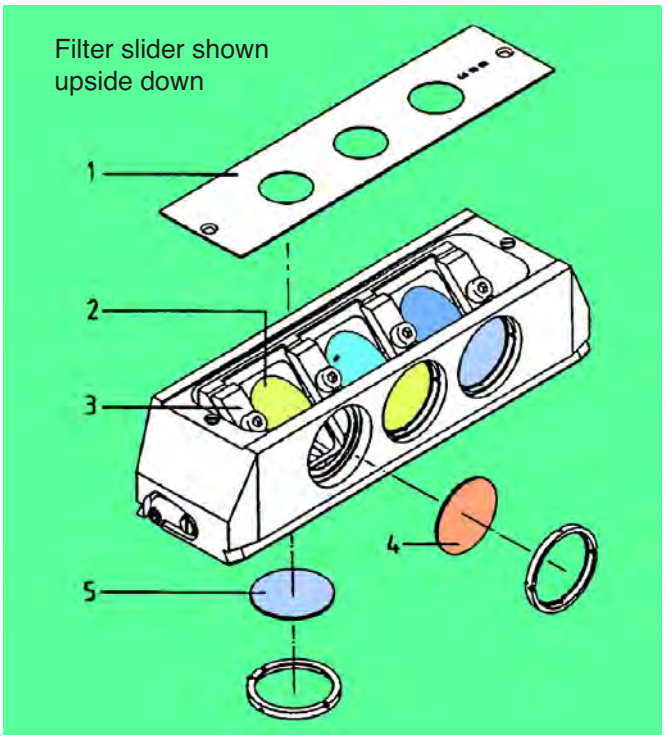
Designing a Florescent Microsocpe

By Ali Afshari

Utilizing Optoform to construct a Fluorescent microscope requires adding more mounting plates to the system. Although it could still be accomplished with existing mounts but we should think of a more professional looking microscope with simple user interface, i.e., to be able to switch between several filter sets for optimum image clarity, and contrast.

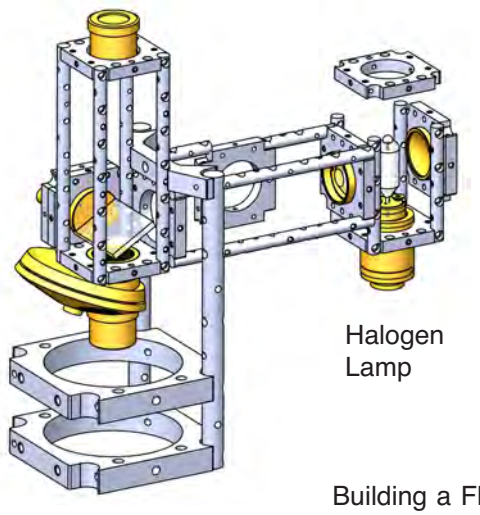
As we saw in our short study of prior art, he best choice would be the beamsplitter slider design because any combination of emission, excitation, and beamsplitters could be arranged for acheiving the desired contrast.



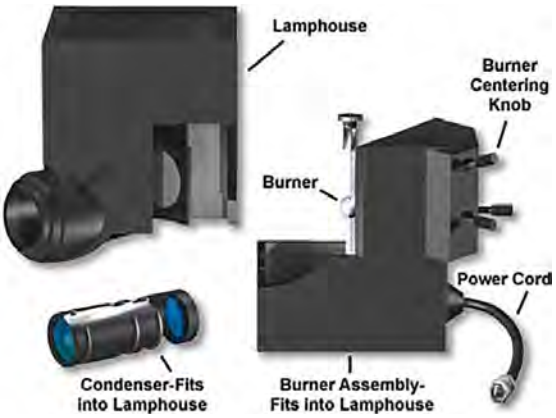
Zeiss AxiosKop Fluorescent filter slider conists of Emission filter (5), Excitation filter (4), and Dichroic beamsplitter (2). The filter block is identical to slider in Axiovert 100.

Designing the new Mount

A new mount will be needed to implement the beamsplitter slider so it will be built using Optoform's frame structure. We'll need to compete with existing microscopes on cost, and versatility. Once we implement it with Optoform, it will exceed in flexibility among other microscopes because it will provide a completely open architecture design.



Halogen
Lamp



Building a Fluorescent microscope isn't just replacing the Halogen lamp with an arc lamp, and adding filters. That would be silly. Let's build a real microscope.

