Experimental Physics - II
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Lecture - 37
Interference Phenomena by Newton Ring (Experiment)

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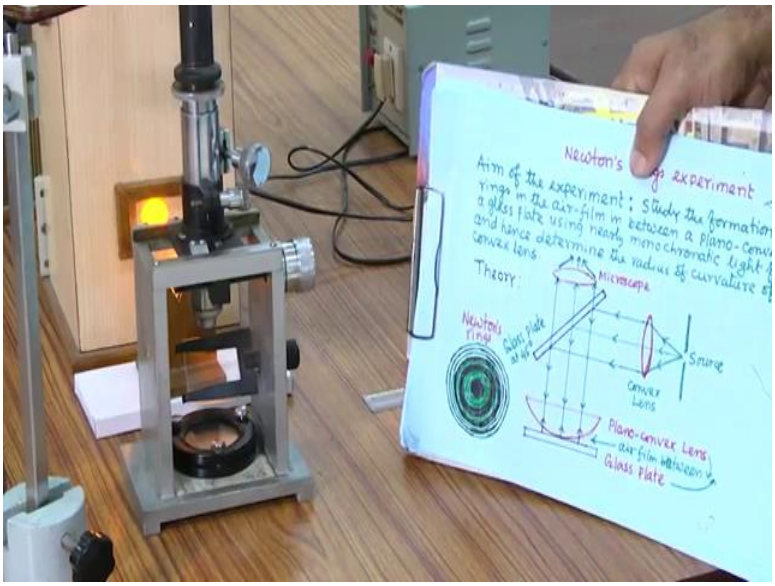

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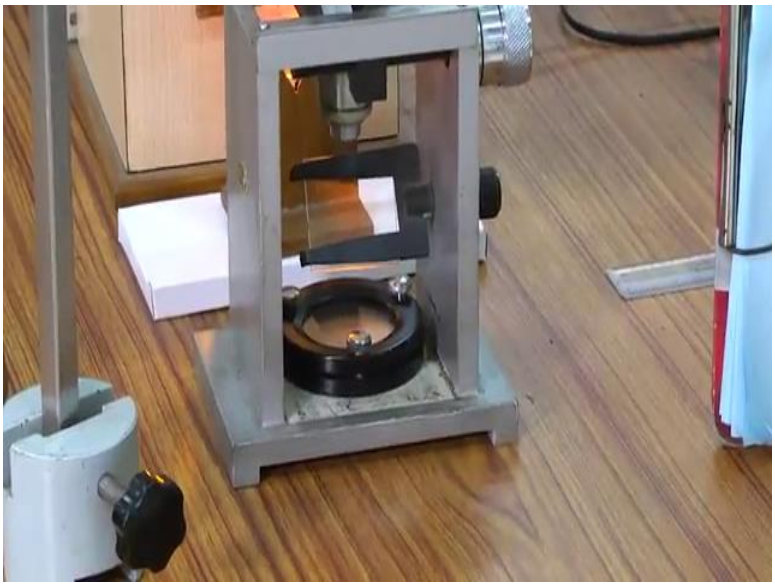

now I will demonstrate the experiment Newton's Rings Experiment. this is the experimental setup for Newton's ring experiment as I showed you the setup this Plano convex lens and this glass plate. this it is a combination of this is this part here in this setup this the combination of Plano convex lens and the glass plate and the glass plate

this part now then this is the glass plate at 45 degree. in this setup which one this one this is the glass plate at 45 degree this angle I can change from here, this angle I can change

from here. I will show you now I have set it for the I observed the Newton's ring, I will show you the ring first then I will disturb and show you

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glass plate and then this is the source sodium source and in front of this sodium source there is a lens there is a lens the sodium source there is a lens. light or from the lens are coming falling on this falling on this other side this glass plate and this glass plate at 45 degree. normal rays these normal rays are falling on this Plano convex lens on the glass plate

this very simple setup you know. what we have to do first we have to get the fringe we have to set it. for setting this is the source Now I have to put the convex lens to get the parallel rays we have put the convex lens here I will show you and this parallel rays are coming. this glass plate I have to; I have to rotate and see the fringe I have to put at a particular position when I will see the clear distinct fringe

So that means, at that point is the it is set at a 45 degree angle. this perpendicular rays and their parallel perpendicular to the Plano convex lens with glass plate. Now through the microscope this is the microscope, through the microscope I will see the fringe here as I have to measure the diameter of the Newton's ring this is the scale; this is the scale will use.

