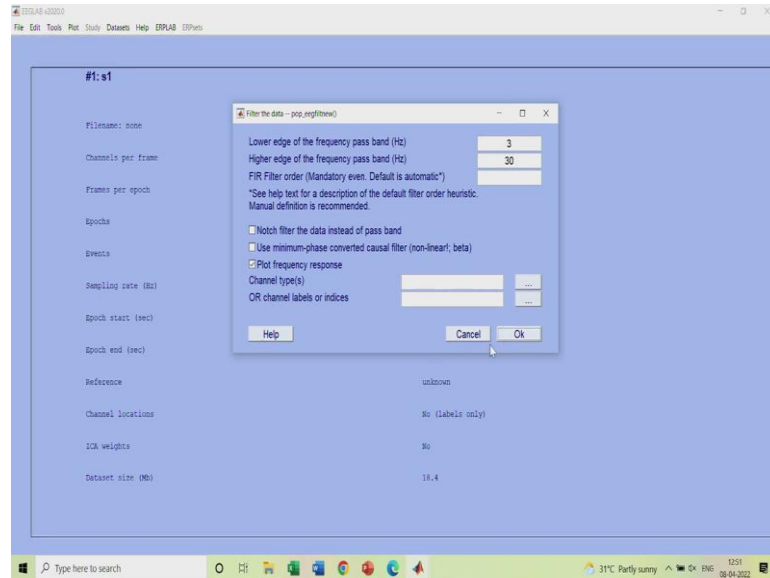
So, what we can do is we can directly take 3 to 30 which lies in the range of brain ways. So, this particular data we are going to filter we want to see the frequency response.
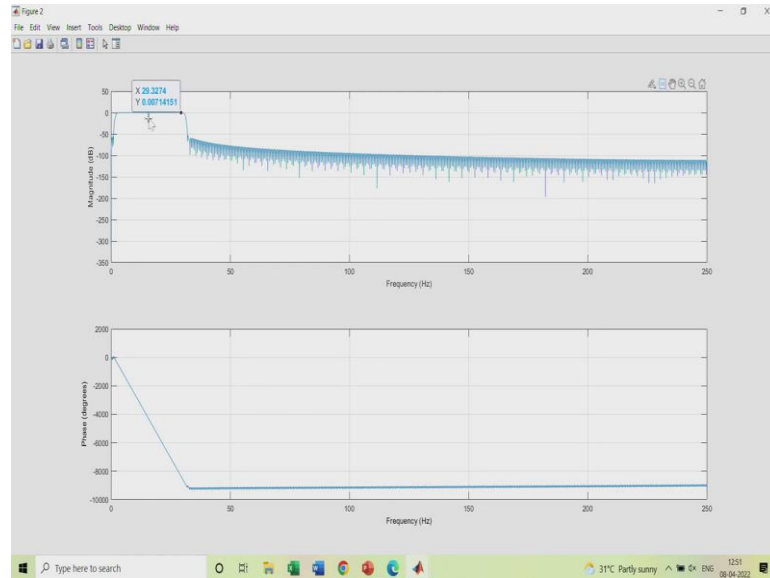
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So, we will quickly see the frequency response, you can see first this. It shows your magnitude is 0. Now, we want to pass this frequency, why it is 0; this is in dB decibel. So, log 1 is 0 that is why, but it allows all this frequency. Now, it allows till which point
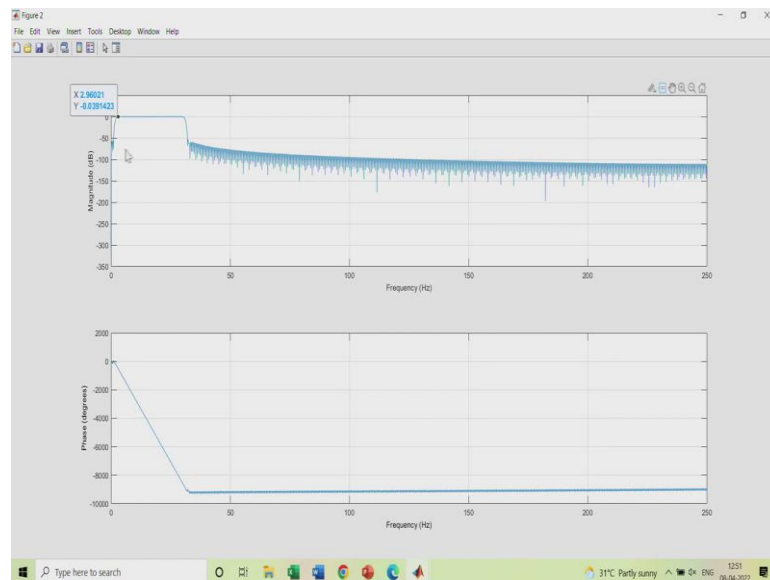
if you want to see you can put an indicator here and try to check. See till 30 it is showing some value.
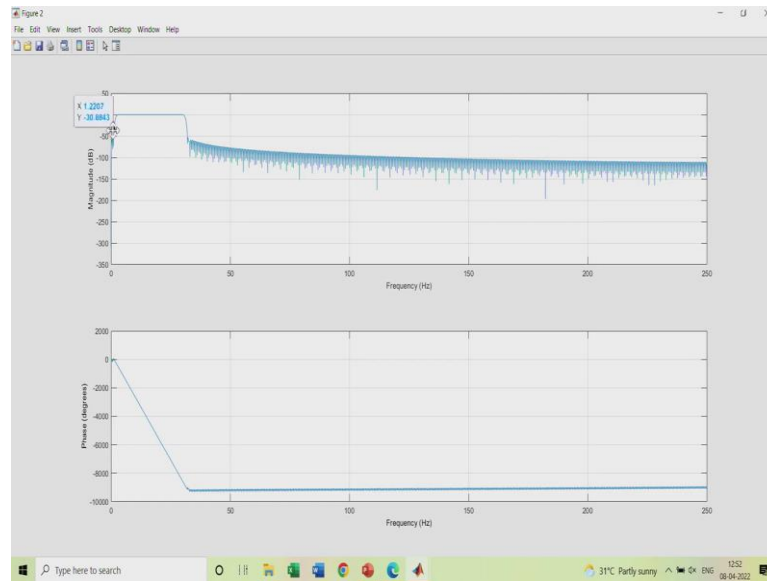
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If you go above, see till 29 it is 0.007. So, it is almost it is allowing 29 till 31.
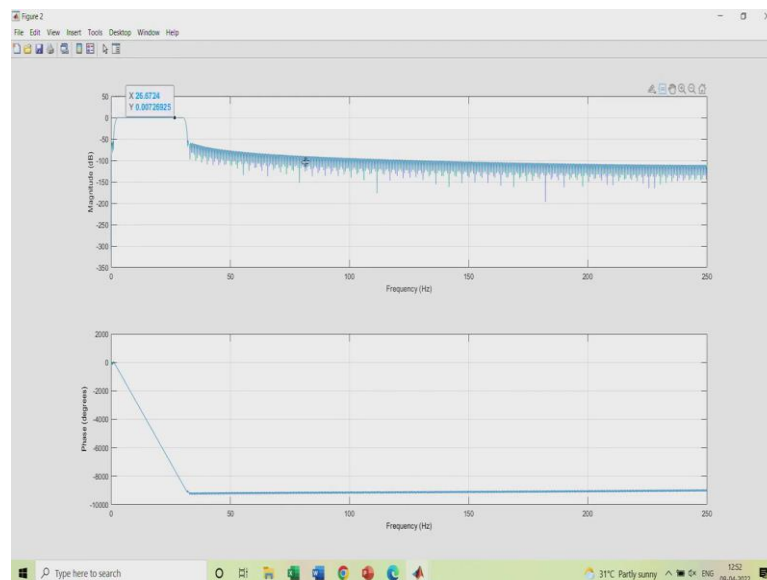
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Also, from which point it has started allowing from 2.96 or something.
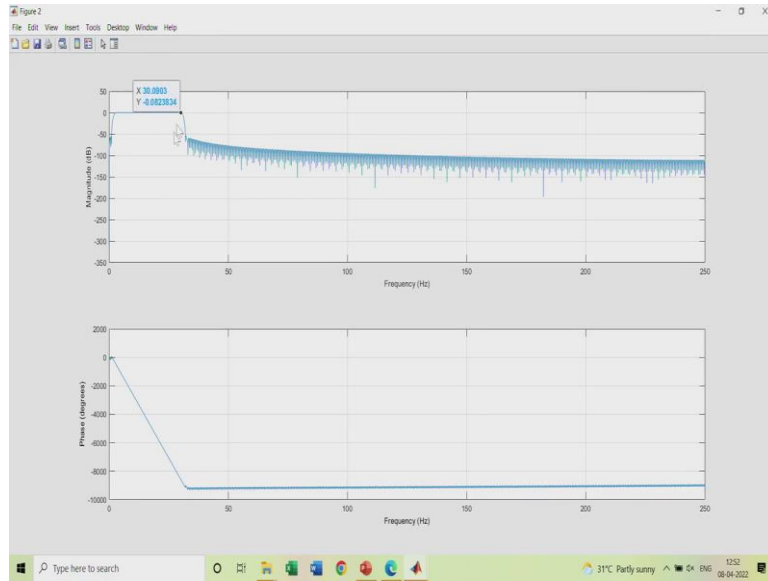
Beyond 2 it is not allowing it is a negative decibel value. So, magnitude will differ in the tense, drastically change. It will allow this frequency which is there in this pass band, and it will not allow all the other frequencies.

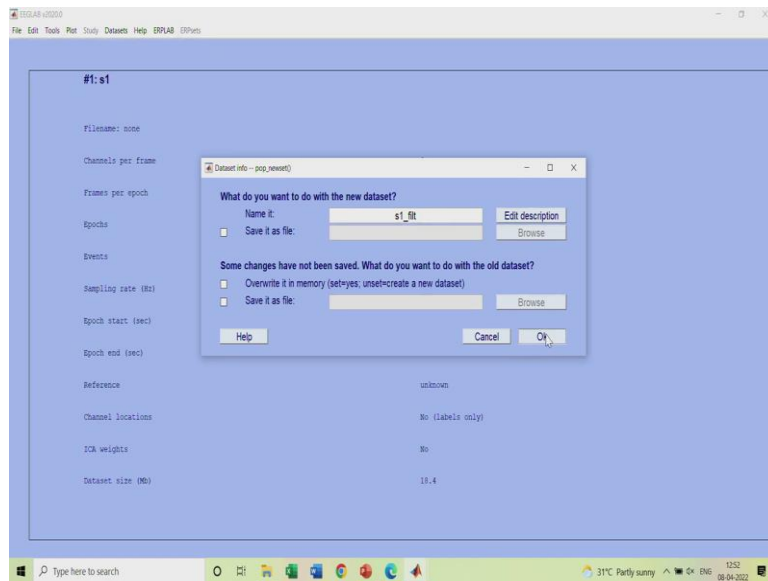This all the ripples you can think you to remove if you want you can select a different form of filter and all.

But for us to for this particular application this thing looks fine. Also, you can see how the phase changes.
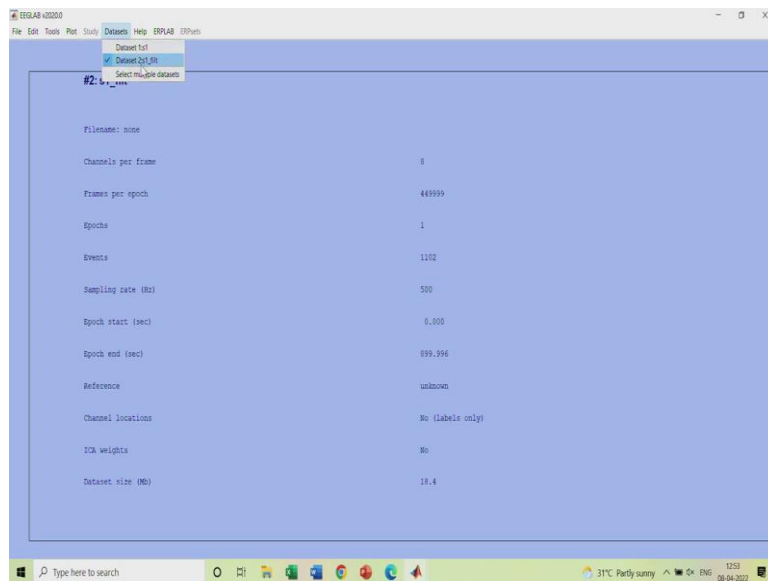
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If you want, you can use a minimum phase filter as well. So, now, my data set will change. Earlier it was a raw data set now it is a filter data set. So, I will just write here filt. And then I have hit ok, now observe this 1 hashtag 1 s1this this is just a first data set. As soon as I give ok there, it will be updated.
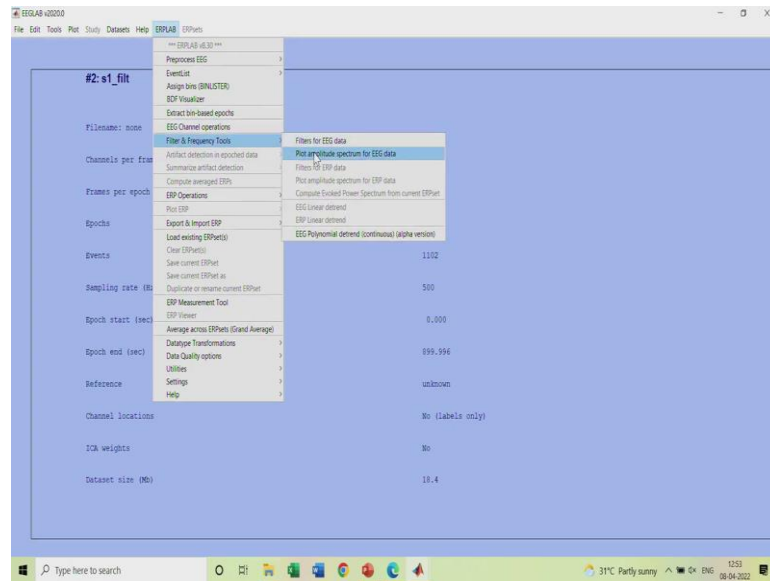
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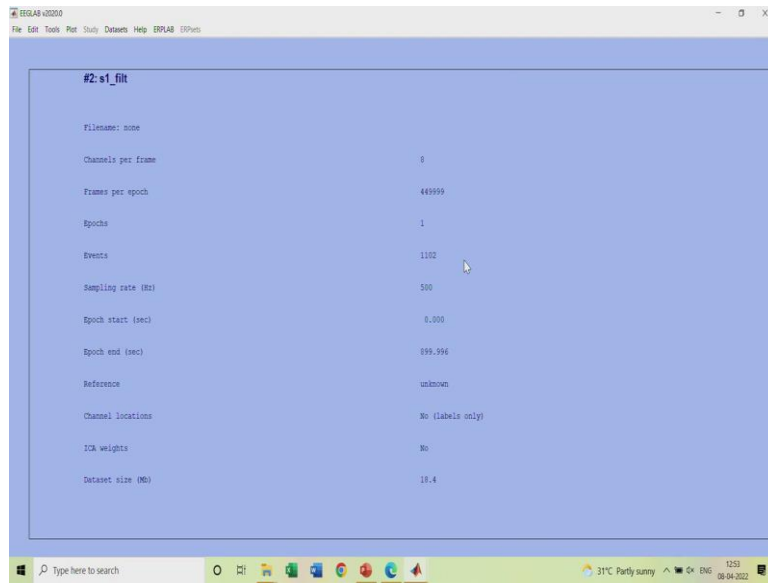
So, now you have second data set which is already filtered.
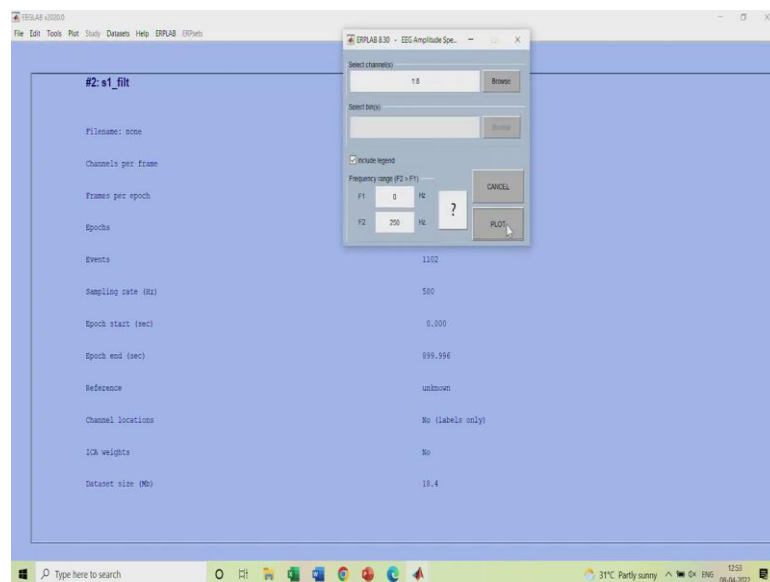
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You can observe all the data sets here, which will see at the last as well, but this is what your filtered data set now.
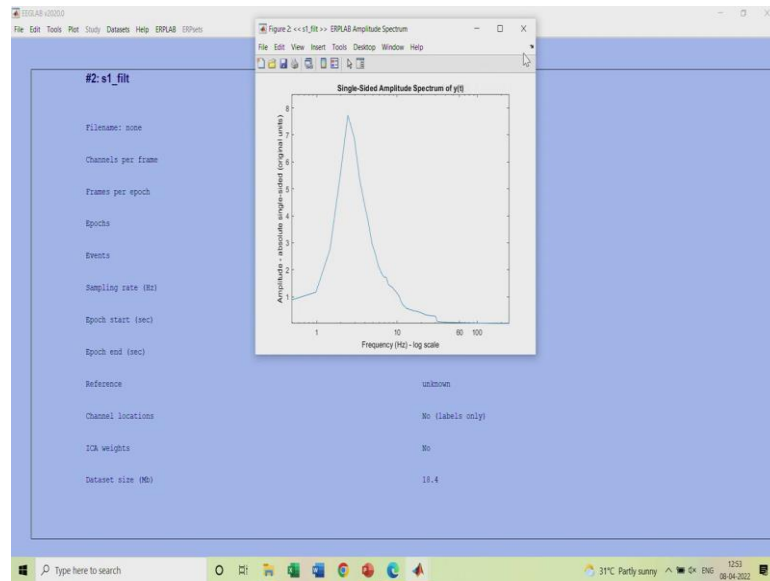
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How to check that whether the data set has changed or not? Again, you go to and check the amplitude spectrum.

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For all eight channels you check the amplitude spectrum.