Before we introduce this new mount, it seems Thorlabs has been offering their own version of my design ideas. Copying has become a trend in our industry. Spindler and Hoyer (now Linos) who was the original manufacturer of Microbench couldn't complain for their Microbench line being copied by Thorlabs after their patent expired some 20 years ago. Microbench was a great idea but wasn't received so well in US, and what Thorlabs did was they brought it to all optics labs across US. They then began adding new components to the system, one being their Z-stage unit that utilized flextures. A year later, I saw Linos copying Thorlabs with their own Z-stage. Incidentally, some great contributions of Thorlabs' design team has been their Z-Stage, and a very compact X-Y stage, and their rotary stage that utilizes rod bearings. Other than that, it has essentially remained unchanged. I wonder now how they'll copy my new idea discussed in this issue.

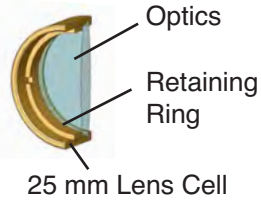
For those who are familiar with Microbench, and the Thorlabs' version, in both systems, the mounts slide along the rods, and are secured by set screws. But one major difference is in Microbench, optics are housed in circular lens cells that could both rotate, and slide within the mounts. In the Thorlabs version, the circular apertures in the mounts are threaded, and the optics would not slide or rotate. Thorlabs has put more emphasis on securing the optics directly on the mounts.

Optical mounts in Optoform are compatible with Microbench, and that's the way every lens cell or mirror holder could be

Cage System

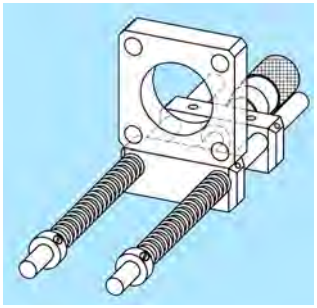
Microbench

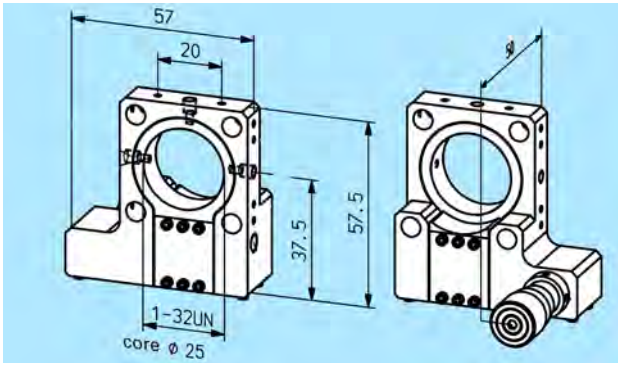
New Optoform 40



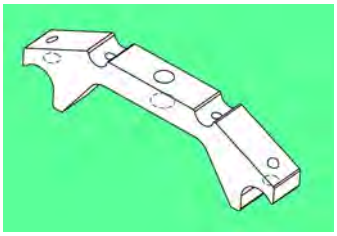
Lens cells in Optoform, and Microbench

TS10M

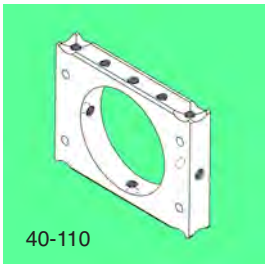




Two versions of focus adjustment by Spindler & Hoyer (above). Linos' copy of Thorlabs' focusing unit utilizing flexures (right).