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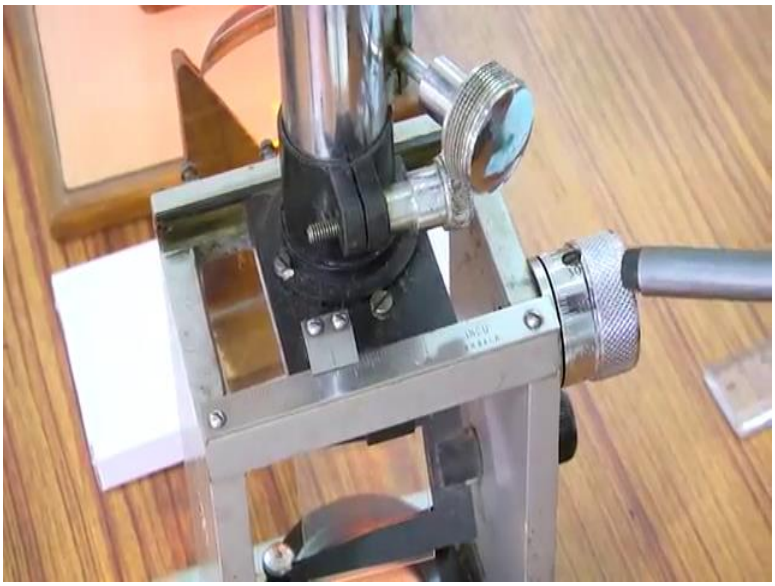

this I can change; I can change this translation motion I can change the position using this one here for each one turn, this is the 100 divisions are there on circular scale. it moves 1 millimeter. least count is 0.001 you just like screw gauge this we will use for the reading. Now as I told if I look at the microscope, I will see the Newton's ring because I have set for that condition. instead of seeing that one I want to show you I am using the mobile camera. You can see this fringe

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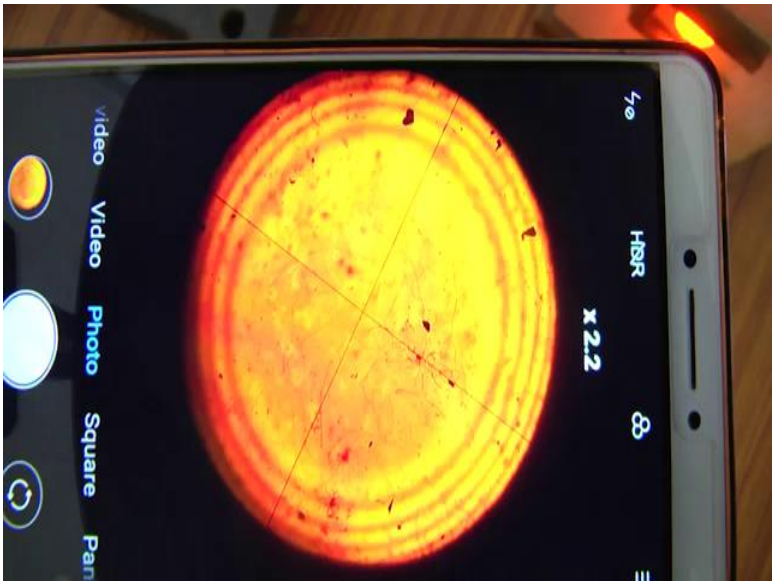

see this is the cross wire this is the cross wire. Now these are the ring this is the central one is broad one you are seeing this is the central one broad one then you are going outside you are getting b dark b dark this concentric rings. actually, from here we will count the b one 1 2 3 4 5 up to 10. we will go that is the n plus 10th fringe will tell, then we will move towards this from left to or to left whatever.

we will take reading of each position of the b fringe on the left side as well as we will go the other side and we will take the readings for the side of the rings for all 10 fringes. then you know this how to calculate the diameter of these rings and that is what we will do.

