Optomechanix

Zeiss Confocal LSM 510

July-Sep 2021

Technical journal of OMiD, Opto-Mechanical Institute of Design

Iran's 3.4 m Telescope: Photo by Majid Ghohroudi. The telescope is a Ritchey-Chrétien design. Both the primary, and secondary mirrors are awaiting final coating, and installation.

This requires an in-house coating chamber facility, and a crane to load, and unload its 4-ton Zerodor primary mirror. The primary's focal ratio is f/1.5, with an exit focal ratio of f/11 after reflecting off of its 0.6 m hyperbolic secondary mirror.

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This issue Dedicated to:

Abraham Louis Breguet (1747 – 1823) was a famous watchmaker, alongside his friend and contemporary John Arnold, Breguet is now widely acknowledged as one of the greatest horologists of all time. Born in Neuchâtel, Russia, he lost his father at age 10, and left formal schooling at age 12, but then his mother remarried to a watchmaker who had a shop in Paris. His step dad sent him to a master watchmaker to learn the trade. The young Breguet soon "astonished" his master with his aptitude and intelligence, and to further his education he took evening classes in mathematics at the Collège Mazarin in Paris. He became a rising star in the watch trade by making a perpetuelle (self-winding watch). He suddenly lost both his parents in a tragic accident, and had to make it on his own to support his younger sister but he somehow managed to survive. Breguet invented innovative escapements, including the tourbillon, automatic winding mechanisms, and the overcoil (an improvement of the balance spring with a raised outer coil).

Escaping the Guillotine of the French revolution in 1789, Breguet returned to Paris in 1795, with many ideas for innovations in watch and clock making. He set up business again in Quai de l'Horloge and quickly established a reputation among the new wealthy classes in the Empire. Breguet sought out the finest available watchmakers in Paris, whom he employed to make watches to his own designs. At the 1798 Exposition des produits de l'industrie française Breguet was given an honorable distinction, the highest award, for "A free escapement with constant force, applicable to the improvement of both astronomical and longitude clocks”. This clock had the very singular effect of resetting the time in a watch. One of Breguet’s complex works was commissioned by Marie Antoinette (No. 160) that took 20 years from to finish.

The mechanical friction of escapement wheel causes a watch to have different speeds depending on its orientation. Breguet invented the Tourbillon movement (left) to average out the watch speed while it is being carried in a pocket (center) or on the wrist (right). Tourbillion remains to be the most accurate movement, and the most elegant to wear in mechanical watches. The pocket watch above, also has a Minute Repeater scheme that announces the hour, and minutes with chime via visible hammers on its left.

Web: www.optomechanix.org
Instagram: optomechanix
For digital subscription or suggestions email us at:
info@optomechanix.org
Chief Editor: Ali Afshari
Contributors: Dr. Omid Jahromi
Publicity Coordinator: Smaneh Karimabadi

Optomechanix is a quarterly journal of Opto-Mechanical Institute of Design (OMiD), with technical articles for practical, hands-on opto-mechanical engineers. This magazine is privately founded.

Cover page photo: Zeiss Axioplan 2 Miroscope.
Front back: Iran’s 3.4 m Telescope.

Introduction

Iran's national observatory just reached the end of its mechanical construction, and this is good news for the 10 year wait for showing something tangible to the scientific community. I came to America as a student back in 1978, and I remember back then, Iran's largest telescopes were a 7" Cassegrain telescope, and a 6" solar telescope by Carl Zeiss, in two separate domes at Atomic Energy grounds, founded by the Shah. Once I looked through both telescopes, my life wasn't going to ever be the same. I might detour to cover the opto-mechanics of the 134" telescope on the next issue.

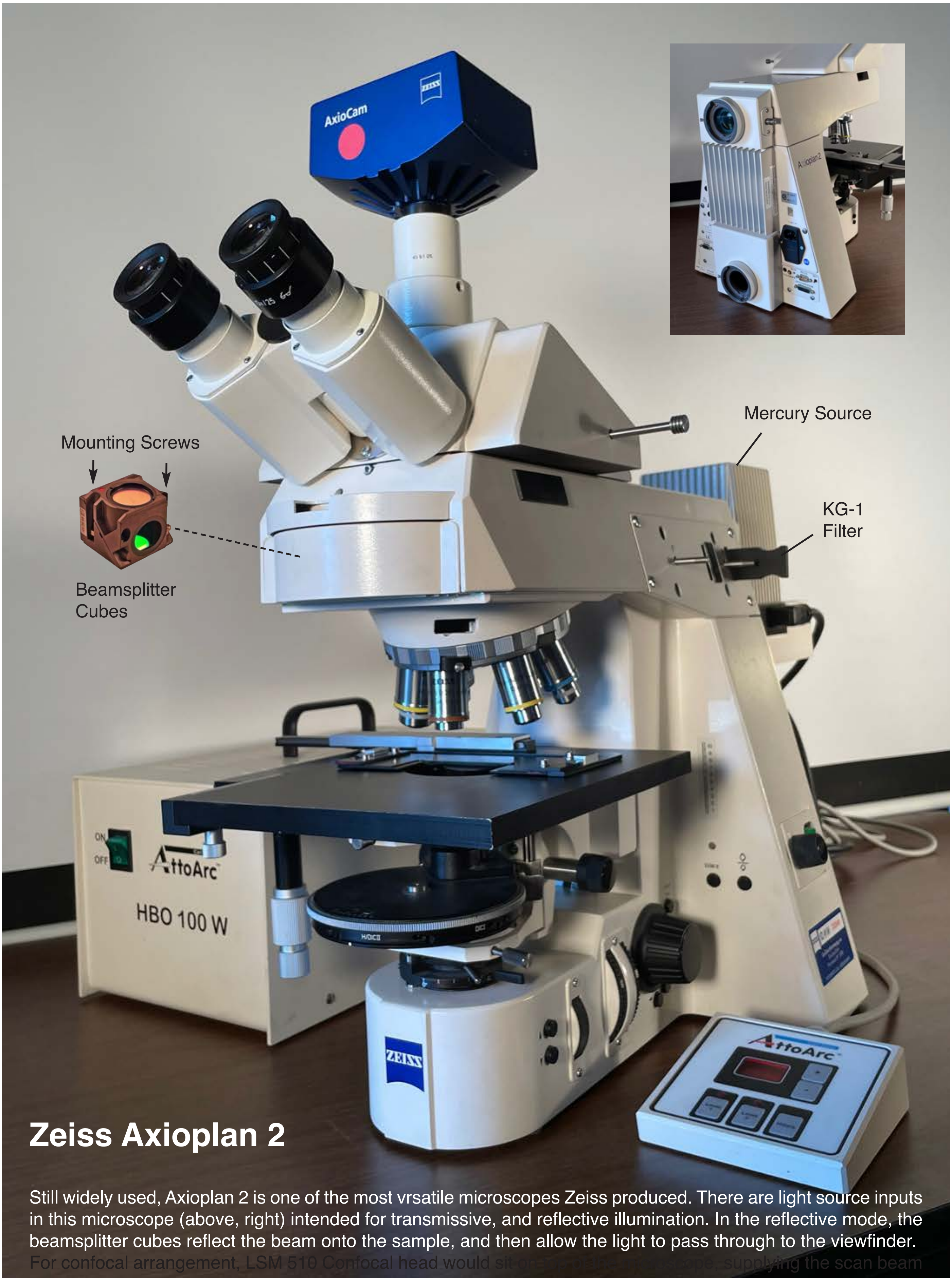
It has been 40 years since Iran was placed in the "Us vs them" basket by the mass media. One thing should be given Iranians credit for is they have played with lion's tail like boys do in Africa to prove their manhood. My friend Ali knows some karate. He said he was driving one late evening in North Hollywood, and saw a young gang holding up an Afro American fellow, to beat him up. He said I stopped, and got off my car, and yelled: "Why are bothering him? Let him go". He said they all paused, and turned their heads in my direction with their mouth wide open. The guy holding his fist up, yelled back with some humor: "Are you Iranian?!" Then they all laughed, including the man they were going to beat. It's not so funny when a country was so singled out in their 8-year war with Saddam Hussein trying to teach him a lesson.

Historically, the outcome of political isolations has only served the special interest, but it has also hurt humanity as a whole. If left alone, everyone's focus would turn to earning a decent living to bring food onto the table for our family, and to raise good children. Insects, animals, and humans, know very well how to do that. By the way, nature studies has been teaching us that if all worms banished from our ecosystem, life on earth would perish in a couple of years, but if we humans seize to exist, the earth would flourish. Science, art, dance, and music, poetry, food, and cinema are what connects us together. The cure for conflict is dialog, not isolation, as there is desperate need for dialog between earth's environmental observers, and the special interest. I have always tried to be like free speech radio because I consider them an advocacy for world peace. I may be ignorant to many things but may be that will change when I reach my 70.

In any case, for this issue, I had a chance to disassemble, and study a Zeiss LSM510 confocal microscope, and I couldn't go on building our own confocal microscope without discussing it first. So, this issue is dedicated to further studying the Zeiss design. We'll build our Optoform version later. Studying the LSM 510 will raise our expectations of what a confocal system should look like. The idea is not to replicate Zeiss. It will be a proof of concept, like a single channel scanner. The end user could then replicate it to have more channels as they'd need. We are also getting close to a point where we'll have to decide if we want to motorize Optoform for computer interface.

Ali Afshari
Editor in Chief, Opto Mechanical Institute of Design

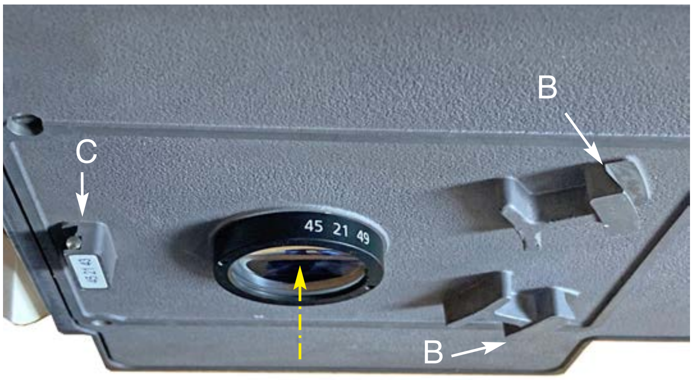
A typical confoguration for Zeiss Confocal microscope: The laser scan is generated by LSM 510 Meta (left), and the scanned sample on the microscope platform (Axiovert 200) gives back signals to the scanner's internal photo multiplier tubes to form the image on a computer screen. The LSM 510 scanner is fed by an external light sources such as a green, red He-Ne, and Argon laser, etc. (center).



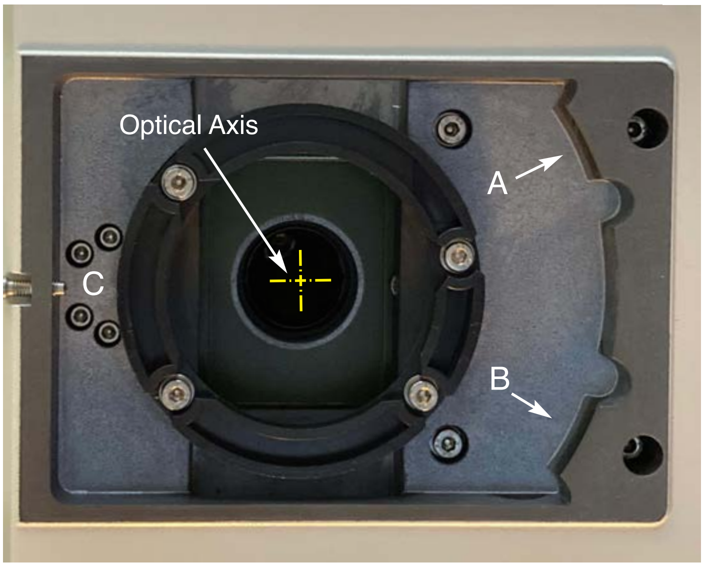
Zeiss Axioplan 2

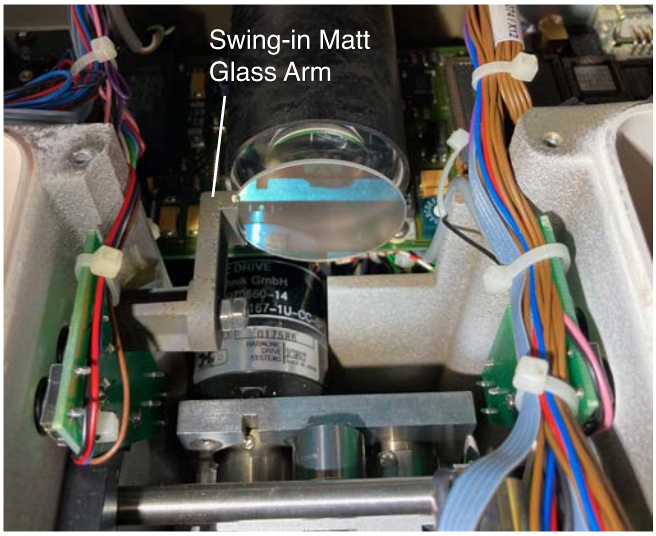
Still widely used, Axioplan 2 is one of the most vrsatile microscopes Zeiss produced. There are light source inputs in this microscope (above, right) intended for transmissive, and reflective illumination. In the reflective mode, the beamsplitter cubes reflect the beam onto the sample, and then allow the light to pass through to the viewfinder. For confocal arrangement, LSM 510 Confocal head would sit on top of the microscope, supplying the scan beam

