

4DX Systems AB
Uppsala Sweden

Instruction Manual
for the
Microspectrophotometer

XSPECTRA

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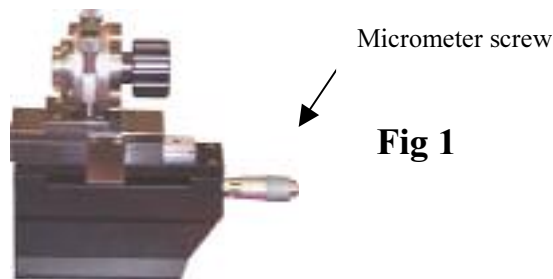
Microspectrophotometer without detector

Getting Started

Remove the two objectives BEFORE you take away the first foam rubber plate.

When you have unpacked the microspectrophotometer, check that all parts looks OK. If you find anything that has been damaged during the transport, contact 4DX Systems AB or the transporting company.

The most sensitive parts are the objectives and the stand with the rotary stage. When you unpack and handle the rotary stage, be very careful with the micrometer screw. See Fig 1.



The microspectrophotometer consists of:

	Pcs
1) Base + stands for objectives, microscope and illumination lamp	1
2) Stand with rotary stage	1
3) Mirror house + 1 frosted glass plate	1
4) Microscope	1
5) Illumination lamp with holmium filter	1
5) 1 spare lamp to illumination lamp	1 *
6) Objectives	2
7) Screws, one with a foot	2
8) Fibre optic cable UV50/60 (objective – lamp)	1
8) Fibre optic cable UV400/440 (objective – detector)	1
9) Light guide (mirror house – illumination lamp)	1
10) Power supply for illumination lamp	1
11) Polarizing filter (microscope)	2
12) Lock wheel	1 *
13) Protection (objectives)	2
14) Pinhole + holder	1 *
15) Spare pinholes	2 *
16) Allen keys for objective adjustment	2 *

* The items can be found in the small yellow suitcase.

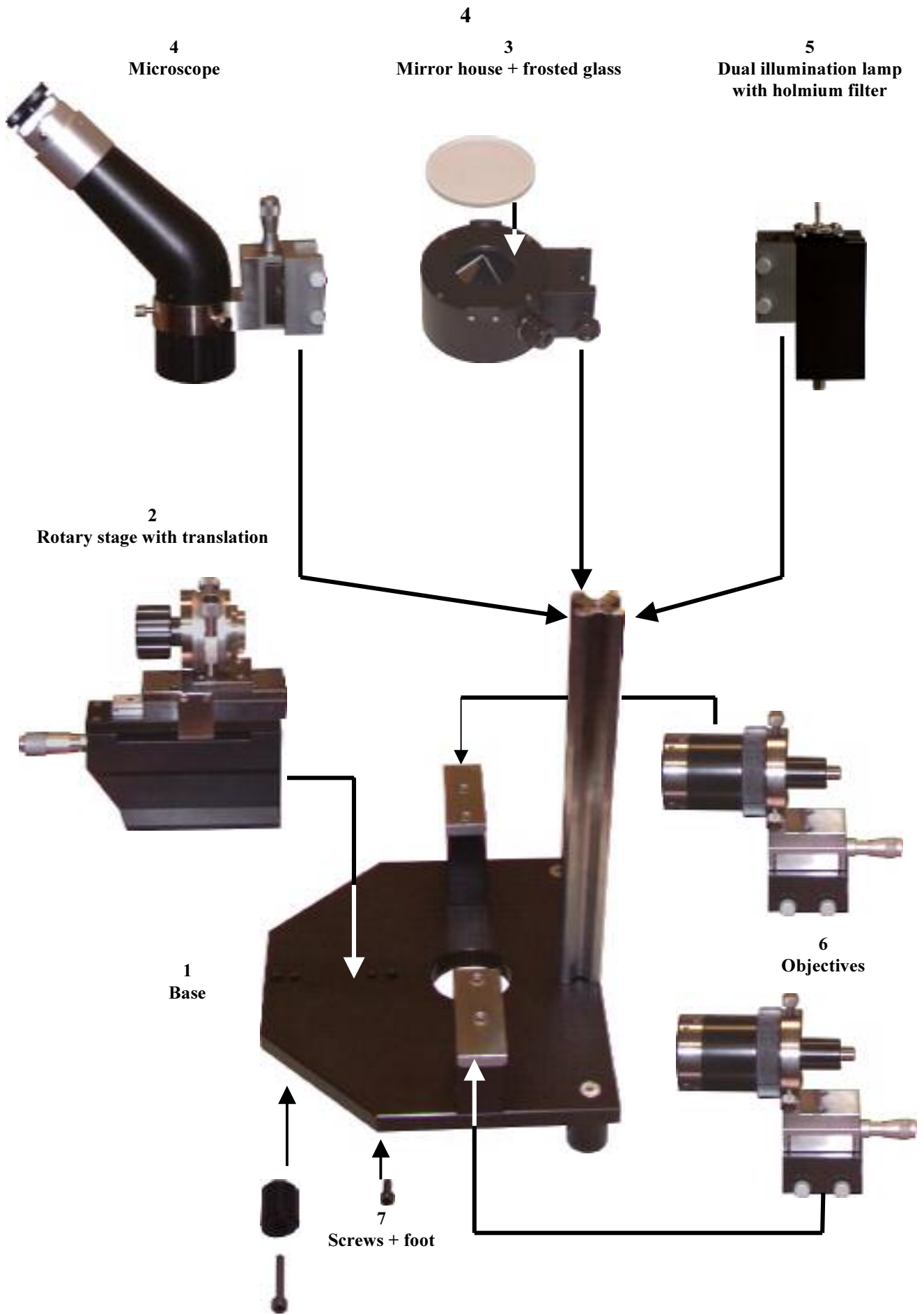


Fig 2

5



8

Fibre cables to objectives
UV50/60 1 pcs
UV400/440 1 pcs



9

Light guide to the mirror house



10

Power supply



11

2 x polarizing filter
(microscope + mirror house)



12

Tool for tightening objectives



13

Protection (objectives)
2 pcs



14

Pinhole + holder



15

Spare pinholes
2 pcs



16

Allen keys for objective adjustment

Fig 3

Assembly

When you start to assemble the microspectrophotometer, use the instruction below together with Fig 2.

- 1) Take away the paper under the mirror house (3) and bring the house down to the bottom, to the base (1). Tighten the 2 screws.
- 2) Mount the stand with the rotary stage (2) on the base (1). There are two steering pins that will fit into the base. Tighten the two screws (7), one with a foot, from underneath.
- 3) Hang the microscope (4) on the stand. The top of the sledge should be at the same level as the top of the stand. Tighten the four screws properly.
- 4) Hang the illumination lamp (5) on the backside of the stand, with the switch facing up.
- 5) Put the sledge with the objective (6) on the stand, one on each side. Fully unscrew the 2 screws facing you, place the **front** of the sledge about 5 mm back from the level of the stand, see Fig A. Tighten the 2 back screws and then the 2 front screws. Repeat for the other objective.
- 6) Connect the light guide (9) between the lamp and the mirror house. There is a hole for the cable on the side of the lamp. On both sides, on the illumination lamp and on the mirror house, there is a 2 mm allen screw to fix the cable, if necessary. Connect the power supply to 220 V.

When this is done, the set up should look like on Fig 4.