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Now actually I will this I can show you that if I change the angle of the you see just if I just change this it will vanish you know; I am changing; I am changing the angle of glass plate You see it is the it is not now at 45 degree it is the fringe vanishes. Now I am just slowly changing to come back at this position at this position. it is I am getting back the fringe. now, at this position it is a distinct one this is at 45 degree and as I told this I will change the position I can change shift

This way I can move; I can move it is very sensitive this micrometer I am rotating this micrometer screw I will go this 1 2 is going out of this it is camera of it is a difficult to show, but that to microscope one has to see and do this experiment So now, what I have

to do I have to look through the microscope and I have to make it distinct Setting the yes so I can see whatever I showed you more clearly better way I can see here

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Now, also this is the lens you know this convex lens you are using this is the source here hole is there light is coming. now I will put this lens here and I have to; I have to; I have to get parallel rays. seeing the fringe for distinct fringe I will change the position of this lens from the source that I can get distinct fringe

So that means, it is approximately it is at the source is at the focal point of this lens. parallel rays are coming Now it is falling on the as I mentioned this on the glass plate, I have option to change the angle. I have to set that one also Now actually I will disturb that one this one

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this here you cannot see because the radius of curvature is so small glass plate and the Plano convex lens, so Plano convex lens has glass plate both side is it is the; it is the plane, not curve surface. Curve surface is inside. that is why it is difficult to see, but it is a combination of Plano convex lens and the glass plate, but it is you cannot see that one, because of the very small radius of curvature and transparent

that we are placing here that we are placing here, and light are coming and then it is the horizontal light, now using the 45 glass plate I am making them perpendicular and so; that means, this light is falling perpendicularly on the Plano convex lens and glass plate on our system. and that image is from reflected rays from the curve surface and this glass plate bottom glass plate of this combination

these two reflected rays are vertically up they will interfere and that interference pattern I am seeing through this; it is shifted; it is shifted I have to yes I got the center; I got the center very nice I got back this fringe as I showed you in camera mobile camera the same fringe I got . now, what we have to do, first we have to note down the; we have to note down the; we have to note down the least count of this horizontal scale

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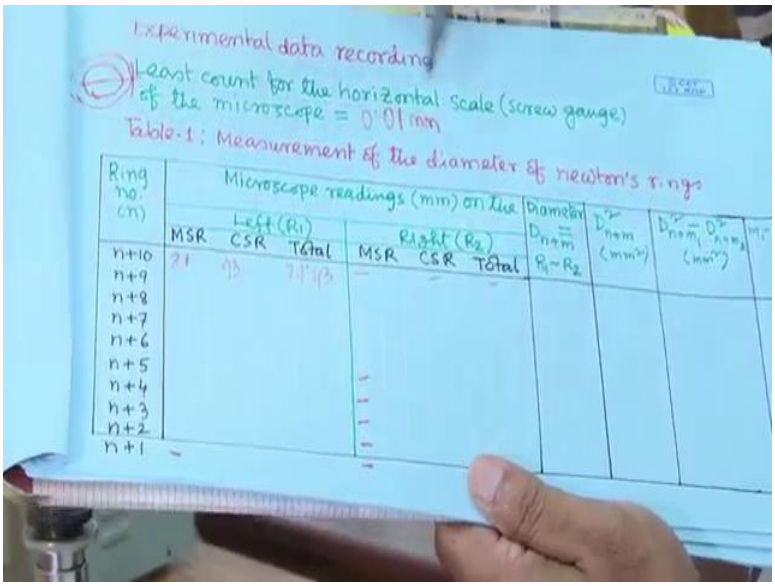

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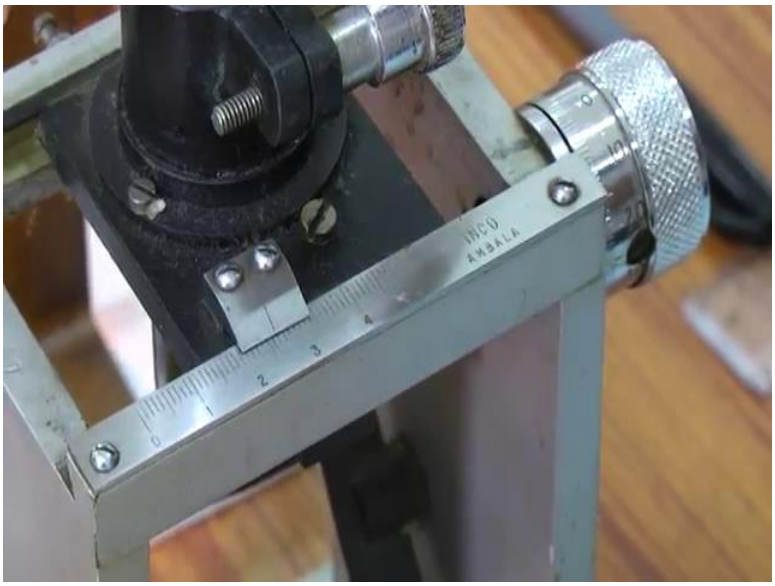