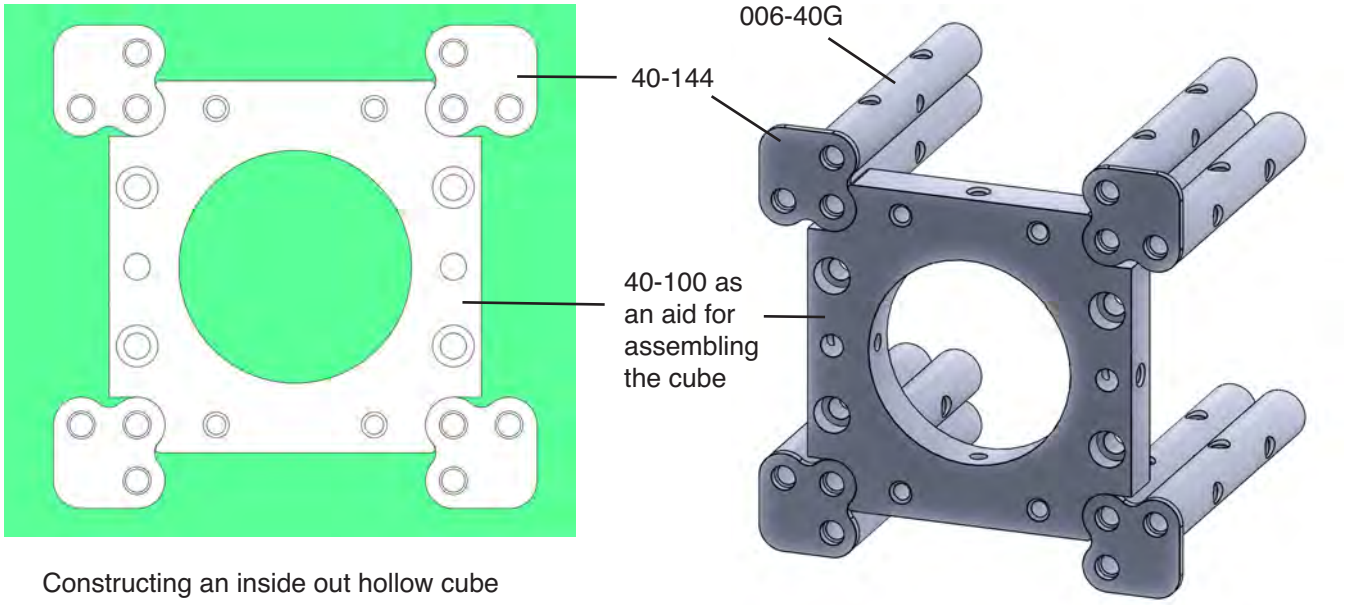
CP40



Thorlabs' versions of Optoform mounts: We were the first to slide the mounts side ways along the rods (40-110, right).

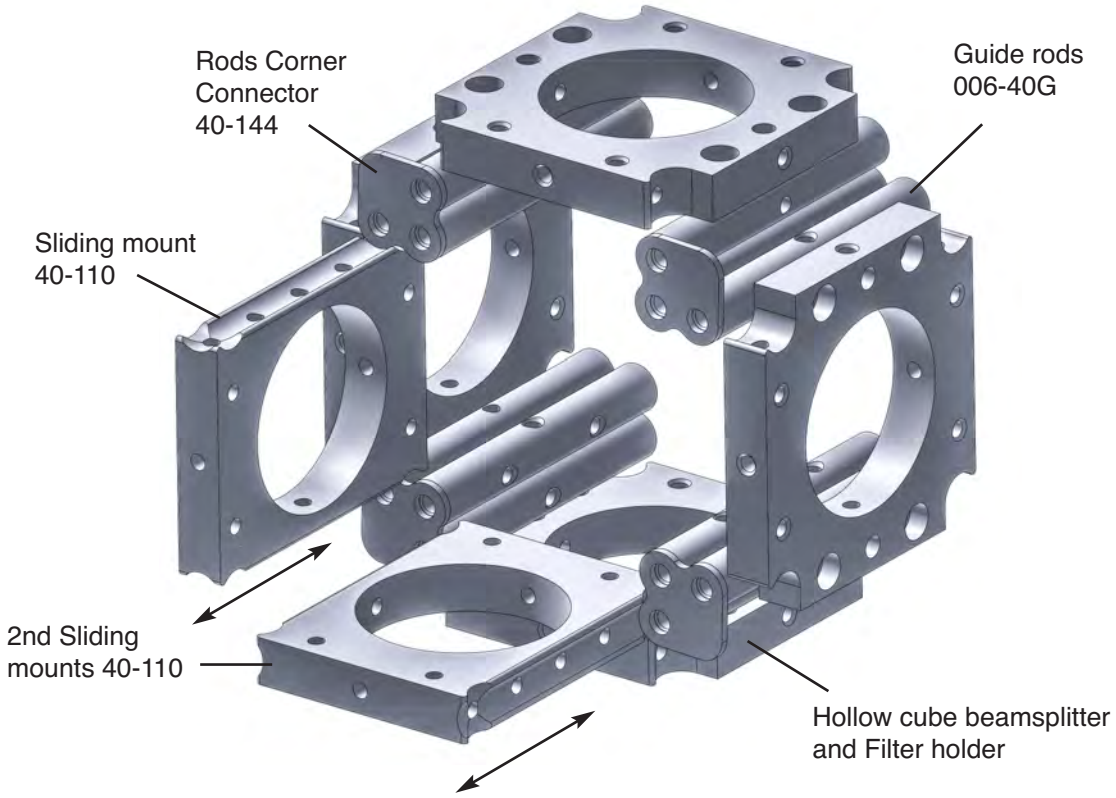
translated or rotated along the optical axis. Additionally, Optoform 40 only utilizes lens cells for focusing, not the rods. Competition is good because it doesn't allow favoritism, and it's eventually leads to better products for the customer. We are no competition for Thorlabs' marketing power house but in Optical Erector Set design, I think Optoform has a fresh idea that the industry has been waiting for: A drastically more affordable optical construction system that may be produced by Aluminum extrusion.