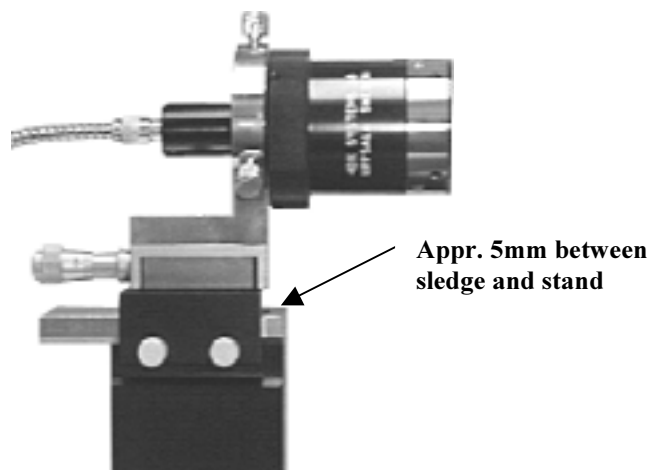


Fig A



Fig 4

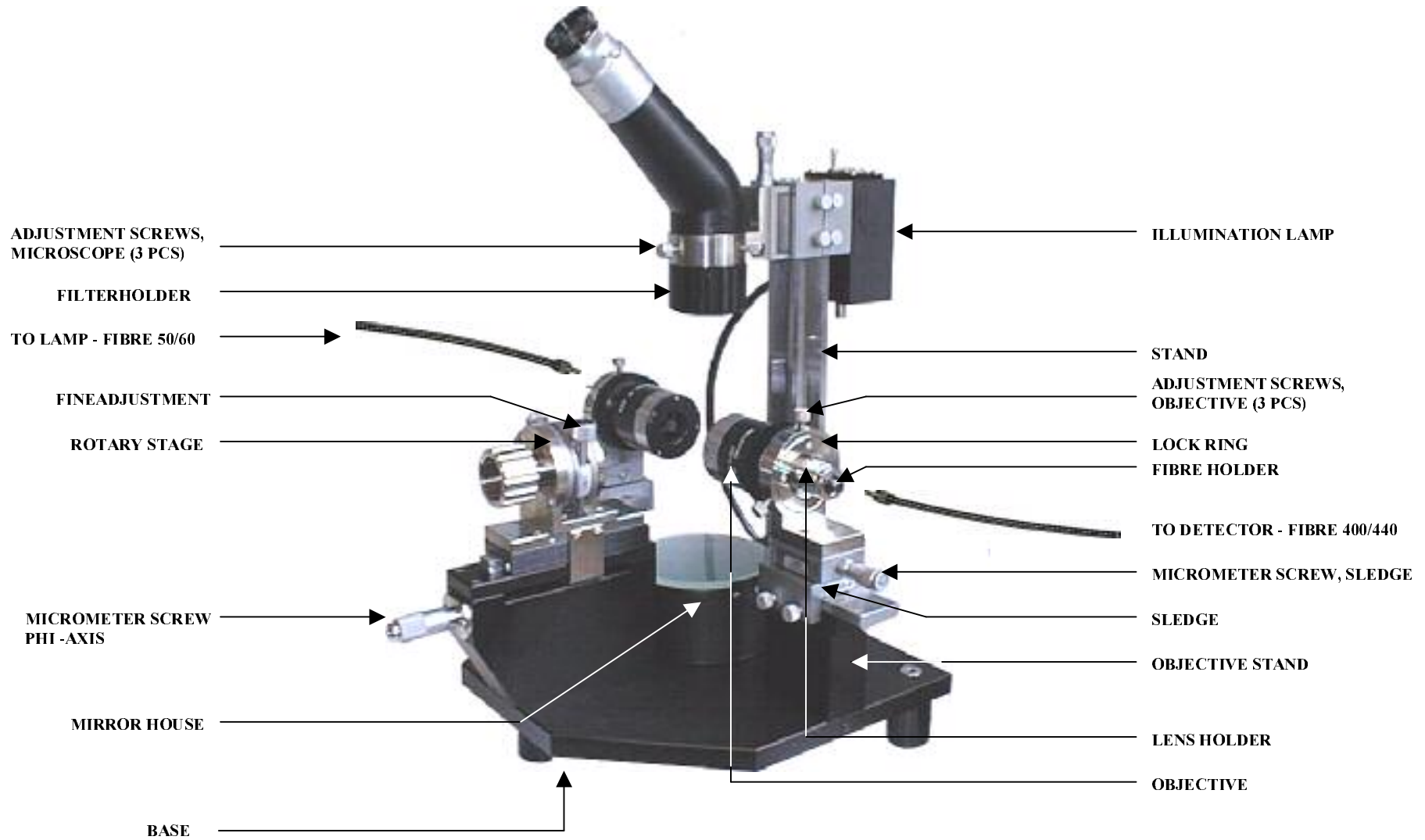


Fig 5

Alignment of Xray equipment, an example

To measure on a crystal, we need:

- 1) An X-ray or a light source
- 2) A crystal or some other sample
- 3) A microscope for alignment of the crystal
- 4) A detector

The relation between 1-4 is:

- a) The beam must hit the crystal, independent of how we spin it around its own axis.
- b) The beam must also hit the centre of the detector.
- c) The crosshair in the microscope must be in the centre of the crystal, also independent of how we spin it around its own axis.

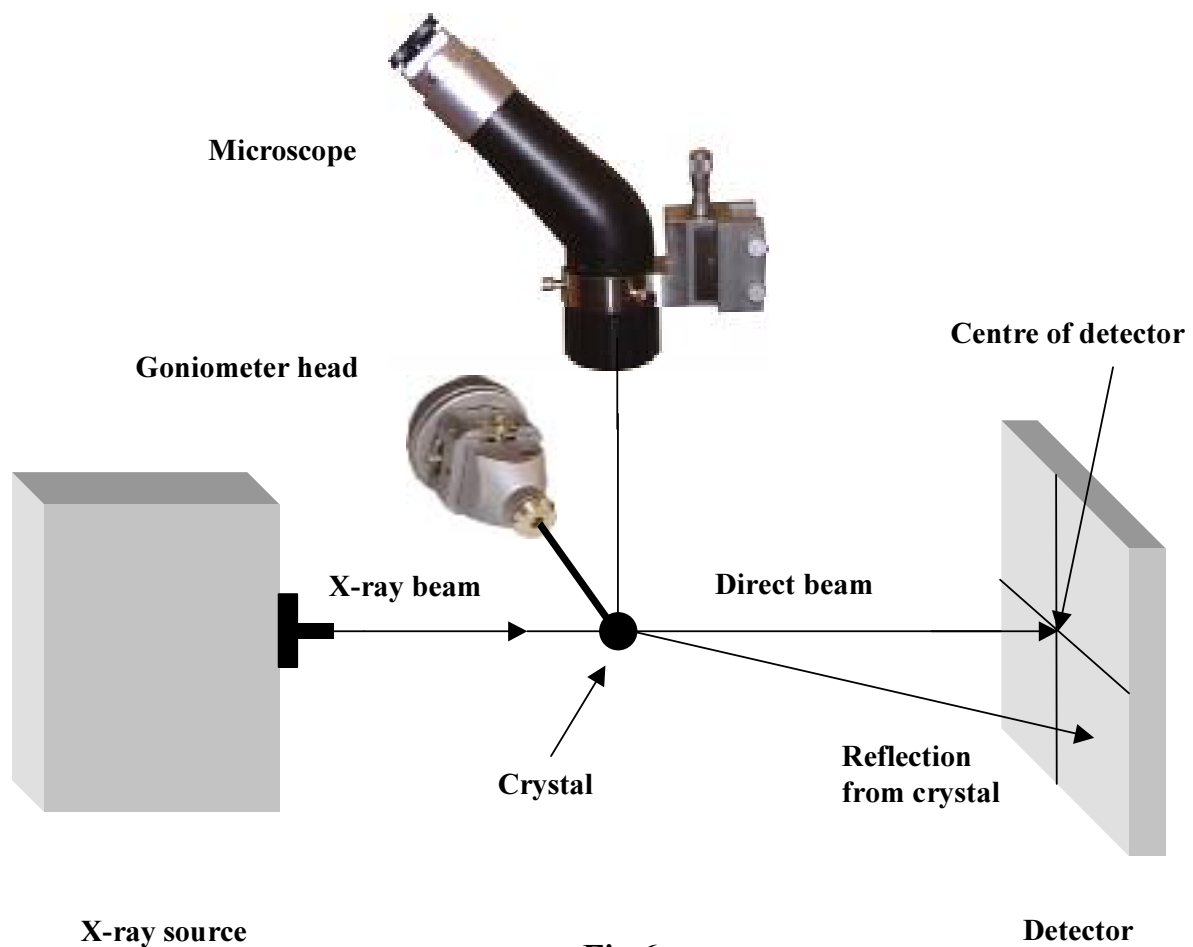


Fig 6

To be able to do this alignment, all four parts must be adjustable in the x and y direction. In fact, they should also be adjustable in the z-direction, but we will come back to that.