Least count of the horizontal scale of screw gauge kind of things of the micrometer. as this as I told this if we if I rotate that I have to do it. it is a 0. I think we can show you it is the. now, it is at 2.5 yes 2.5. is division of this one is 1 millimeter. if I rotate once 10 division 20 30 this way if I rotate so on 70 80 90 100 come back. it is now 2.6

1 millimeter shift due to 1 computation this due to or 100 division least count will be 1 millimeter divided by this 100. that we have to note down that I will note down. I think

reading I want to write in millimeter I will write it in some millimeter this is the least count. now, table measurement of the diameter of the Newton's rings

Newton's ring number is n initially I am taking as I told that in center one how many rings are there it is difficult to tell that is why what we are doing this from center we are going moving out that one we are from whatever we are able to this is the in center is the n fringe I cannot distinguish them nth number ok, n plus 1, n plus 2, n plus 3, n plus 4, n plus 5, n plus 6, n plus 7, n plus 8, n plus 9, n plus 10

I will go to the left. Now that n plus 10 I am taking reading, I will move; I will move this one I have to move this one I will go n plus 10. I have to go to n plus 10 This I will take 1 then 2 then 3 then 4 then 5 then 6 then 7 then 8 then 9 then 10 this position at it is a towards the towards the this yes, it is the and left in which way you are looking I am at this position now if you take left or whatever does not matter.

it is a I am at position. I move that side is in my case is the left position, but for this experiment that is opposite way. It is it will be and this other one will be left, but it does not matter because it is it is a symmetric from the center, they are symmetric you note down this reading main scale reading I will not note down.

it is 2 point I can see. I have to use this one I can see this 2.1, 2.1 or in millimeter if you analyze a 21 millimeter. I will write this is 21 millimeter and circular scale I have to find out circular scale it is 43 this is 43 circular scale reading. total will be 21 millimeter, and this is 0.1 for means 0.43 millimeter then I will go back to the I will go back, now I am moving towards the other side I will set at you should not loose ok; now I am at the 9th n plus 9 3.

again, I have to note down the reading then go to the 8 set at 8 set at 7 6. that way you continue the measurement on each rings and then now I cross the center going other side I will take the reading of this n plus 1. this way I will come up to this.

Now I am other side I said I will take reading of this one for this n plus one for other side then I will move to the next n plus 2 n plus 2.

this cross wire we have to say it is a it will be tangent on this on the circle you know. Then you are moving along the diameter to the center this line if you draw the line

through the center, if you draw a line through the center this ring concentric ring if you draw the line the center cross wire if you put like this; it will be tangent only when it is moving along the diameter

this way you set for the next 2 then 3 then 4 this a other side also you take reading this difference how to calculate the difference as I mentioned. for each one this reading and this reading this is R 1, and this is R 2. difference of these two will give this difference of this one will give you the diameter of n plus 10th ring, the next one n plus 9th ring the next one will give n plus 8th ring

this is the diameter square then diameter square difference of this two rings this as I mentioned will calculate difference between this n plus 10 and n plus 1. n plus 1 whatever the reading we will get for n plus 1 n plus 1 whatever the diameter we will get n plus 1 that we will subtract all the time from n plus 9 n plus 10. that means, here we are writing D n plus m 1; that means, D n plus m one say is the 10 minus this n plus m 2 means n plus 1 m 1 minus m 2 will be 9 and this diameter square difference will be corresponding difference we will get.

