Experimental Physics - II
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Lecture – 21
Basic discussion on spectrometer and prism (contd.)

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in last class I have shown you the spectrometer prism spectrometer.

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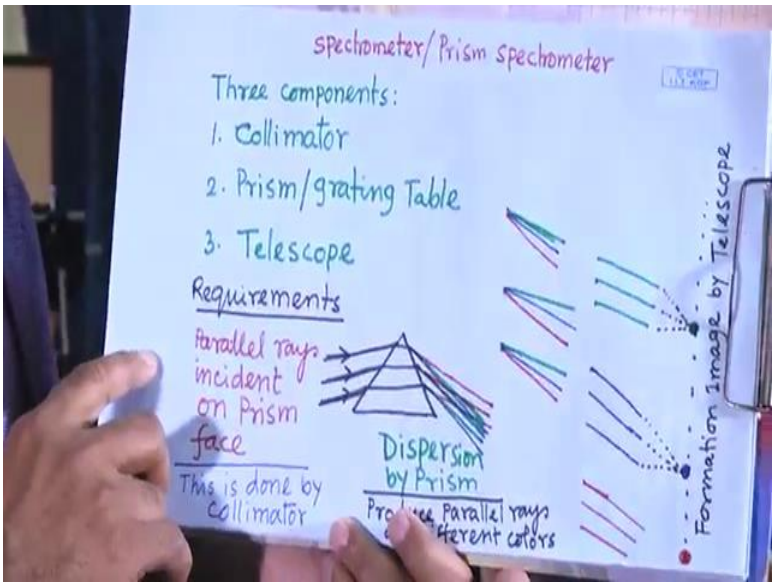

what I have showed in last class; this as I showed you that three components in this spectrometers: collimators then prism or grating table and telescope; this is the three main components. this is the collimators, this is the collimator, this is the prism table or grating table and this is the telescope, this is the three major components. what are the requirements for doing experiment using these spectrometer?

requirements are this we need parallel rays means say you have prism on the prism table. parallel ray will fall on the prism. we need parallel rays incident on the prism face valid. this parallel rays we will get from the collimator. collimator is used to produce the parallel beams which will incident on the prism or gratings Then prism by dispersion prism has capacity of dispersion means when white lights will fall on the on the prism, then other side all colors will be separated; all colors will be separated.

Generally when we draw ray diagram then we take one ray falling on it, white light ray and then after refraction due to dispersion; this different colors are separated for beam means not a single ray there are many rays, there are parallel rays when they will fall on these prism; other side each ray will give different color or each ray from each ray the colors will be separated. other side other side the from each ray you will get the separation of each color, separation of each color. if you look for a particular color other side this particular color rays are parallel, particular color rays are parallel other side you will get different sets of parallel rays of different colors.

So now, we want to see image of the source. other side due to the effect of the prism you are getting the parallel rays of different colors Now, to see the image of the of the source this parallel rays they have to meet, they have to meet somewhere where they will meet? They will meet parallel rays; they will meet at each infinity. you will see the image at infinity, but in lab in a smaller space if you want to see the image then we use these another part of the of the spectrometer that is the telescope. function of the telescope is to is to converge this parallel rays on the spin, there it will form the image and that image we will see we will see through our eye.

in telescope this is the function of telescope to form the image these three parts collimator which is producing the parallel rays which will incident on the prism that is the requirement of the experiment other side after the dispersion you will get parallel rays of different colors ok, set of parallel rays of different colors. to form the image, we

have to this parallel rays has to diverge converge ok, otherwise it will converge to the meet at the infinity. in laboratory to converge them we use the telescope.

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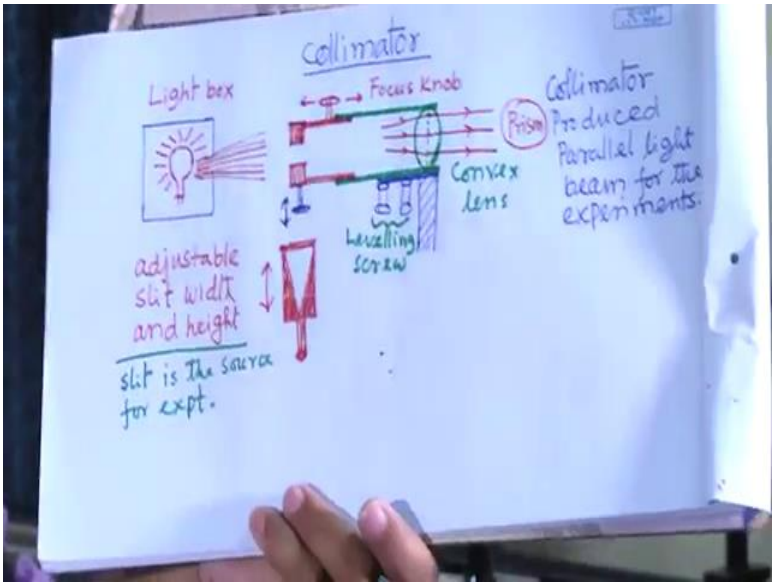

in collimator how we get the parallel rays for the for the prism? we have light source, we have light source light box basically; this is the light box generally we do not tell this is a source for the experiment this light is coming from this box, now this light diverging light ok; it is emitted in different all direction. divergence light it is coming, and this is the collimator, this is the collimator. it is this diverging light is passing through the slit. here already I have showed you the there is a slit here, there is a slit here.