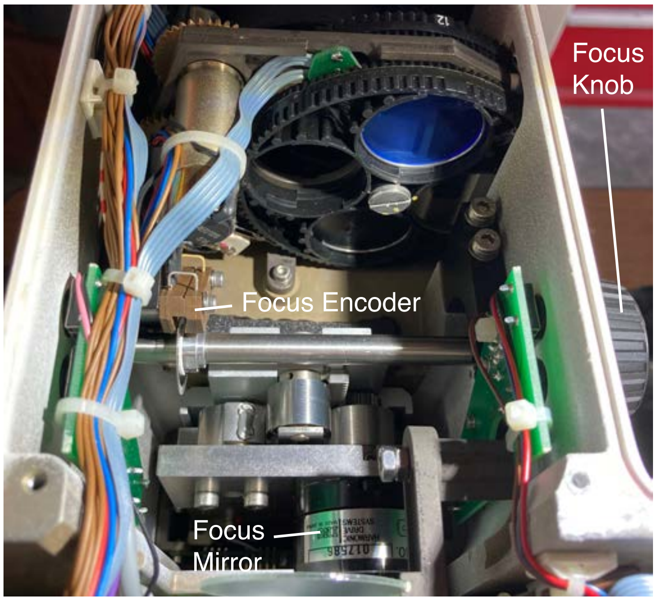
Zeiss Axioplan 2 is a motor driven, heavy, rigid platform (70 pounds) that outweighs, and outsizes most microscopes of its class. In transmissive illumination mode, the light passes through filters, bounces off of a 45 deg. mirror (below the microsocpe), then goes through the condenser optics to reach the sample. Bottom view of the microscope with base

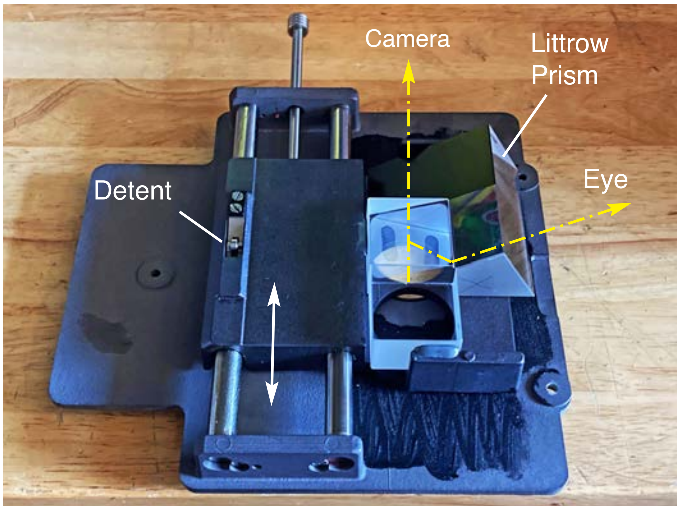


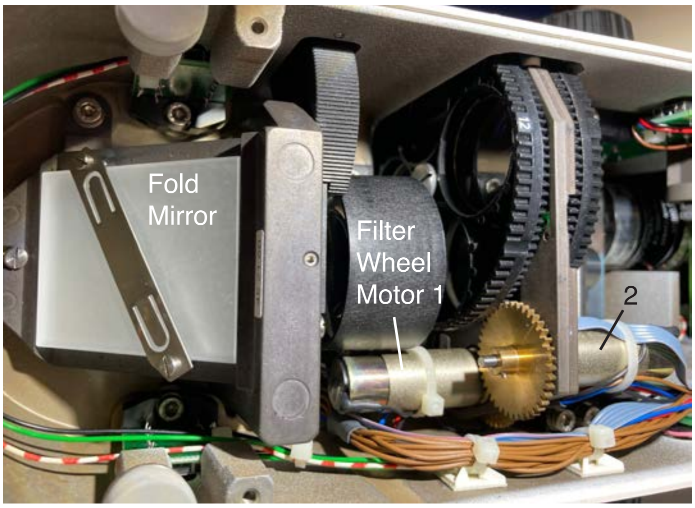
Bottom view of viewfinder housing shows the tube lens (above), and its three dovetailed hooks to mount to microscope top (below). Inside view of the viewfinder (bottom) shows the prism slider for camera/eyepiece light path control.





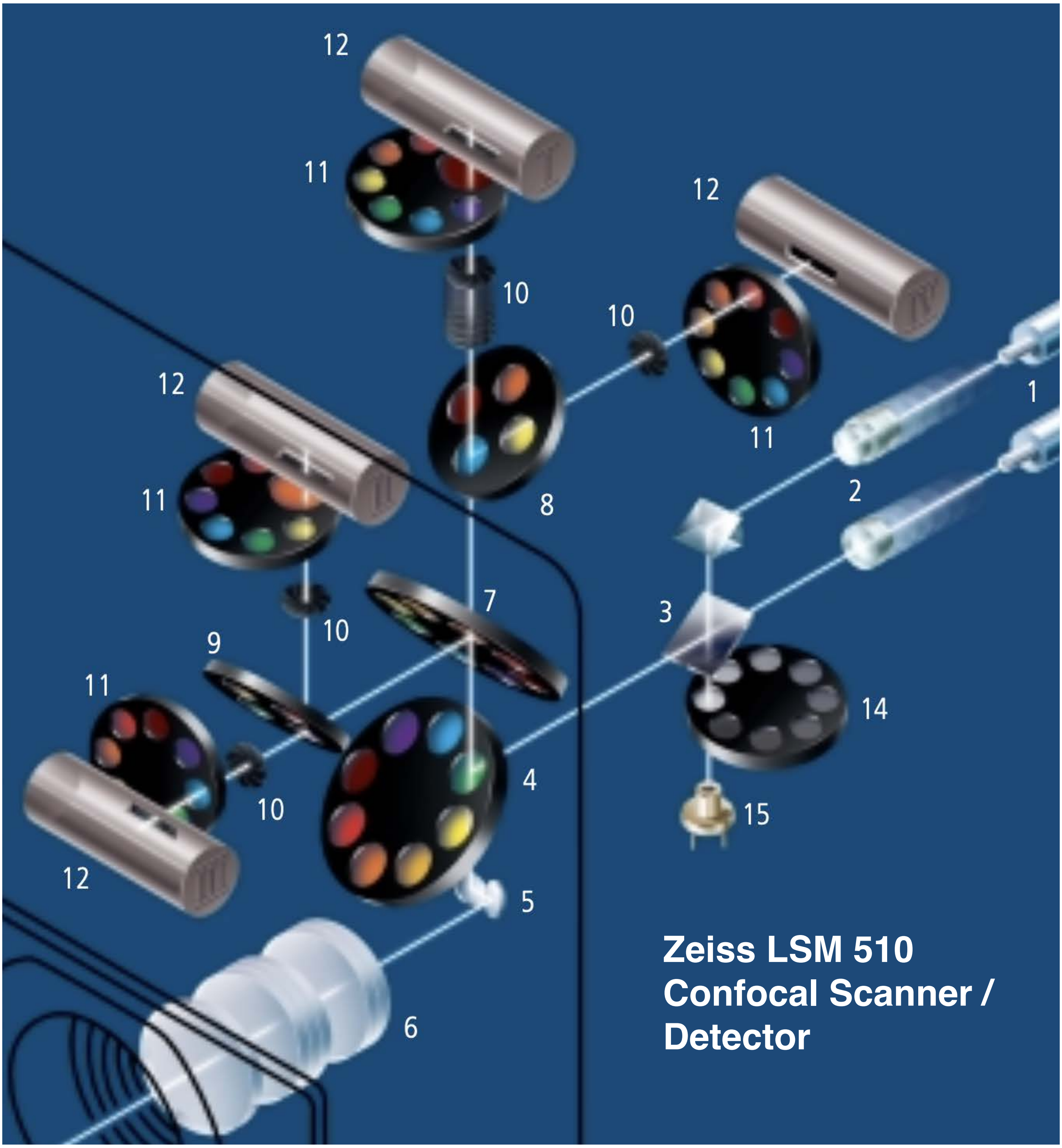






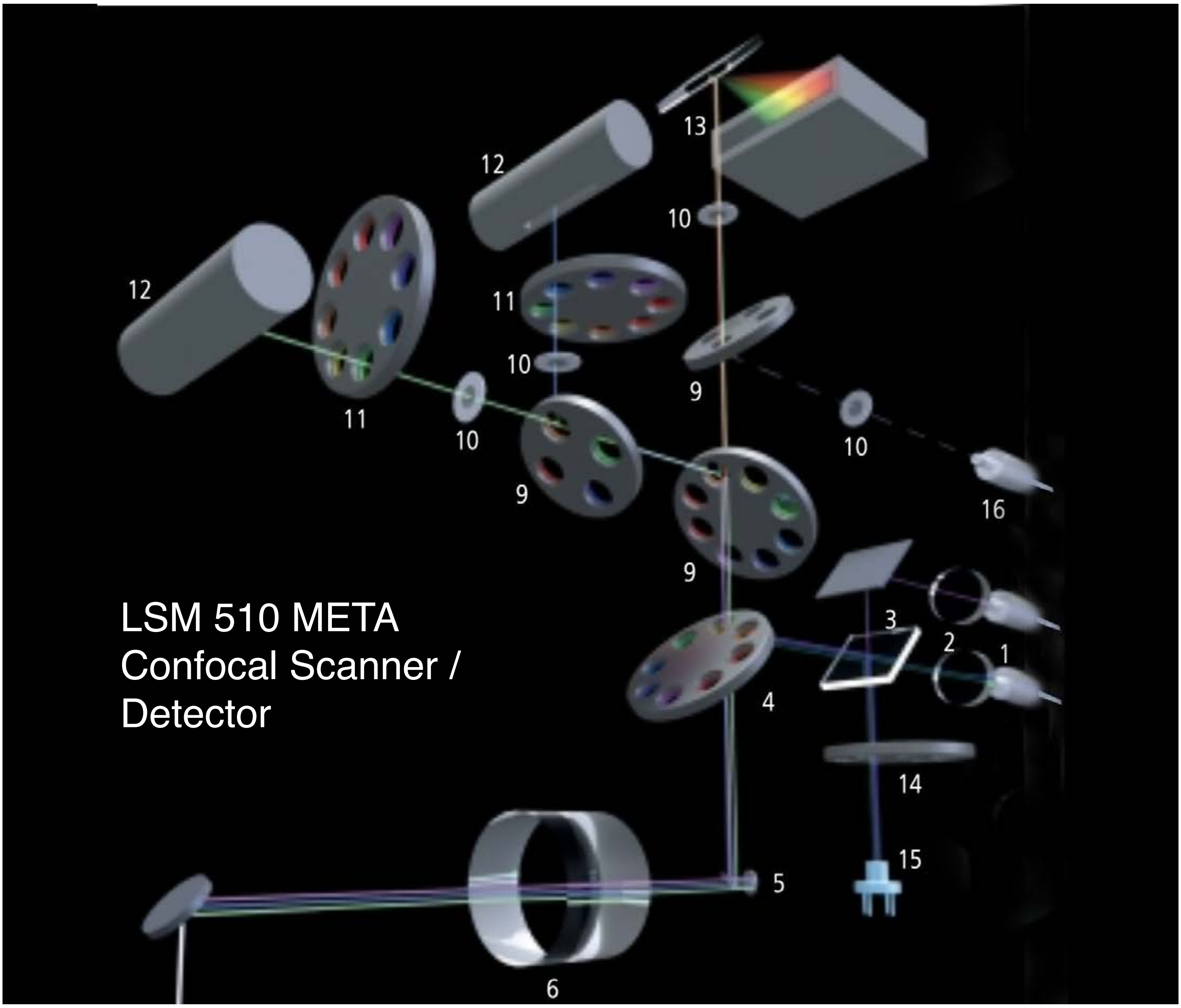
cover removed reveals the motorized filter wheel (above/right). The motor driven focus mechanism can also bee seen (middle right) The focus encoder shaft commands the focus motor to rotate clockwise or counterclockwise.

