Experimental Physics - II
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Lecture – 09
Basic Components (Contd.)

Today I will discuss about one of the most important basic instrument in the optics laboratory, that is prism spectrometer and it's leveling.

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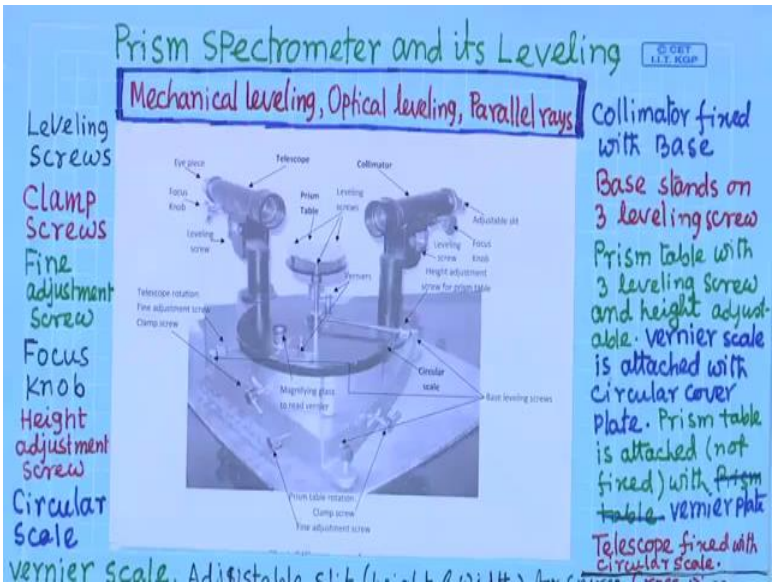

In spectrometer in optics laboratory, this prism spectrometer is used for many experiments, at least 30-40 percent experiment is based on this prism spectrometer. Before starting any experiment, there are some basic works has to be done with this spectrometer, which is we tell that is leveling of the spectrometer. This and also leveling for parallel rays.

Three steps. First step is mechanical leveling, then optical leveling, then parallel rays leveling for parallel rays. This is the picture of the spectrometer and its different parts are shown. Further parts can be can be categorized like this. What are the things are there: leveling screws, then clamp screws, then fine adjustment screws, focus knob, height adjustment screw, then circular scale, and Vernier scale.

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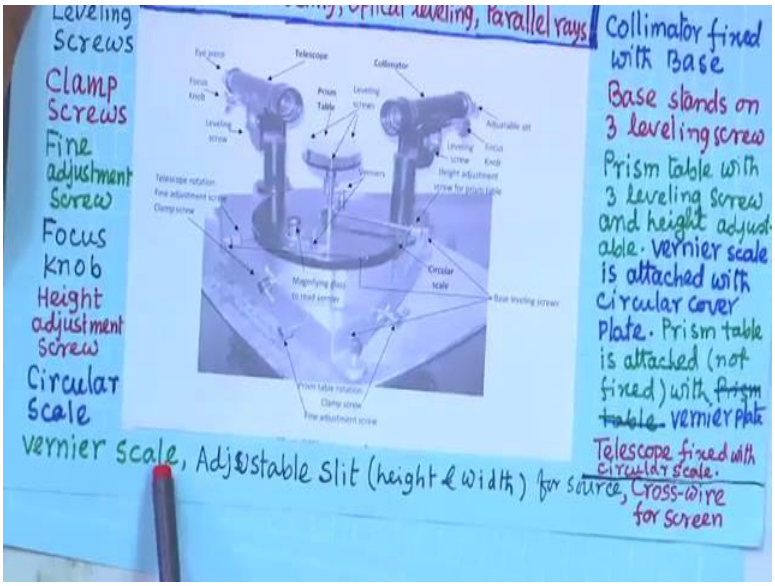

Vernier scale, adjustable slit for height and width for the source, then collimator fixed with base, base stands on. There is a collimator. Collimator fixed with base. There is a base, which base stands on 3 leveling screw. Then prism table with 3 leveling screw and height adjustment and its height is adjustable. Collimator then prism table and then telescope.