that slit you can adjust the width of the slit and there is another part on it this type of shape. if you move this one on it you can adjust the height. this arrangement is there I will show you again. So now, so light is diverging light is entered through this slit; now this diverging light will fall on a on a convex lens, that convex lens is placed in this collimator. here this convex lens is there and here slit is there. when it will so in this case the source, we tell the source we tell this is the slit is the source for the for the experiment ok; light source for the experiment.

what by image you will see there is the image of this slit. from the slit diverging lights are coming and it is falling on the convex lens and the other side, if I want to get the parallel rays of the other side. you know that this slit has to be at the focal point of this lens ok, to place this focal point on this lens; this part this slit part you can move, you can

move focus knob this is the focus knob Like this is the telescope for telescope this is the focus knob, this is the focus knob for the collimator. if you just rotate this one slit is going out and coming in

this way you have to place this slit at the focal point of this convex lens of the of the collimator. how to put how I will know that it is at the focal point? that I will I will describe. here you can adjust the slits height, you can adjust the slit width and you can move the slit in and out And, this idea is to put this slit at the focal point of the of the collimator's lens. now, parallel ray will come and then it will fall on the on the prism whatever a requirement for the experiment then come to the to the telescope

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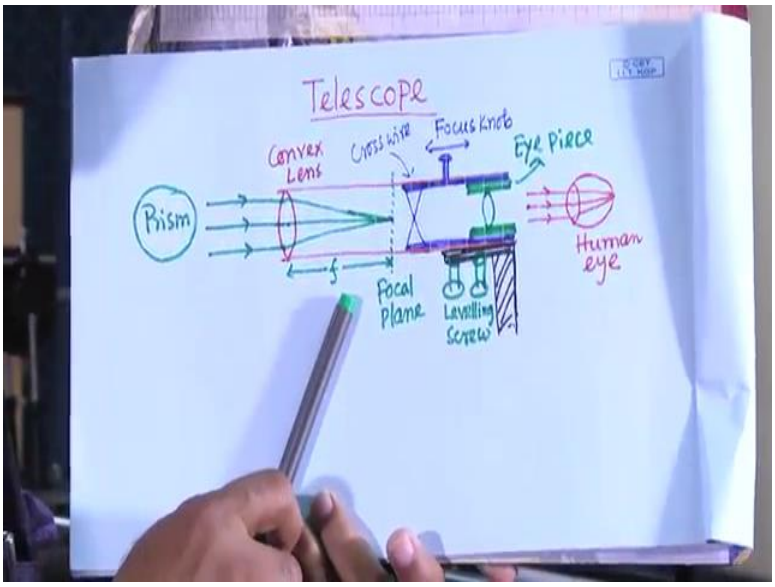

parallel rays will fall on the prism will falls on the prism ok, then due to dispersion or whatever the refraction etcetera light will come out. whatever light will come out; that that light we have to catch and then we can see the image of the of the slit. now this from prism from prism this lights are coming; it's the parallel rays are will come from this prism parallel rays will come. after refraction or dispersion, we will get again each so parallel rays are not a single rays. all rays are falling at same angle on the prism.

they will be refracted in all will refracted in same angle so; that means, this refracted rays will be also parallel. Now, that refracted rays these refracted rays they will come they are parallel. Now, if I want to see the image either we can see at infinity or here we will use the telescope. or in telescope there is a lens convex lens, in telescope there is a convex

lens; this is the convex lens here in telescope. let me take out this one. this is the convex lens.

from prism refractive rays parallel rays are coming falling on this on this ah convex lens Now, this convex lens parallel rays are falling on this convex lens they will meet; they will converge at the focal point of the of the of this lens. They will converge at the focal point of the of these lens this is the focal plane ok, this is the focal plane. Now, this focal plane on this focal plane their image will fall, now I have to see these image

I will use my eye; I will use my eye. Now, actually in our eye all the time this rays say parallel rays comes and we have lens in our eye, and they will converge on the retina, there the image is formed. Then our sense our brain actually functions to see this image. forget this part. here what happens? here image is formed. So now, in telescope there is another part is called the eye piece.

this eye piece helps us to see this image, also it helps us to the magnify these image in eye piece is there is a lens, there is a lens of smaller focal length compare to this focal length. this eye piece this eye piece if this eye piece the lens of this eye piece is put here in such a way that these will be the focal point of this eye piece of this lens also of this lens also ok, then from this lens. this is now this point source from there this diverging light will fall on this eye piece lens and from there other side will get parallel rays.

that parallel rays will enter into our eye and we will see the image. magnification of the image is ah magnification is equal to this focal length of this lens telescope lens divided by the focal length of this eye piece; there is the magnification. through eye piece we will see the magnified image. Now, here actually we want to measure the position of the image etcetera on the focal plane; we use cross wire

this cross wire here this cross wire it’s the movable, it’s the movable We tell this is the focus knob actually what happens this cross wire actually we have to place at this focal plane, we have to place this at this focal plane. for that this we have arrangement to move this one here whatever this moving. this cross wire is set here cross wire is set here. this cross wire and this eye piece they are they are separated ok, then that one.

if I take this is the eye piece. it’s a there is no single lens here, this is a combination of lens for the this is for I think for lams then type eye piece. combination of lens is there,

but it simple way we can tell that is the this is the function of this lens is this and then for color it of this color aberration it can remove. this is the eye piece. an cross wire is inside here, cross wire is insider here.