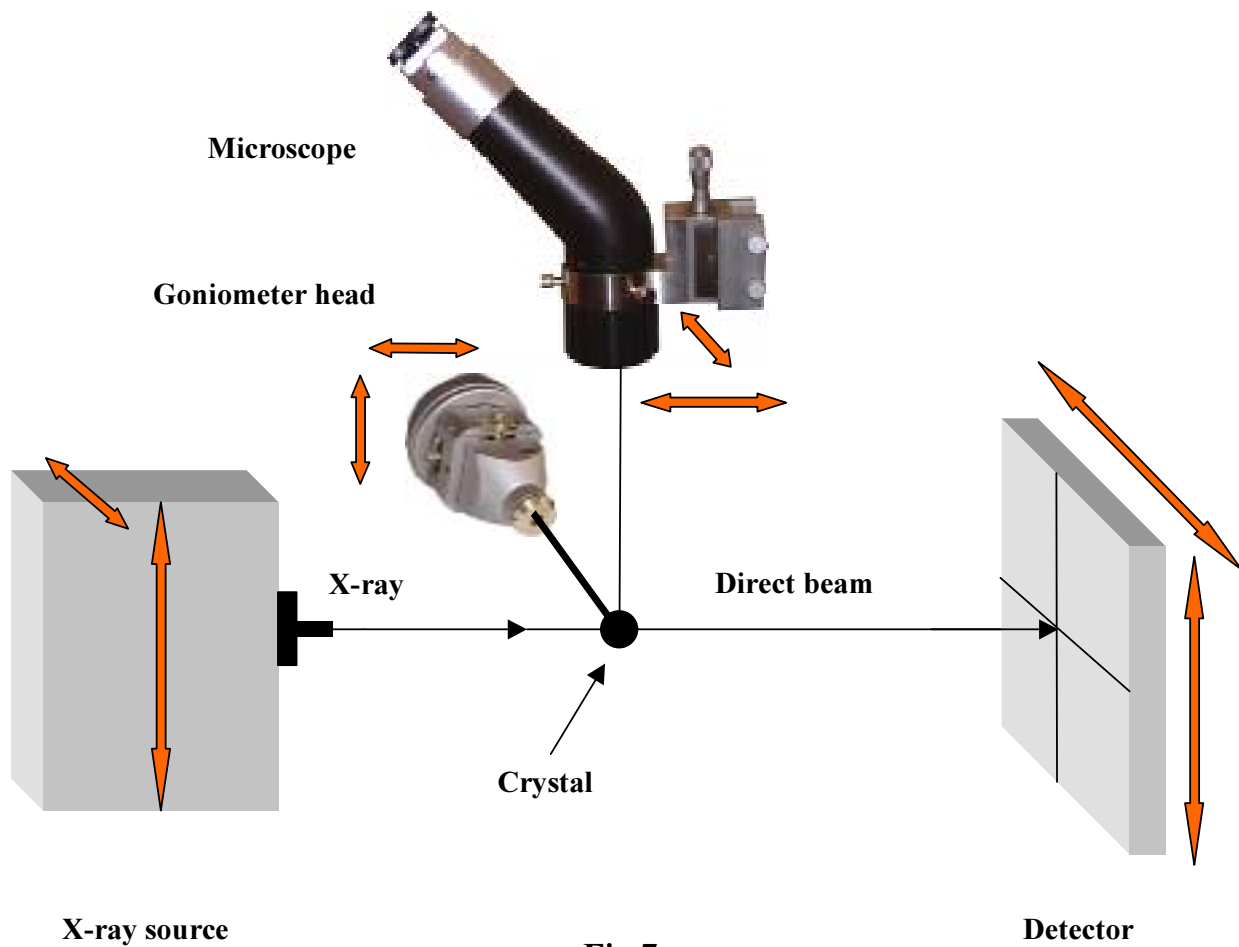


Fig 7

Alignment of the microspectrophotometer

As can be seen in fig 8, we have replaced the Xray source and the detector by two objectives. The procedure for alignment is the same. We have also replaced the crystal by a pinhole. A pinhole is a small plate (3mm diameter) with a very small hole, 12.5-25 μm , in the middle. See fig 9. The pinhole makes it very convenient to align the objectives and microscope.

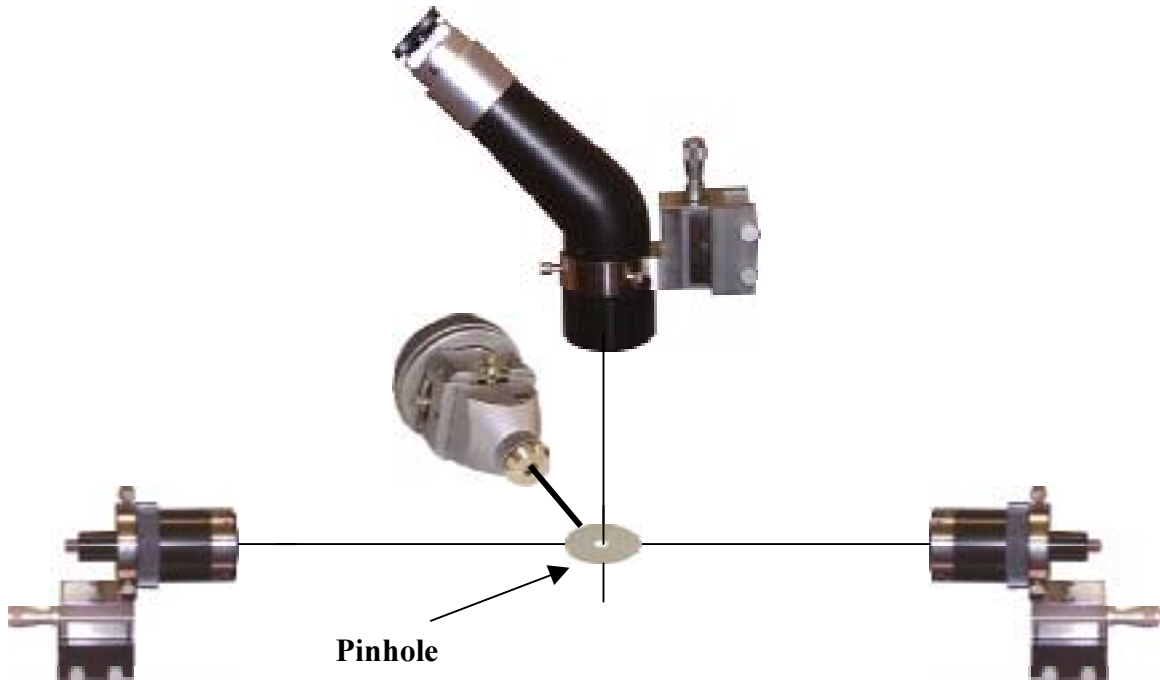


Fig 8

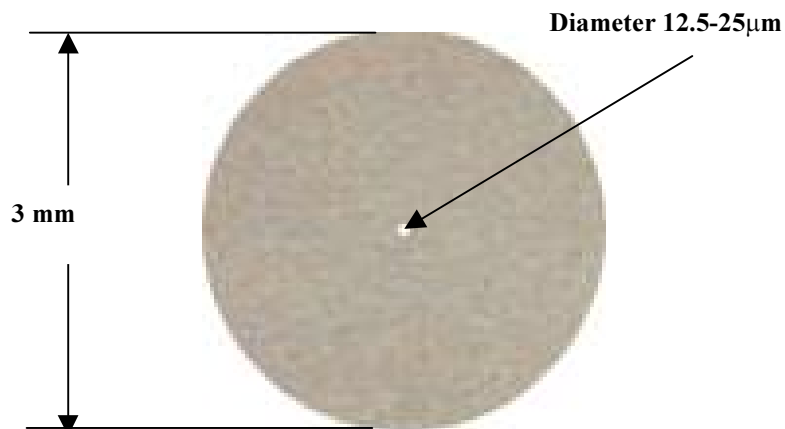


Fig 9

In turn we have to adjust:

- 1) The crystal or pinhole on the goniometer head
- 2) The microscope
- 3) The two objectives

Goniometer head

The goniometer head can be adjusted in two directions. See Fig 10.

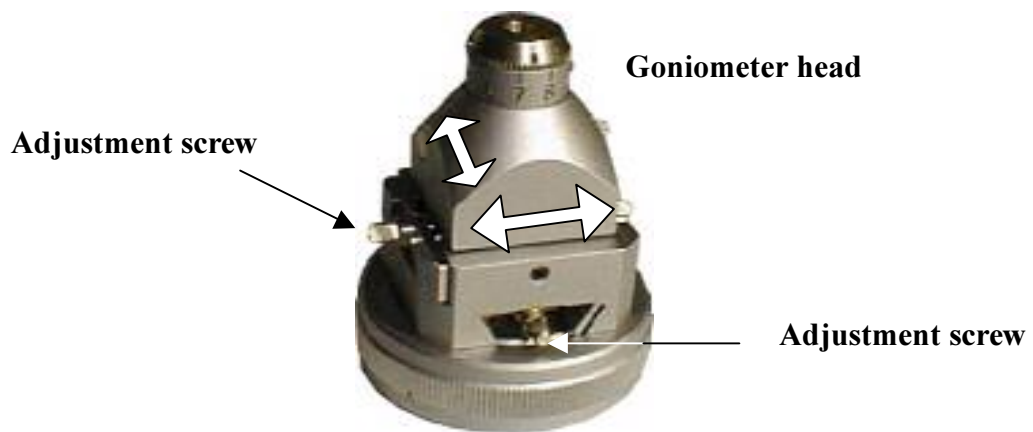


Fig 10

Fig 11A shows a bad adjusted goniometer head, with an eccentric movement, and fig 11B shows a good adjusted goniometer head.

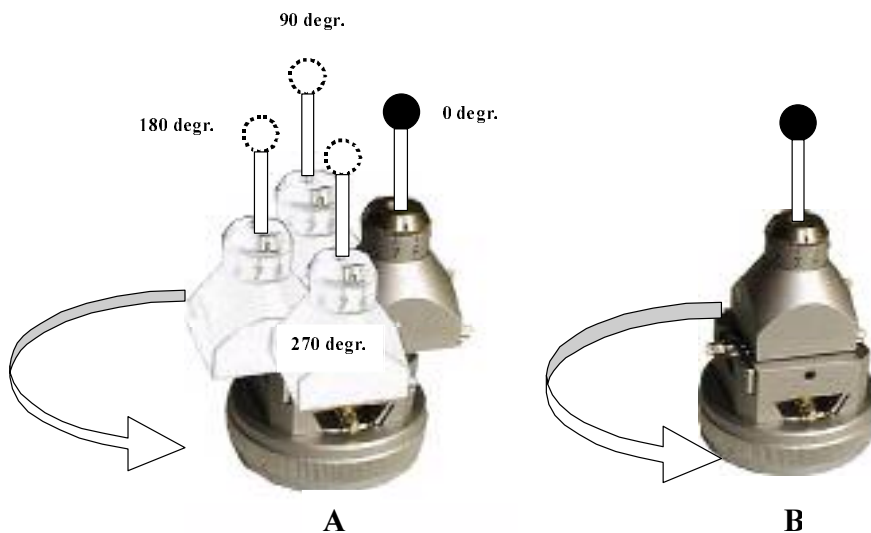


Fig 11

Mounting of pinhole

Loosen the lock screw on the holder of the pinhole holder and put it very carefully on the goniometer head. **The pinhole is very fragile.** It is important that the surface of the pinhole is parallel to one of the adjustment screws on the goniometer head. It doesn't matter which one. That makes it easier to adjust the pinhole later.