The upper-right two views show the light path emerging from the halogen light source at the base. Zeiss always provides a swing-in matt glass, in this case, activated by rotating an Allen Hex screw. The illumination beam then passes through two filter wheels that are controlled by Motor 1 and 2. The motorized rack and pinion focus mechanism is counter spring loaded to increase its positioning sensitivity. Zeiss's Stage could handle heavy loads such as X-Y motorized stages.



Beam path inside Zeiss LSM 510 (above) reveals how the illumination and detection beams are arranged to scan the beam via two galvo mirrors shown not to scale (5) to enter the microscope through window 6, and a fold mirror to reach the sample on the microscope stage. The input fiber cables 1 come from several light sources (He-Ne red, and green, and an Argon laser). Photo diode detector 15 measures the entrance beam intensity, and a dichroic filter wheel 4 to excite the sample at various wavelengths. After the emitted beam comes back from the sample, it arrives at the same scanning galvos 5, but this time passes through the dichroic mirror. The rest are various bandpass filters that guide the beam to photomultiplier tubes 12.

Next page, we'll take a look inside the LSM 510 META: Input fiber 16 is available as an option. The lasers are mounted on a 12x16" granite table, and combined into a single fiber (one at a time) to provide various wavelengths to the scanner. Although we are only focusing on the LSM 510 head, it's part of an elaborate system, consisting of a separate control box with plug in cards to control the scanner, a processor board, and elaborate software to display the image for the user, and to control the internal parts of the Axioplan 2 microscope


LSM 510 META
Confocal Scanner /
Detector
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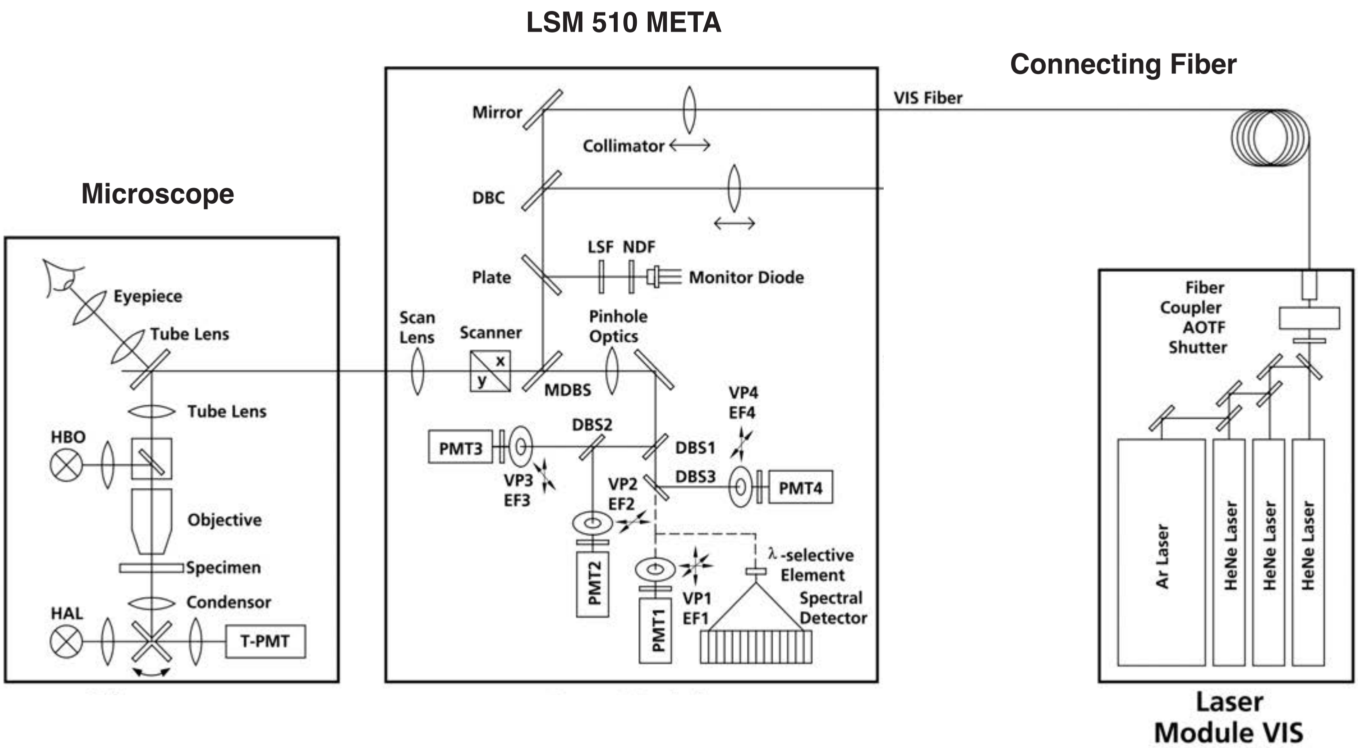
LSM 510 META
Connecting Fiber
Microscope
VIS Fiber
Mirror
Collimator
DBC
LSF NDF
Plate
Monitor Diode
Eyepiece
Tube Lens
Scan
Lens
Scanner
Pinhole
Optics
MDBS
Tube Lens
HBO
DBS2
DBS1
VP4
EF4
PMT3
VP3
EF3
DBS3
PMT4
VP2
EF2
Objective
PMT2
λ-selective
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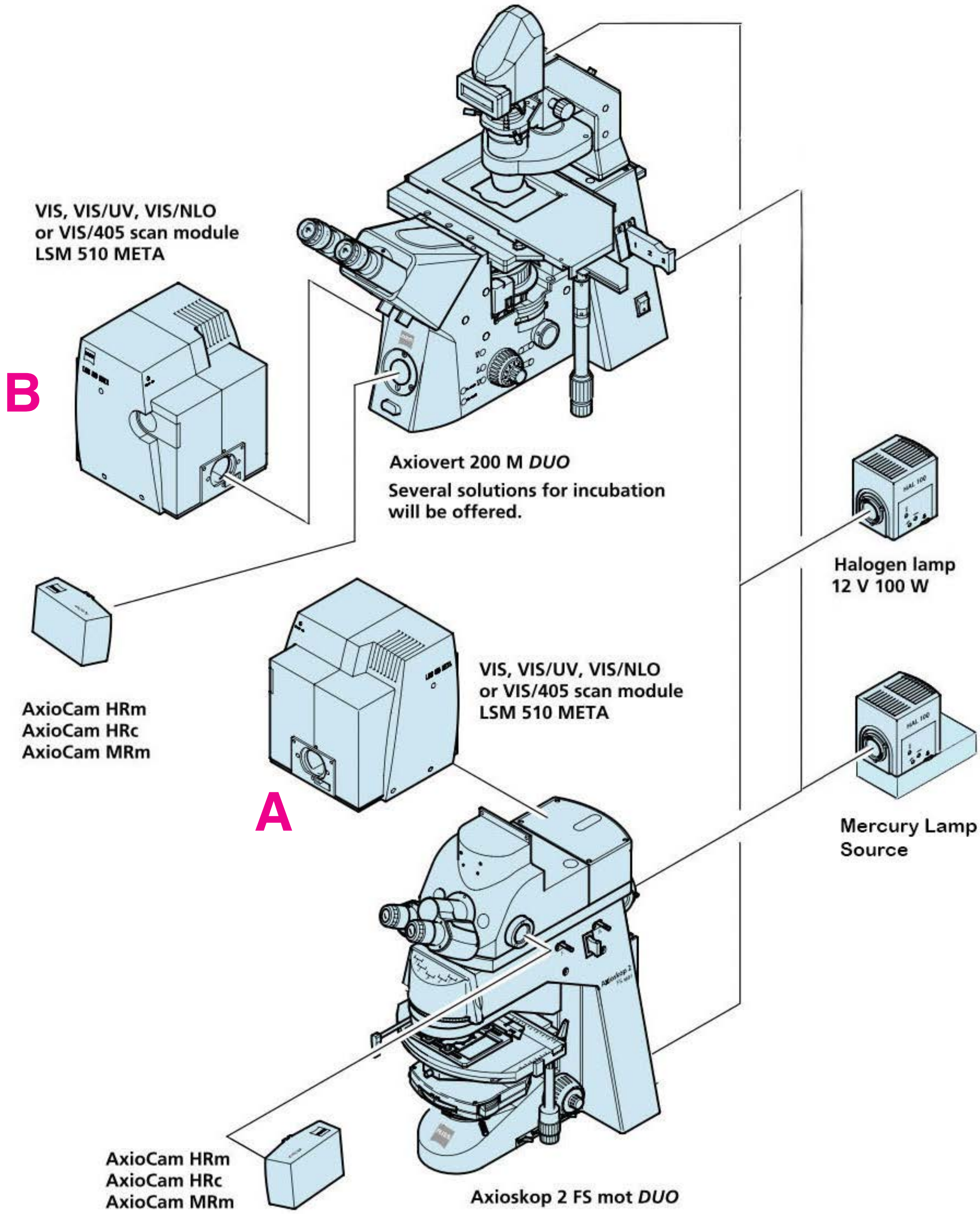
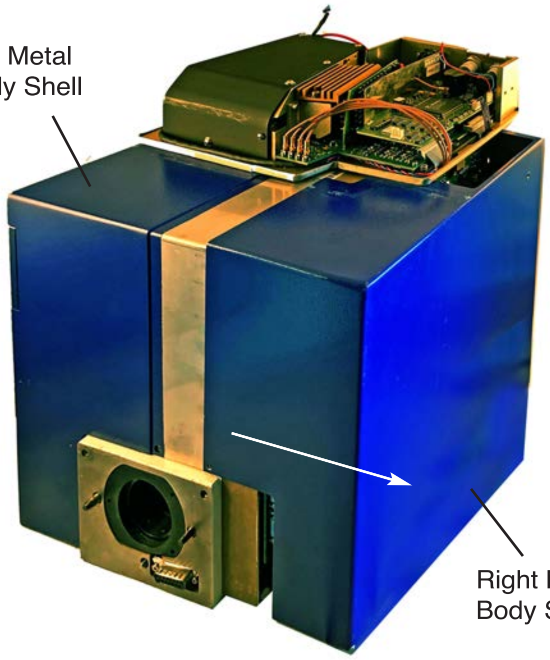
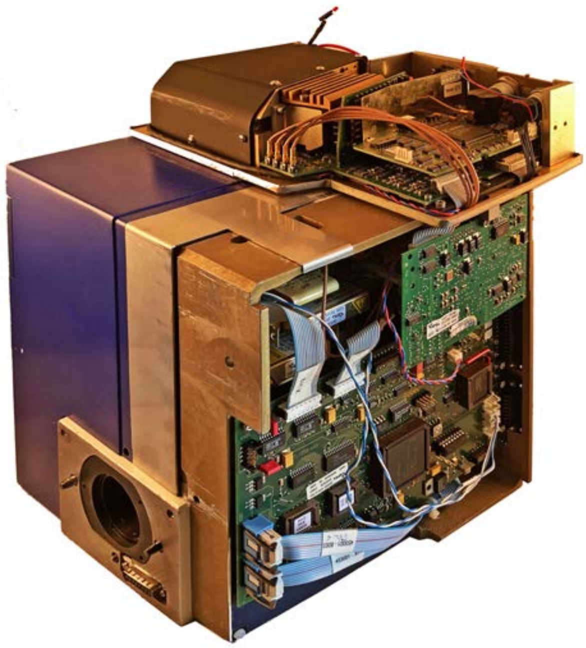


The opto-mechanical question is how would you integrate two relatively heavy assemblies into one precisely aligned setup. The answer is you really can't. In optomechanical interfacing, there is always the slave/master arrangement. For example, in the above diagram, you'd have no problem mounting a camera to the microscope because it weighs 70 pounds. The camera could be simply hanging from its side. But for the scanner head, you are dealing with two heavy pieces, and the only practical approach is to give yourself room for some minor mis alignment.

The solution is all the critical aligned components are housed inside the microscope or Viewfinder Optics, and inside LSM 510's separate housing. So, what's leaving LSM 510 is a scan beam which could be centered within a millimeter to the entrance window of the microscope. For the upright, it would be sitting on top of the microscope itself (A), and for the inverted, it would be sitting on its side on a flat table beside the Axiovert 200 microscope.