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And you can see now some mountain kind of shape is there, whatever the DC offset of 70 magnitude or something has been removed and which should be removed because you want to have an idea about what exactly is happening underlying the brain and which is like underlying the skull which is 3 to 30 years or something. So, you are getting this kind of amplitude spectrum of your data.
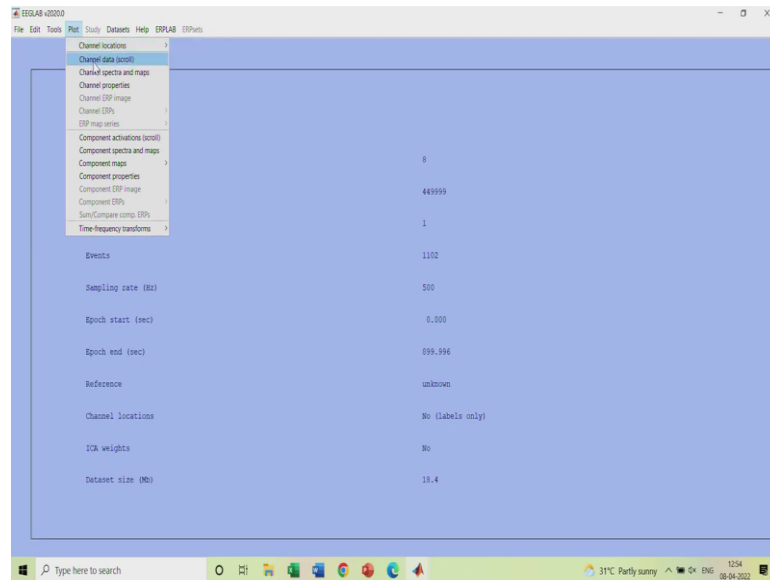
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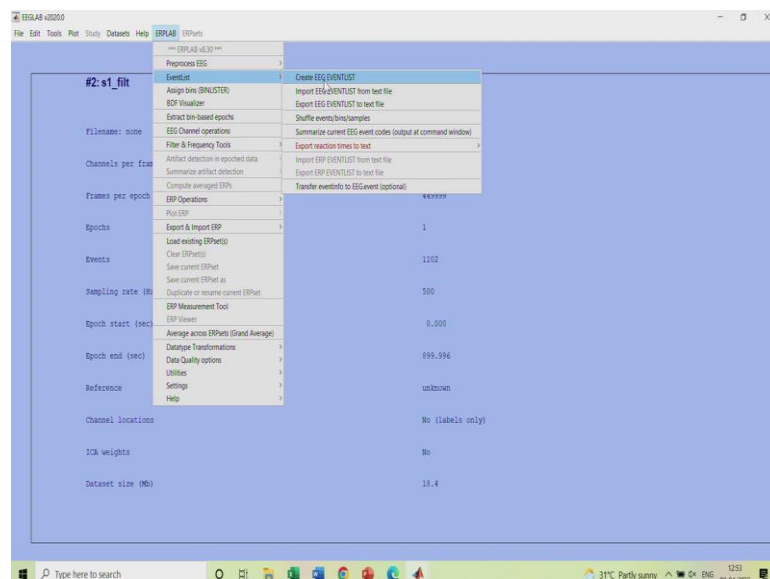
Next step is to give an information to your system about events. When particular event happened, what how many standards, how many target, how many destructor to identify
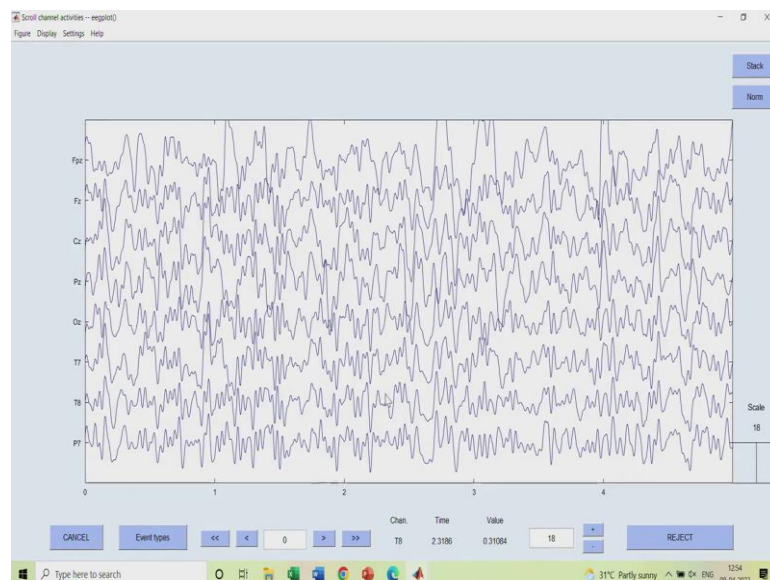
that there is something called event list. You have to create the event list to tell your computer that at this particular time this standard come, at this particular time this distractor come. How do you do that?
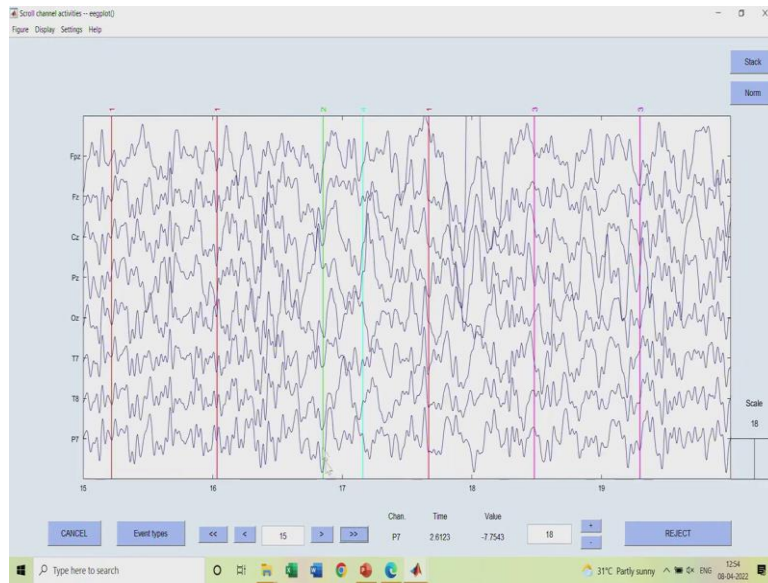
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Like if you have seen the channel data scroll now it will look much better first of all.
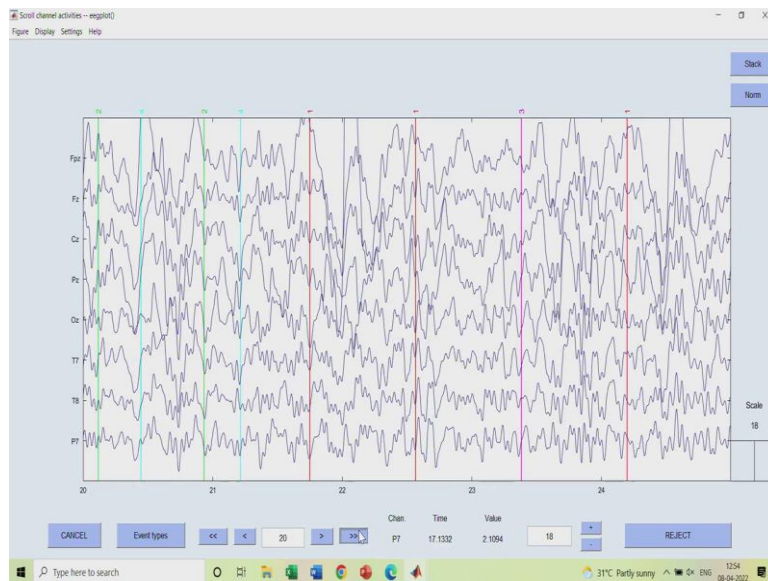
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Because we have filtered the data it will look much better than previously.
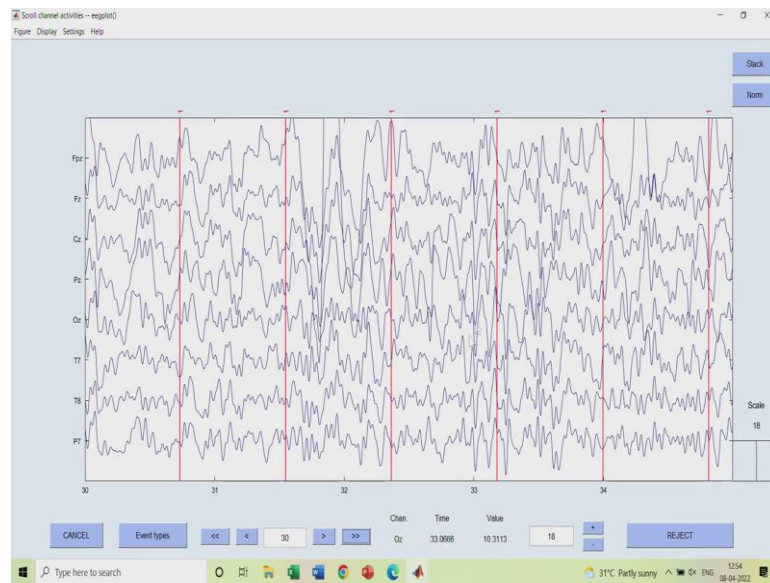
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See it looks like a clean eeg data and also triggers are there.
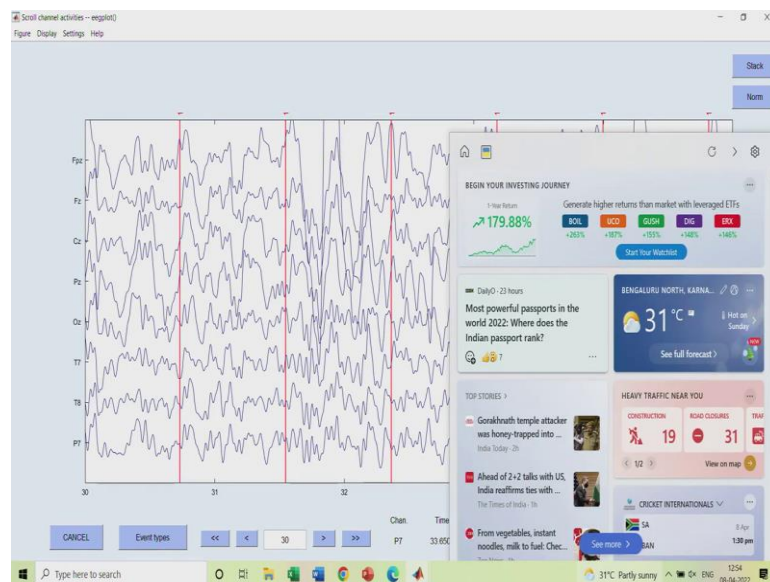
(Refer Slide Time: 14:20)
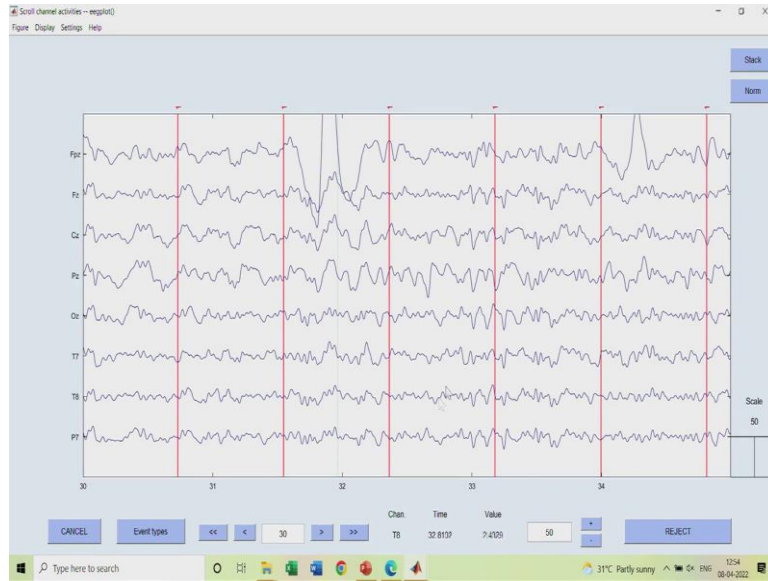
(Refer Slide Time: 14:21)

But it looks much better than what you have seen before it is not interfering to each other.
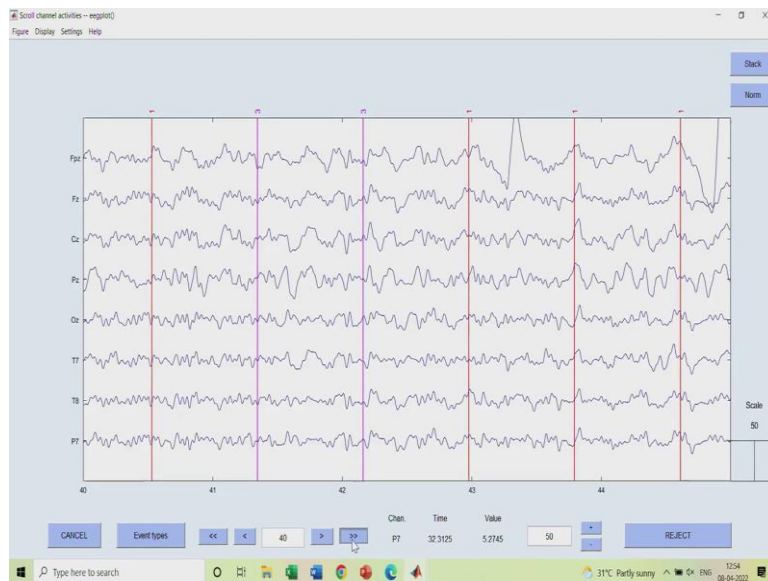
(Refer Slide Time: 14:26)

Also, you see the scale has been reduced drastically. Earlier it was some 500 or something, now it is 200 or something and now it is just 80.
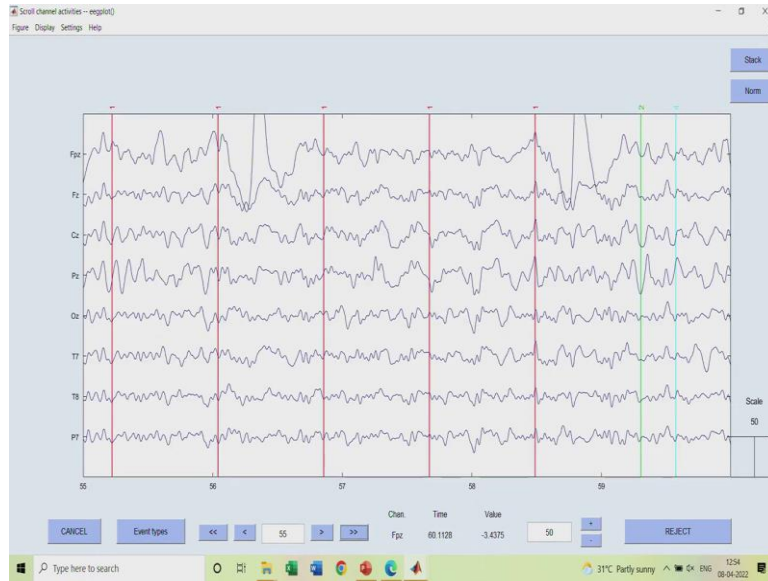
(Refer Slide Time: 14:34)

If I further go down, see you can see the clean eeg looking really good right.
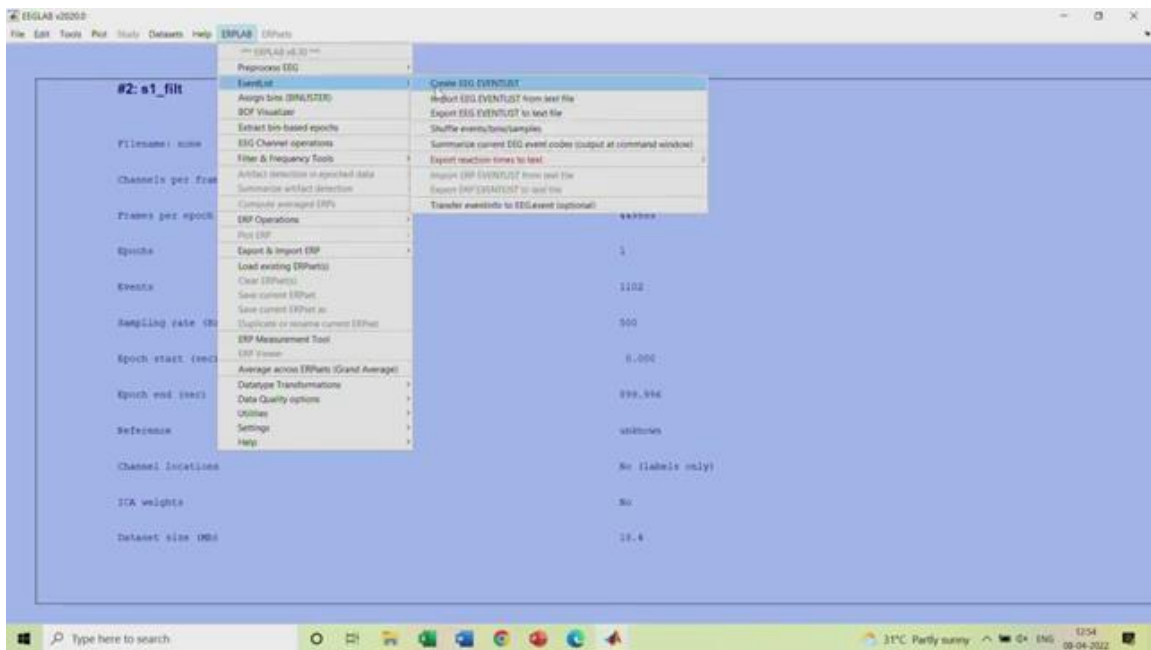
(Refer Slide Time: 14:39)

(Refer Slide Time: 14:41)

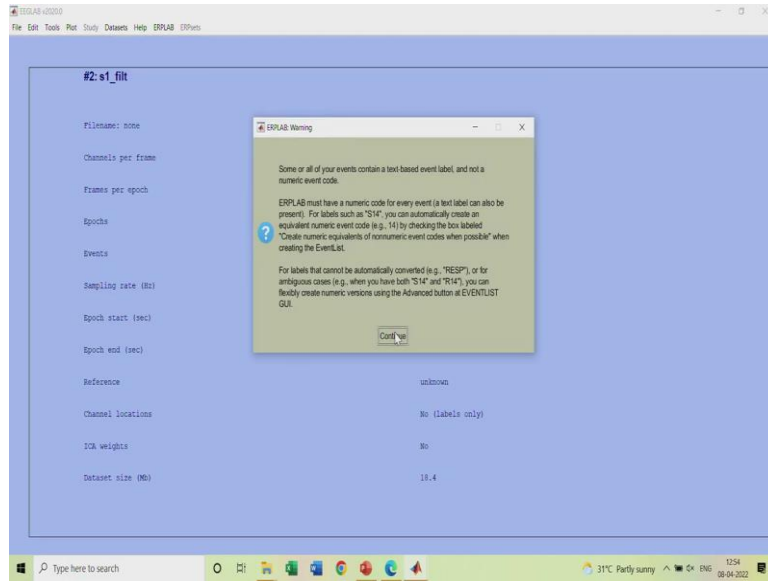So, this is the filtered data, and this is the you know advantage of filtering the data.
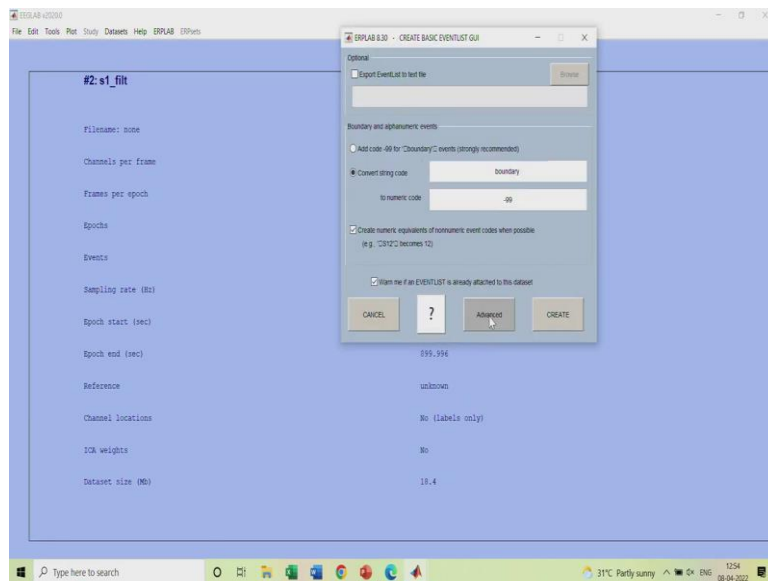
(Refer Slide Time: 14:51)

So, let us say this is a filtered data, next step is to give computer a sense about the triggers or timing information you can do it by creating event list. How will you do that?
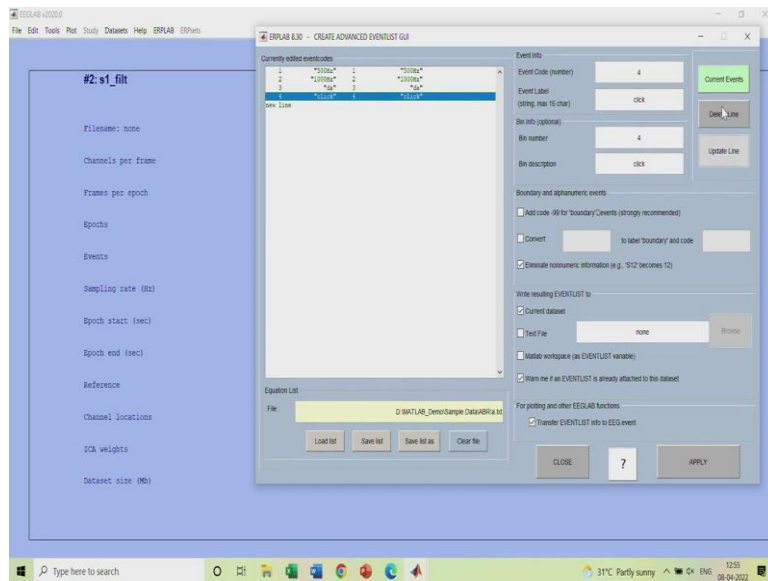
(Refer Slide Time: 14:56)

Go to create event list.