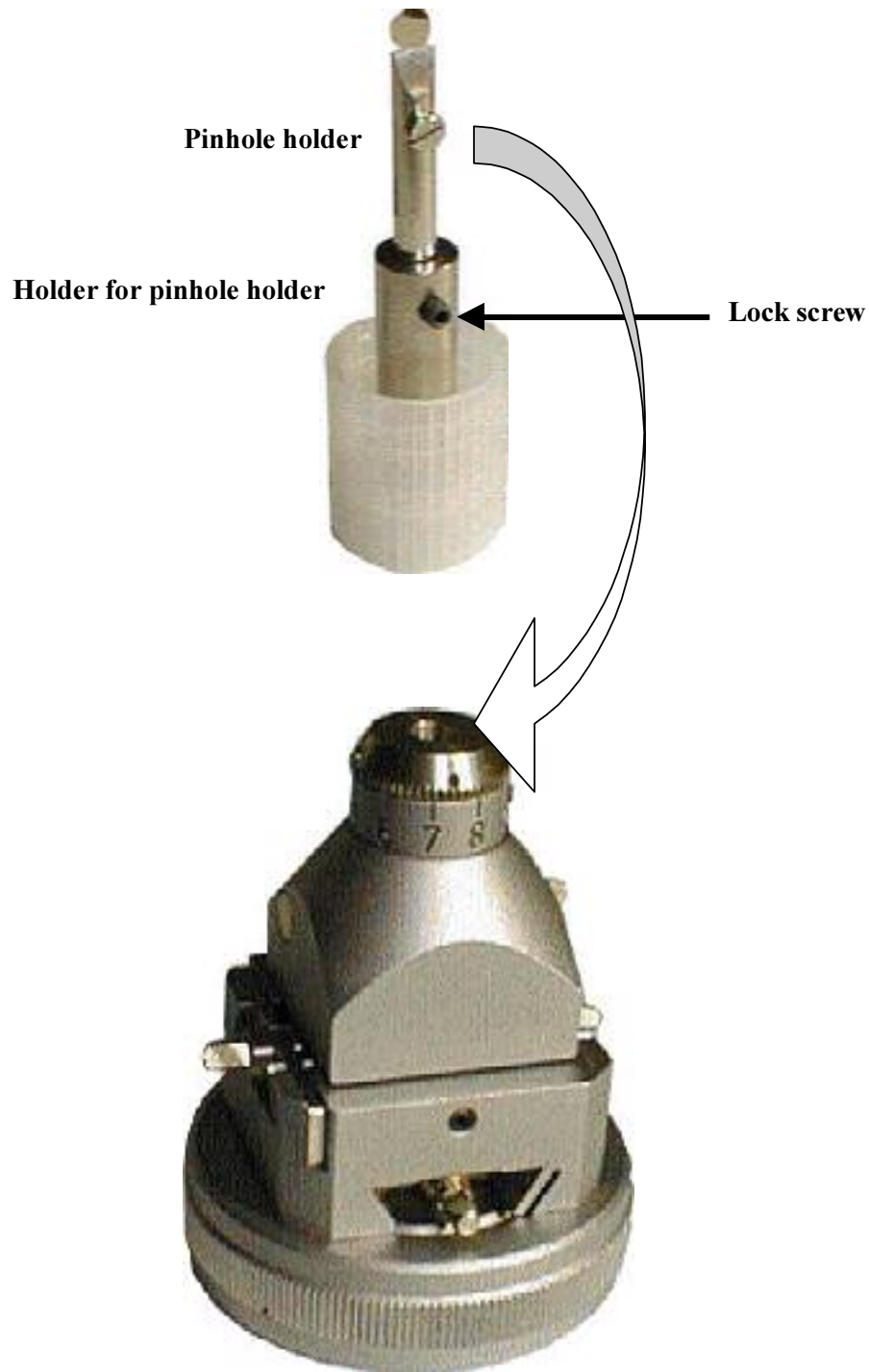


Fig 12

Alignment of pinhole (crystal)

If we put a crystal on the goniometer head, we must be able to rotate the head 360 degrees without any movement of the crystal. It must be still in the space. To do this we use the two adjustment screws.

To make the adjustment as easy as possible, turn the goniometer head so that the adjustment screws are perpendicular to the microscope axis. See fig 13.

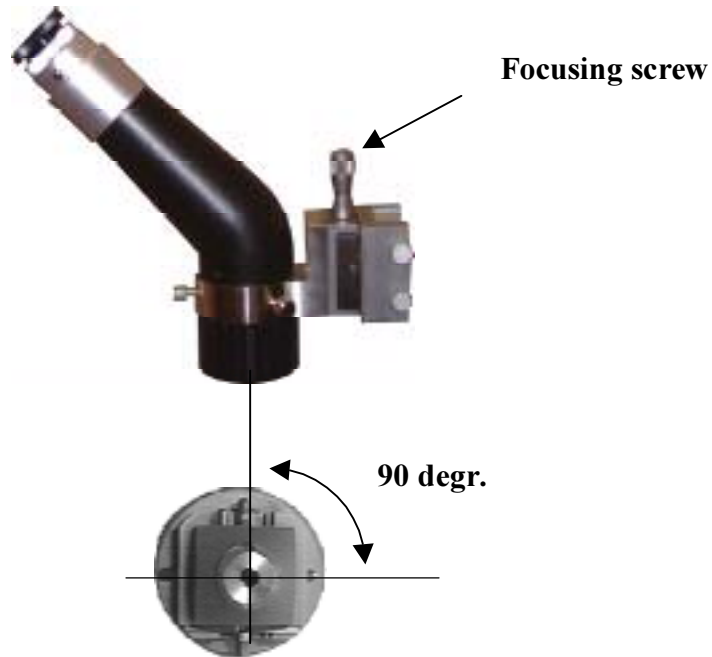


Fig 13

- 1) For this adjustment, look into the microscope, without taking any notice of the cross hair at this moment. Just observe the position of the pinhole and adjust the focusing screw (fig 13) for a clear picture. Adjust the micrometer screw on the rotary stage (2) so that the pinhole lies on the X-axis in the microscope. Notice the exact position of the goniometer head, in degrees. This we will call 0 degrees.

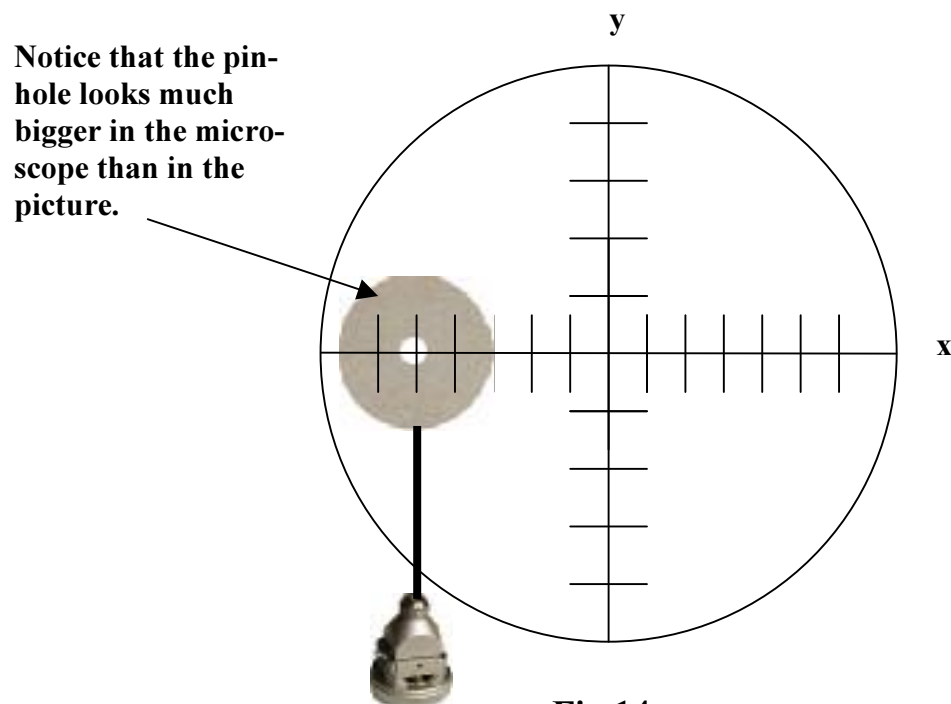


Fig 14

- 2) Turn the goniometer head **exactly** 180 degrees and observe the new position.

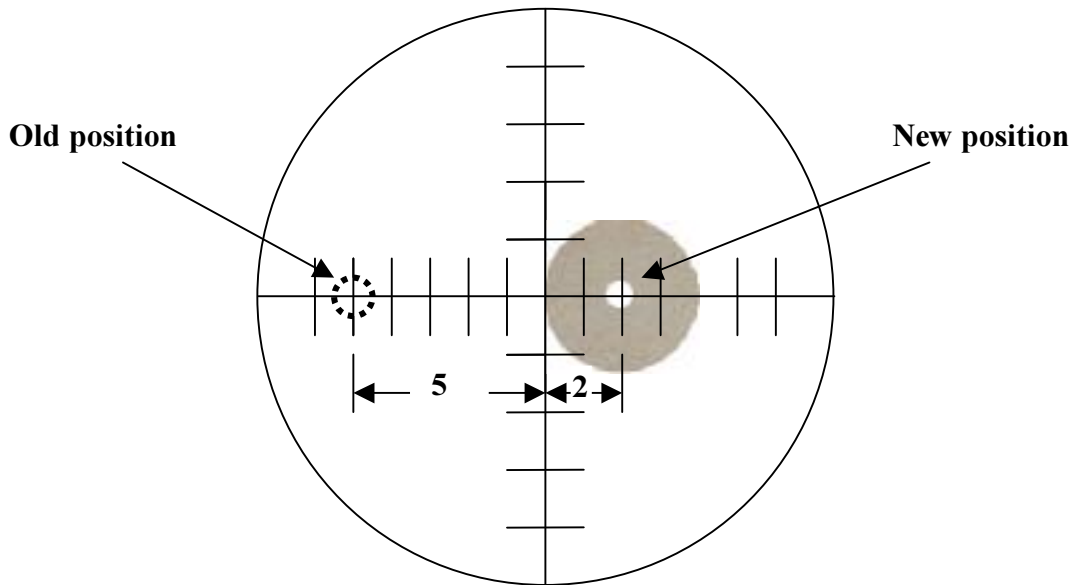


Fig 15

- 3) Now, adjust **HALF** the error with the horizontal adjustment screw on the goniometer head. ($5+2 \text{ lines}/2=3.5$).