The entire workstation, with motorized turret, and focus stage, and control software can be programmed to scan the sample in depth increments to present a 3D construction on we'll now take a look at inside the actual LSM 510 Meta Confocal scanner.

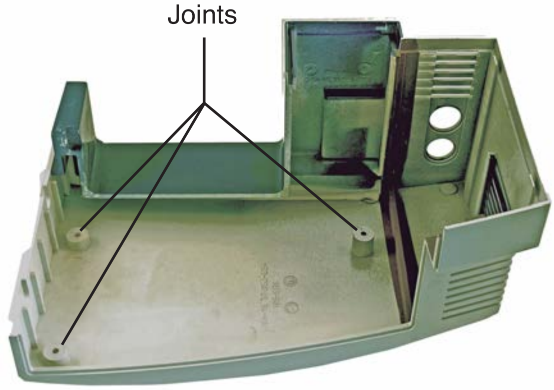




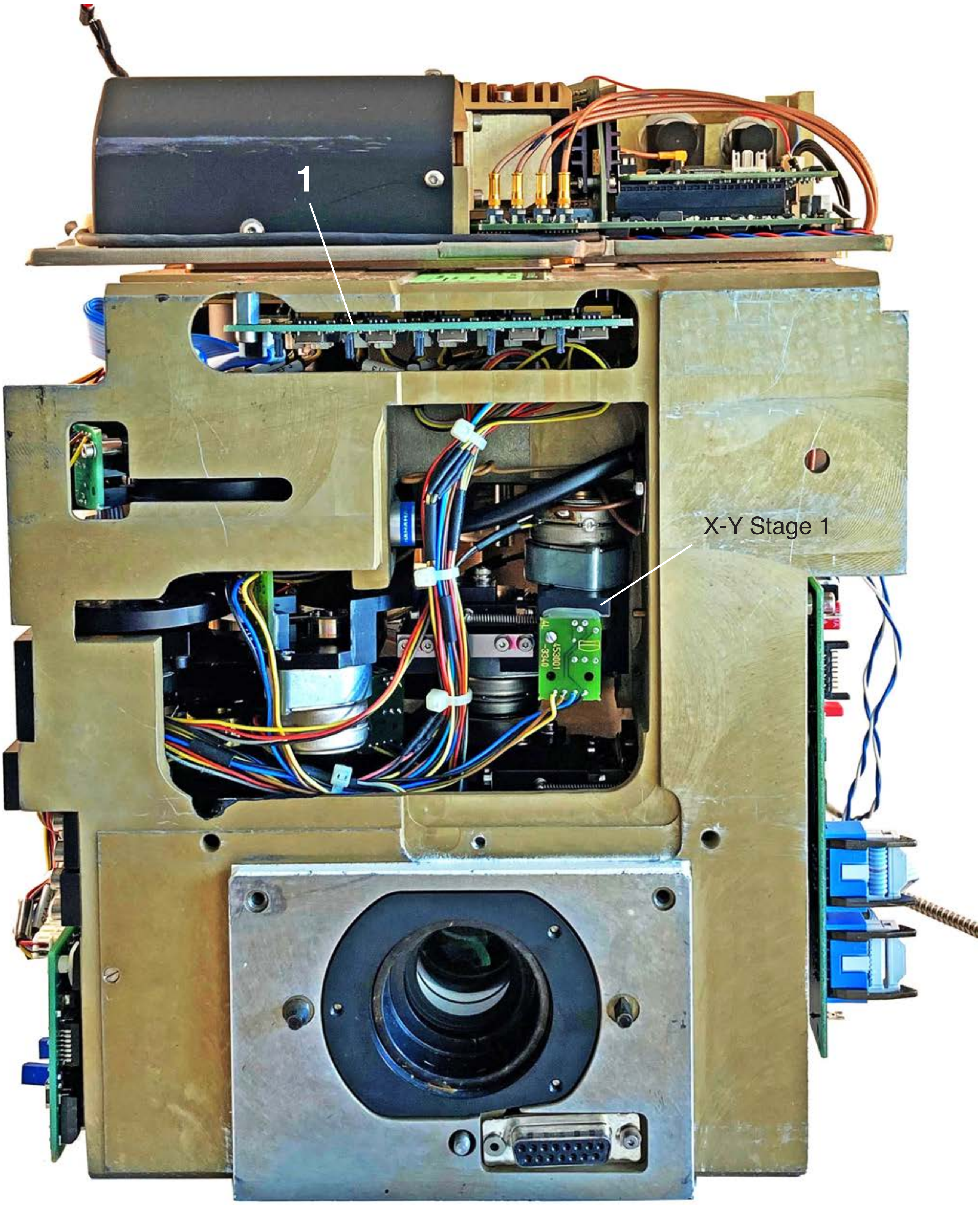
Removing the Body Shells

LSM 510 META is the next generation scan head after their previous model LSM 510. The additional META detector is placed on top of the unit, two additional plastic body shells (right) covering the unit could be taken off to reach the main metal housing.

The design is reliable, and robust. In most examples I have seen, the connecting joints had broken off but I found the plastic stand-off posts for the screws were intact, and the covering was as sloid as new. Further reaching the inner chassis is accomplished by removing screws from front, and back, that are securing the blue metal shells (above) to the inner diecast housing. There are three leveling legs to adjust the instrument's height on top of the microscope.

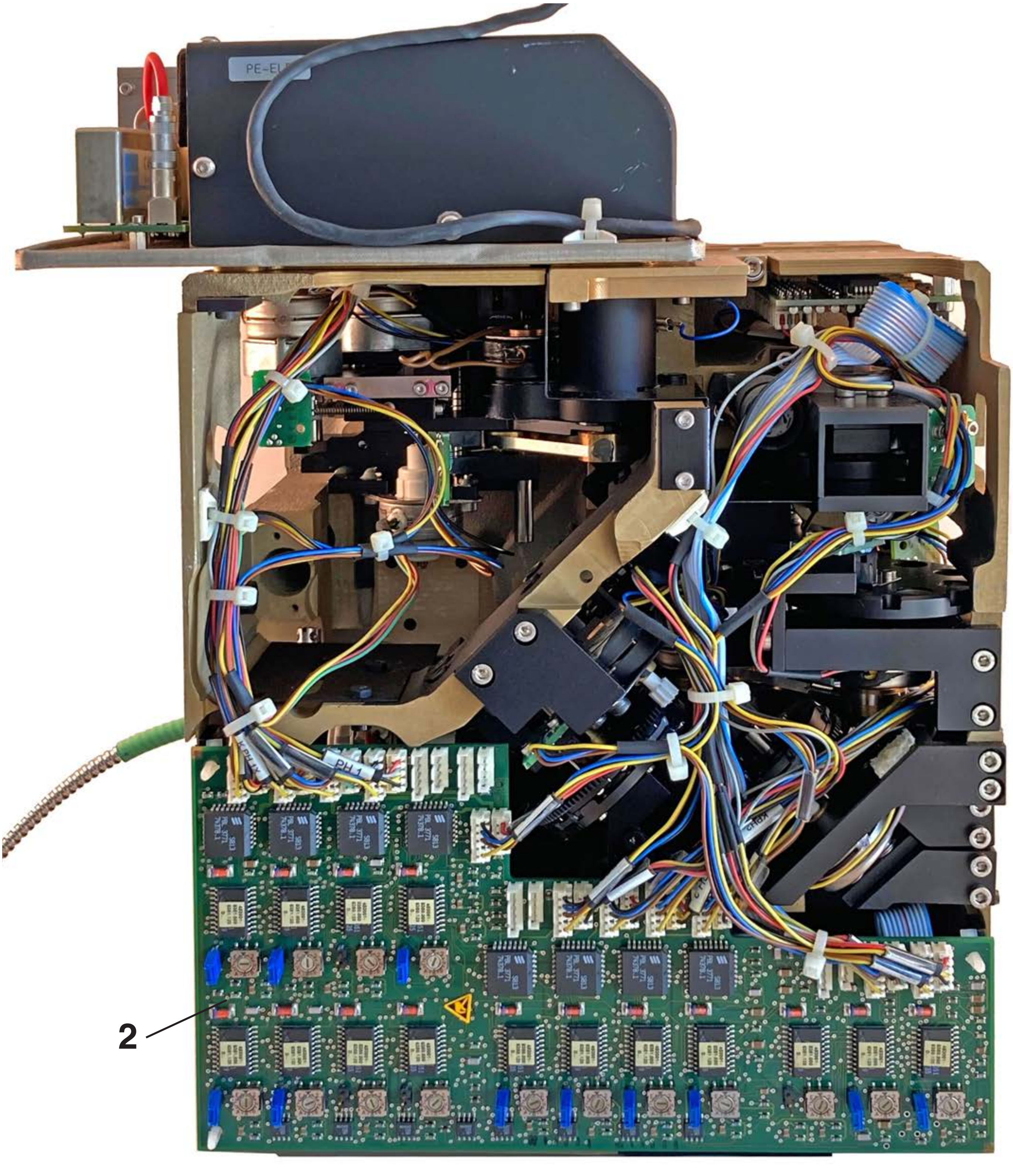


Plastic Cover (1 of 2)



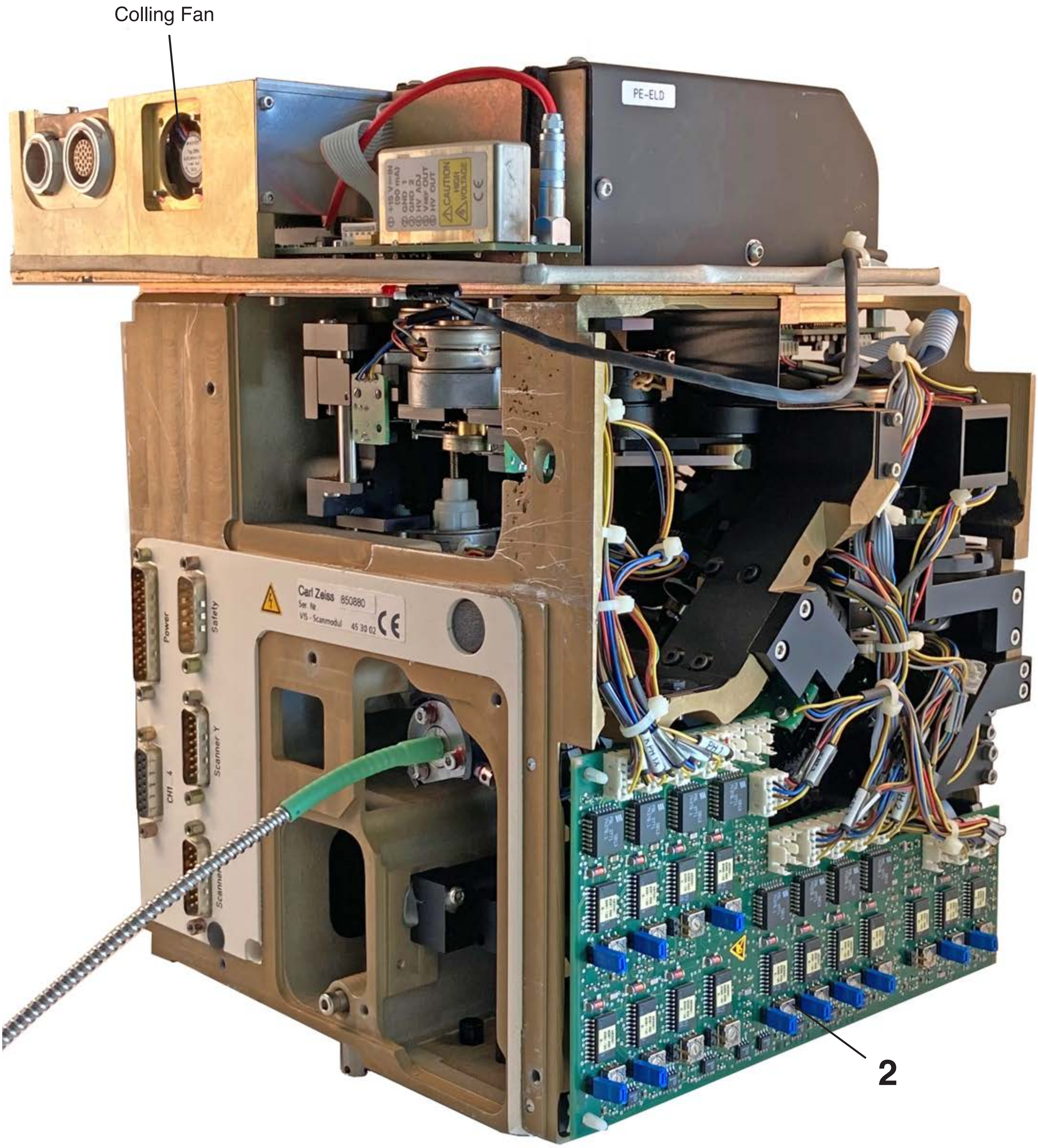
Removing all the body shells (previous page), we begin to see the inner electronics boards, stepper motors, and electromagnetic actuators. There are 9 electronics boards to control the motors, to receive feedback signals from positioning sensors, and to receive, and amplify the signals from the photo-multiplier tubes, etc.