These are the three main parts of this spectrometer. The three parts, to this there are different screws I mentioned. They are used to label this collimator or prism table, and the telescope, also their adjustment or this is called this what I told this actually it is called clamp screw, yes as I showed for clamping the clamping the prism table clamping the this telescope. These clamping screws are used.

These things are whatever the screws I mention, Vernier they are attached with this with this collimator prism table and telescope. prism table with 3 leveling screw and height adjustable, its height is adjustable, and Vernier scale is attached with circular cover plate which is prism table is attached, but not fixed with the Vernier plate, cover plate. And then telescope fixed with circular scale there is a circular scale that is fixed with a telescope, and also there is a cross wire for screen where we will see the image, Vernier that will tell the screen. There is a cross wire at the screen place.

Here you see the picture if we just zoom this part, if you just zoom this part, this picture, Vernier here you can see this three made main parts is that this collimator, this is

collimator. This is collimator. And this is prism table, this is the prism table, and this is the telescope right. This is the telescope right. Here you see the collimator, Vernier this is fixed with this base.

This is based this based on 3 leveling screw, this is one, this is another, and this is I think another one is here; you cannot see, third one is here. Vernier this base is stands on this 3 leveling screw this leveling screw means if you rotate this screw, then you can just decrease or increase the this height from the ground. This collimator is fixed with this with this base, and this base stands on the on the 3 leveling screw.

Now, in collimator what things are there, in collimator what things are there here it is at this end at this end this is adjustable, adjustable slit, here is called adjustable slit, and then there is a leveling screw there is a leveling screw. And another knob is here, this knob is called focus knob. I think we should magnify this part, this part, then it will be easiest to show this leveling parts. Focus knob. And Vernier what are the things with the collimator adjustable slit here, source put here, and then this light falls on the slit and pass through the slit. This slit act as a source for the experiment, slit source, it will slit source.

And these and then this focus knob, what is the purpose of this knob that I will discuss, and other end here there is a convex lens collimator lens you tell this is the collimator lens. And this leveling screw takes a actually here this a, here there is a knob you can you can change the height to make it horizontal we can adjust the height of one end. Other end is, this end is stand this is a stand on a on a platform. With this leveling screw, with this leveling screw, you can you can you can make it like this Vernier to make it perfectly horizontal. There is a leveling screw.

Then if you come to the come to the next part prism table, say prism table there are 3 leveling screw, this is one, this is another and this is third one. Using these 3 leveling screw this platform of prism table the surface of the table is made horizontal. And this is the height adjustment; this is the height adjustment screw for prism table. you can increase or decrease the height and you can fix it. And this one, this prism table is attached with this, this cover this cover and Vernier scale is attached with this cover Vernier scale is attached with this cover. this prism table you can when you will rotate this cover, this prism table will also rotate, that means, this Vernier scale will rotate with

the prism table as well as also without, Vernier if you just rotate this prism table without rotating this Vernier scale, you can rotate this prism table.

And then this part is telescope, this is the telescope. at this end at this end again like collimator, here also there is lens, convex lens. And other end there is a eye piece. In telescope, we have a lens at this end – convex lens; at other end there is a eye piece. And it has also leveling screw like collimator you can, you can adjust the type of tilting to make it horizontal as well as there is a focus knob.

This focus knob whatever I am telling both are present at the collimator and are present at the telescope. this focus knob is used for focusing means, Vernier there is the lenses are there, and this slit source is this knob focus knob when you are you are rotating, this slit, this slit it is a move in and out move in and out. This slit attached with a tube that tube is inserted into the collimator tube. With this focusing knob, you can change the position of the position of the slit.

Focusing means, we want to put this slit the source at the focal point of the of the of this collimator lens, convex lens, Vernier that when a source is at a focal point of a convex lens, then you will get other side you will get parallel rays. If you Vernier there is a level passing, and this for other this focusing for the telescope is this eye piece here again focusing knob is there. this focusing knob we are rotating means this there is a tube, there is a tube where this cross wire is put means that cross wire plain is taken as a as a screen position, image will form on the screen.

Instead of screen, we put the cross wire. This cross wire plain act as a screen. And the eye piece, eye piece is nothing but another lens convex lens, Vernier that eye piece is that lens fixed with a tube, and that tube is put into the tube of the cross wire. And that tube of the cross wire is again put in the tube of the eye piece. eye piece is put in such a way that the cross wire will be at the focal point of the lens of the eye piece.