(Refer Slide Time: 14:57)

(Refer Slide Time: 15:00)

And you have to go to advance option, and you need to change this. This was some previous experiment. So, I will just remove this. You need to add your own understanding, or you need to tell.

(Refer Slide Time: 15:13)
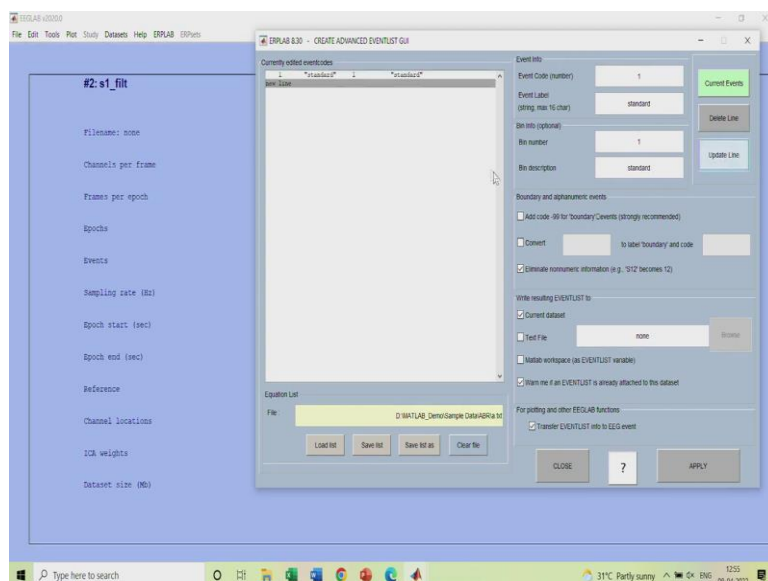
So, event code 1 stands for standard, again it will form a beam number 1, I will name it std ok or we can write standard also standard. As soon as you give all this thing you have to update that particular line.

(Refer Slide Time: 15:28)
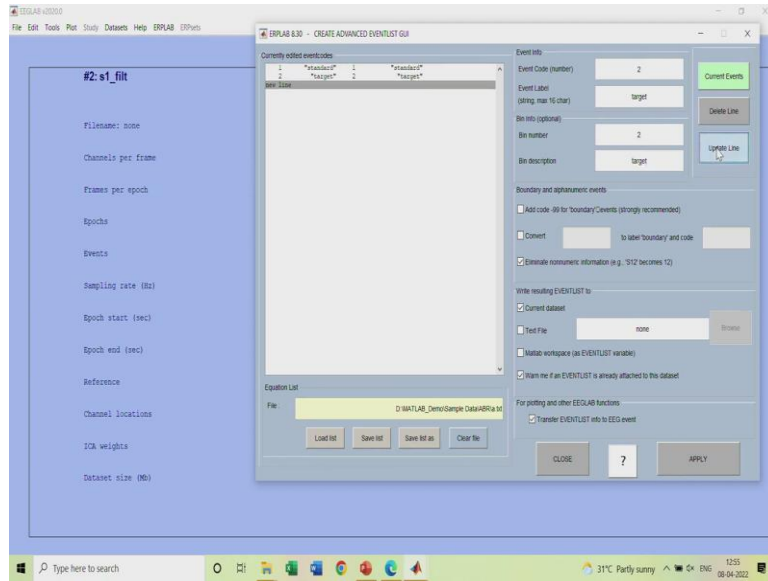
Again go 2, 2 was target we have seen in response to that subject was praising the thing, again 2 is target. Update the line.
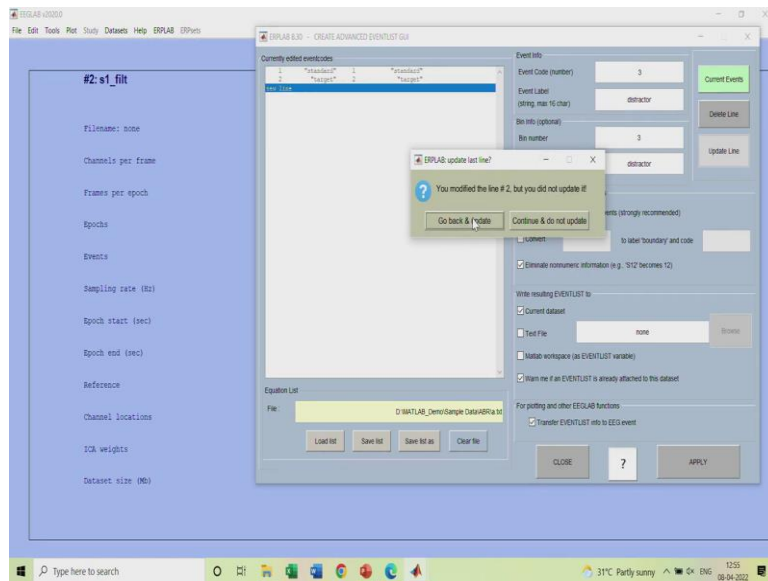
(Refer Slide Time: 15:42)
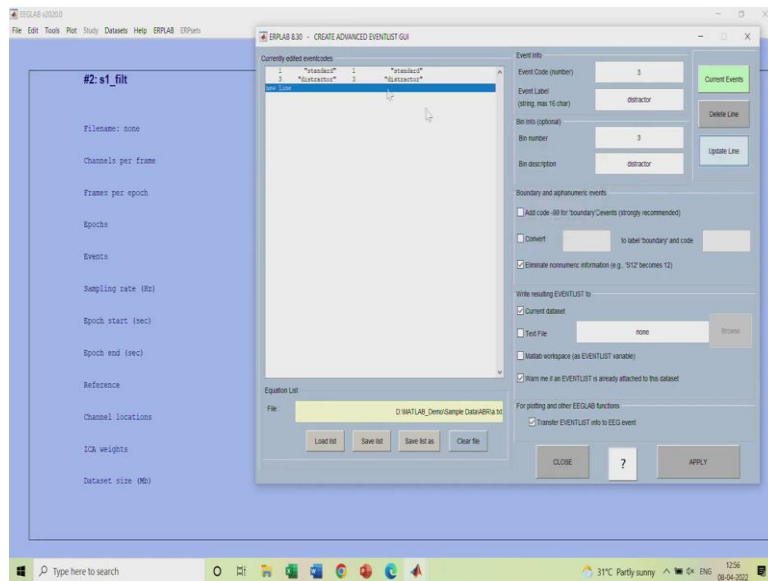
Same thing you do for distractor as well.

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Once you do that event list will be automatically created which we can further see. Now, if you forget to update the line this pop up will come that you would update it. You have written it here, but you have not update. You can go back and again update it. So, all these things have been this is I need to again update the second line because it was updated in the previous line.

(Refer Slide Time: 16:19)
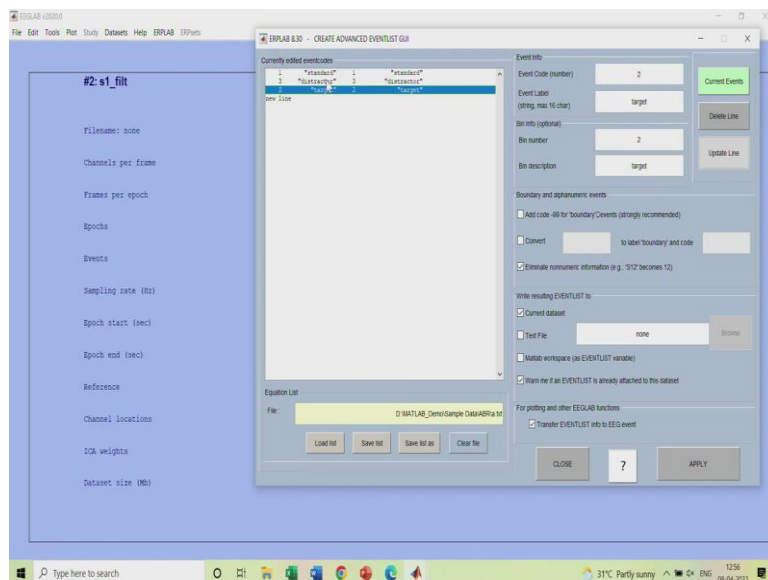
I will update it here again, 2 was target, again 2 was target and again I have to update the line. So, you can see all these three events are there. Currently I am not interested in you know response or pressing the button.

(Refer Slide Time: 16:38)
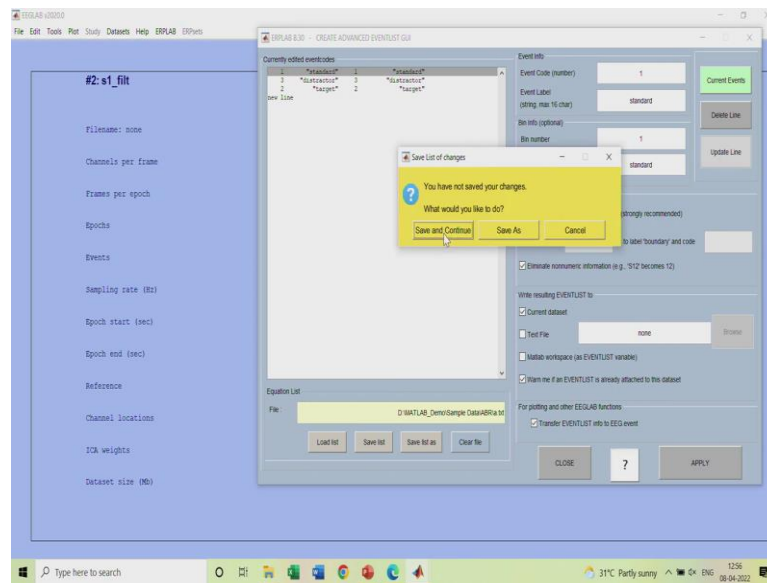
So, I will just apply this to event list, it will say and then it will ask to quote the labels whatever has given.

(Refer Slide Time: 16:42)
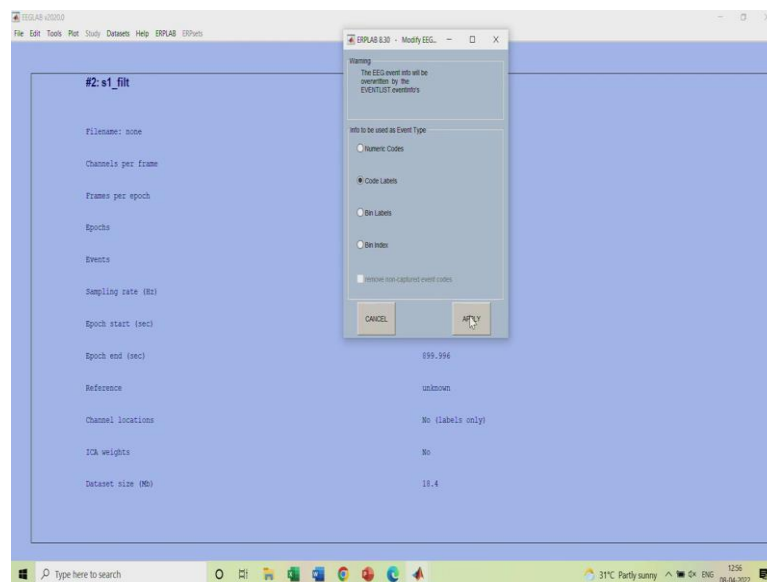
So, these labels have been generated through the system 1, 2, 3, 4 what you have seen in the when we were scrolling through the data.

(Refer Slide Time: 16:51)
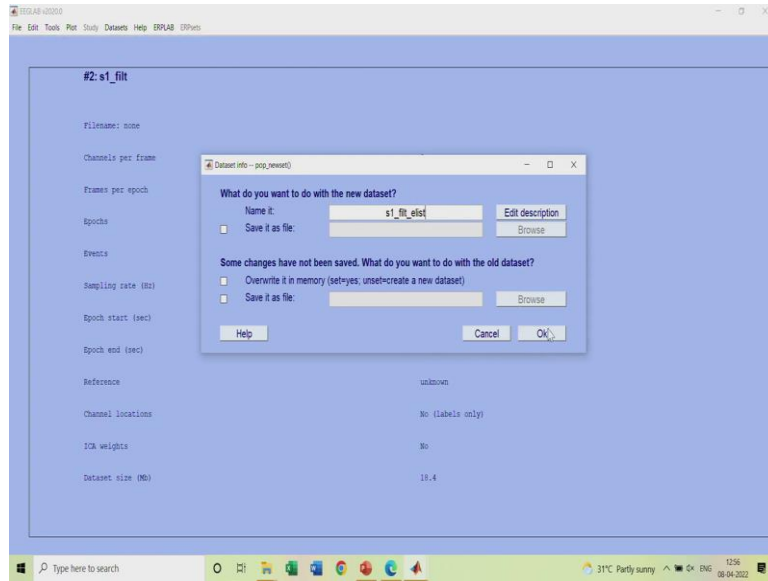
So, it will again it will ask to change the name. So, you just append elist to that. So, it will create one more data set.

(Refer Slide Time: 16:58)
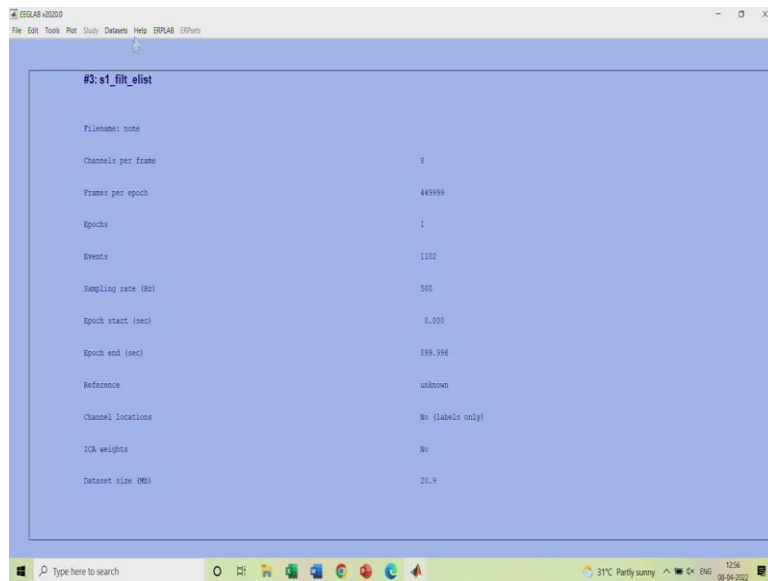
So, this 2 has been shifted to 3. First, we tick the data filtered it and generated elist. How that elist is generated? What is there in elist?

(Refer Slide Time: 17:07)
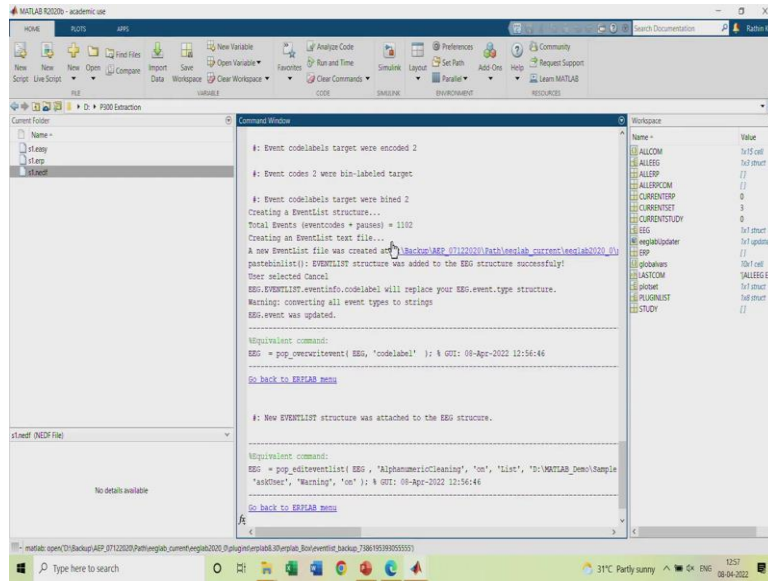
You can go to here command window and here you can see a new event list was created at this particular place. Go there, open that particular file click on that. It will show you the generated event list yeah.

(Refer Slide Time: 17:22)
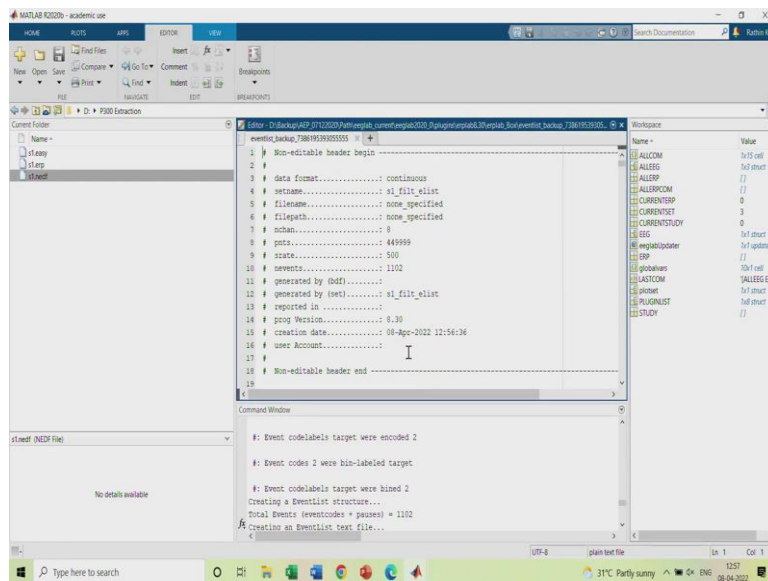
So, you can see that when it is generated, using which version of ERP program it is generated?

(Refer Slide Time: 17:29)

Also, you can see there are 800 standards, 100 targets, 100 distractors.

(Refer Slide Time: 17:35)
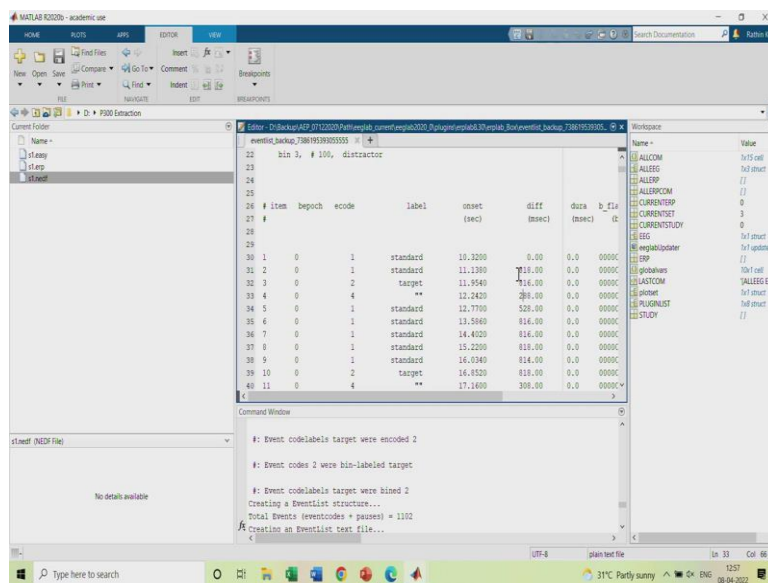
Now, when it is generated? What particular time? What is the difference between two particular events? All this thing you can check here. Now, generally 800 was given now it is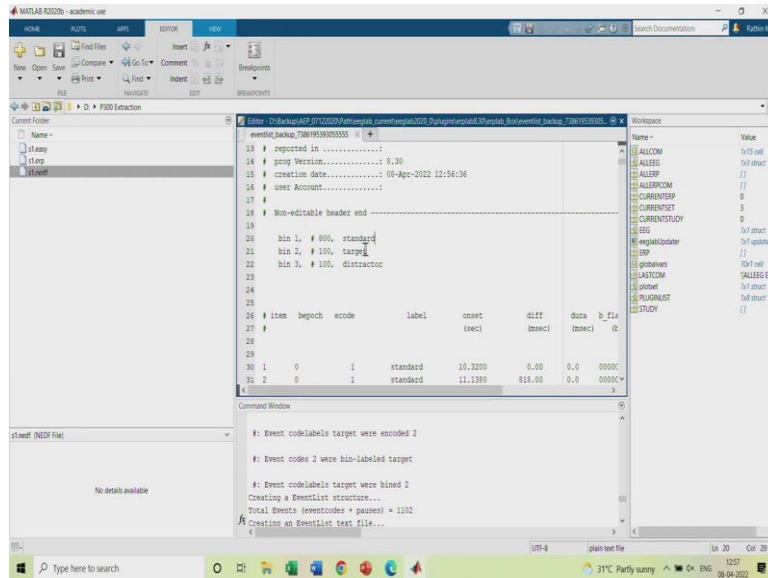 slightly more 18. So, difference is 18 millisecond 1 8 millisecond is jitter. Here it is 288 because it is we have not given the name, but it is fourth number event code is 4 which is a click of the mouse that is why it is less.