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this is the cross wire ok; I do not know whether you can see cross wire as I told you as I told you it has three parts you know; it has three parts. Telescope this is the convex lens is there, convex lens is there it has a focal length. somewhere inside here there is a focal plane Now, at that focal plane actually I want to put this cross wire, I want to put this cross wire. there is a spinning know this is the spin, on that skin focal plane if I put the skin is this cross wires I am putting. that is act as a skin then on this skin I will see the image will found.

Now, that image I will see through this through this eye piece ok, now eye piece has again lens this eye piece lens again actually this cross wire, this cross wire is the skin which is which will be placed at the focal point of the telescope lens of the telescope lens So now, first what we have to do? We have to put this eye piece inside of this one and adjust the adjust the adjust the distance between this eye piece and this cross wire such that this cross wire will be having to be at the focal point of this eyepiece lens.

that just you can one can see one just one can see this way just put make it sharp yes, I can yes, I can make it sharp through eye piece we are seeing this is quite sharp. I have adjust is the.

Student: (Refer Time: 20:00) yeah.

Distance of the.

Student: (Refer Time: 20:03).

Eye piece from the cross wire you can see this.

Student: (Refer Time: 20:08).

Cross wire is very sharp

Student: (Refer Time: 20:11).

that way I put this adjusting the distance of this eye piece from the cross wire, I focus this cross wires Now, this we will put we will put here; we will attest here I attest here which part? You know this part will move; that means, this cross wire will move ok, eye piece will not move; eye piece is fixed I will not disturb eye piece. this is fixed with respect to the cross wire.

Now, this way I can move the cross wire means I have to put this cross wire that is screen at the focal plane of this telescope lens. that is the condition to form the image at the at the cross wire. that is what different parts of the of the telescope and already I have discuss the leveling screw; there are two leveling screw here and this focus knob this one. And I showed you eye piece, I showed you cross wire I showed you convex lens.

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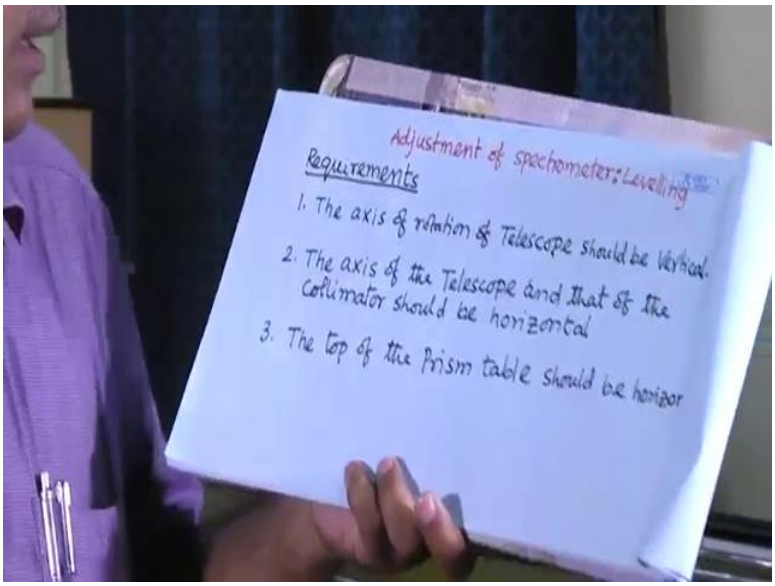

next before doing experiment we have to we have to we have to do leveling of the spectrometers; that already I have told you. What is the purpose? Why I need leveling of the telescope? Because, here you can see the rotation of the telescope for measuring the angle you know, rotation of these prism table I think I have to I have to begin it. rotation of the prism table generally we tell this Vernier table ok, prism table generally this is the prism table. this part we tell Vernier table this is the rotation

this for this rotation here we need we need the axis of rotation of telescope, axis of rotation of the telescope, axis of rotation of the telescope. These telescope is rotated. What is the axis? Axis is this one ok, it should be vertical, it should be vertical we have to make sure that axis of rotation of this telescope is vertical Then axis of the telescope and that of the collimator should be horizontal; axis of the telescope is this one, axis of the telescope and axis of the collimator this is the axis.

this axis of telescope and collimator has to be horizontal and also top surface of the prism table has to be horizontal. this is the condition for the experiment before experiment we have to make sure that vertical axis of rotation and the horizontal axis of the of the telescope and collimator, they are perfectly positioned