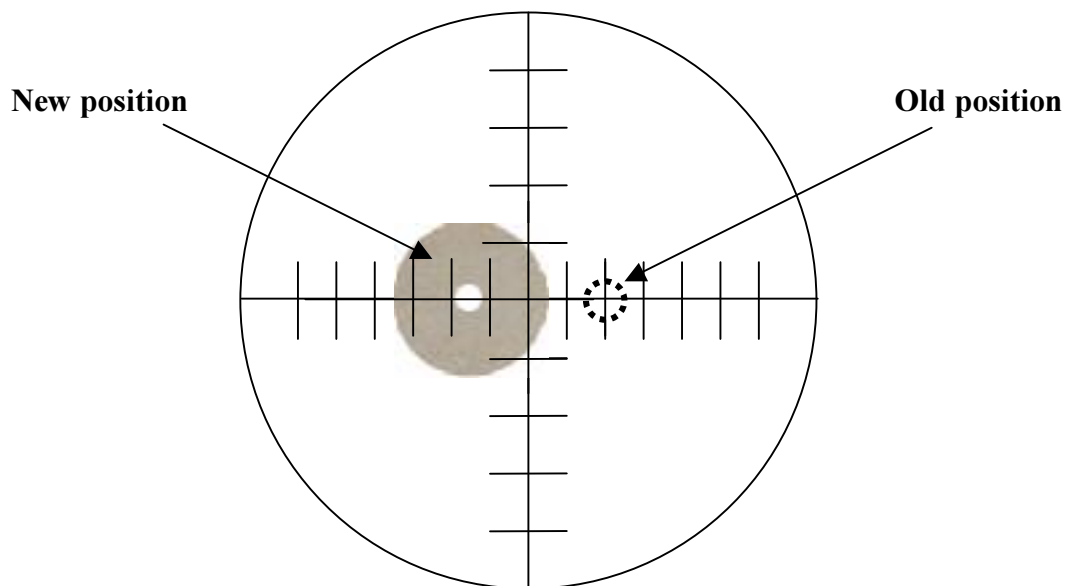


Fig 16

- 4) Repeat step 1-3 until the pinhole is in the same position for both 0 and 180 degrees.

- 5) Turn the goniometer head to 90 degrees and observe its position on the scale. Now you will see just the edge of the pinhole
- 6) Turn the goniometer head to 270 degrees and observe the position.
- 7) Now, adjust **HALF** the error with the other horizontal adjustment screw on the goniometer head.
- 8) Repeat step 5-7 until the pinhole is in the same position for both 90 and 270 degrees.
- 9) Repeat step 1- 8 until the pinhole is totally still when you rotate the goniometer head 360 degrees.

If this procedure was done properly, the final position of the pinhole will be as in Fig 17.

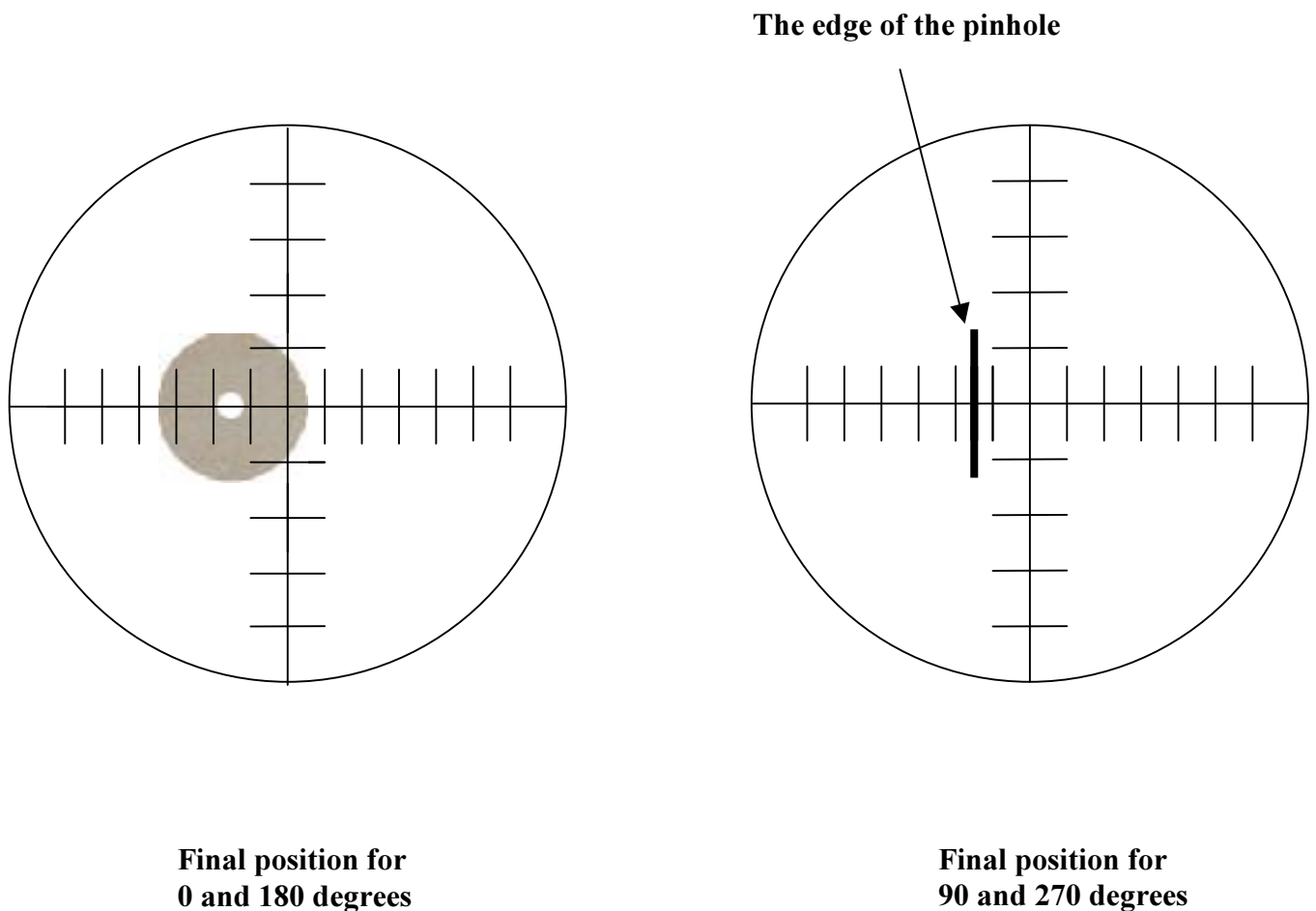


Fig 17

Microscope adjustment

Now we know that the crystal is adjusted and can be rotated without moving. Next step is to adjust the microscope so that the cross hair comes **EXACTLY** in the centre of the crystal, pinhole.

The microscope has three adjustment screws. Adjust them so that the picture in the microscope looks like fig 18. If it is hard to turn them, loosen the filter holder slightly. Turn the pinhole to 0, 90, 180 and 360 degrees and check that the pinhole remains in the crosshair.

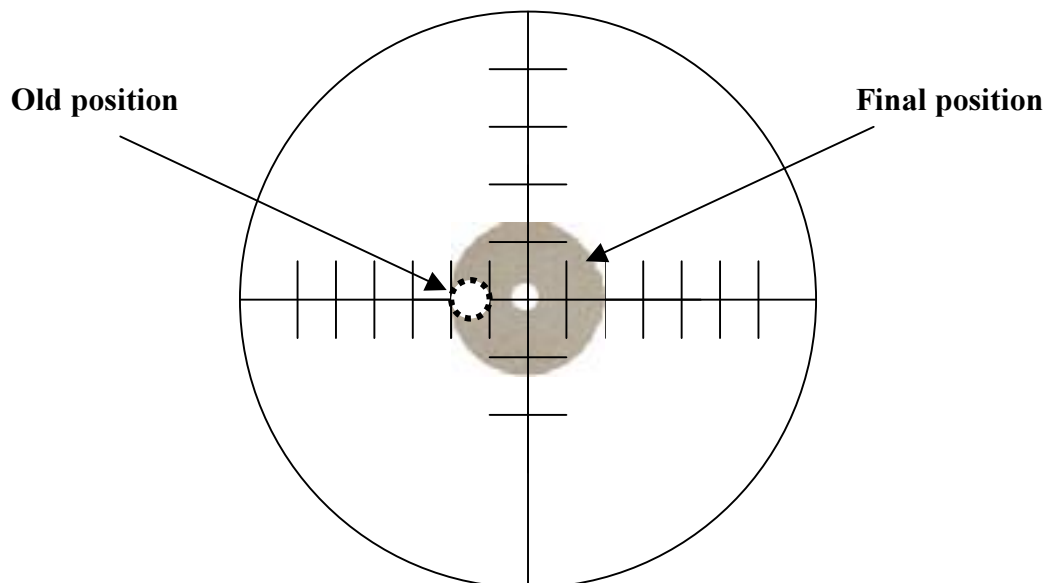
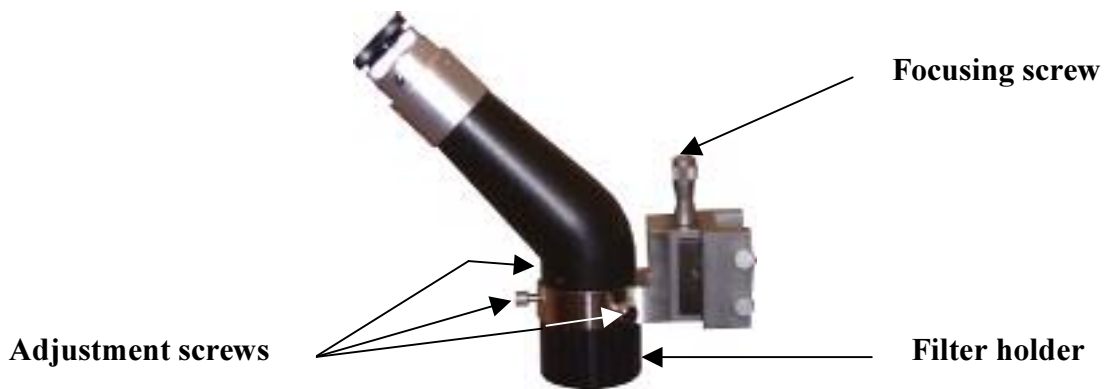


Fig 18

The crystal and the microscope are now aligned:

Objective adjustment

Now it is time to adjust the objectives.