Motorized X-Y Stage 1, Necessary to control the beam centration, and focus, located above the scan lens housing. Referring back to page 6, these stages would be responsible to center the pinholes 10. The galvo assembly is tightly housed below this assembly, visible from Side 4, behind scan lens (below).



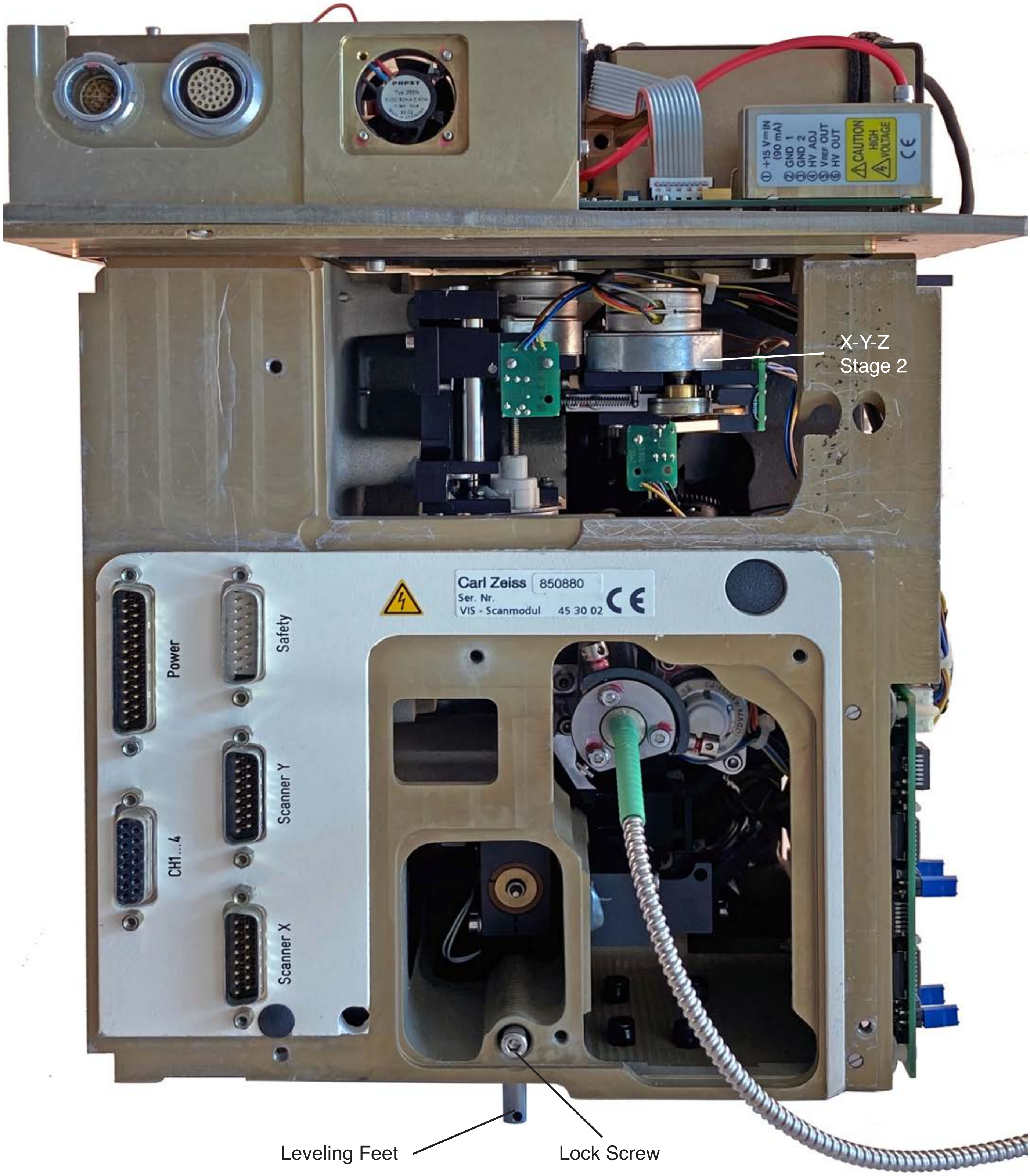
Rotating the assembly to side 2, we begin to see the inner electronics boards, stepper motors, and electromagnetic actuators. The photo multiplier tube (PMT) is barely visible from this side, and we'll have a closer look later. It is so interesting how each filter wheel, and actuator is mounted to the sides (on the right of the chassis, above), or at angle, mounted on a diagonal wall at the center of the housing. These decisions are made while converting a working prototype to a computer design software such as Solidworks.

The diecast body is divided to three pieces to house all the opto-mecha-tronics. I will supply an exploded view drawing of the diecast body on the next issue.

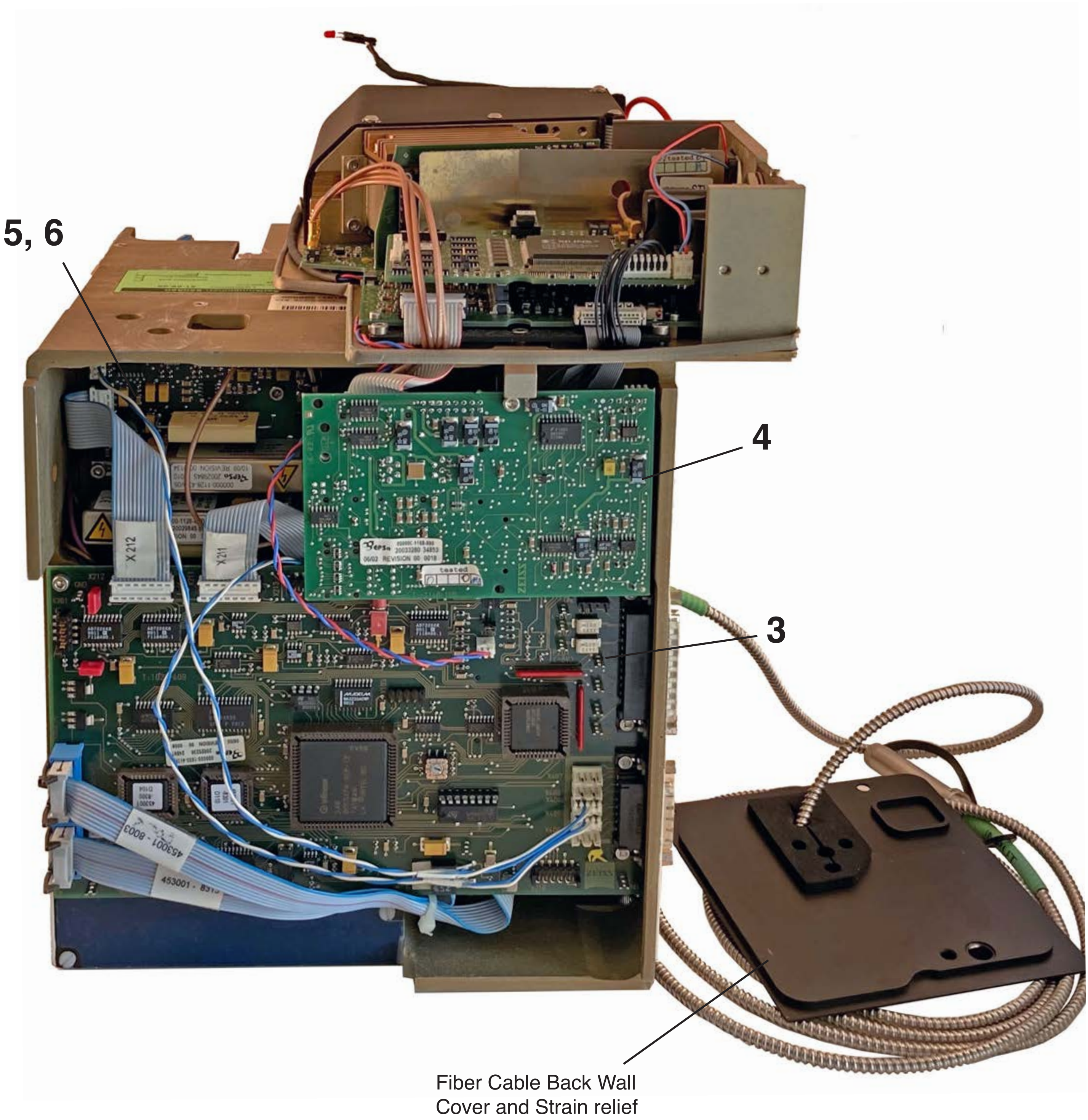


Rotating the unit further, we start seeing the fiber coupling that carries several light sources like He-Ne Red, and green Laser, and an Argon Laser. We'll take a closer look at the fiber coupling later. There is some empty space on this corner of the chassis, meaning they didn't have anything to fit along the light path on this corner of the assembly.

The META detector, and its drive electronics are placed on top of the chassis. So much caution has been made to isolate the META detector from the rest of the electronics boards, and to use separate connectors to reduce noise. The power supplies are also separated, and the detector itself is shielded with the black painted cover shell. This portion of the housing is also thermally isolated from the rest of the boards, having its own cooling fan.



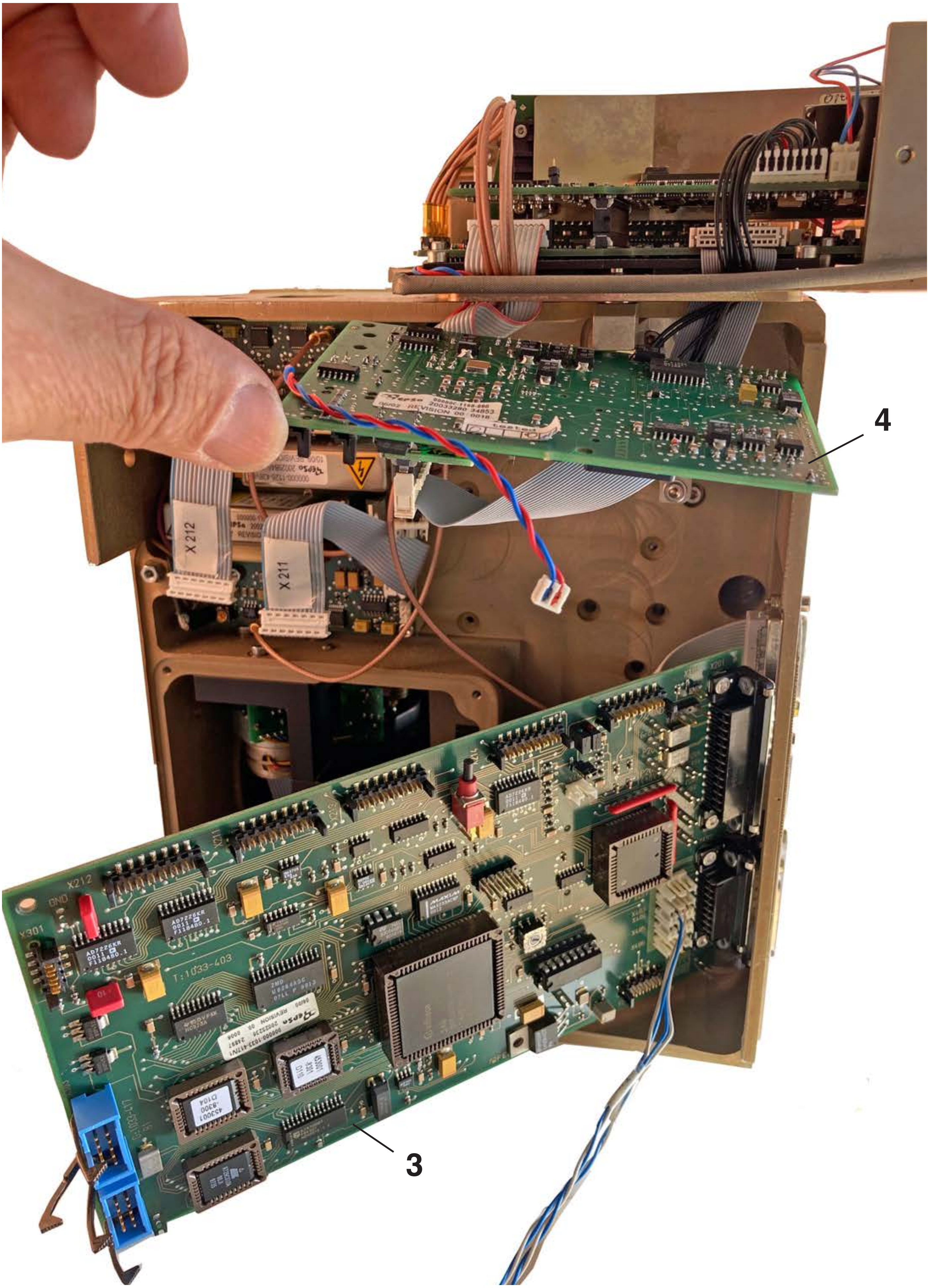
Side 3: We can see the electronic connectors, clearly labeled X-Y scan, etc. There is a cooling fan on top, and two Canon connectors for the META detector. The simple is better is observed here on the leveling feet: They can be adjusted by inserting a pin from the side to level the scan head on top of Axioplan microscope. There is a visible lock screw to prevent the head from slipping. X-Y-Z stage 2 is responsible to center, and focus the emitted Fluorescence beam precisely on the entrance pinhole of META detector.