(Refer Slide Time: 17:57)
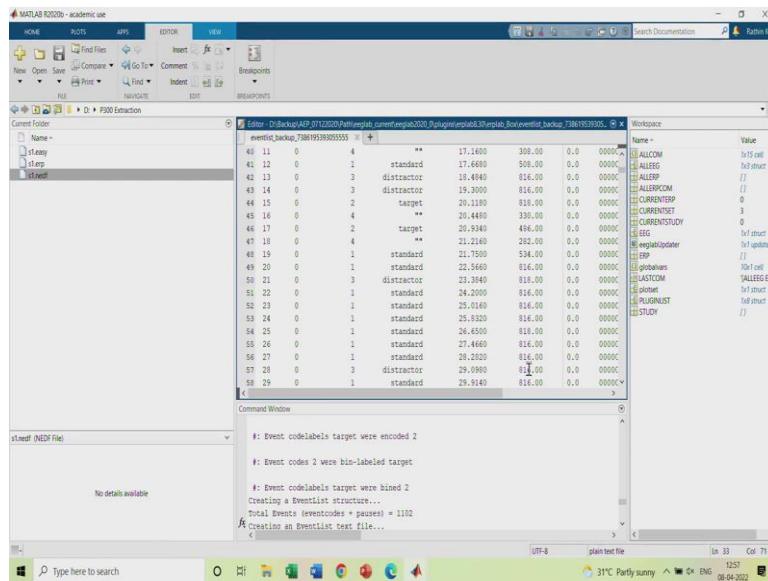
Otherwise generally it is around 816, 888, 816.

(Refer Slide Time: 17:59)
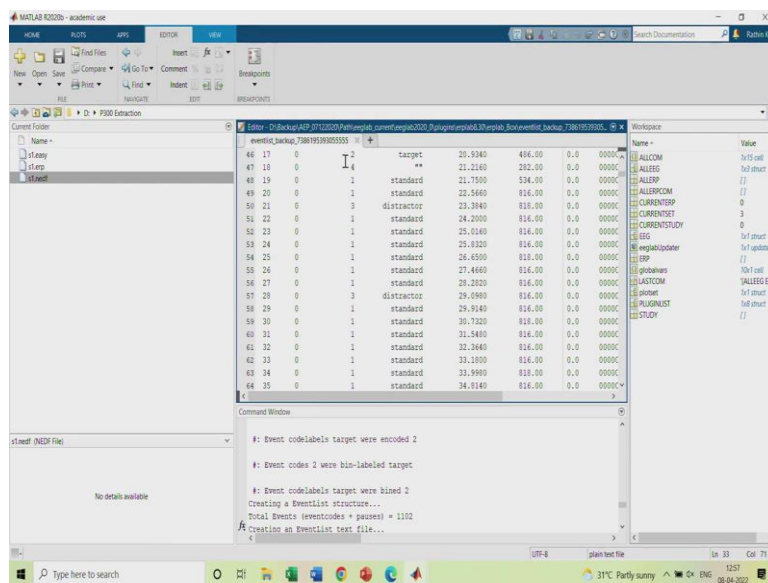
Some delay will come in order to give the trigger, but that can be compensated later. So, this is elist has already been generated and you can see that total 1102 events are there out of which our interest is only for this 1000 event. 102 keypress we are not considering much, but here if you can see this is the elist.

(Refer Slide Time: 18:28)
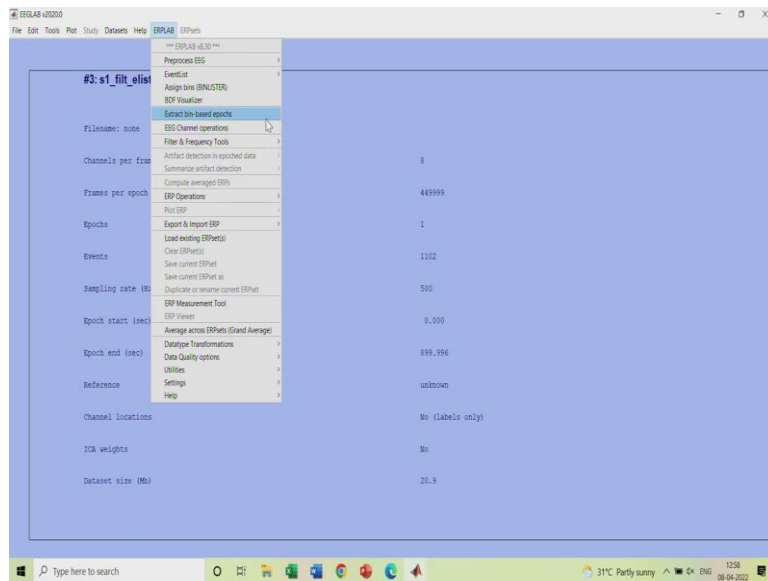
Next step is to generate the bin-based epoch based on this elist.

(Refer Slide Time: 18:32)
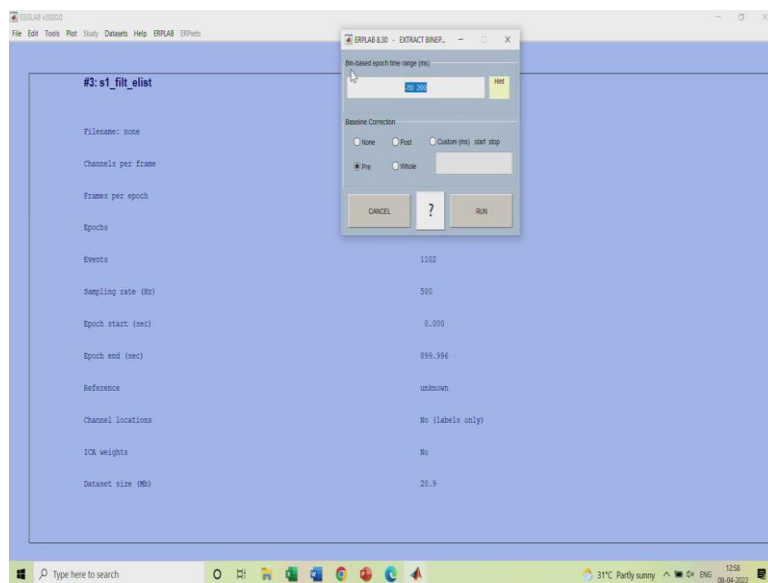
So, I will generate the binbased epoch. Here the important thing is when a particular event happens how much amount of time before that you want to consider because there is something called baseline. I will show it to you in graph itself.

(Refer Slide Time: 18:47)
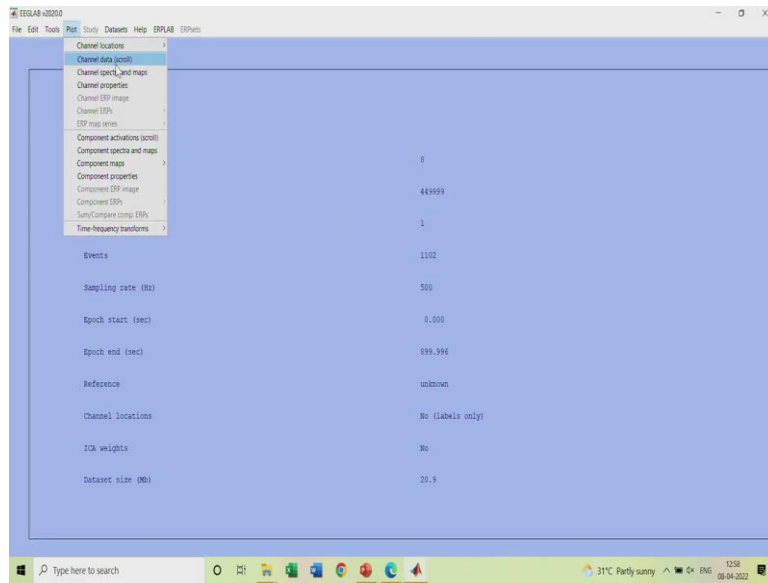
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So, if you can see here channel data scroll, another change which has happened is.

(Refer Slide Time: 18:54)
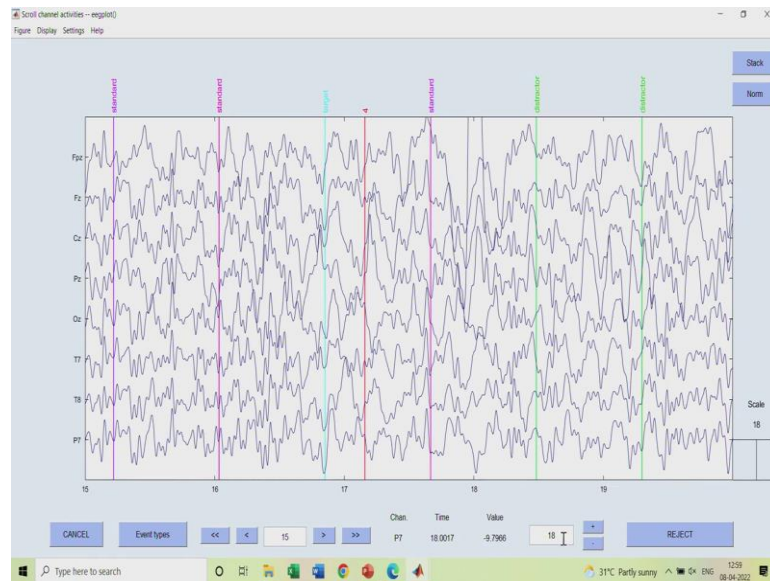
You can see now the name of the particular event has started coming. Standard, target the fourth number we have not given is the response.

(Refer Slide Time: 19:09)
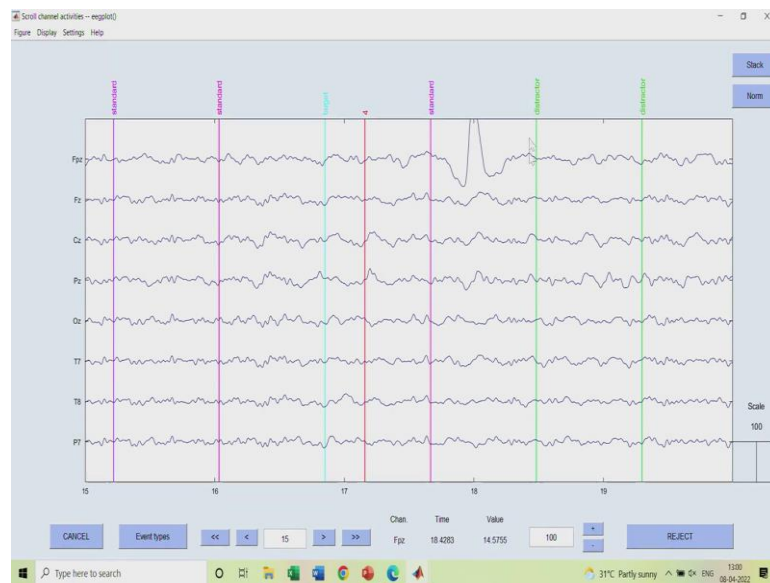
So, for me to record or you know make the sense out of it, it is important that I will consider not only after onset that is called post stimulus data, but pre stimulus as well, that before you have given thi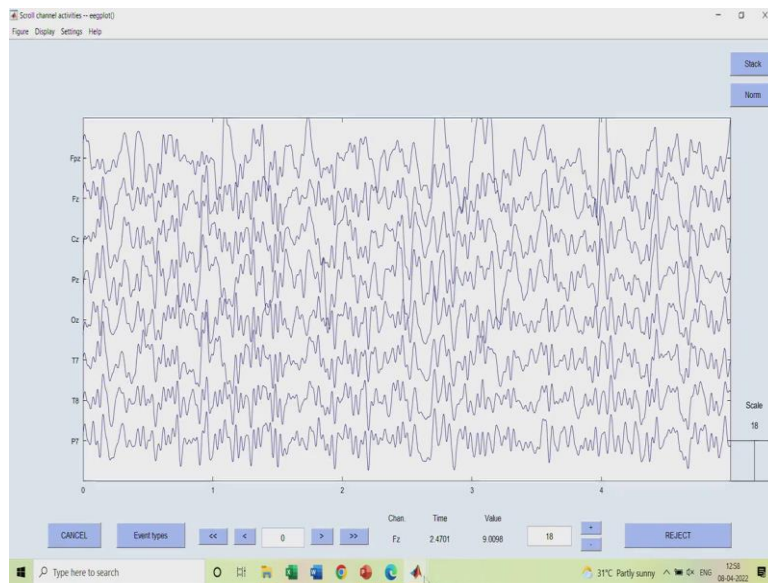s particular sound what was the trend? So, what I will do is exactly before this I will take some amount of data and then after. So, that will give me an idea that how much change this particular event has posed when this particular event happened. So, pre stimulus some time and post stimulus at the time of your interest we need to consider. Now this ITI is 800 milliseconds.

So, post stimulus we should take anything which is less than 800 milliseconds, it is like a common sense and pre stimulus we need to take some data. Generally, thumb rule is if you are taking 500 millisecond this time this side post stimulus take 10 percent of that pre stimulus. So, -50 to 500 or -100 also depends on how you know your baseline. And this all are like as I mentioned your frequency for filters you can take 1 5 to 30 1 to 30 or 3 to 30. Similarly, your baseline you can take -50 to 500, -100 to 500 or even -50 to 700, -100 to 700.

So, it is like a problem of choices, you can only identify what is the optimal values of your parameters by doing it. So, the idea of showing all these thing is to make you people understand that what is baseline, what is called pre stimulus interval, what is called post stimulus thing and why baseline is important?

(Refer Slide Time: 20:46)
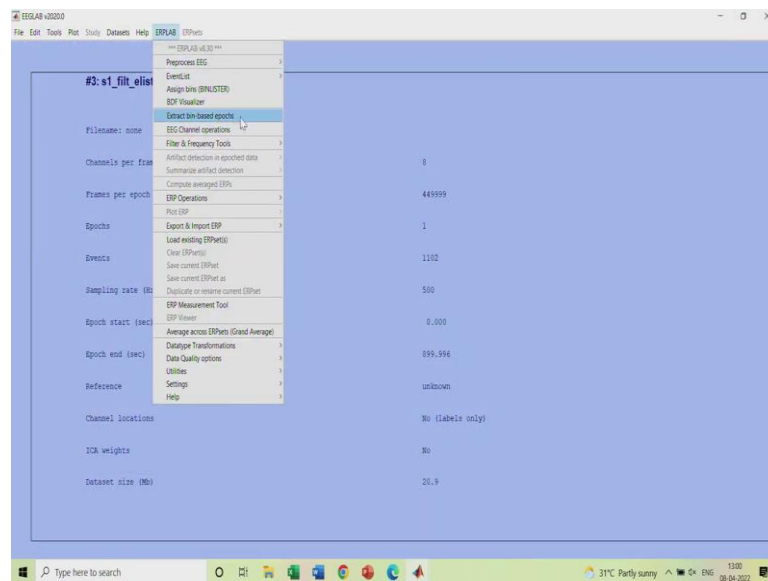
So, now and all this thing matters when you are generating bin-based epoch.
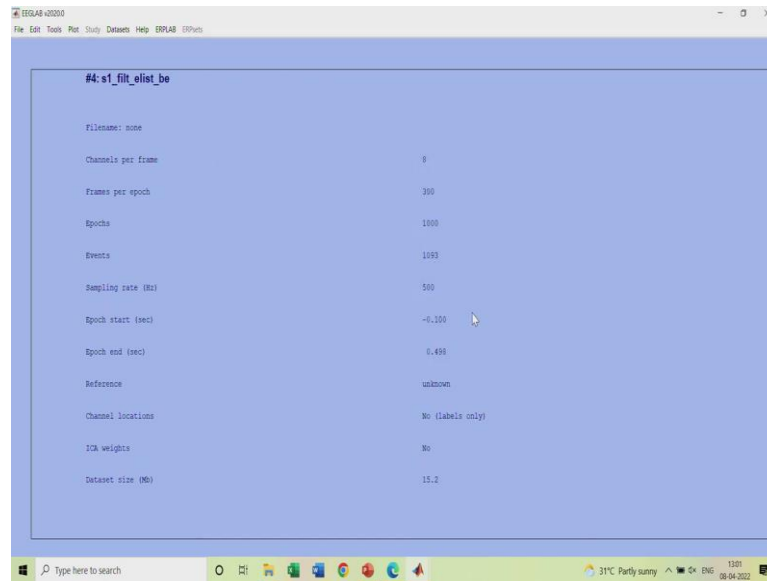
(Refer Slide Time: 20:48)
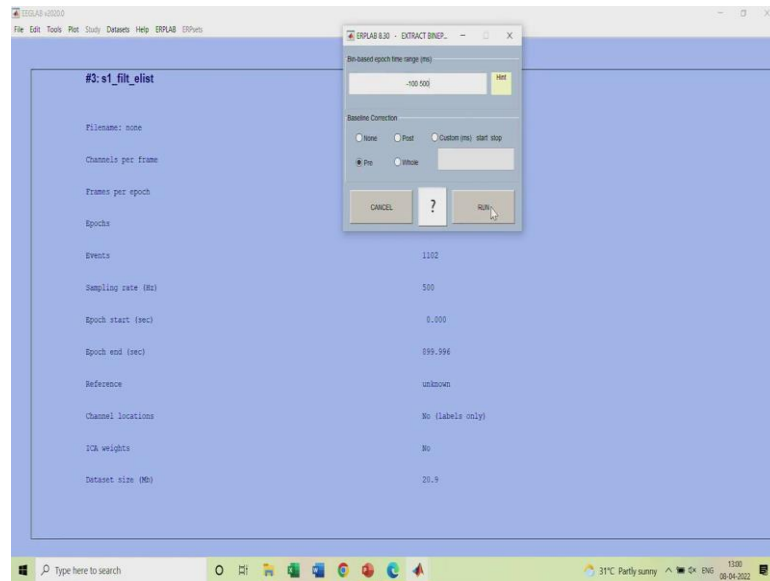
So, now you will generate a binbased epoch as I mentioned we will let us take -100 to 500 milliseconds. It is written already in millisecond baseline correction we are giving pre stimulus baseline correction, just run the command it will generate the bin-based epoch.
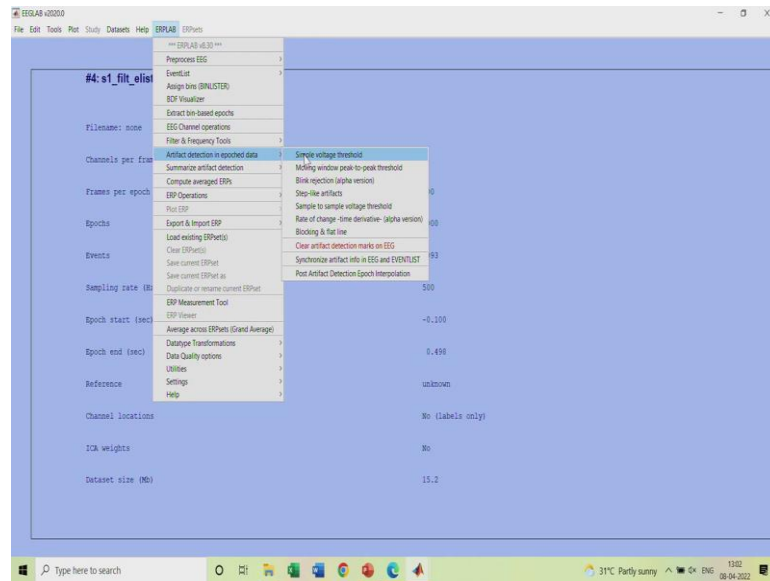
(Refer Slide Time: 21:05)
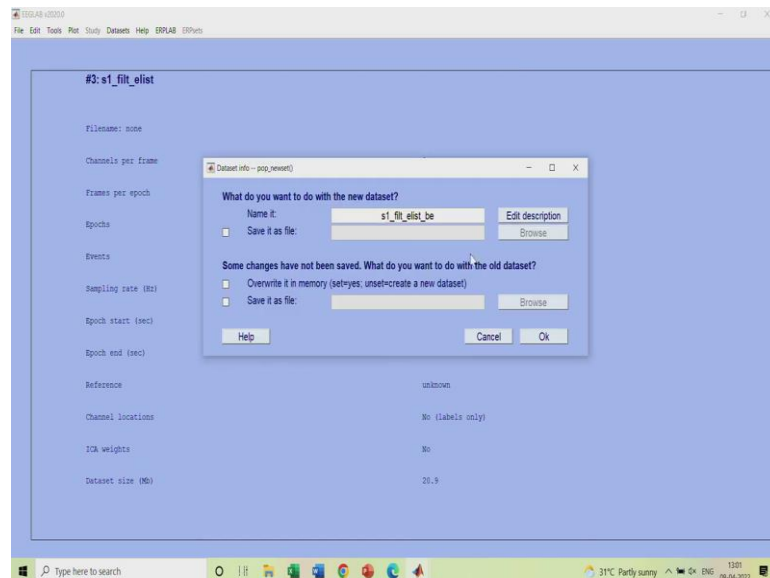
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So, now, if you see here, you can see here the thing has come is epochs 1000 because we have generated bin-based epoch. And this 1000 means 800, 100, 100 also frames per epoch. Now we have gone for -100 to 500, 600 milliseconds whereas, sampling rate is 500 hertz. So, each epoch will take 600 milliseconds. 600 millisecond is nothing but 300 samples, that is why frames per epoch comes at 300, total epochs are 1000, sampling rate is 500. Epoch starts at -100 millisecond or –0.1 second. Epochs end at 0.498 second which is around 498 milliseconds.
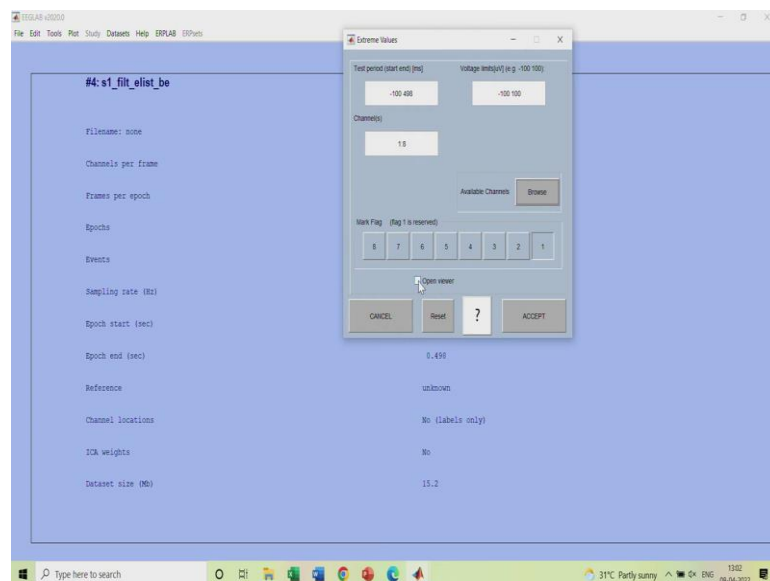
Reference we are not given that is fine because we already filled reference externally. Now this is your binbased epoch is done.
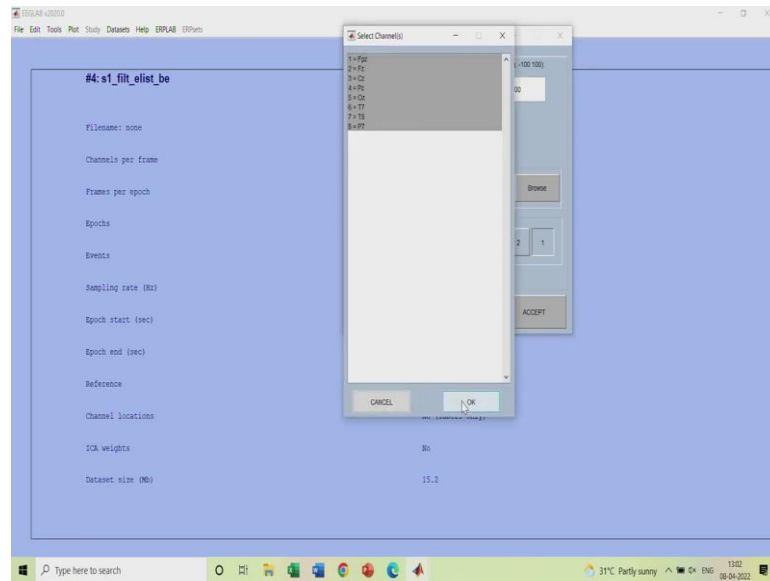
(Refer Slide Time: 22:04)