- 1) Connect a fibre cable, **UV50/60** (No.8 on Fig 3), between the illumination lamp and the left objective, fig 19. Turn on the lamp.



Fig 19

- 2) Turn the pinhole so that the angle to the objective is appr. 45 degrees. Fig 20.

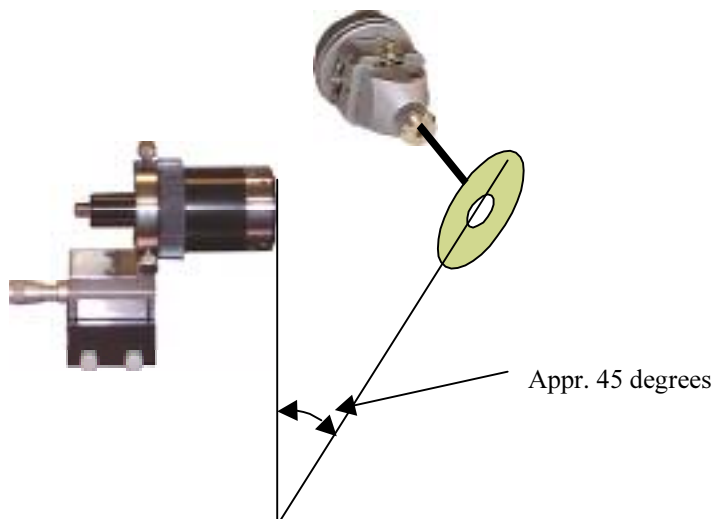


Fig 20

- 3) Look into the microscope. Use the three adjustment screws on the objective, fig 21, to find the light spot. It may be necessary to first look right on the pinhole, not through the microscope, to find it. As can be seen in fig 21, it is possible to move around the objective in the outer ring, with the adjustment screws.

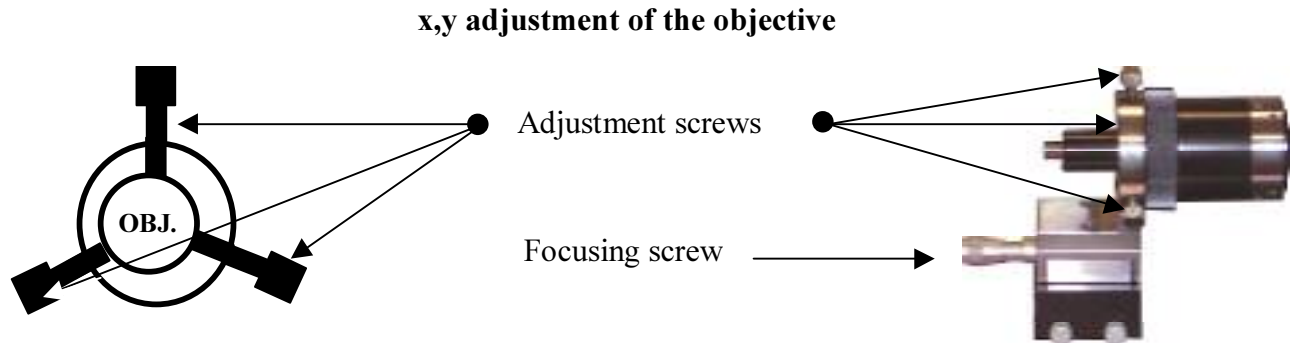


Fig 21

Fixing the objective

Depending on if it is hard or too easy to move around the objective with the screws, it maybe necessary to tighten or untighten the lock ring on the objective holder. Use the tightening tool, no 12 in fig 3, and put it with the two pins towards the backside of the objective holder. Fig 22 shows the lock ring with four holes. Tighten or untighten it appropriately.

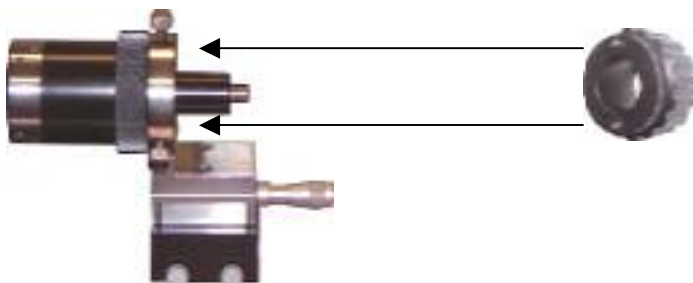
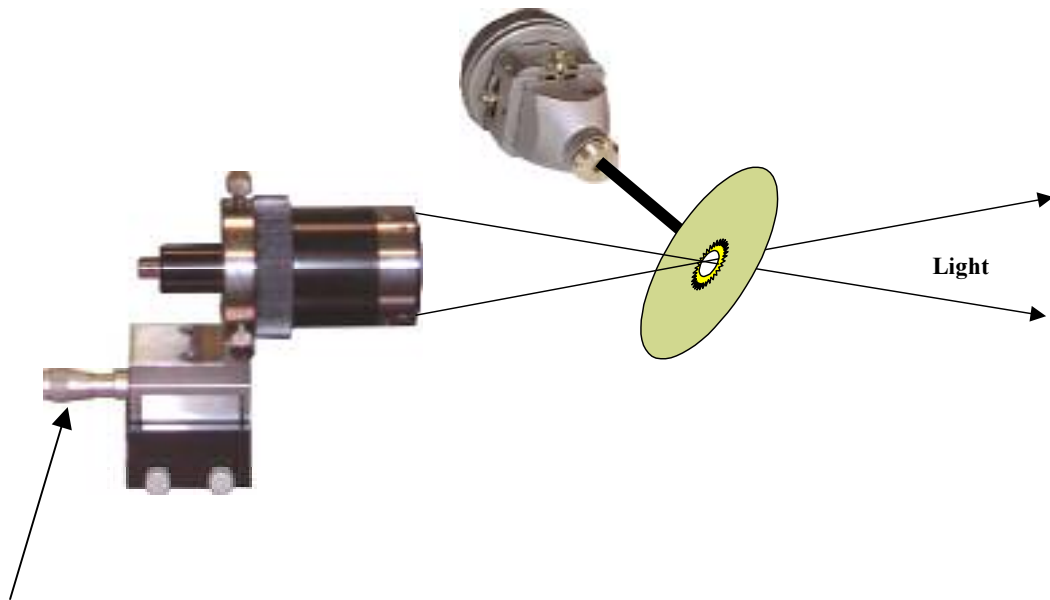


Fig 22

- 4) When you can see the spot in the microscope, adjust the focusing screw, fig 21, so that the spot becomes as small as possible, fig 23. At the same time, you may have to adjust the pinhole, by turning it back and forth a little bit, so that the spot is as clear as possible. As can be seen in fig 24, the spot will be bigger if you increase the distance to the pinhole (c). The same thing will happen if you decrease the distance (a). After adjustment of the three screws on the objective and the focusing screw, the picture in the microscope should look like in fig 24 b.