Side 4: Rotating the unit further to the right by 90 degrees, we end up on the side 4 of the unit (above), finding the main control board 3. We'll start removing the electronics boards to see what's inside the chassis. The two ribbon cables on the bottom end up to X-Y Galvos buried behind the scan lens on side 1.

Four high voltage connectors from board 6 above, feed the META detector's PMT on top (board 7). There are two ribbon cables coming from board 5, 6 (on top) getting control signals from main control board 3.

Board 6 supplies the high voltage to the PMTs inside the META detector via high voltage cables.



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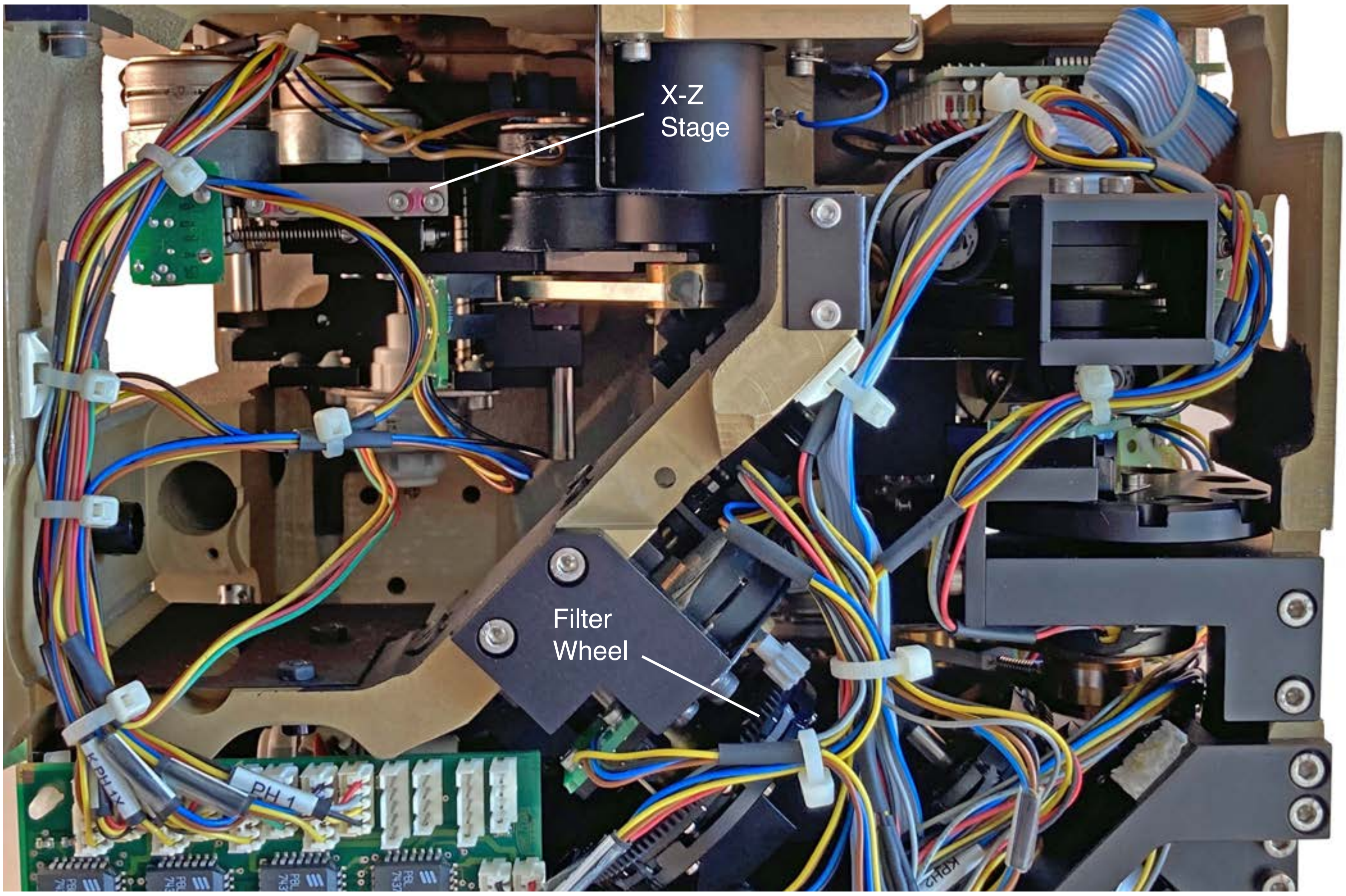
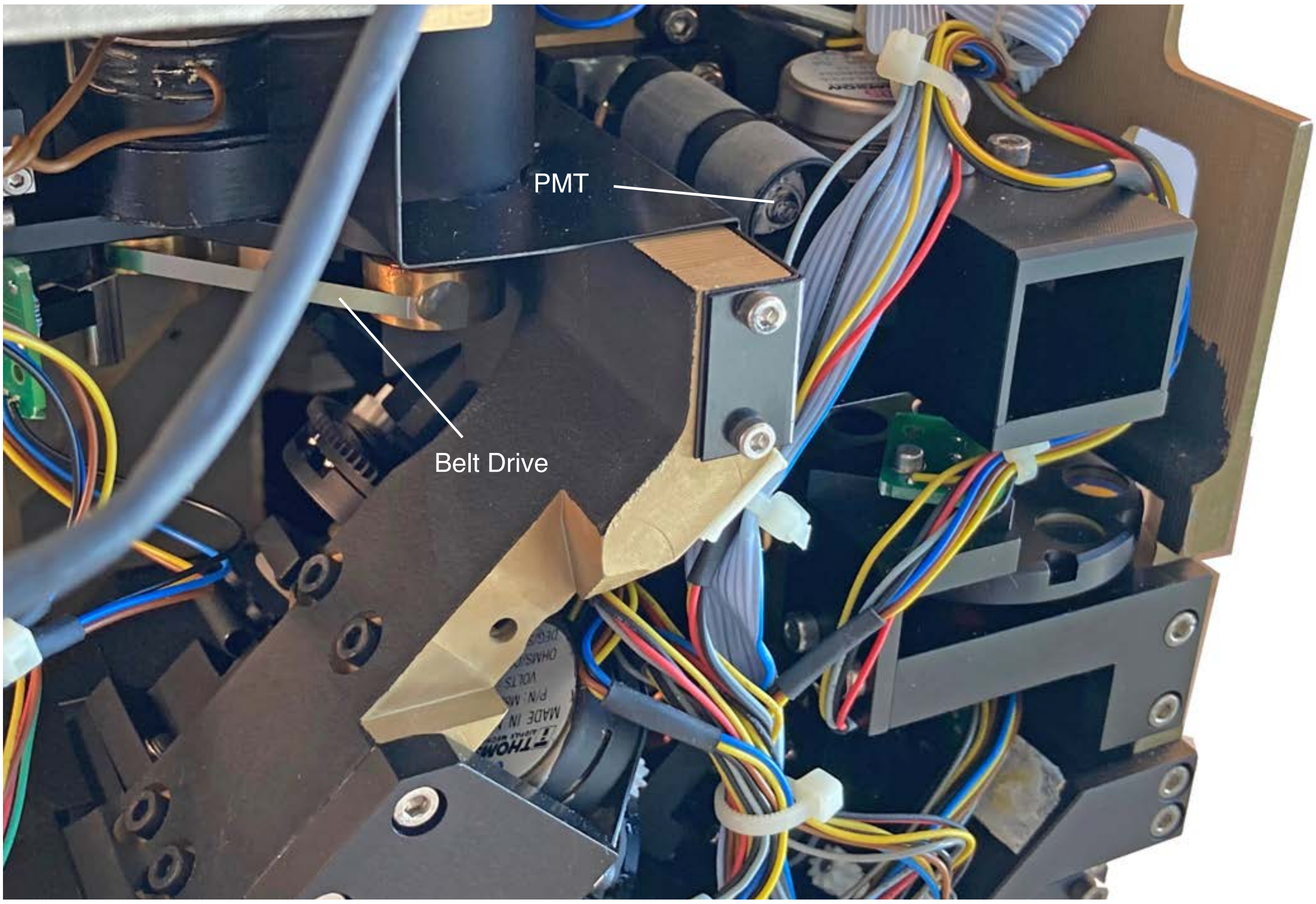
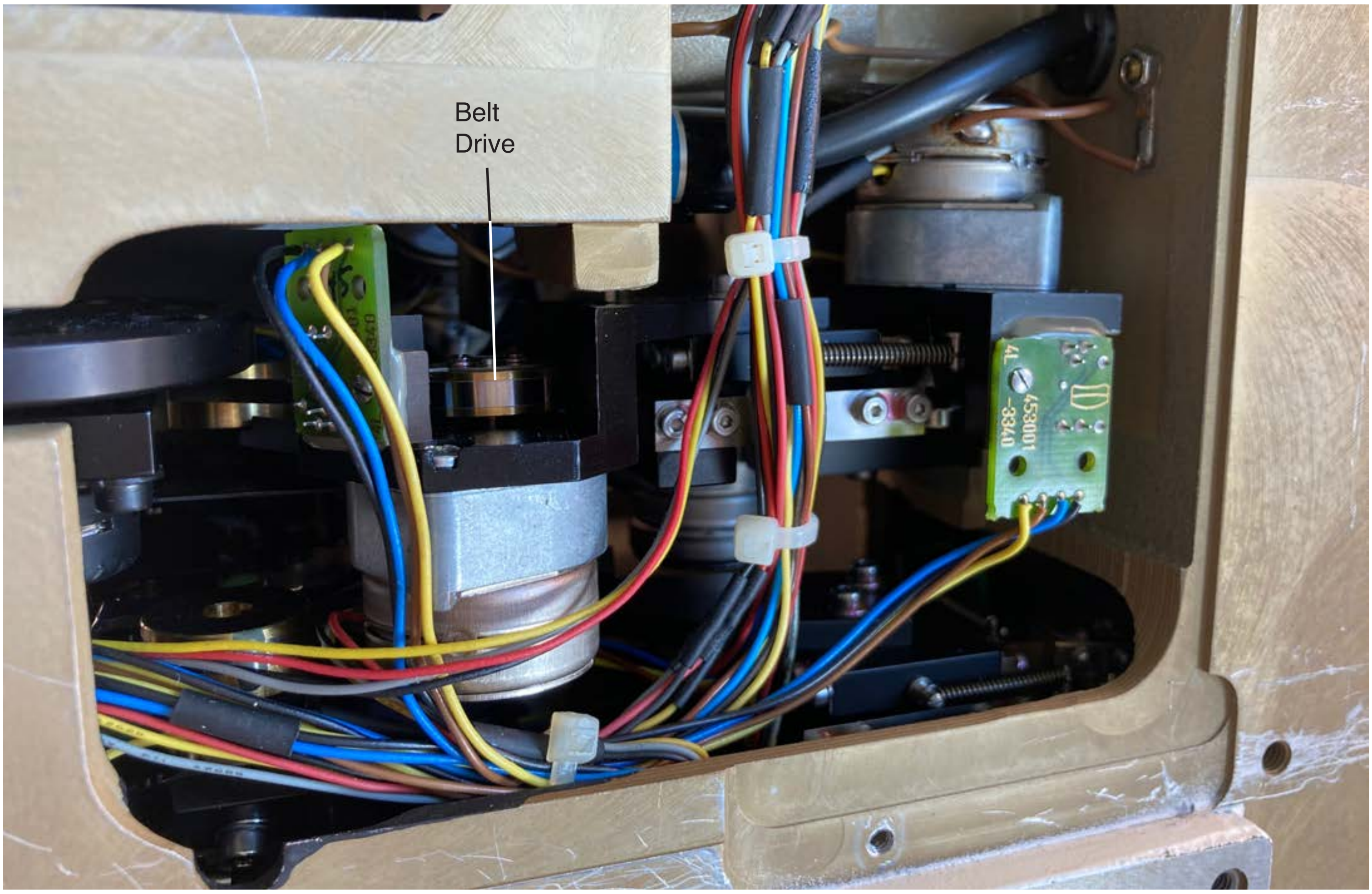