Designing the beamsplitter housing for Fluorescent filters

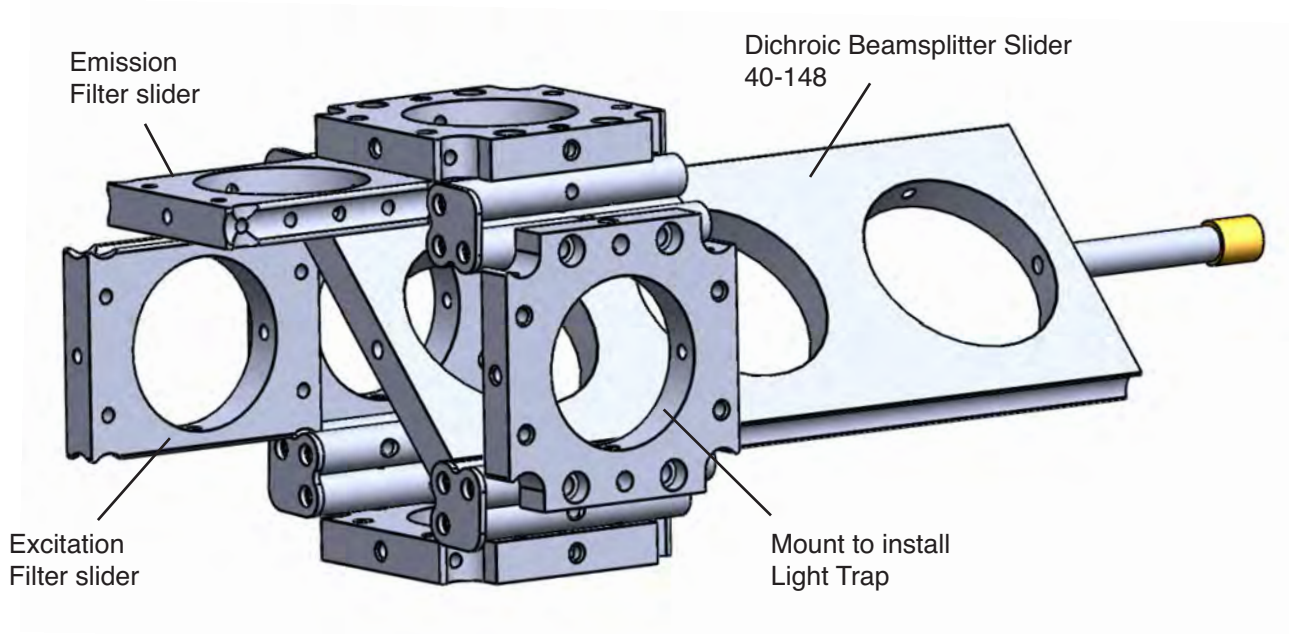


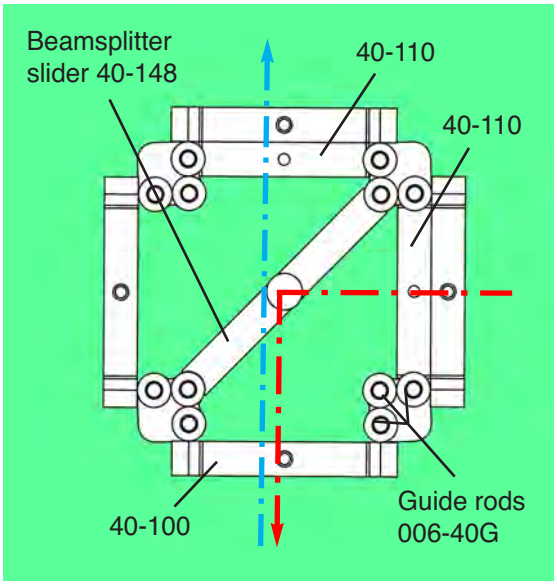
Constructing an inside out hollow cube

The idea would be to have a means to form a cube that is hollowed from inside out so it would allow mounts to slide in and out without obstruction. Let me show you what I mean: What we need to build is a beamsplitter housing that would



accept any number of filters on its four faces around a central beamsplitter (above). This is accomplished by side mounting the rods by a corner connector 40-144 that basically secures three rods side by side to provide clearance for sliding mounts 40-110 to be inserted without collision with the neighboring mounts. It would therefore allow inserting a multiplicity of beamspliiters, and filters without any obstruction. We could either side connect the sliding mount 40-110 to insert various filters or to switch between filters very rapidly, we could make an extended version. We'll also need to design a diagonal sliding mount to secure various beamsplitters, mounted in 30 mm lens cells. The 30 mm lens cell provides a 28 mm clearance aperture to provide the necessary beam path clearance when mounted at 45°.