Focusing screw

Fig 23

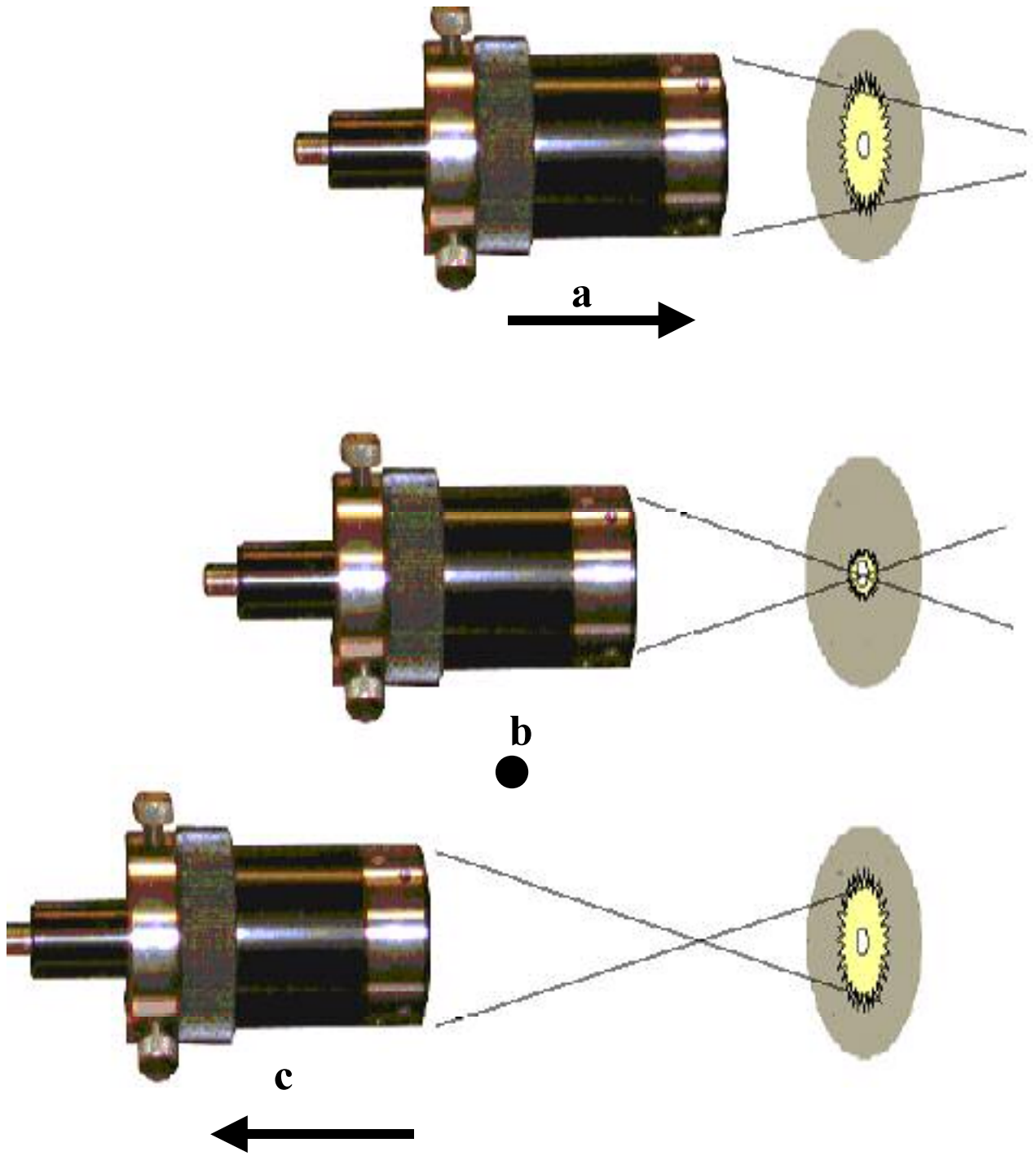


Fig 24

- 5) Turn the pinhole 180 degrees and check that the spot still is in the centre.
- 6) Loosen the fibre cable from the illumination lamp (not on the objective side). Connect the other fibre cable, **UV400/440** (No.8 on Fig 3), between the illumination lamp and the **right** objective. Turn on the lamp. Repeat step 2-5. As can be seen on the pinhole, the light spot from the right objective is much bigger. That is because the diameter of this fibre is bigger. Try to avoid the brightest spot, by turning the goniometer head (the pinhole) a little bit.
- 7) **After these alignments, do not touch any of the screws. If so, the spectrophotometer has to be realigned.** It is also recommendable to leave the two fibre cables on the objective side in place, since even a slight change of the fibre position in the fibre holder can affect the beam position on the crystal or the pinhole.
- 8) Connect the fibre cable from the left objective (50/60) to a lamp and the fibre cable from the right objective (400/440) to the detector.

Done.

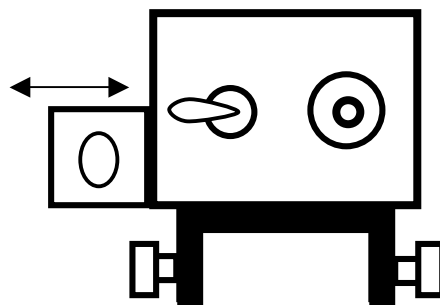
Good luck.

Illumination lamp with Holmium filter

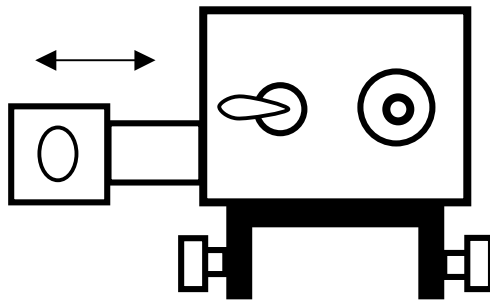
This model of the illumination lamp has a holmium filter which makes it possible to calibrate the spectrograph/detector. When the Andor software is running, you will be asked to take a:

- 1) "Background" = **Closed** on the illumination lamp.
- 2) "Reference" = **Open without** holmium filter on the illumination lamp.
- 3) "Take signal" = **Open with** holmium filter on the illumination lamp.

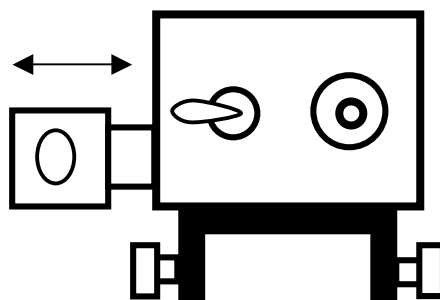
The Holmium spectrum can be found on page 25.



Closed



Open, without holmium filter

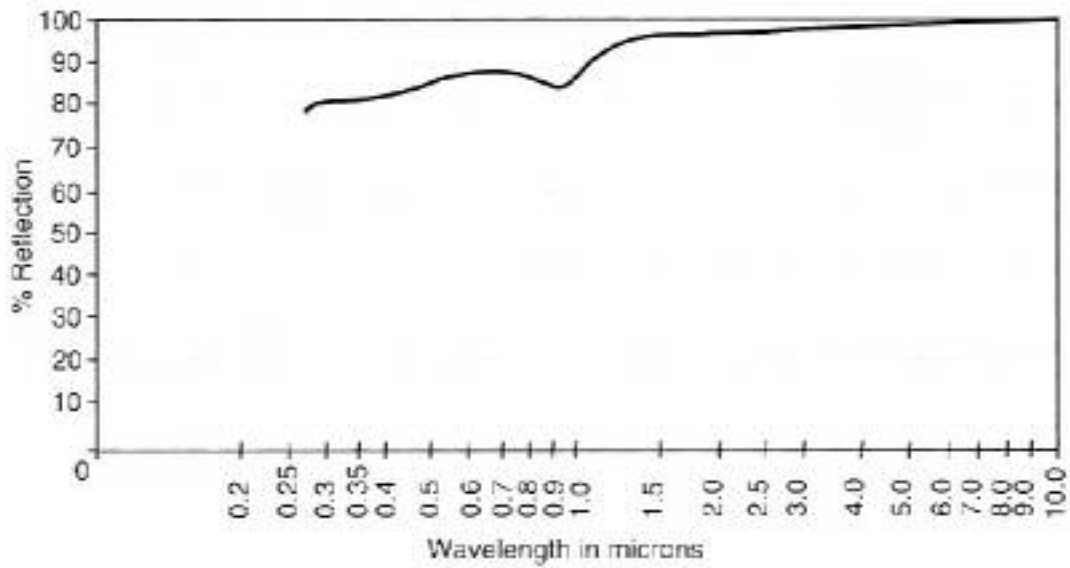


Open, with holmium filter

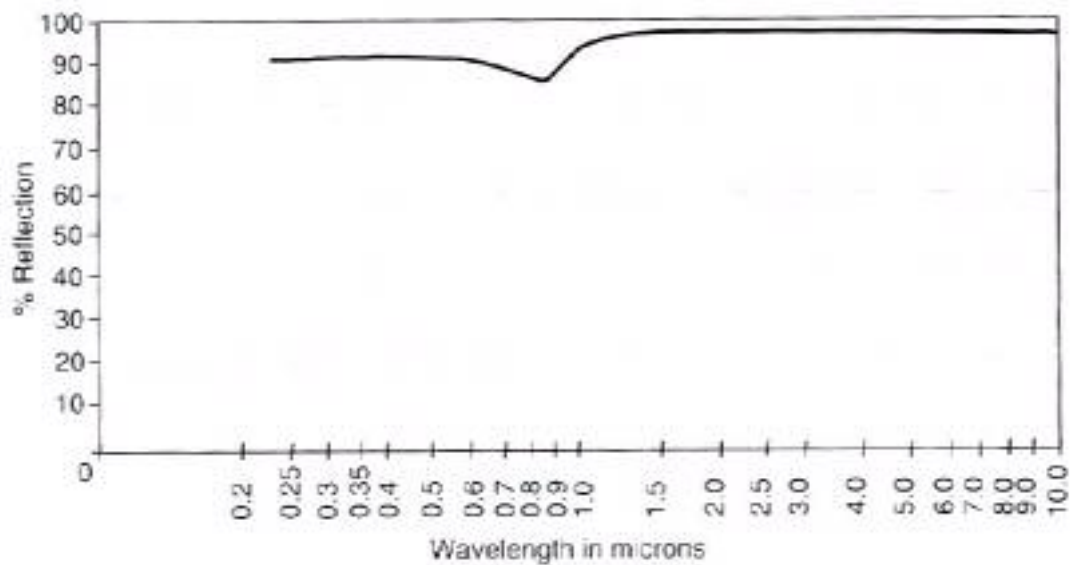
OBJECTIVE SPECIFICATIONS

Focal length	13.0mm
Magnification, 160mm tube length	X15
Visual field of view at object	1.2mm
Numerical aperture	0.28
% of central area obstructed	17.5%
Working distance (approximate)	24.0mm
Length from RMS shoulder	50.7mm
Maximum external diameter	46.0mm