Next step is to artifact rejection.

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So, you can use a simple voltage threshold here as you can see. And here again you need to change the interval -100 to 498 in all channels you want to see and this value again. I talk about parameters about you know filters, cut off frequency, etcetera. I talk about parameters, pre stimulus interval, add one more into that voltage threshold or voltage limit. You can give -100 to plus 100. In some of their cases you can give -50 to plus 50 up to you.

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You can select all the available channels from here already selected. So, you can see here; and after your artifact rejection if you want to see the viewer that out of all the data what are the data has been removed, you can see that.
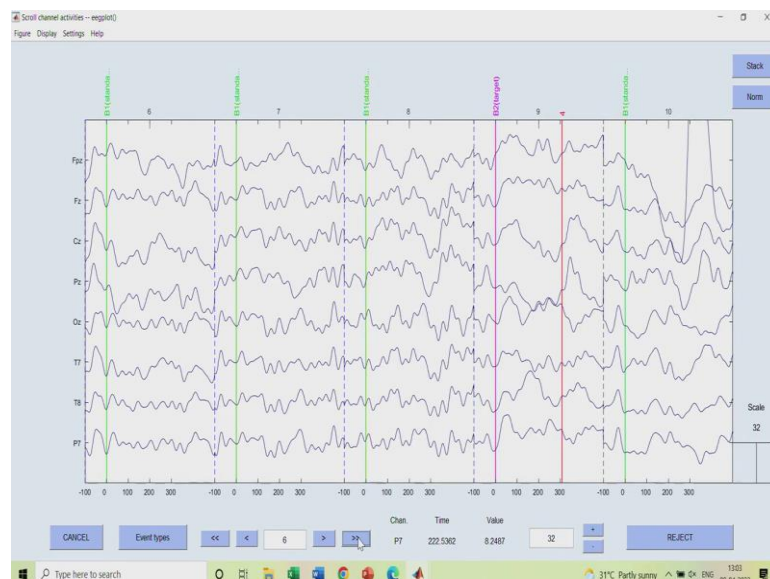
(Refer Slide Time: 22:59)
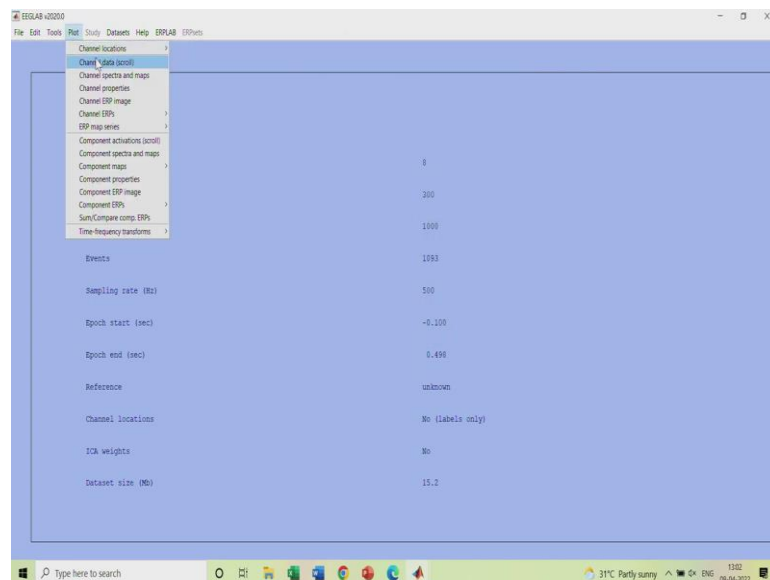
Before that, after every step it is important to see the channel data scroll what change it has enforced.

(Refer Slide Time: 23:02)
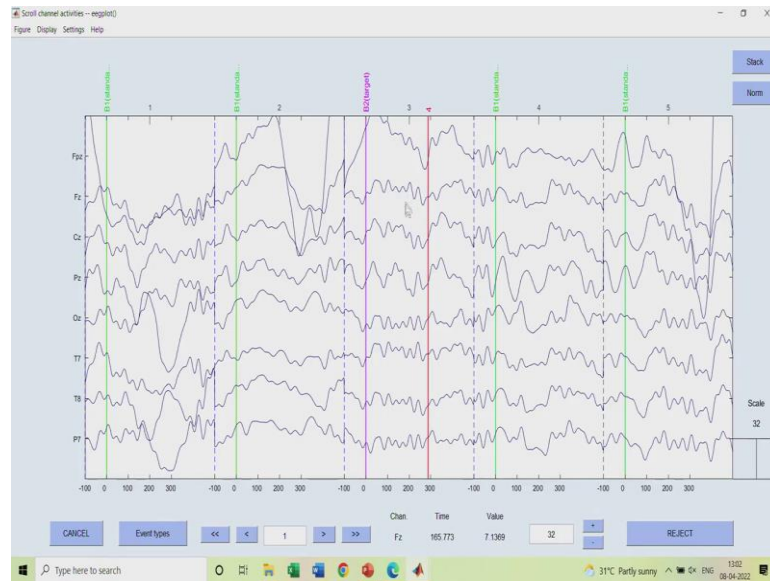
So, before that you have seen only target and all the data now bin is created also this dash line has come which we wanted. I told you we are interested in 100 milli second prior to stimulus which is happening. I told you we are interested in 500 milliseconds after the stimulus which might be somewhere here. Same thing you can see here -100 and somewhere around 500 here again -100, 500.
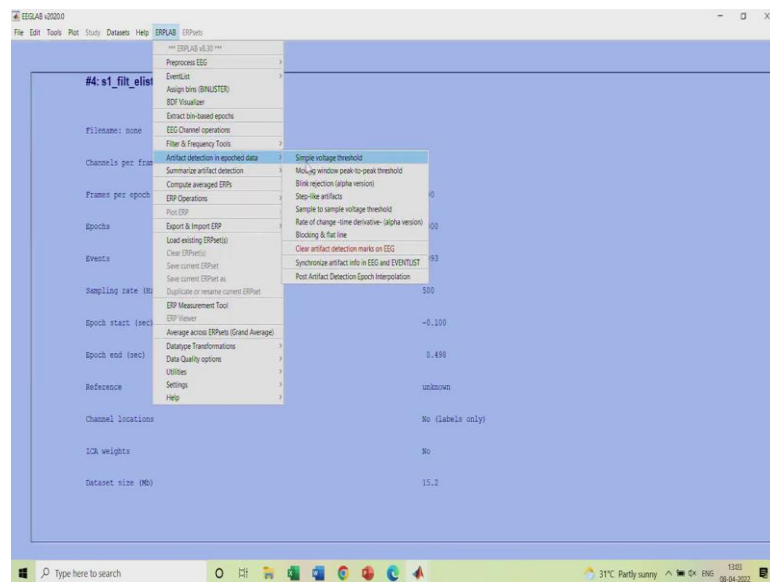
(Refer Slide Time: 23:36)

(Refer Slide Time: 23:38)
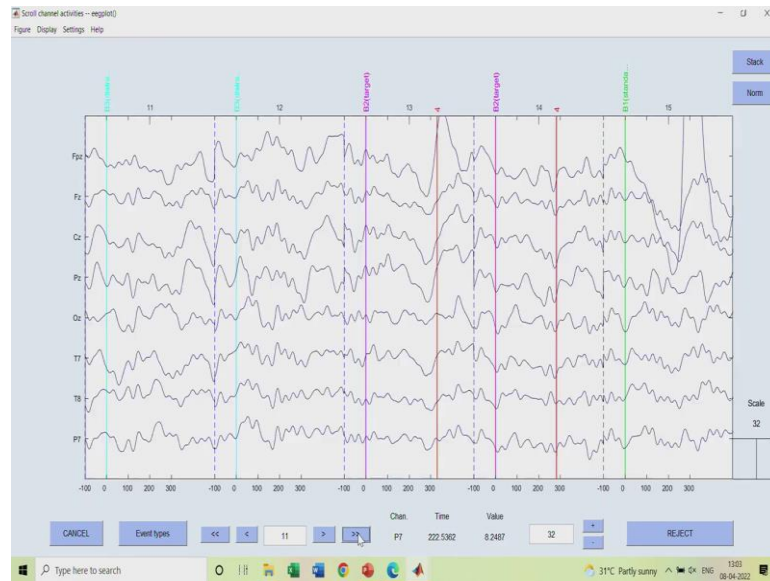
So, time axis, which was continuous and going like a 10, 15, 100, 200 has been limited now to -100 to 500 because that is the only thing which matters. So, let us see epochs are created.

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We can quickly see the artifact do the artifact rejection.

(Refer Slide Time: 23:49)
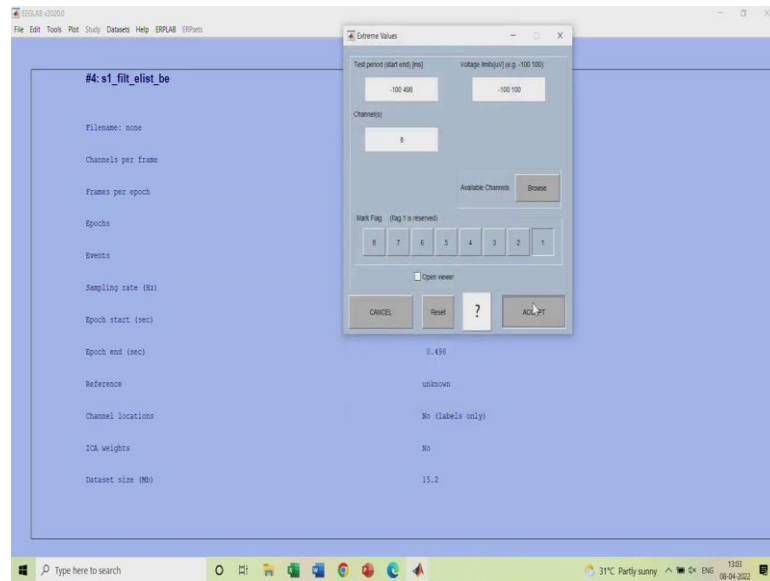
Go here, -100 to 498, -100 to 100 is fine

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That is a standard range of artifact rejection. Select all this thing and just hit the accept button.

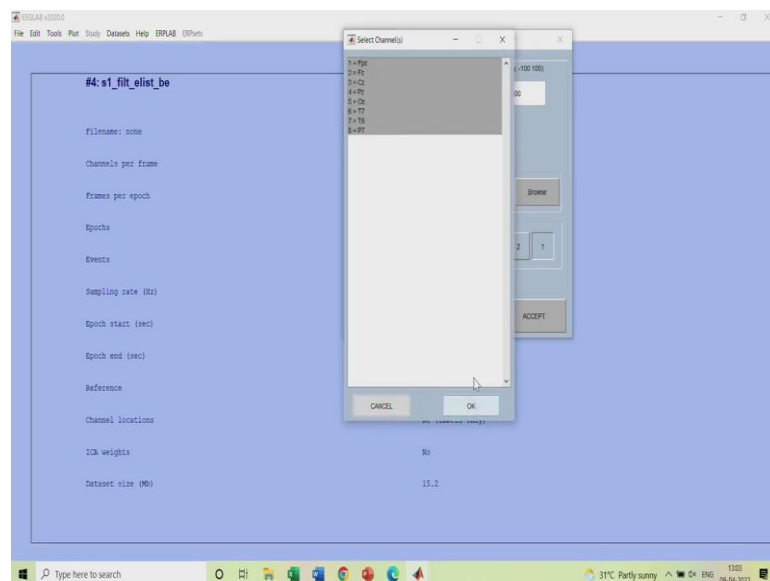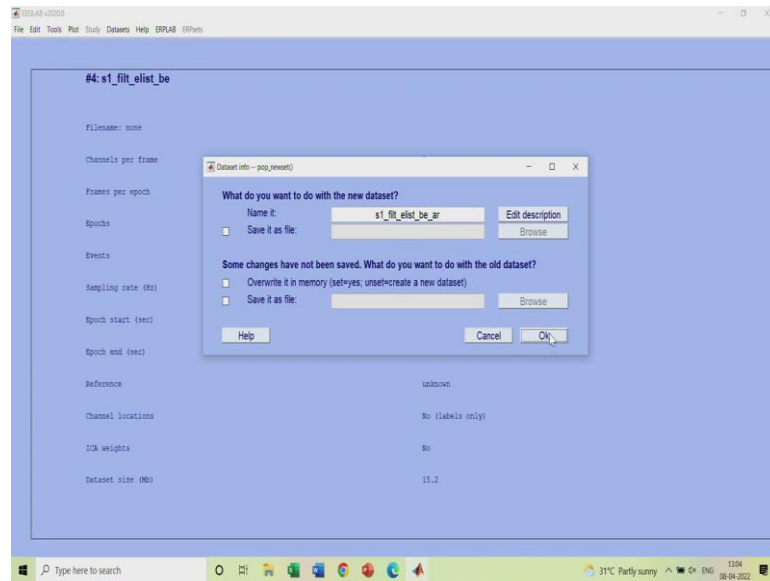(Refer Slide Time: 24:01)

So, again as I mentioned it will keep on adding all these different naming conventions. It will get suffixed because why this all is important? Because if I just read the name, I can get an idea the subject row data was taken, filtering was done, elist was created, bin based epoch generated and artifact rejection is done.

(Refer Slide Time: 24:24)
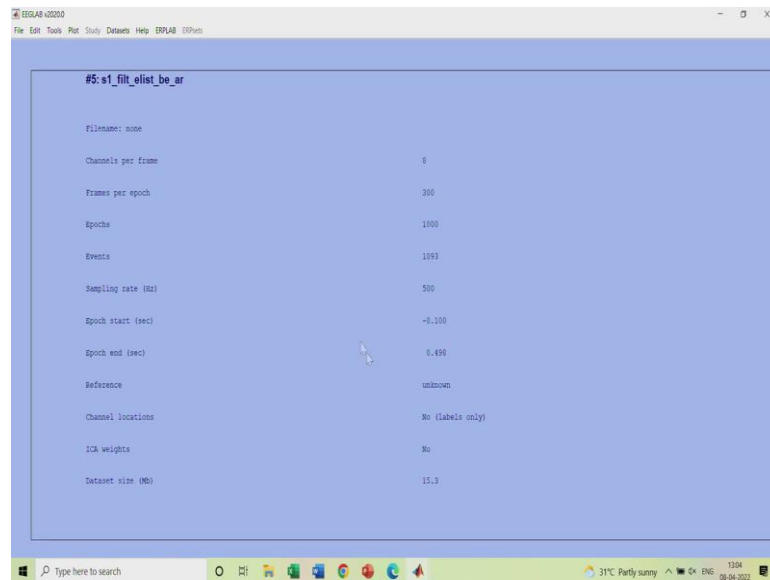
So, it is an important nomenclature and makes things much easier.

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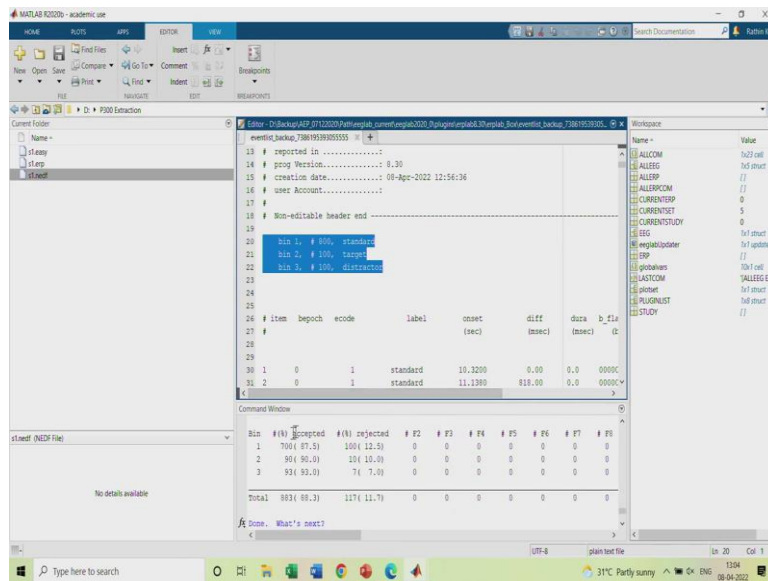
So, if you see here this should summarize your overall artifact rejection. Out of 800 standards, 700 were accepted, out of 100 targets, 90 were accepted, out of 100 distractor 93 were accepted. All over 1000 events 883 were accepted which is good enough to average it out and make the sense. So, now, we have got this artifact rejection stuff.