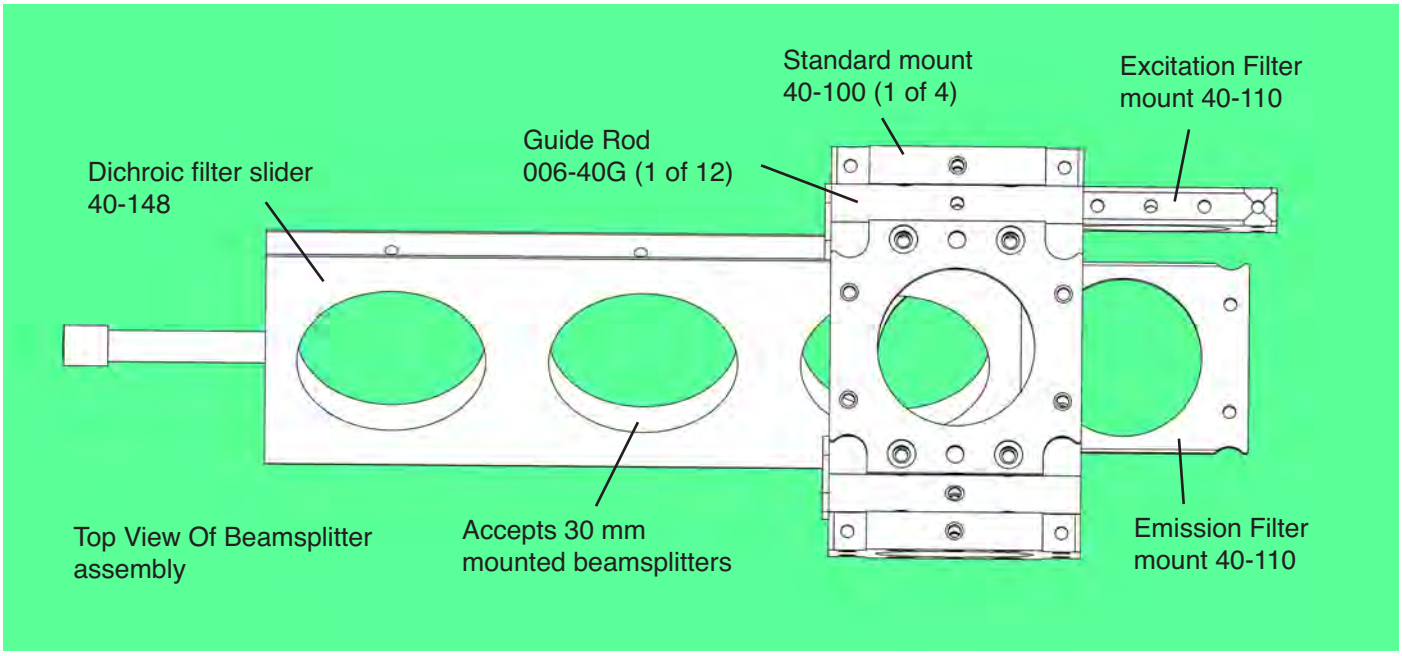


Sliding Beamsplitter 40-148

I think we are there now to start constructing our beamsplitter assembly. Let's view the assembly constructed above. It takes 8 Rod Corner Connectors 40-144 to construct this cube.

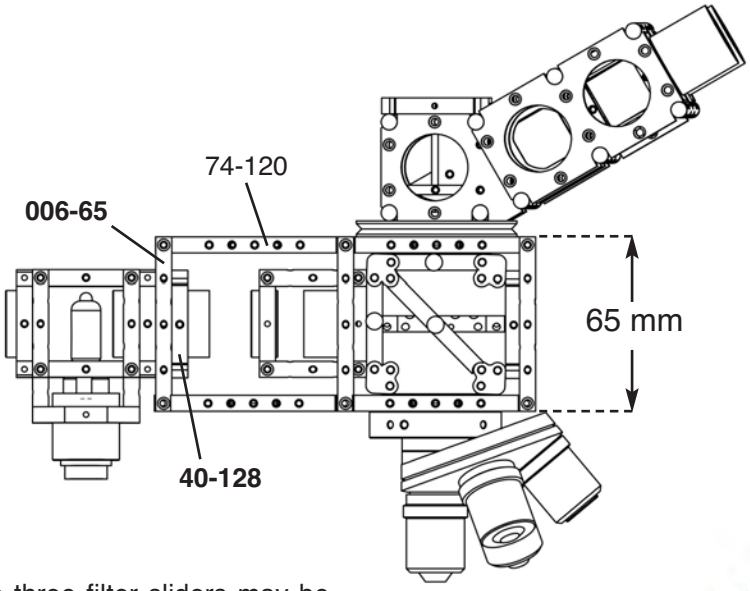
Several sliding mounts 40-110 could be side connected to add as many filters one would wish to have, or a 3-position filter holder could be designed for securing a set of 3 filters for Emission, and another set to secure Excitation filters. If you notice there are four sides to the beamsplitter cube, securing the emission, transmission and the objective lens. What could we use the 4th aperture for?