Protected Al. Coating

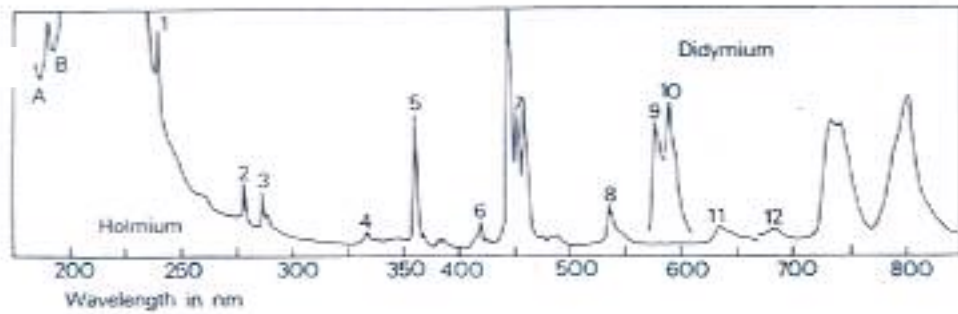


Unprotected Al. Coating

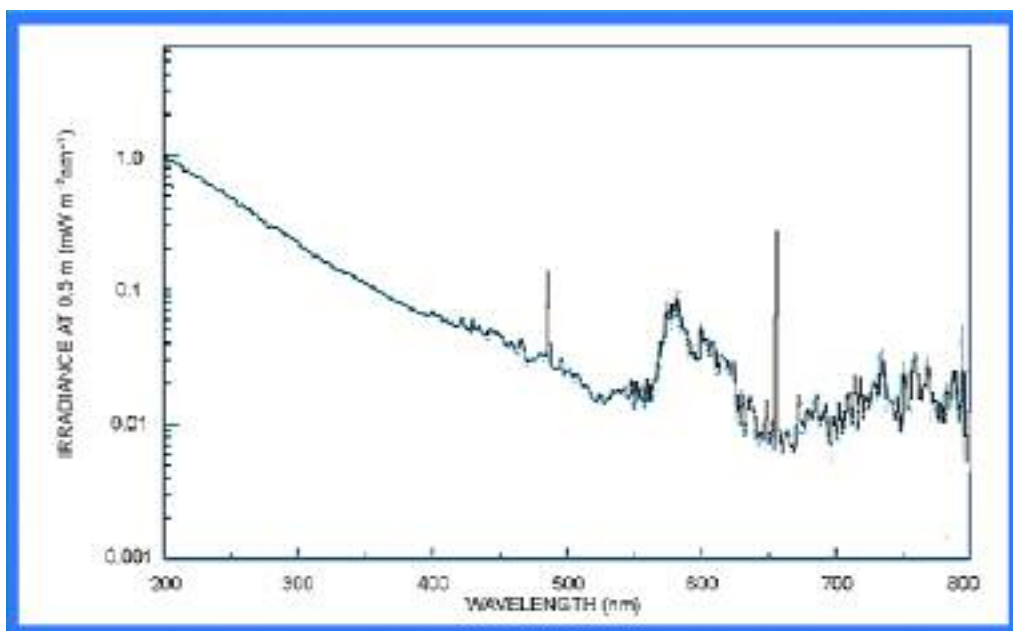


Holmium and Didymium Spectrum

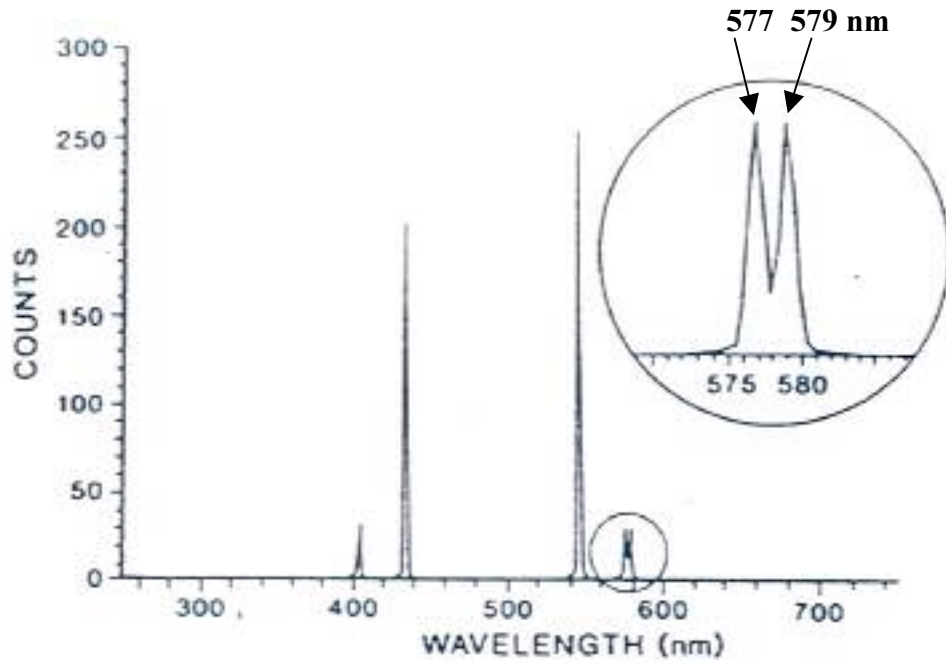
1	H	241.5nm	8	H	536.2nm
2	H	279.4nm	9	D	573nm
3	H	287.5nm	10	D	586nm
4	H	333.7nm	11	H	637.5nm
5	H	360.9nm	12	D	685nm
6	H	418.4nm			
7	H	453.2nm			



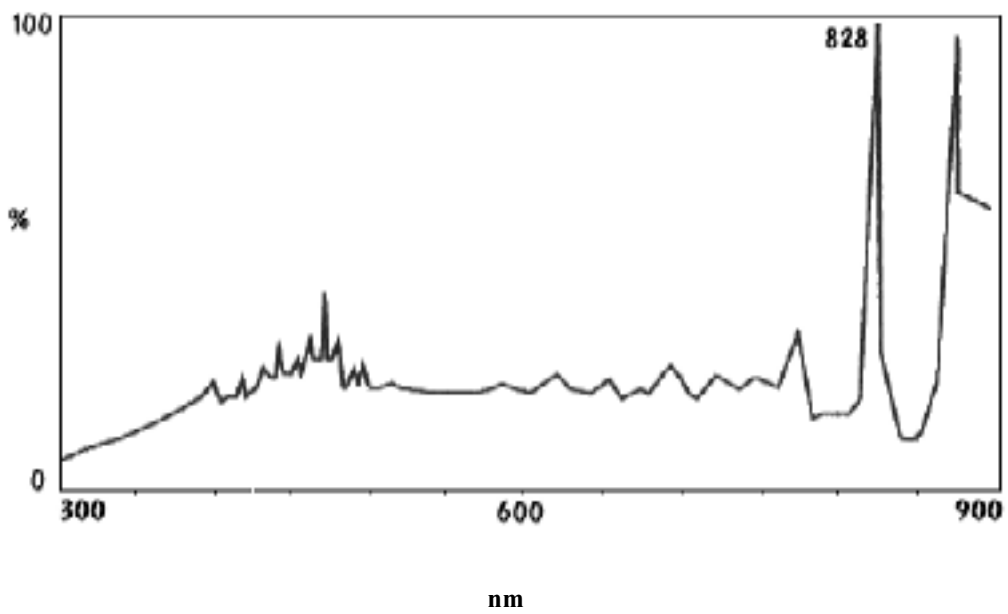
Deuterium Lamp Spectrum



Mercury Lamp Spectrum



Xenon Lamp Spectrum



Lens adjustment

The lenses are adjusted at the factory, but IF they for some reason has to be adjusted, do as follows.

- 1) Unscrew the lens holder from the objective.
- 2) Connect the fibre cable 400/440 between the lens and the illumination lamp.
- 3) Loosen the 2mm Allen screw on the lens holder. See Fig 25.
- 4) Turn the holder towards a white surface 1.5-2 m away.
- 5) Observe the light spot while the fibre cable holder is adjusted so that the spot becomes as homogenous as possible.
- 6) When ready, tighten the Allen screw.

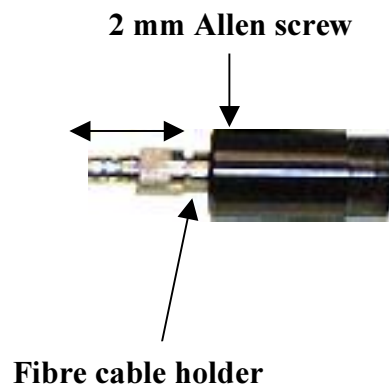


Fig 25

MIRROR ADJUSTMENT OF THE OBJECTIVE

Seldom, but sometimes, they have to be adjusted.

The objective consists of a small convex primary mirror and a larger concave secondary mirror. To check or adjust the primary mirror, do the following:

- 1) Remove the microscope from the stand and put one of the objectives there instead. Connect a fibre cable between the objective and a lamp. Put a piece of white paper on top of the mirror house.
- 2) You should be able to see **ONE** black spot with three “legs”. (fig 26A)
- 3) If the picture looks like fig 26B, adjust the two Allen screws in the front of the objective until the picture looks like fig 26A.



A



B

Good luck

Fig 26