(Refer Slide Time: 24:57)
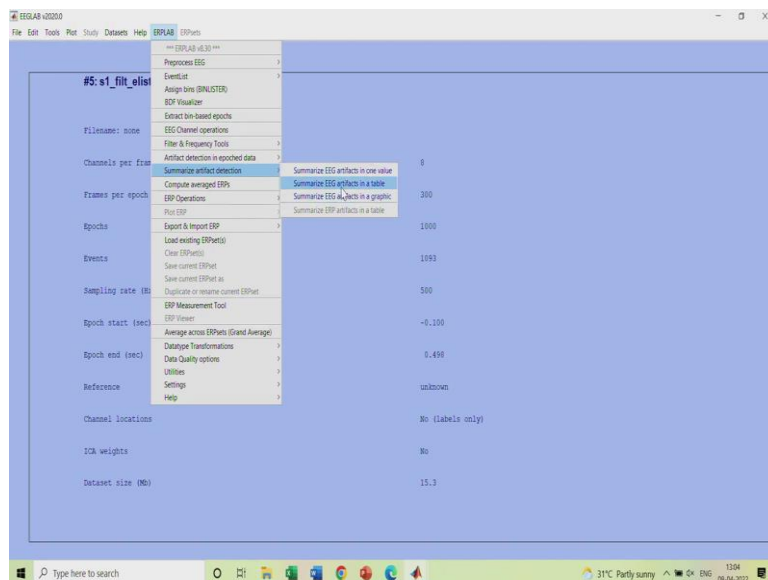
You can also see go here and summarize the artifact rejection in table, graphic. You can put it in one value also, you can see all this thing.

(Refer Slide Time: 25:09)
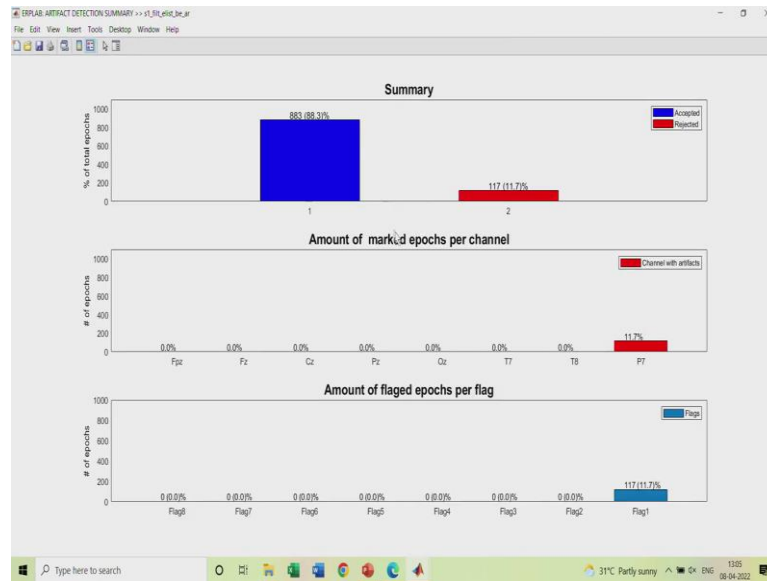
Like, I have just asked to summarize the artifact rejection in graphic. So, whatever we have seen in command window you can see in a very nice way that 883 were accepted, this were rejected. Out of all electrodes which channels was having artifact and what is the flag of that. So, all these things you can analyze and check.

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Thing is now we have got the data filtered, elist generated, bin-based epoch generated and artifact were rejected.

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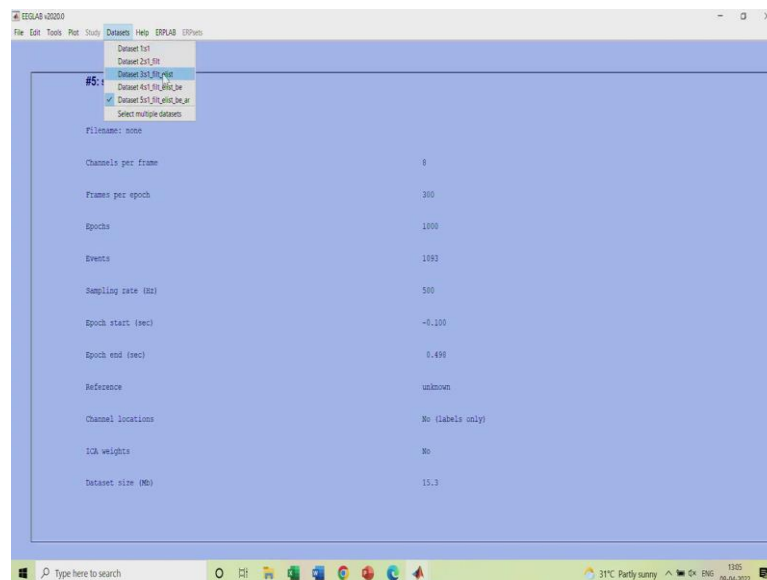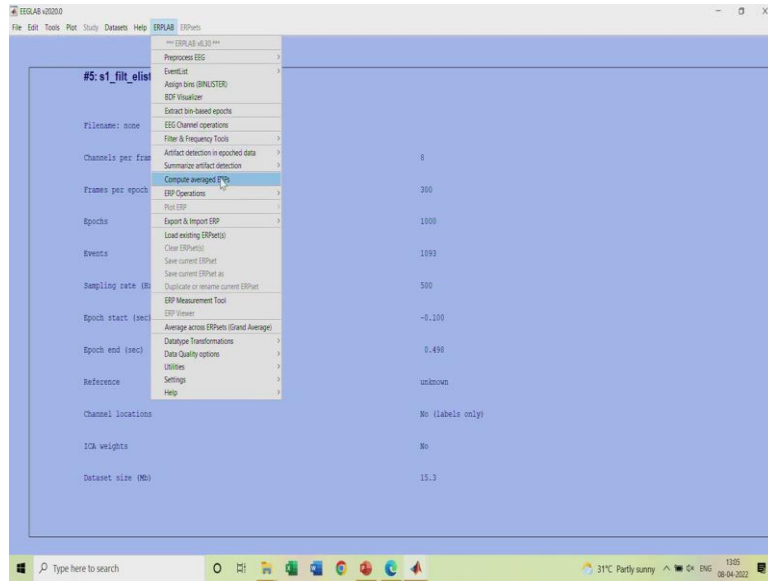So, we can we are good to go with the average. So, this step is important what it does is it converts your eeg into ERPs.

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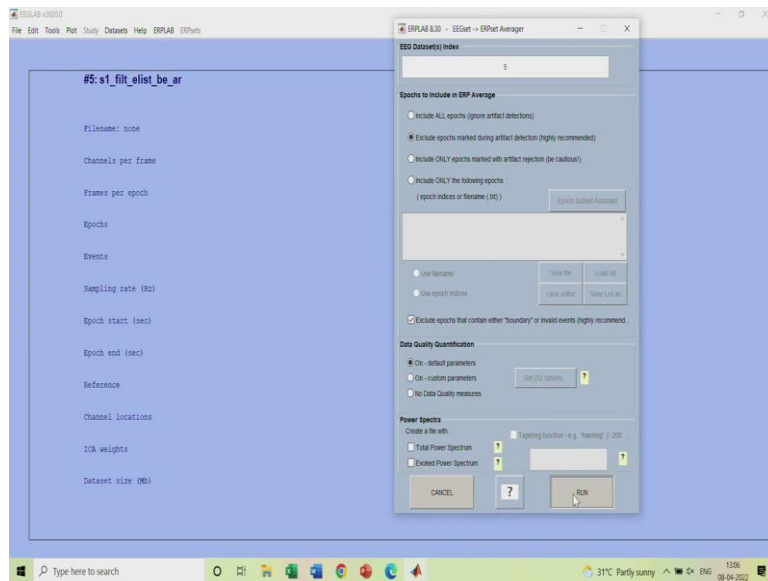Here all these options you can select that you have to include all the epochs you have to exclude the epochs which has been rejected during artifact detection. You can do both. Also, what you can do is you can select this data quality parameters. If you want, you can also generate power spectrum and evoke power spectrum. For now, I will just consider with the default option and I will just trying to generate the ERP. Also, you can see the data set number is 5.

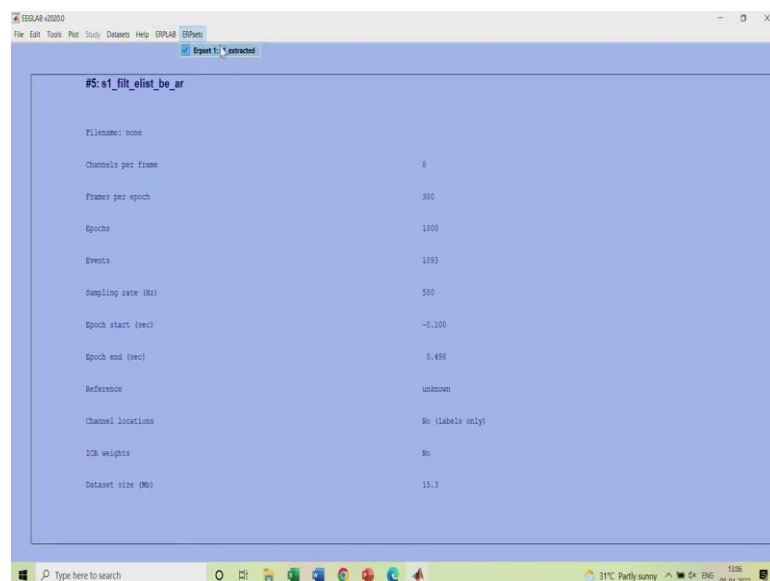There are multiple data sets 1, 2, 3, 4 but what we want to include is data set 5 which has been gone through all the set of operations which is our best fit to neural data set. So, I will just run this.

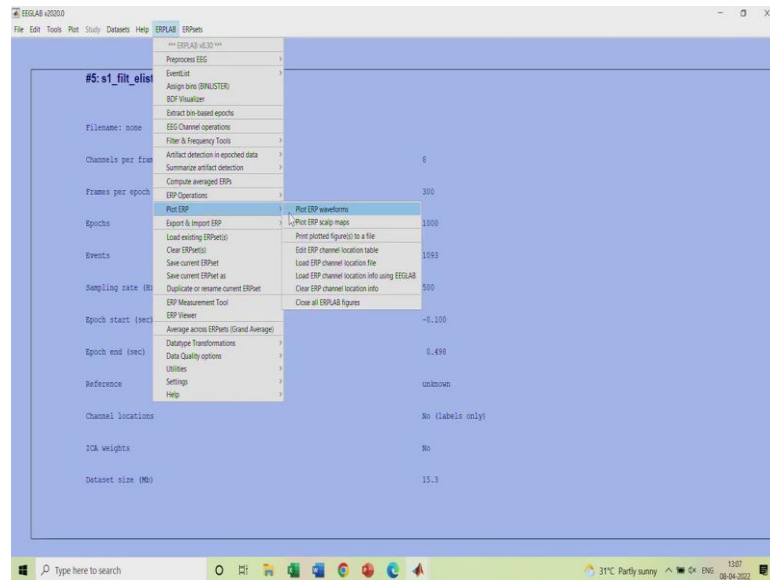(Refer Slide Time: 26:36)
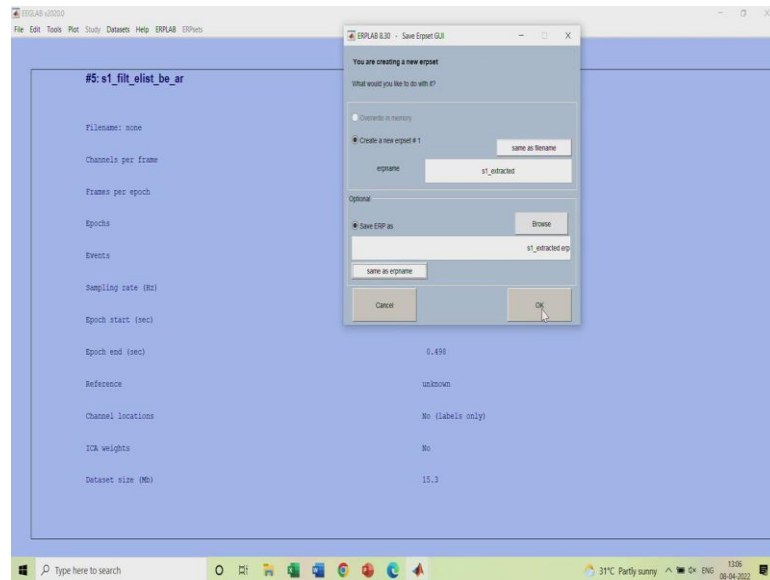
You have to name the ERP, I will just name s1 underscore extracted. So, you can save the ERP as well.
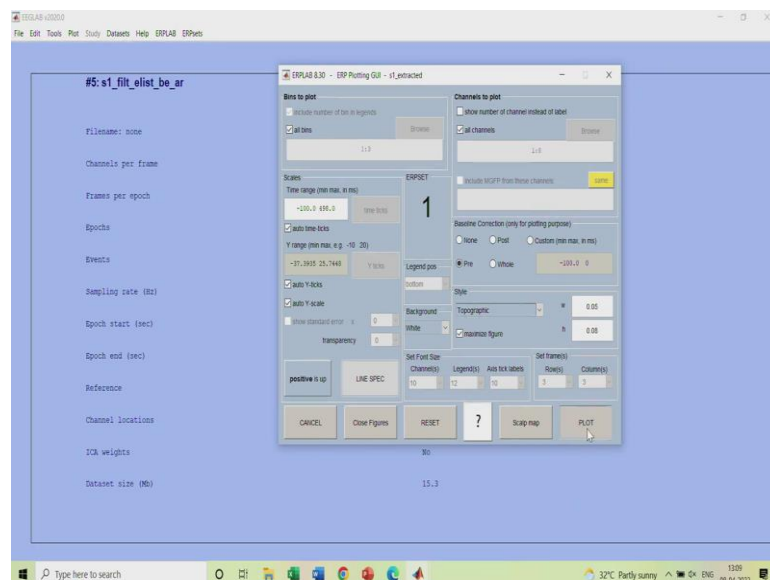
(Refer Slide Time: 26:53)

So, now, you see earlier data sets were there. Now, ERP set you can see one ERP which is generated. So, once ERP is generated next step is to analyze it and check what are the data lies there and all.

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So, you can plot the ERPs using ERP lab plot ERP function.
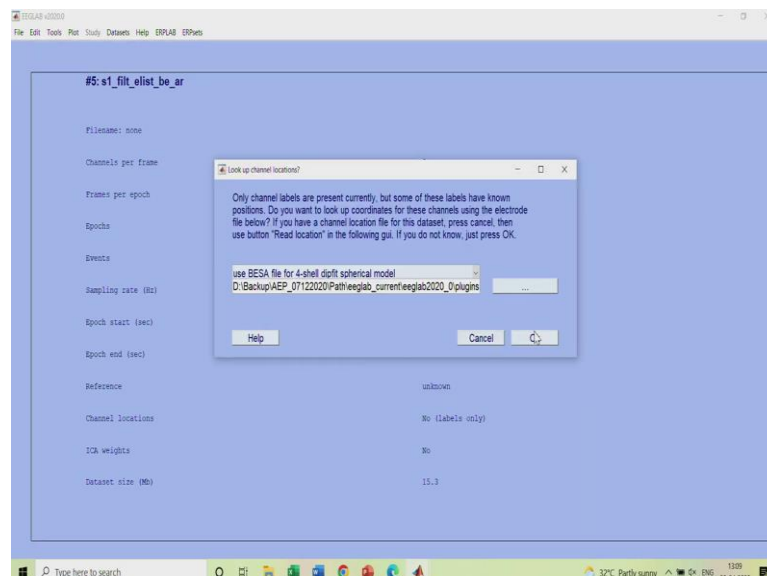
(Refer Slide Time: 27:12)

Yeah, here you can see a lot of options. And it is very easy first is there are 3 bins which we have created. It will ask what are the bins you want to plot, you want to only plot standard, you want to only plot distractor you can do that. You want a legend or not. So,

that is what this guy tells ok this particular dialog box the scales. The scales you want from minus 100 to 498. In time domain what are the range you want.

Further you can say you want a specific scale or not. Also, SEMs very important it shows the trend you are going you are doing almost 100 to 200 or even for standard 800 epochs. During each epoch it gives different response. So, what is the variability amongst the epochs? So, the trend and variabilities will be given using this option. So, what you can do is, here you can enable it, or we will enable it later I will show it to you. Some of the neurophysiologists or clinicians prefer to see the negative up when they are specifically checking for negative potential.