The fourth side is utilized to secure a light trap. The light trap is the most crucial part of the beamsplitter assembly. It would influence the image contrast. Several designs are offered for light traps. One simple example would be a small can, painted dull black on the inside, filled with black anti static sponge.



Building our very own Fat Microscope

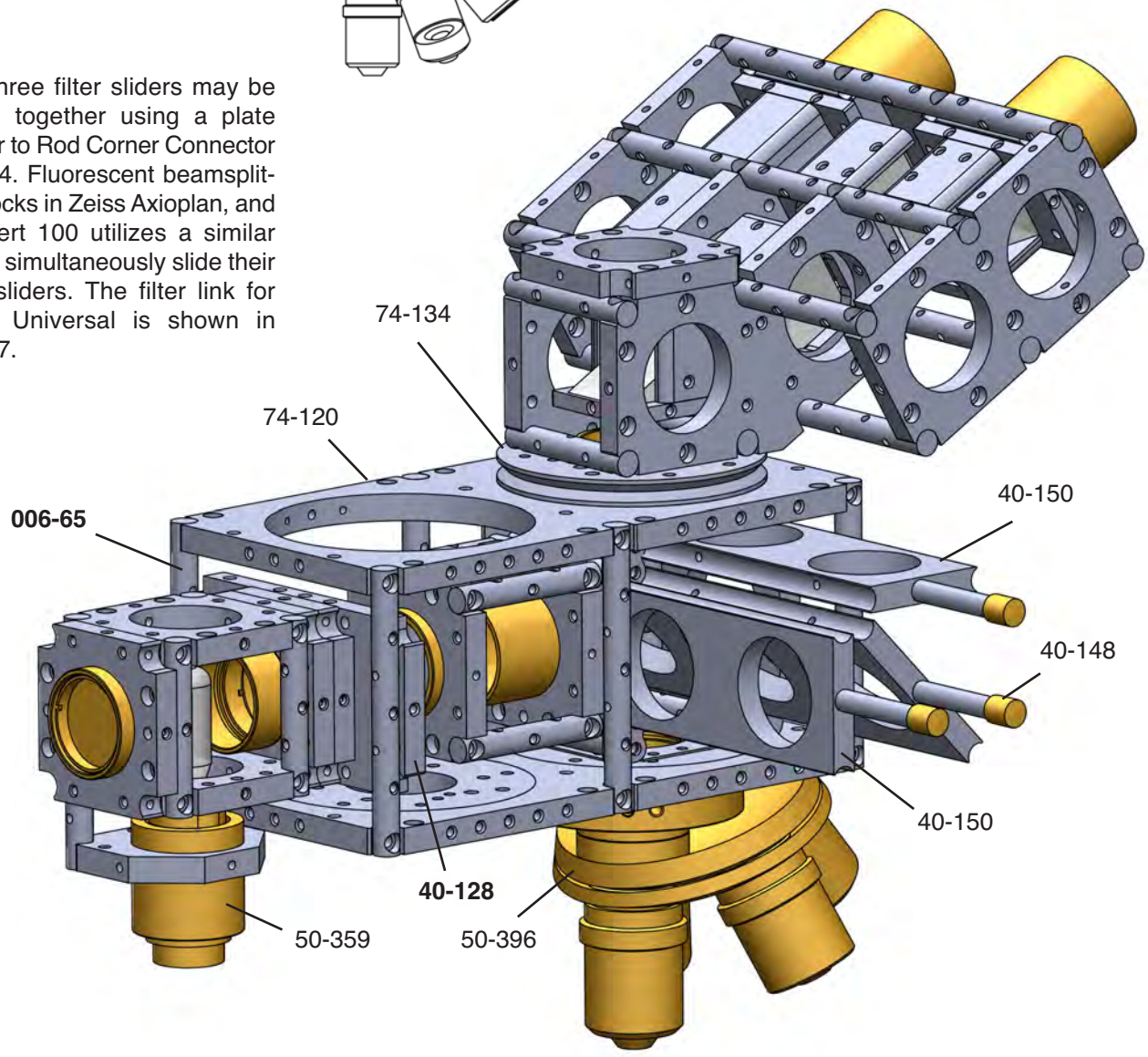
Lets now integrate our beamsplitter assembly with other sub assemblies we had constructed in past issues. The filter sliders are also shown. The light source could be Halogen but a high intensity Mercury or Xenon lamp is recommended. We'll be making one later. We now have to decide where we'll mount the beamsplitter assembly. The best option would be to mount it inside a larger housing to light seal the beam path. So we'll remove the upper, and lower 40-100 mounts,