Now, we will not disturb the position of the eye piece into the cross active. Now, and this eye piece is it is a fixed in the fixed in the cross wire tube. Now, this focus knob, you are you are rotating means this cross wire tube is going in and out you can take in and out. we want to put that cross wire plain at the focal point of this telescope lens, Vernier that is the that is it is cause call focusing means here parallel rays are coming from the collimator, now prism table here either will put prism or the or the getting.

Now, other side diffracted or diffracted rays will come is depends up parallel rays will come. Now, that parallel rays if you want to see the image, Vernier that you have to focus on the focal plane of a lens, then this image will form at that focal point. Vernier this focus knob we are we are rotating to place the cross wire plain at the focal point of this of this lens, Vernier that is the focusing. And this is the circular scale just below this cover plate with which these Vernier scales are attached, below that one there is circular scale. And that circular scale is attached with the telescope attached with the telescope. Telescope sorry this is the telescope.

If you, Vernier if you rotate the telescope; that means, these circular scale is rotating. here this collimator is fixed, you cannot rotate, you cannot change the position. Prism table you can rotate, Vernier scale will rotate, and the telescope you can rotate. this both table will rotate with respect to a common axis, Vernier that axis passed through the center of the table. This is the axis of rotation for the for the prism table as well as the telescope.

Now, your reading will change due to the rotation of either prism table means this Vernier or the telescope means the circular scale, rotation of the circular scale. to take this reading, one has to use the magnifying glass. Vernier that here generally whatever cover on cover this Vernier are there. They are generally two magnify glass. is attached, sometimes it is attached or sometimes it is just common transparent plate is fixed. In that case you have to use magnifying glass. And there are screw this, this two screws are there it is called clamp screw.

Prism table you can rotate as well as this telescope you can rotate. After rotating, you want to fix at a particular position. You can clamp it, you can clamp prism table as well as you can clamp telescope. This two clamping screws are there. This two should clamping screw as well as there are fine adjustments screws. After clamping, Vernier if you want to change magnitude rotation of prism table or the telescope. There is a knob for fine adjustments. This is one, and this is one, and other should be I think this one.

This for this is for telescope rotation fine adjustment screws for telescope, and clamp screw for the telescope. And this is clamp screw for prism table rotation and fine adjustment screws for the prism table. Vernier there are many, Vernier there are many

components small, small components attached with the prism spectrometer. You have to know what the function of this each component is, and how to use them or what purpose.

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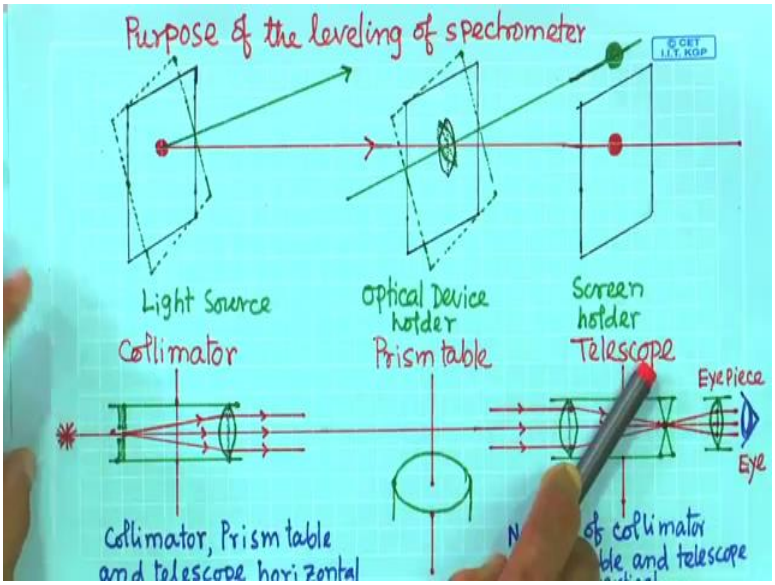

I will proceed more. If I Vernier purpose what is the purpose of what is the purpose of leveling of the spectrometer. Vernier common sense tells that or optical experiment, you need light source, there is a light source. Light will come, and then it will fall on a optical device, it will fall on a optical device. Then there will be reflection, refraction, diffraction whatever something will happen and then there will loop and there will fall image. You need screen. Source, then optical device, and then screen. in spectrometer they are equivalent components is collimator, prism table and telescope.