Then n plus 2 will n plus 9 and then n plus 1 then this that is m 1 minus m 2 will get 8 Then next n plus 3 and sorry n plus 1 and then n plus 8 this way n plus 1, we will subtract from this reading these then we are getting diameter for the difference we are getting for the 9 th ring then 8 ring 7th ring. this way then we can plot the graph we can plot the graph as I mentioned, we can plot the graph actually I have to we can plot the graph.

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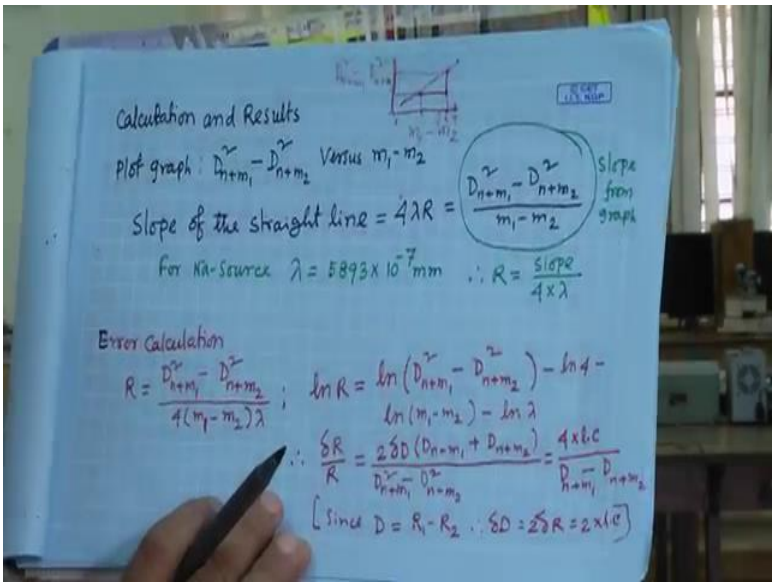

what I am getting; I am getting this is the m 1 minus m 8 and this diameter n plus m 1 square minus d n plus m 2 square as I told this for you are taking reading n plus 10 and n plus 1 that the difference ok; that means, for 9. for this it is a 9 whatever diameter reading we will get that will be the maximum then for n plus 9 and n plus 1 that depends for it is if it is 9, then other one will be 8, then other one will be 7 this way we will go up to 1

you will get this type of straight lines you get this type of straight lines you can find out the slope from this curve. You can find out the slope from this curve. this is the slope. Now this slope divided by 4 into lambda, lambda is this. we can calculate the R from the graphical method this is the best method to find out otherwise individually you can calculate lambda for each case and then take the average of lambda.

And in our calculation as this I mentioned this your least count only you have to know the least count that is 0.01 millimeter and from the graph particular this case you can take n plus 10 and n plus 1 corresponding that you can find out the error in the error in the measurement from the graph itself we can this D value this is the difference D value and corresponding m 1 and m 2 means the difference that m 1 minus m 2 difference you can find out here

from this value you can calculate this that will be average error. Otherwise for a particular data one has to calculate the error I think this is the very it is the; it is the

simple experiment wise getting the fringe is the challenging task, but an measurement also one has to keep the track of the rings You are counting you should not lose the lose the number of track of the number of the rings, because they are generally we do mistake

from left side to side you are going so you should count properly, and you take reading because this fringe that 10 9 plus n plus 9 for that whatever reading n plus 8 or n plus 10 these are very close. that change you will get in the only in the circular scaling no. you have to be very careful of taking reading from the circular scale and generally we get very good results close to the; close to the radius of curvature whatever company supplied the value

here the just using a microscope simple microscope and these just Plano convex lens with the glass plate the system and one just glass plate for changing the angle getting the for getting the normal incidence of the rays. in this case you see this inclination, inclination is constant you know inclination angle inclination angle is constant.

This fringe we are getting because of the variation of the; variation of the thickness, we will also demonstrate another experiment where inclination is constant inclination thickness is constant. we will get ring because of variation of the angle of the inclination you need one variation. Generally, this 2 d sin theta or cos theta 2 t cos theta this type of these type of different relation we get

dot that is the thickness or distance difference and this theta is the angle of inclination. one of them; one of them should vary in this case thickness is varied, inclination is constant. Other experiment inclination varied, but thickness is constant I think I will stop here.

Thank you for your attention.