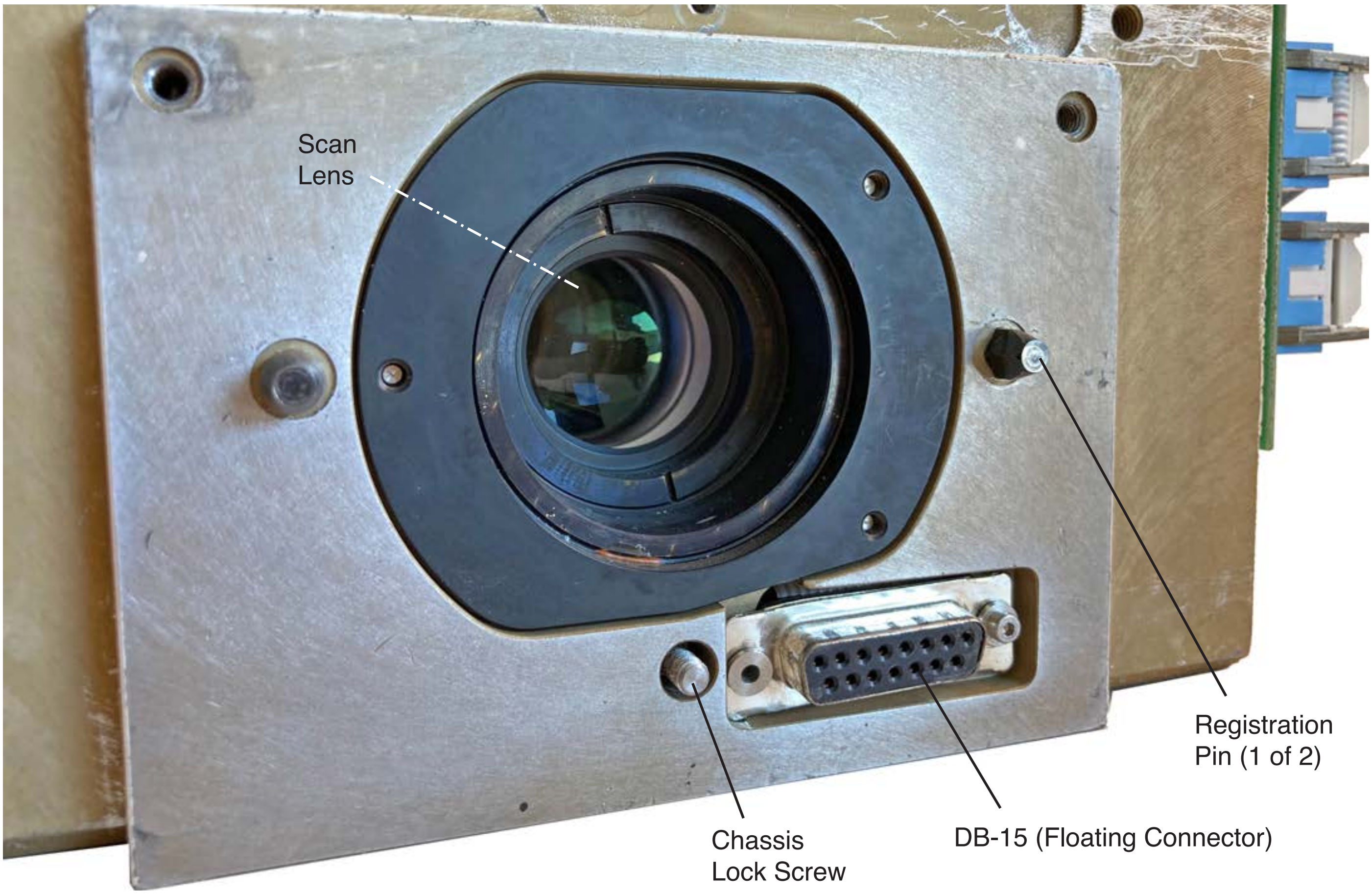
This is side 2 of the assembly explained on this page, and the two following pages. The PMT is housed inside a tubular housing (below) to receive fluorescent signals coming back from the sample. We'll have a closer look at this filter wheel.

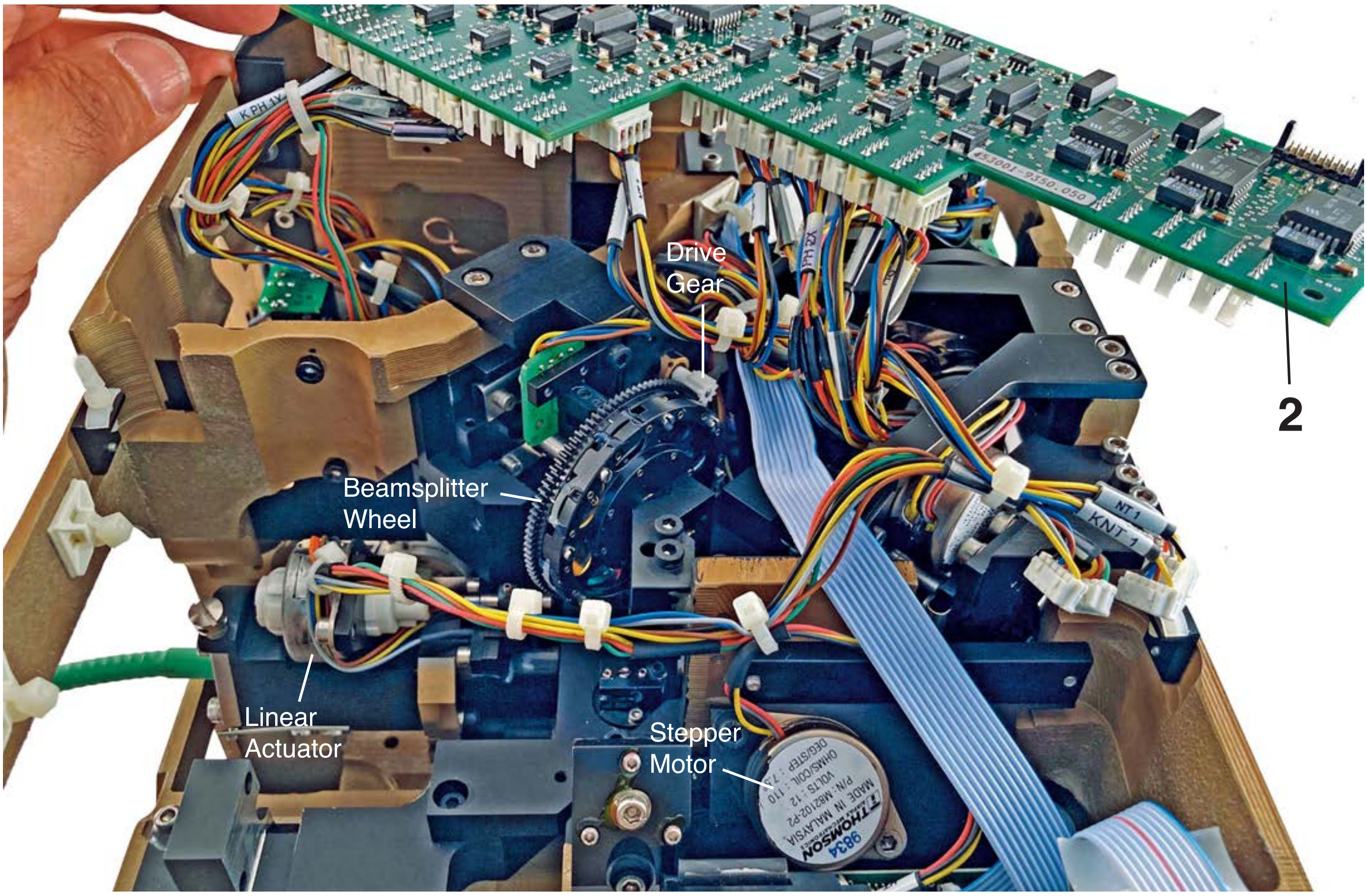


Side view of the X-Y stage 1 assembly reveals its belt driven mechanism; A thin steel belt links a motor spool with the linear stage. The belt is hard mounted on the spool so there is no slippage (very popular in opto-mechanics) .