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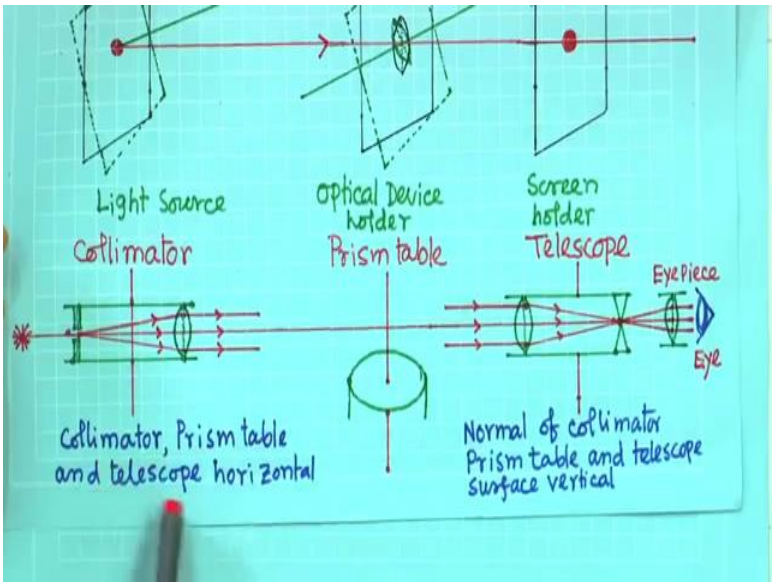

Vernier here you can see if this source of light source say this is on this on this plane, there is a hole here on this plane there is hole. Light is coming through the hole, Vernier this hole acting as a as a source. Now, if light is coming, Vernier small hole is there. Light is coming through it. Now, if this screen is not is not say vertical this way, if it is rotated if it is rotated, then what will happen, light will go along this direction. it will not go in this direction.

Similarly, if this lens it is say on this plane, it is a say holder, it is a holding this lens. Now, this if this holder is not is not this way it is not say this vertical. If it is rotated like this, Vernier what will happen what will happen, Vernier light will go Vernier image, Vernier light will go this way and image will fall here, instead of forming image on the screen here placing here. it will image will form on that place. and this screen also Vernier if it is not this way, if it is rotate, then you will not get circular image if when this source is circular.

If it is rotates, this image will be deformed. it will be optical. This is very important to keep them, to keep them vertical, to keep them vertical. that means, this collimator should be kept, collimator axis this vertical I am telling this is the it is the axis of rotation you know axis of axis of rotation. Here axis of rotation is this one. This can be tilted like this. Because this, this is the perpendicular plane. it is rotated this way or it can be tilted like this. we have to make it this way vertical with this the direction of light should be

this plane should be vertical with the direction of light. In case of collimator, this collimator this tube is like this. This is the slit source.

Now light, this, this vertical axis, it should be vertical. And this plane should be this surface or axis of the tube axis of the tube has to be horizontal, and this perpendicular to the tube it has to be vertical that is the condition. If it is not vertical, it will up and down. Now, you imagine light will go in either in this plane or this below to this plane. And if it is not horizontal, again light will go this way or light will go other way. Similarly prism table also has to be horizontal that means this normal to the prism table has to be vertical, and surface of the table has to be horizontal. Then only when any optical device like prism or gating will put here, that will remain vertical as well as its surface will be horizontal with the with the prism table.

Similarly telescope also. This telescope tube has to be, it is normal has to be vertical, and its axis length has to be has to be horizontal. collimator prism table and telescope, it has to be horizontal, and normal to the collimator prism table and telescope surface has to be vertical, that is that is a necessary that is I try to tell you showing this example that. If it is not, then what will happen we want light will go that should be this, this should be horizontal, this should be horizontal this line has to be horizontal, it is not like light should go this way or this way. That is we have to achieve it for that we need leveling of telescope prism table as well as collimator that is the purpose of the leveling.