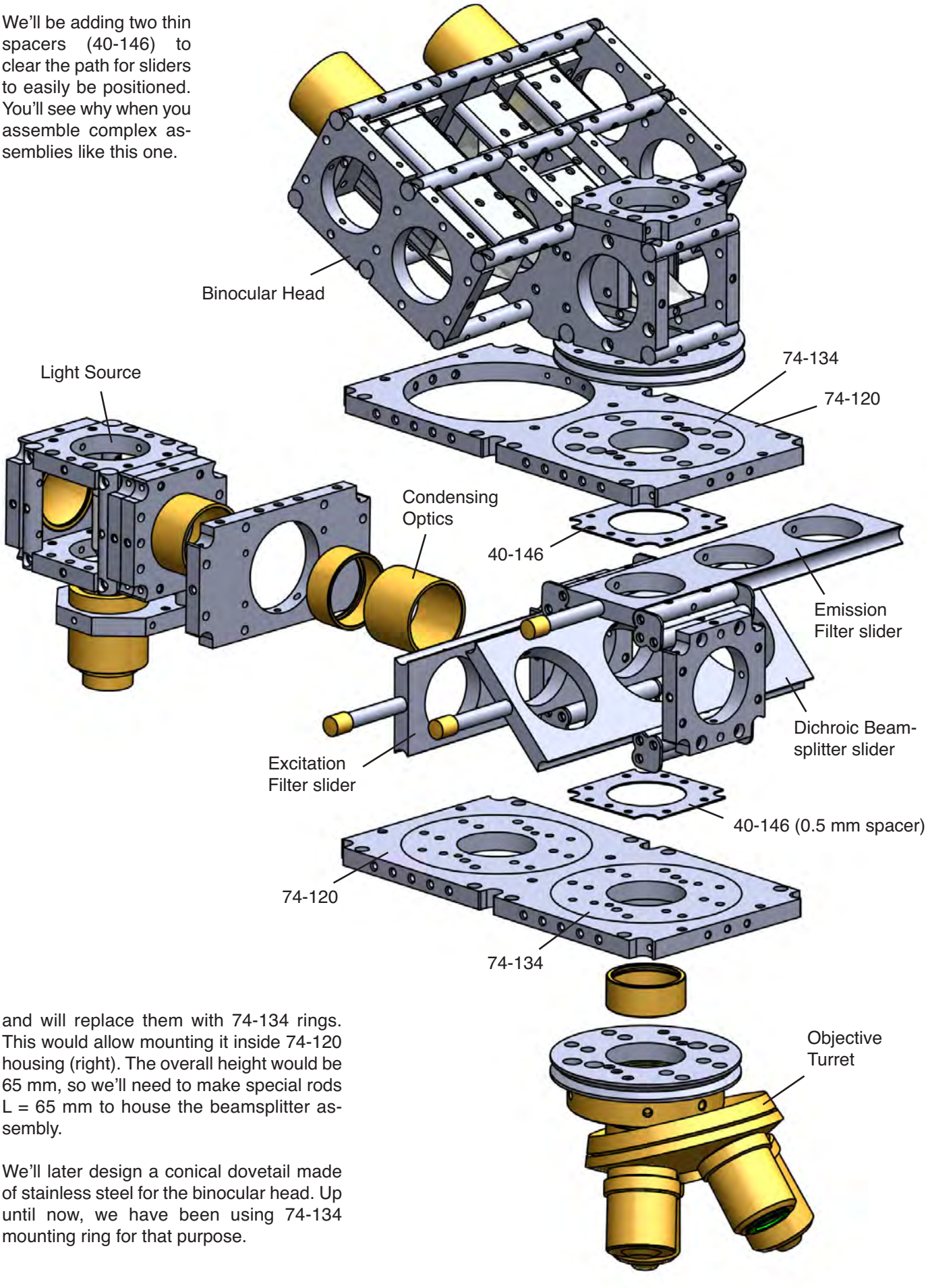
Note in spite of the height difference in this illumination assembly with standard 40, and 74 mounts, mount **40-128** is mounted at the center of rod pair **006-65**.

In this case, 40-128 is secured to 006-65 from the inside. This allows cover plates to cover the illumination housing without any mechanical conflict with its lamp housing.

The three filter sliders may be linked together using a plate similar to Rod Corner Connector 40-144. Fluorescent beamsplitter blocks in Zeiss Axioplan, and Axiovert 100 utilizes a similar link to simultaneously slide their filter sliders. The filter link for Zeiss Universal is shown in page 7.