So, they just have to see positive like upside peak and make a sense out of it. In that time, you can go here do negative up positive up anything is fine. Also, you want to see all channels or a particular channel. Now, I have mentioned that this is a visual P 300 experiment where all the data and all the dominancy can be seen in the centro parietal occipital lobe, which is my 3, 4 and 5 channel. So, we will come to that, but first let us see all the channels also you can go here and go for a topographic view. So, it will give you a better indication of how the data looks like.
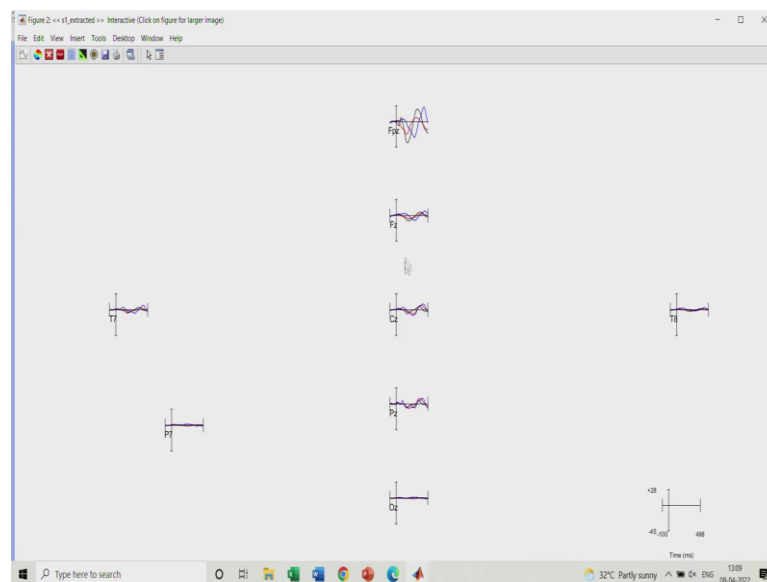
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So, let us just quickly plot it first and it will ask for channel location.
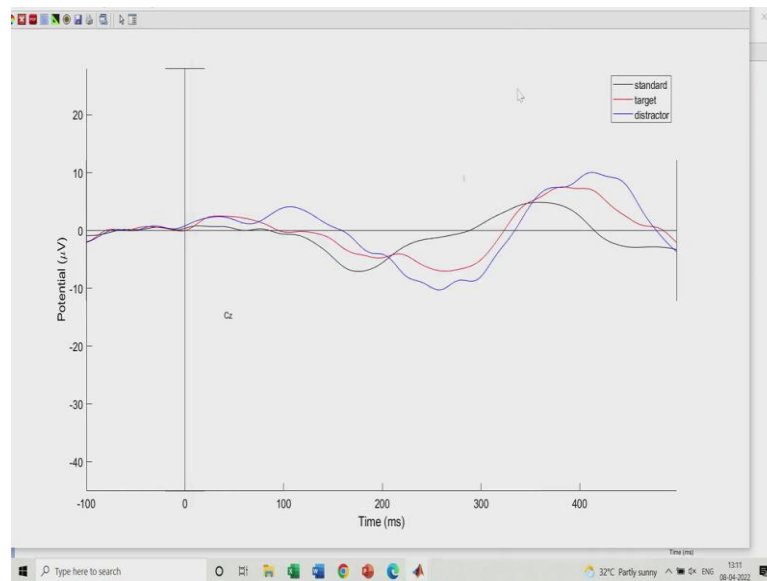
(Refer Slide Time: 29:11)
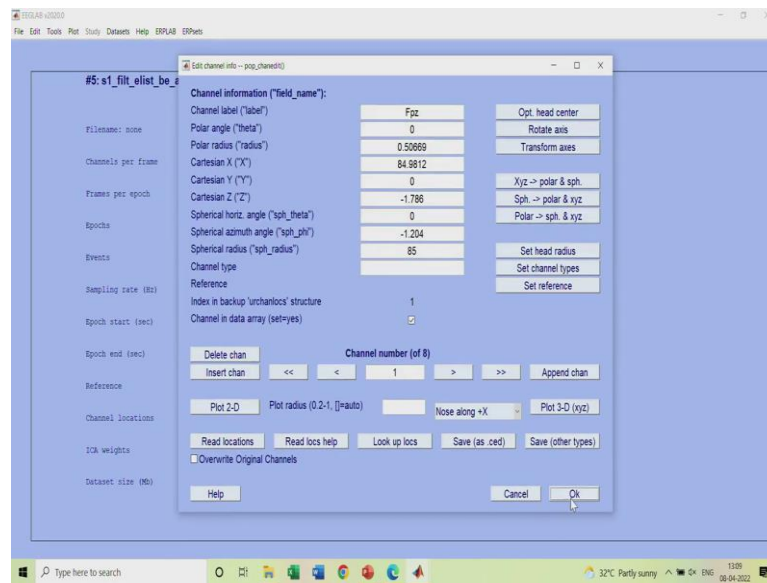
If you have deep pit inside, you can just give the channel location and you can see the data.
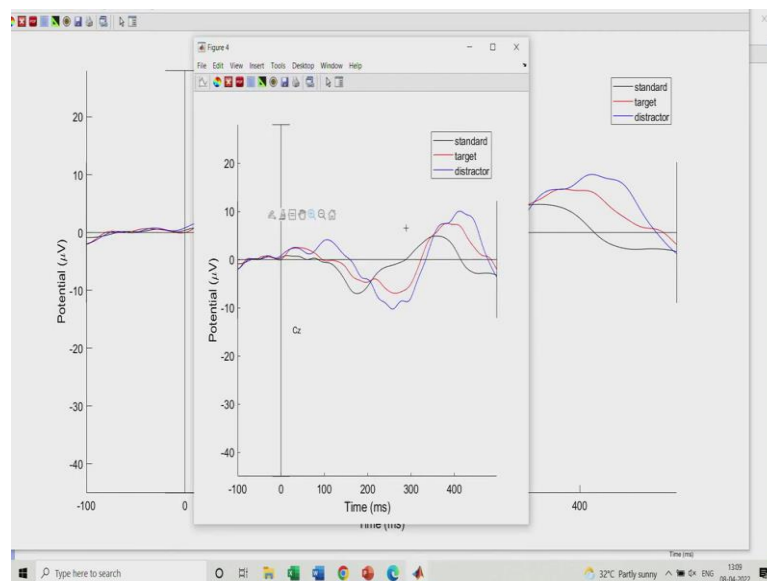
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So, F PZ, F Z, C Z, P Z, O Z, T 7, T 8 is on your temporal lobe and P 7 here. Here is the scale which you can use, but this is entire midline on your head. Why did I do that? I just want to show you the response according.
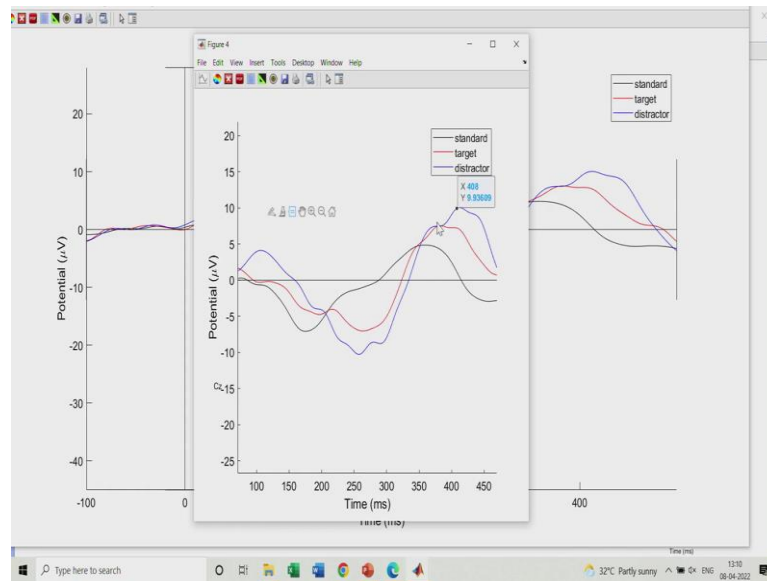
(Refer Slide Time: 29:38)

If you want to see any particular thing you can click on that. You will see only that particular electrode.
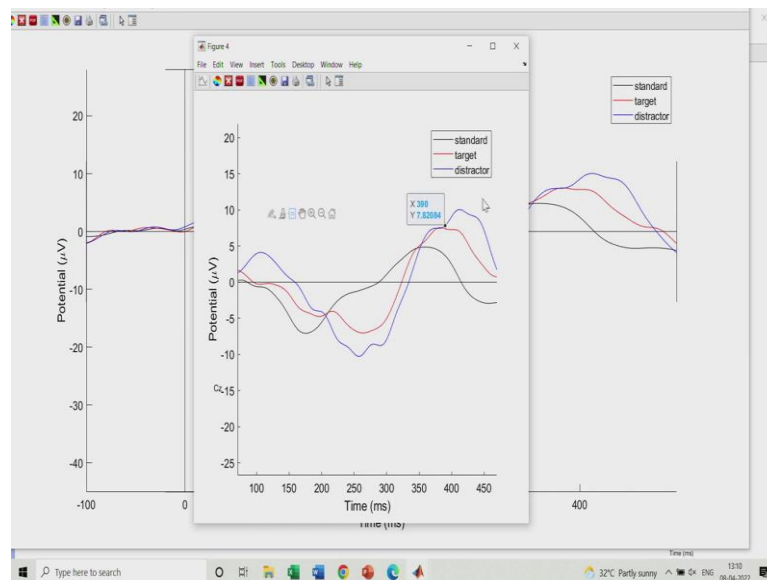
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You can stretch this; it will give you a better result. Now this experiment is around known as P 300 ok. P 300 means some positive peak around 300 milliseconds, so with respect to your target and distractor. So, you can see here, this is black color line is your standard as it is shown here. Further red color line is your target, target means a big ball. So, when you click on the big ball, and it comes around if you see here around 350 or somewhere you can see the peak which is significantly higher than your standard. Same for distractor it is even higher.
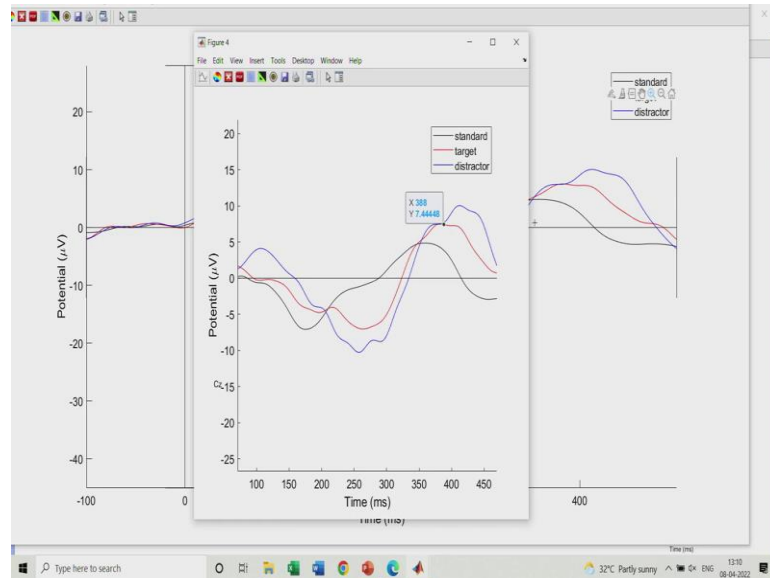
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So, you can put a indicator here and see when actually the peak occurs. So, for distractor, it occurs around 400 milli second.

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Whereas I can consider this peak its 390 or something. I am talking about this red color trace not the blue one.
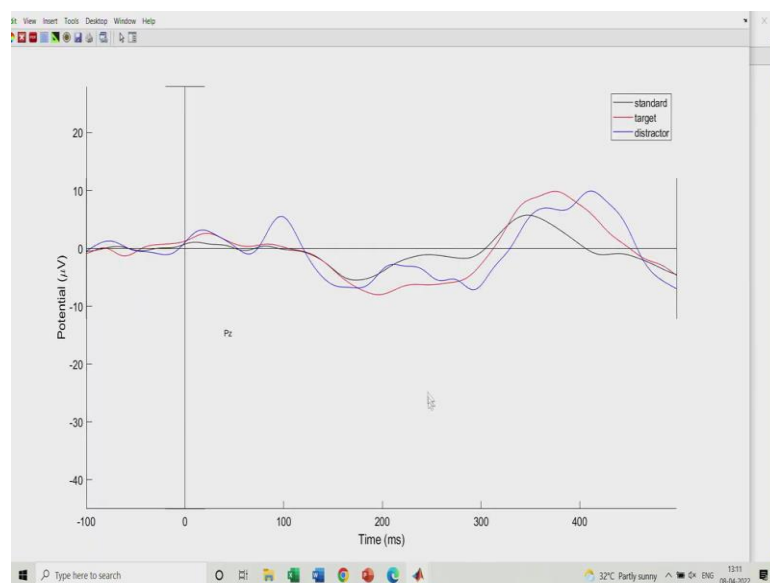
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So, if you can see here, it is around 388 also you can see there is the plateau. It results due to multiple peaks because all this standard and target basically target known as P 3 b working memory and this distractor known as a P 3 a component or P 3 100 which is for attention. So, this comes on because of a several neurophysiological processes happening underlying your scalp.

So, that is why sometimes you get multiple peaks sometimes you get plateau as a result of multiple process, eliciting due to your event triggers. So, this particular thing you can see here is nothing but your C's response from your C Z electrode.
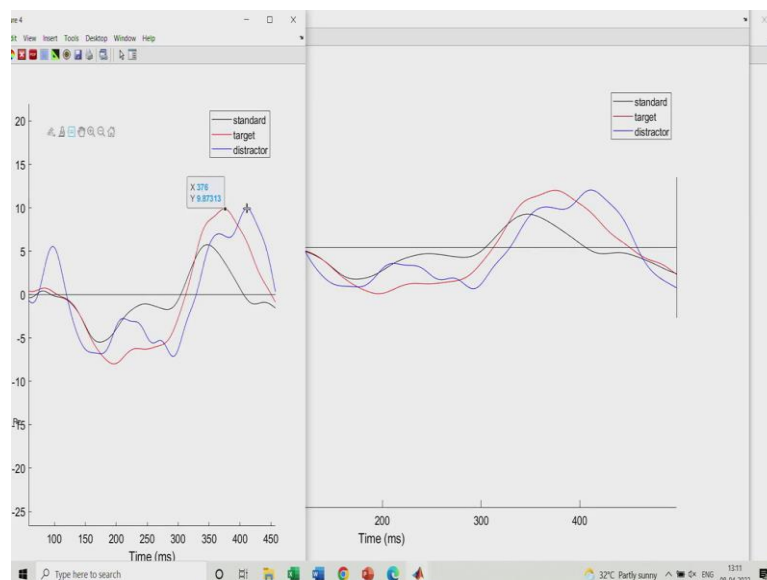
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And you can see a very nice P 300 here, same thing as I mentioned that you will get a better response in C Z, P Z, O Z. So, here if I open the P Z electrode you can also see the similar form of response.
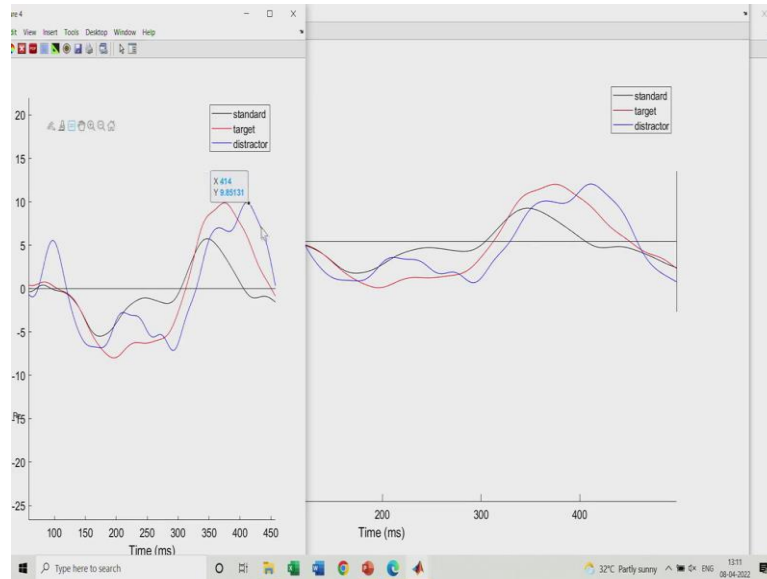
(Refer Slide Time: 31:39)
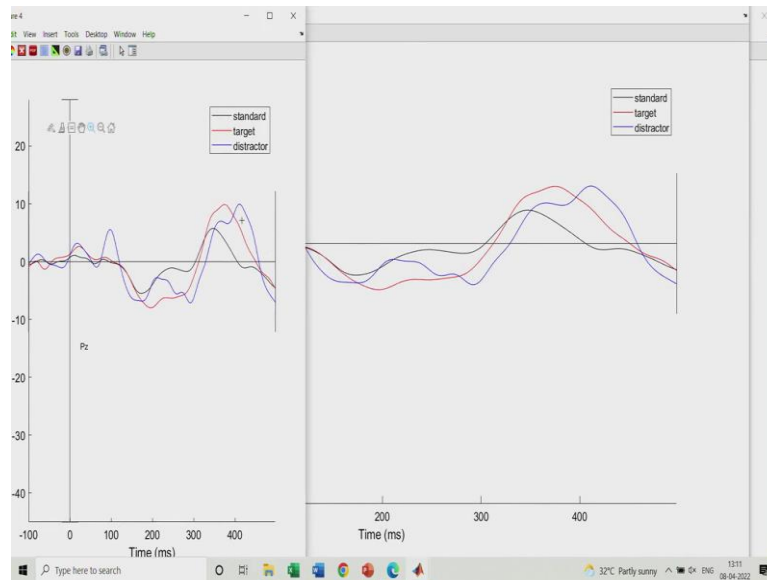
And it also peaks around 300 to 400 milliseconds.
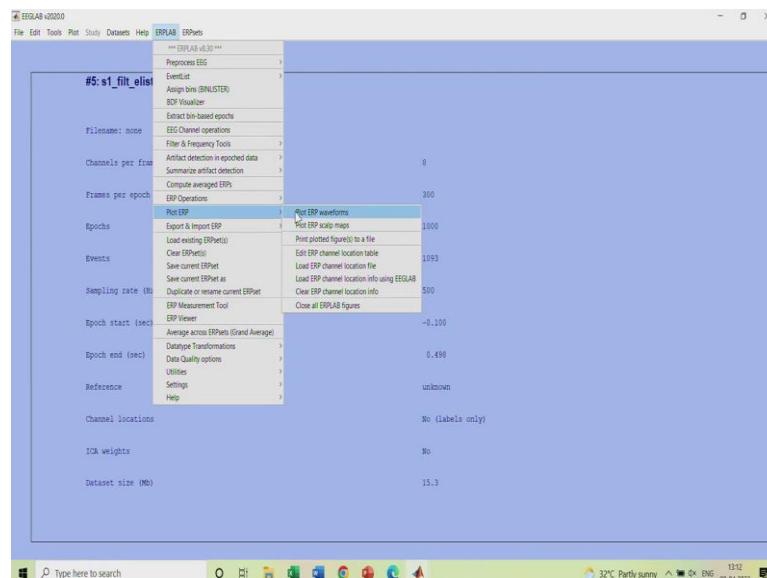
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Here if you see this target trace elicits way much before in terms of time 378 millisecond.

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Whereas this distractor peaks at 414 milli second. So, it is an objective measure for some of the subjects it might be earlier, for some other subjects it might come slightly delayed, but name P 300 suggests that there should be some positivity after 300 milli second. It comes generally in 300 and 400 millisecond. It is a topographic view now as we have seen and analyzed we are sure that the better results are there in C Z and P Z. Now C Z and P Z is nothing but your third and fourth electrode.

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So, now, we will specifically plot only these two electrodes.
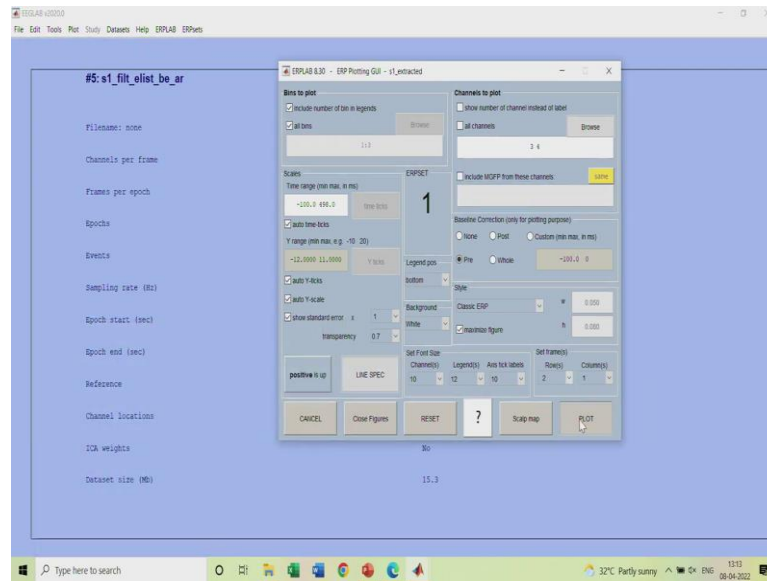
And it will give you an idea what is SEM. For that I will just do a classic ERP. I will turn the SEM on instead of selecting all channels I will just select third and fourth channel. So, now if you see third and fourth channel and I want to see here you can select how many you know rows and columns you want. I can just opt for, I just want it in 2 row and 1 column. So, I will just take 1 column here.