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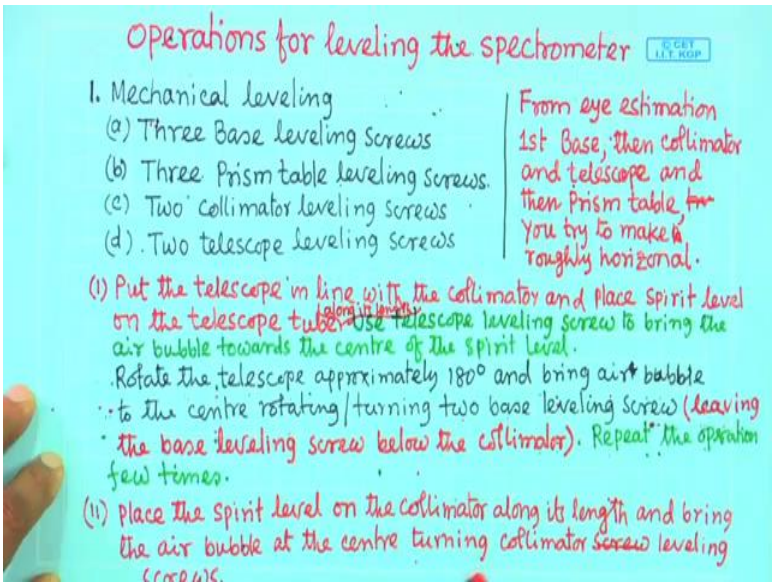

Ah how to get it, how to do this leveling? it can operations for leveling the spectrometer. There are few steps for leveling the spectrometer. First step is the mechanical leveling. in mechanical leveling, this these are the things that we have to we have to use. This three base leveling screws we will use, then three prism table leveling screws will use. Two collimator leveling screws, there are two collimator leveling and two telescope leveling screws are there below the in picture whatever I showed this one was seen, another one was not seen in the picture. This screws leveling screws will be used for the mechanical leveling.

Purpose is to as I mentioned purpose is to make the telescope prism table and collimator perfectly horizontal, and normal to them has to be perfectly vertical. first from eye estimation, this this you can you can just make leveling the base, and then collimator, and then the prism table. Collimator, then telescope and then prism table. you should try to make roughly horizontal, that is from eye estimation.

You rotate the screw adjust the screw in such a way that you make them horizontal from your eye estimation. Then put the telescope in line with the collimator. Collimator is fixed, telescope we can rotate. You have to if it is locked, you have to unlock. clamping screw are there, unlock it, you rotate it and take in line with the collimator, and place the spirit level on the telescope tube telescope tube along its length, along its length, then used telescope leveling screw to bring the air bubble towards the centre of the spirit level. This is the after eye estimation adjusting the leveling screw.

You use the spirit level put along the length of the along the length of the telescope, on telescope you put it along the length of the telescope. And then use telescope screw two screws are there, you use them, you rotate the leveling screw telescope leveling screw to bring the air bubble towards the center of the spirit level.

Now, you rotate the telescope approximately 180 degree just this close to the telescope collimator. And again repeat the again you see this whether this spirit level that air bubble is it is at the centre or it has change. Again you adjust the in that case you adjust the base leveling screw leaving the base leveling screw below the collimator. There are 3 leveling screw in the collimator sorry in the base. one leveling screw below the collimator, where sometimes this the fixed one or sometimes you adjust the height,

leaving that one the other two screw, leveling base leveling screw, that you rotate to bring the air bubble at the center.

Keeping this telescope at 180 degree that means, you close to the collimator. Then next you place the spirit level on the collimator along its length like telescope the way you put on telescope, the same way you put, and bring the air bubble at the centre turning the collimator leveling screw. Using the spirit level this way bringing the bringing the air bubble at the centre of the spirit level.

First telescope you are making, we are making horizontal using the telescope leveling screw, then telescope putting at 180 degree we are using the base two base leveling screw leaving the third base leveling screw below the collimator. Repeat the operation few times for this. Then this your telescope is mechanically horizontal, then we make the collimator horizontal using this spirit level, and turning the collimator leveling screw.