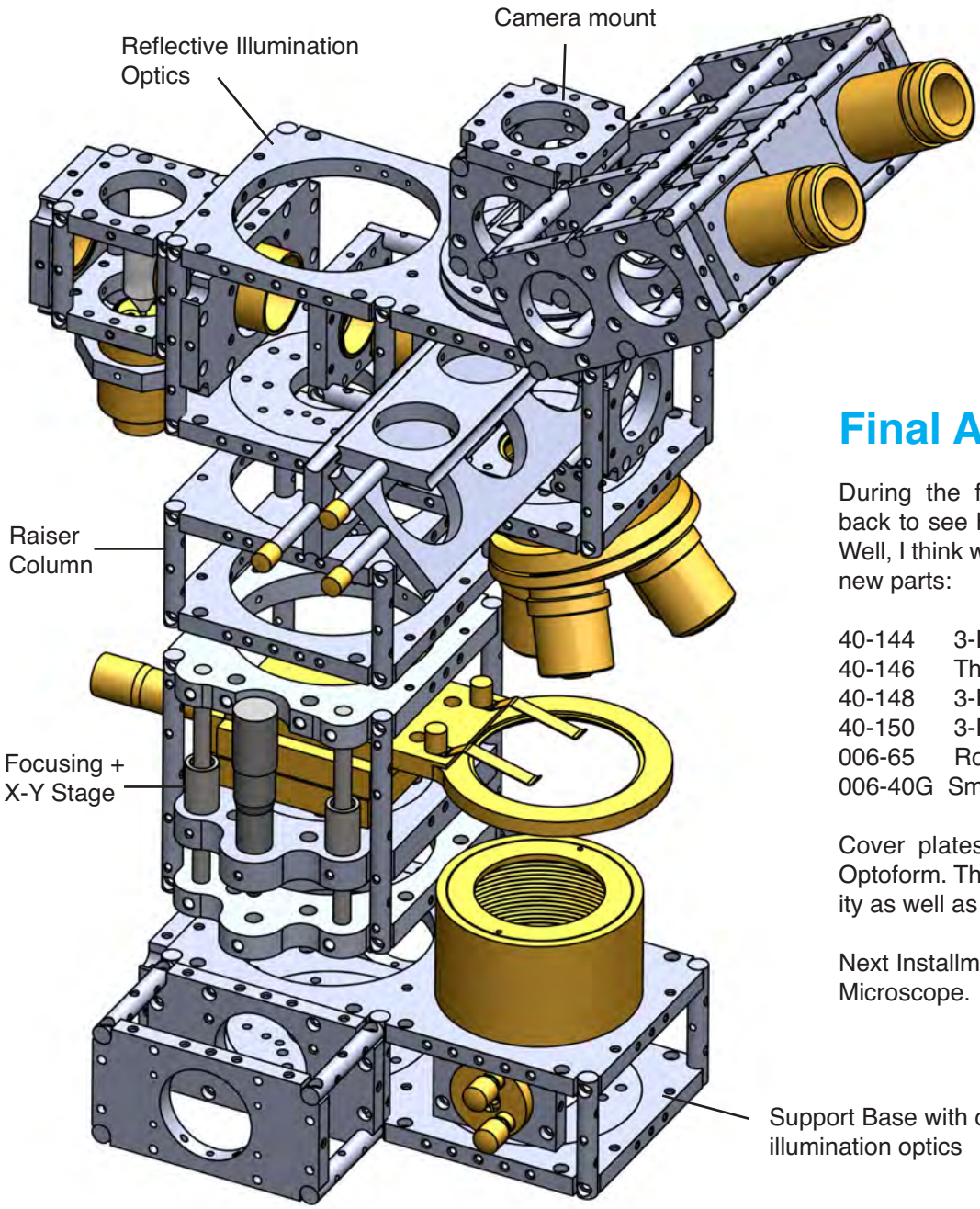


We'll be adding two thin spacers (40-146) to clear the path for sliders to easily be positioned. You'll see why when you assemble complex assemblies like this one.



and will replace them with 74-134 rings. This would allow mounting it inside 74-120 housing (right). The overall height would be 65 mm, so we'll need to make special rods L = 65 mm to house the beamsplitter assembly.

We'll later design a conical dovetail made of stainless steel for the binocular head. Up until now, we have been using 74-134 mounting ring for that purpose.



Final Assembly

During the final assembly we'll look back to see how we did in our design. Well, I think we did ok by just adding six new parts:

40-144	3-Rod Corner Connector
40-146	Thin Plate 0.5 mm thick
40-148	3-Position Diagonal Slider
40-150	3-Position Filter Slider
006-65	Rod L = 65 mm
006-40G	Smooth Guide Rods

Cover plates play a big role in new Optoform. They provide structural rigidity as well as light seal the assembly.

Next Installment: Scanning Confocal Microscope.