So, I can put the things exactly next to each other below just below each other. And now if you see the Y scale has also reduced because F PZ has had more fluctuations in the previous graph, if you see this now.
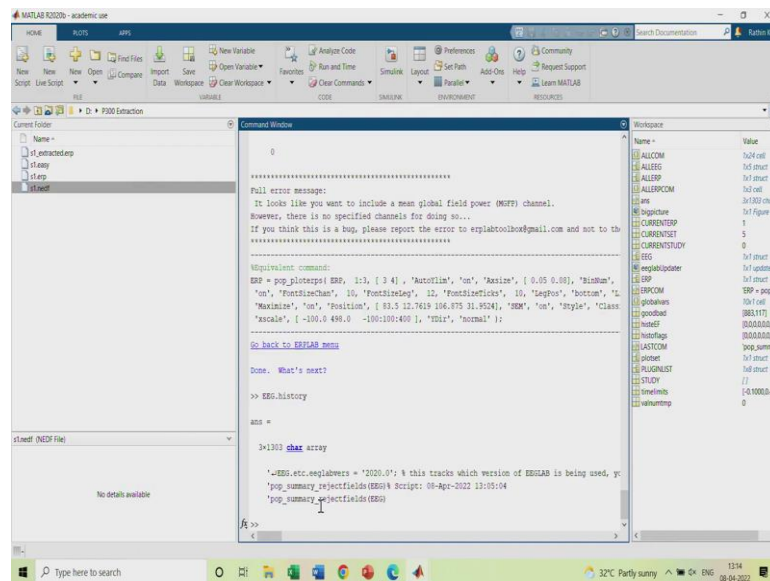
(Refer Slide Time: 33:16)
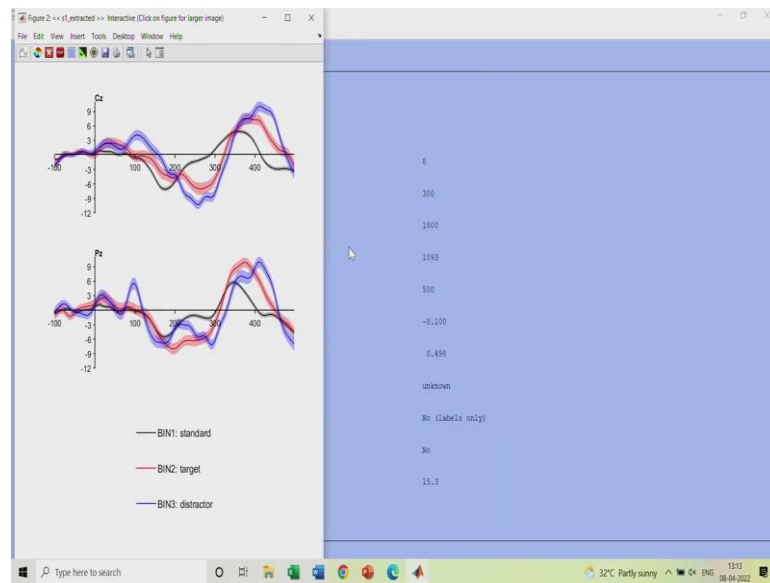
If you see this, you can see the graph. Now why did I do this? Just to show you the SEMs. So, this light color you know things is nothing but your SEMs, you can see that even SEMs are getting separated. SEM is nothing but your variabilities. During all the 100 trials it would have gone slightly up slightly down also, but it also follow this thing. So, this concludes that you can see this P 300 it is there. And also, it is getting generated using your target or distractor stimuli.
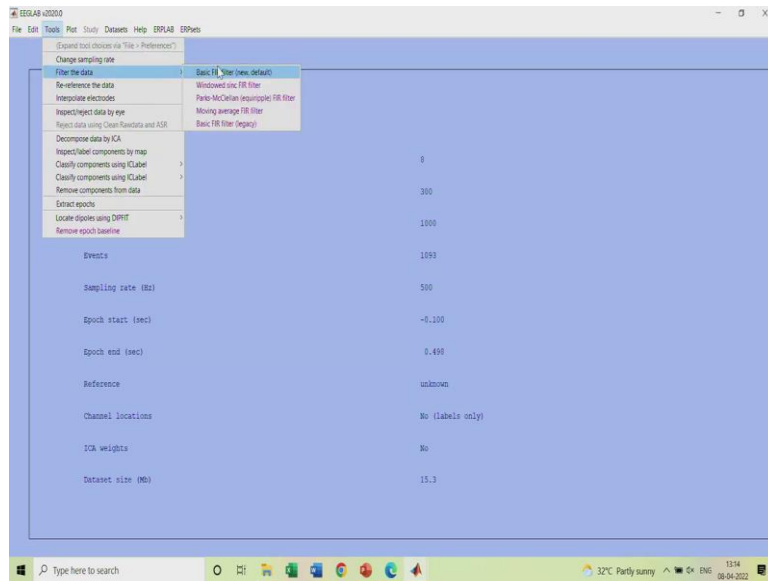
(Refer Slide Time: 33:58)
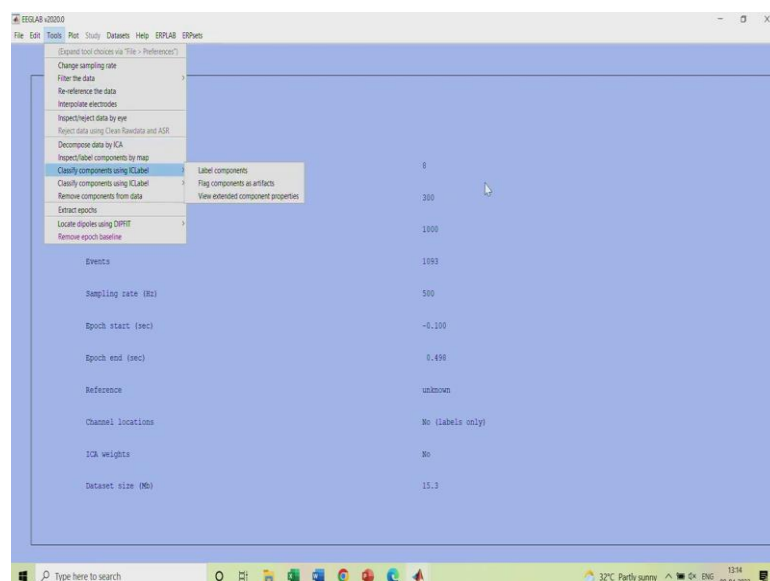
Another thing is you can use this thing to resample it if you want, you can do all this reinforming. ICA is also a very important topic Independent Component Aanalysis in your eeg, then how many approximately how many components are lying there. So, accordingly you can remove your unwanted components and check the things. Now, one last very important point, you have seen how I have used gui to do this thing. Suppose I have a data from 500 patients or 500 subjects of this sort of data, what do I do? How can I get it done using scripting?
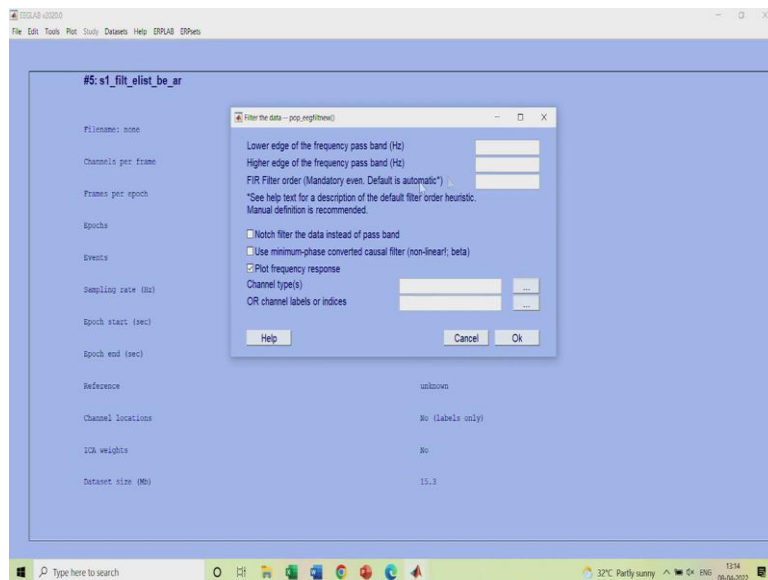
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So, what you can do is whatever I have done so far in eeg lab there is a command eeg.history. If you hit that command, it will tell you that I have done this machine ok fine.
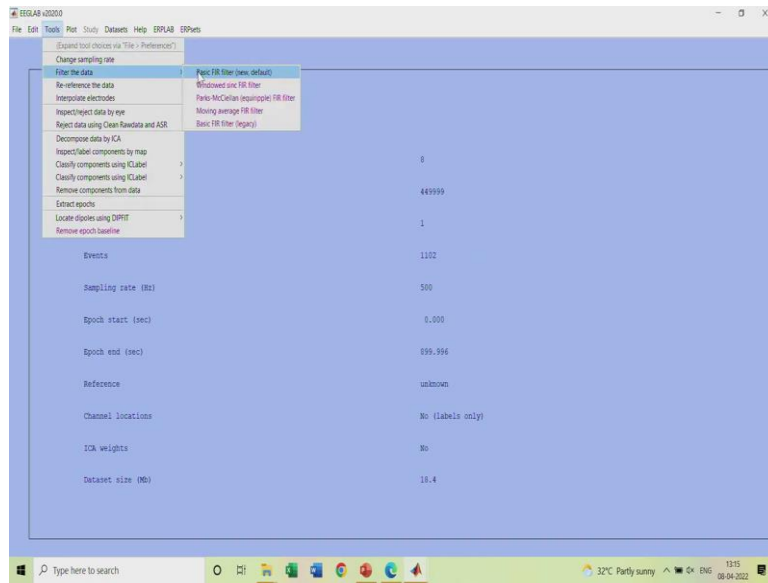
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What I will do is I will again import the data or let us say I will do the filtering, basic filtering to your initial data.
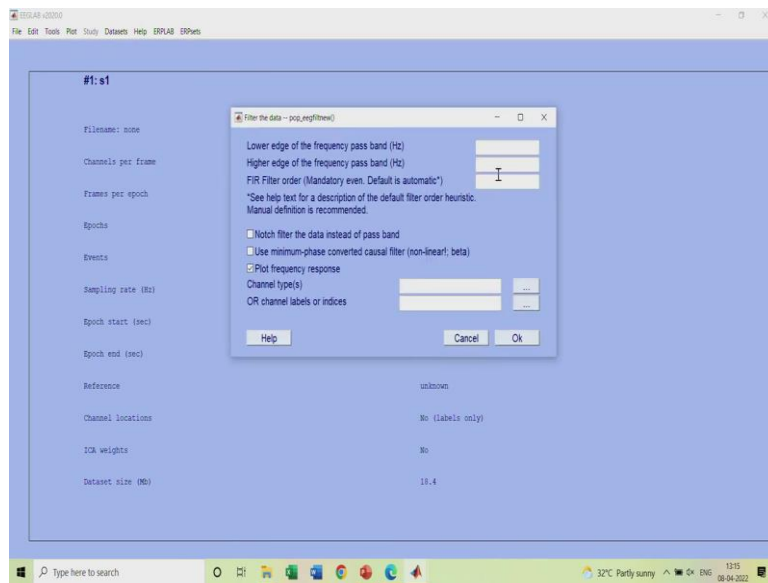
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Because this thing already we have done it is just to show you a glimpse of how you can convert gui to scripting.
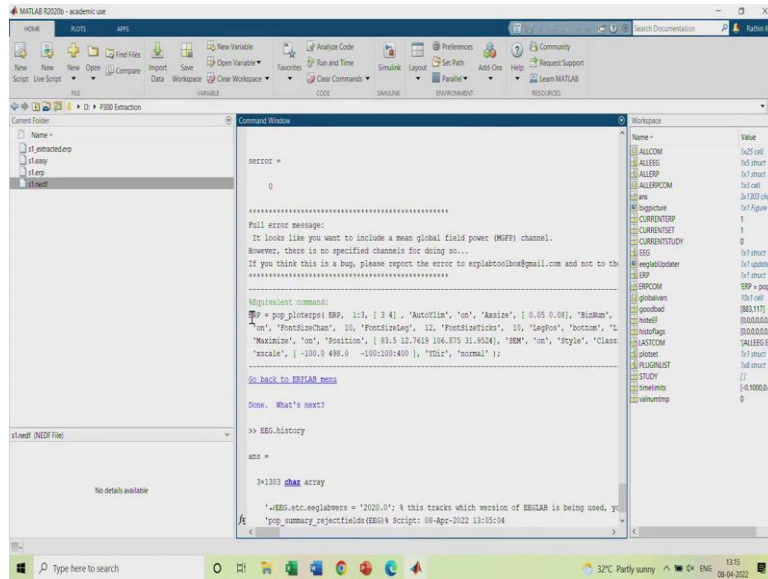
.

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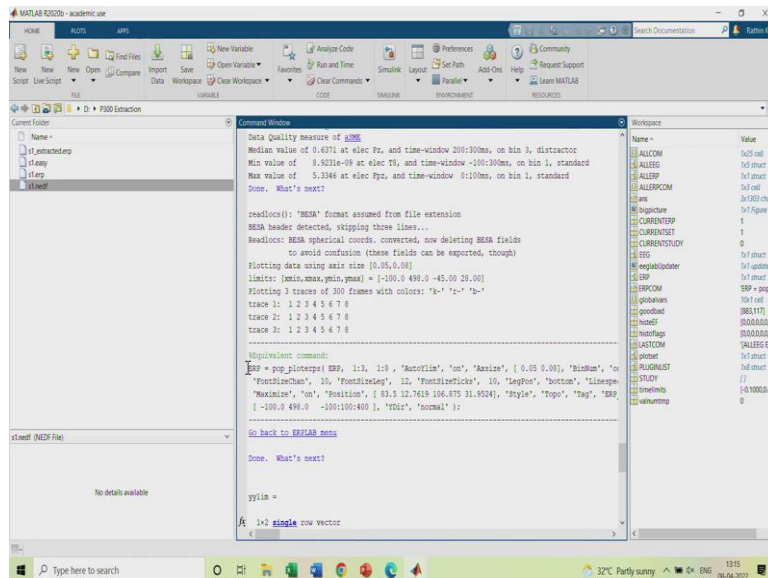

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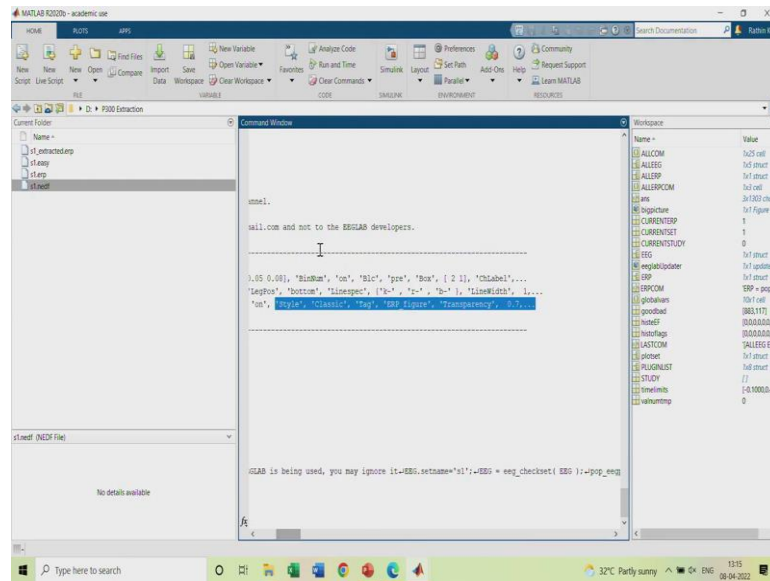
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Anyways if you scroll here, you can see equivalent command everywhere. When you are plotting this is equivalent command.
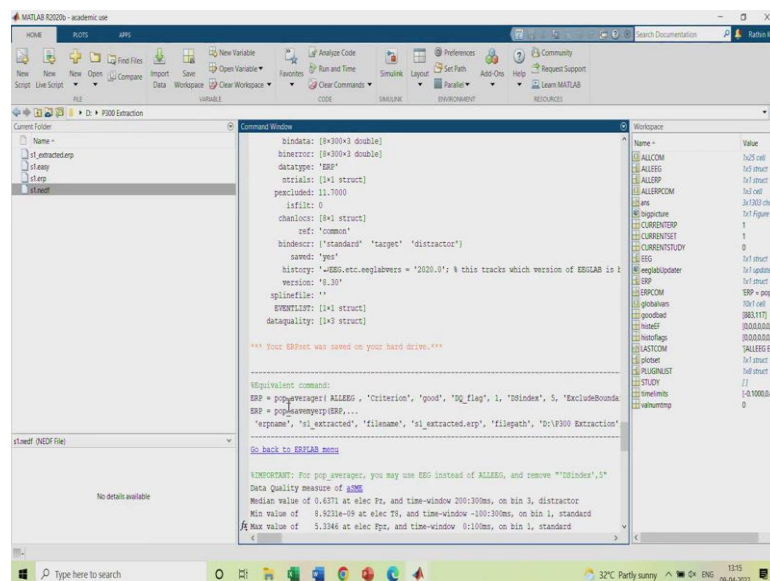
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If you even go before, we plot it twice this is plotted using topographical view. So, style is topographical whereas, this was plotted using your normal view classic ERP. So, style is classic ERP.

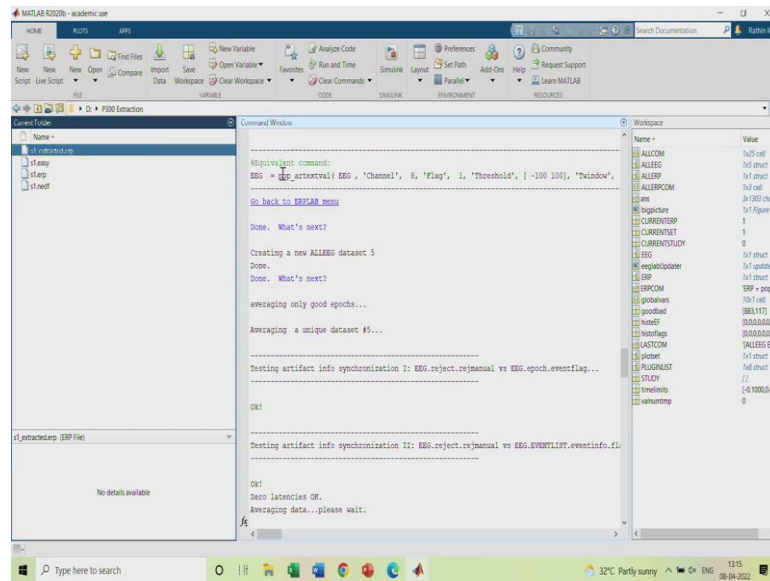(Refer Slide Time: 35:30)

Also, when we plotted second time we have turned SEM on. So, this SEM is on.
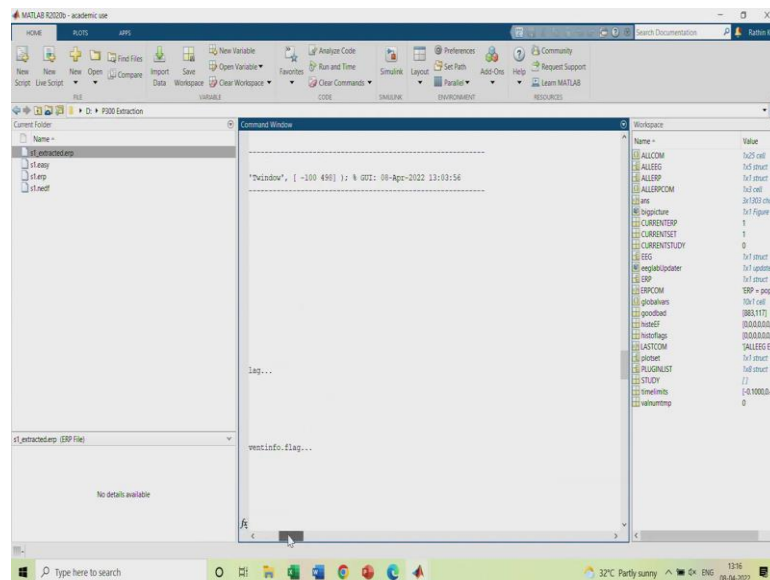
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Basically, for each command which you give in your gui or eeg lab there will be a equivalent command here. When we I did averaging it was this, we kept this dataset DQ flag on, data set option. So, it is 1. While saving it we have given this name. So, this is the name saved ERP will be saved here you can see here.

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Also, if I go further below you know ahead this was what we have used artifact rejection for all 8 channels 100, ±100 millisecond.

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For how much time? -100 to +498. Also, it will show you the time at this particular time you did that.

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So, similarly this is just a summarization of artifact rejection before that we did pop epoch bin.

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So, it is like a highlight after cricket or any match you see the highlight, same thing after doing all this thing using gui if you go through the command window you can see the highlight of equivalent commands what you have done. So, when you have multiple files or multiple subjects you can use all this command run a for loop and you can get the things done very easily.

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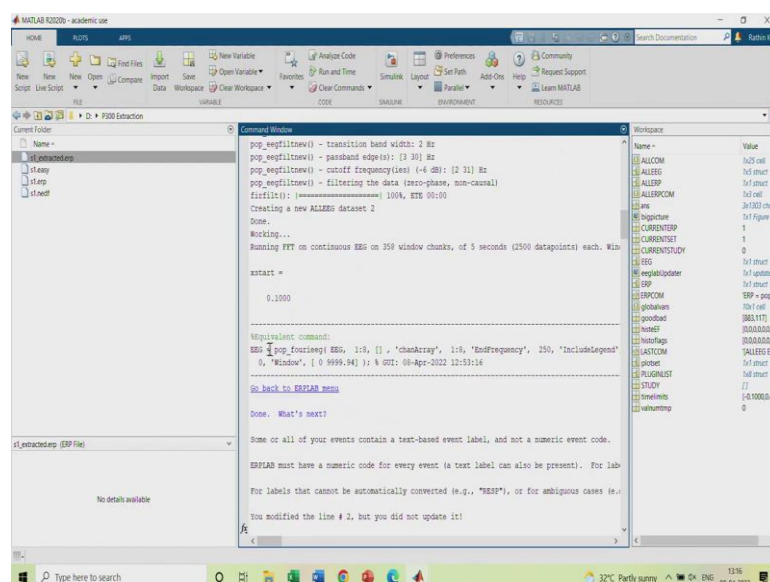
This is to check the artifact is there or not, the same thing.

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So, this is from you know checking the spectrum till getting the ERP done everything can be done using scripting.

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So, this is an overall idea. This is advisable when you are doing badge file processing, also further if you want you can go to you know plot any do ERP imaging and all sorts of thing based on your requirement you can explore this thing at your own. There is an excellent documentation available for eeg lab as well as ERP lab. And it is very important when you are processing data and to make sense out of your you know recorded eeg data.

So, that is basically a short module on how you can extract the ERPs using data. If you have any question or anything, feel free to write in the forum. Maybe I will see you guys in some other course next time. Till then, all of you take care, bye.