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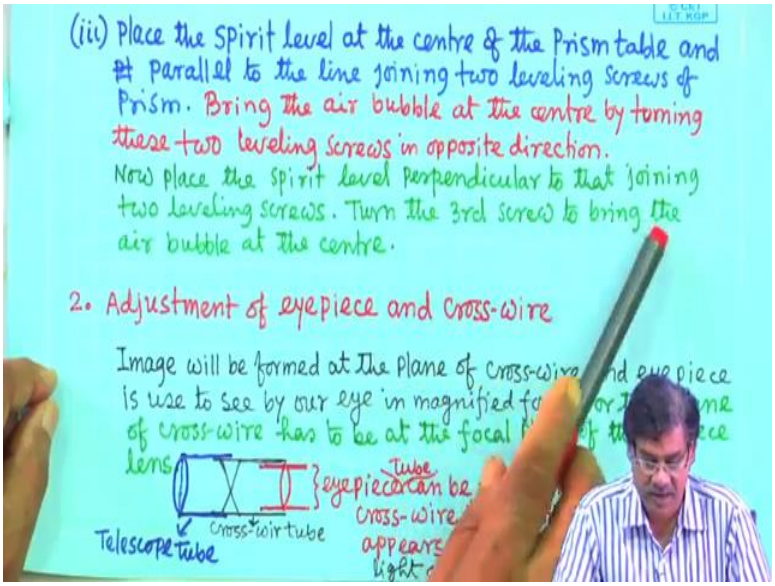

And then you will place the spirit level at the centre of the prism table. And in prism table there are 3 leveling screw. Spirit level you put in such a way that it will be parallel to the line joining two leveling screws. Now, to bring the air bubble at the centre of the spirit level, turn these two screw these two screw this which are parallel to the spirit level in this screw you rotate it in opposite direction.

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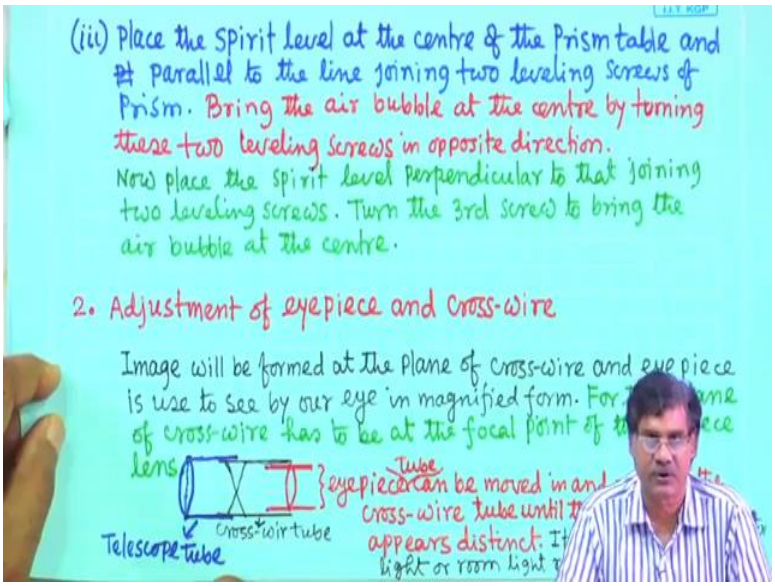

Opposite direction means if one is clockwise, other one would be anticlockwise. Its height of this one side is increasing, height of the other side will decrease. because for leveling it is put in parallel to this two screw, to bring the air bubble at the center, it is necessary if it will be necessary to increase the height of one corner means we are using one screw. Definitely this other side it has to be opposite. That is how we tell rotate them in opposite direction.

Now then place this spirit level perpendicular to that line perpendicular to that line joining which line that joining the two leveling screw, and putting in perpendicular to that joining two leveling screw, you turn the third screw to bring the air bubble at the at the center. and then you repeat this, this operation few times, that this spirit level this air bubble in the spirit level it will remain the remain at the center. That is then your mechanical leveling for the telescope, and then collimator, and then prism table, all these three main components is done. I will stop here. In next class I will continue the other adjustment.

Thank you for your attention.