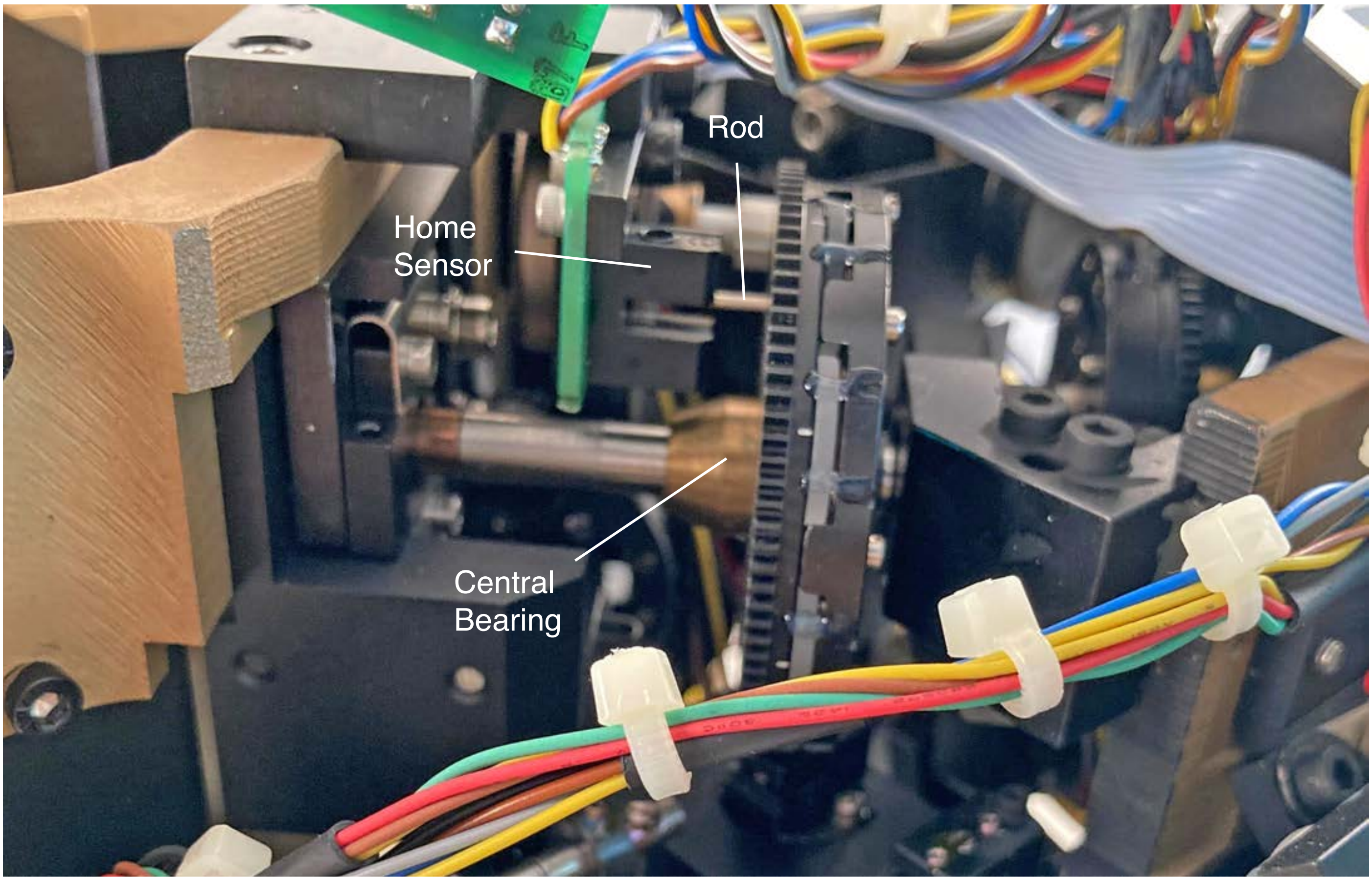


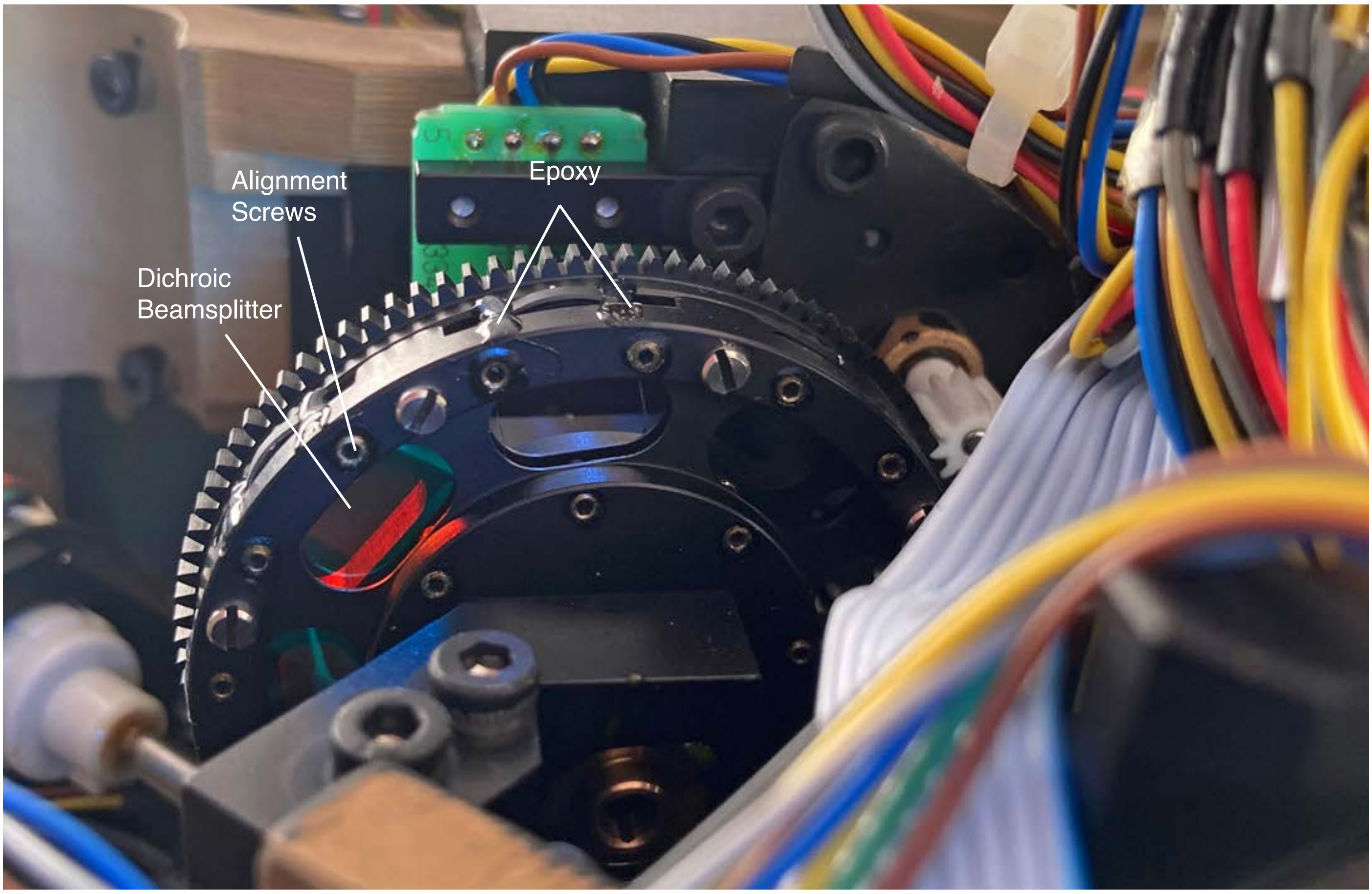
The opto-Mecha-Tronic interface is a DB-15 connector that mates with a specially designed observation head to establish electrical contact between the scanner, and microscope. There is actually only one contact that connects with the microscope main body, through the viewfinder housing to provide an interlock so the laser beam won't reach the eye.



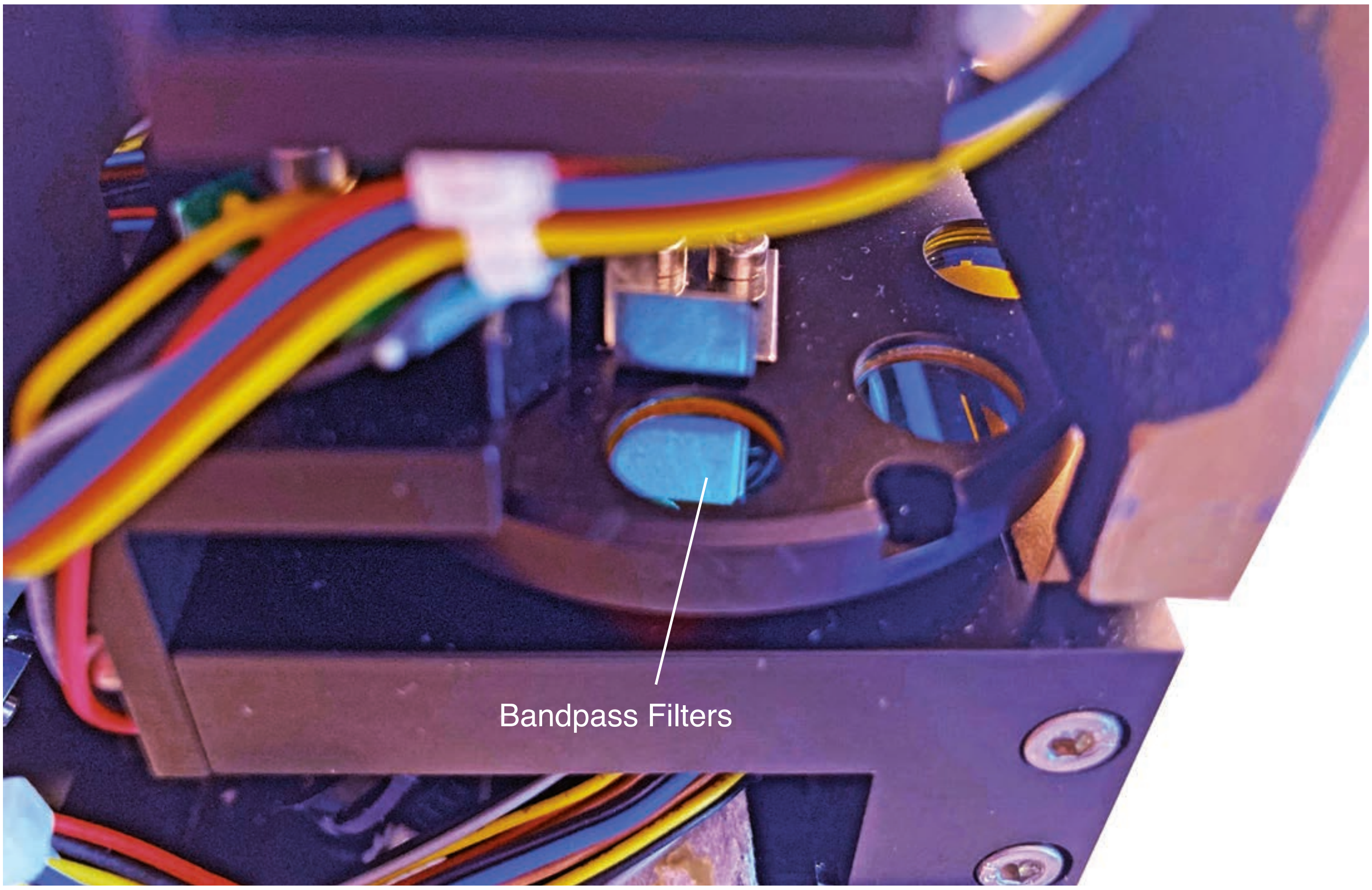


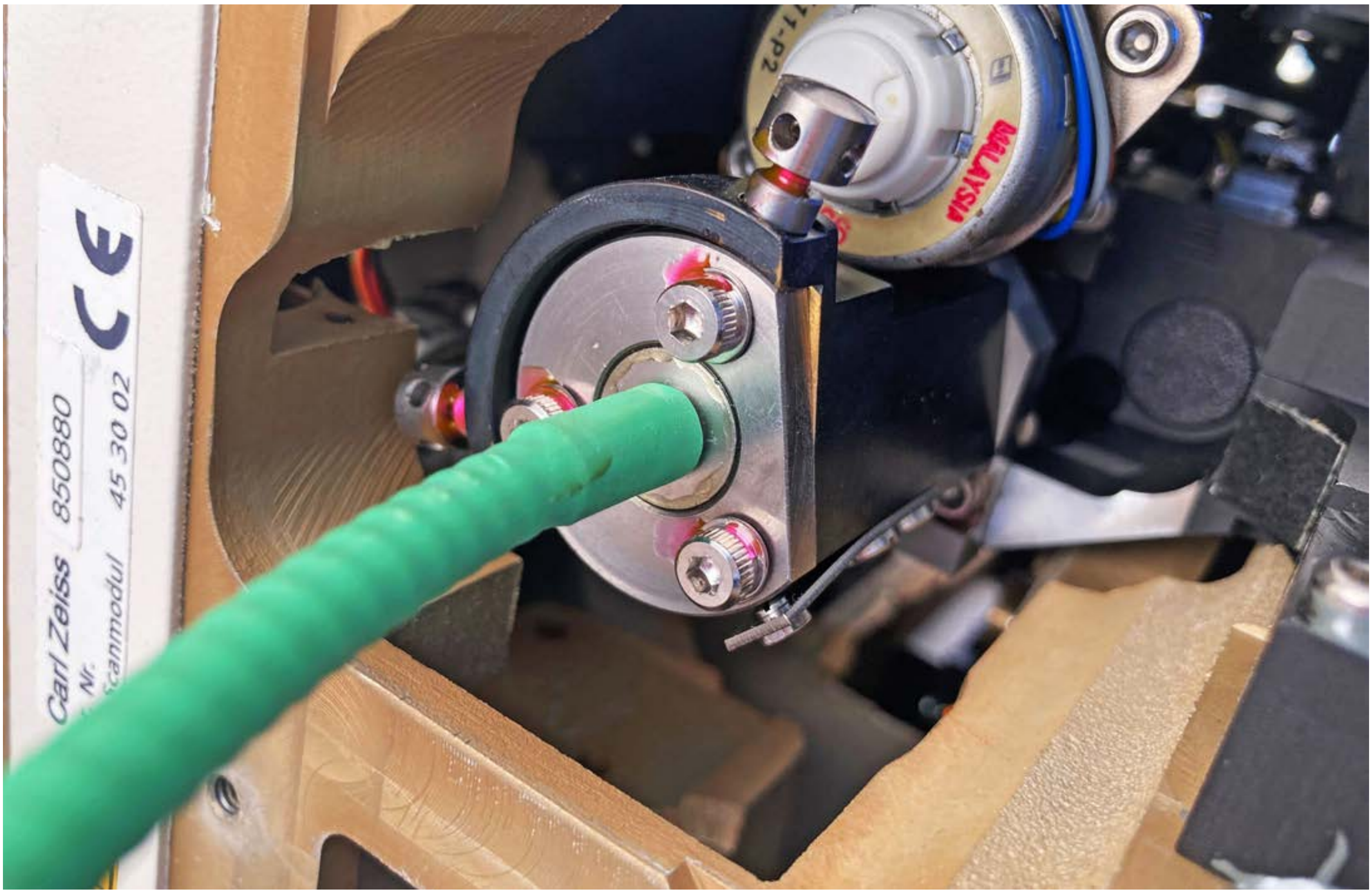
Removing board 2 reveals some of its actuators, and stepper motors. If you noticed how the Excitation/ Dichroic Beam-splitter/ Emission filters work inside the Axioplan 2 microscope, when adding the LSM 510 , all the internal filters (page 4) are bypassed by the scanner's own filters (Page 6, 7). There are three dichroic beamsplitter wheels, each containing



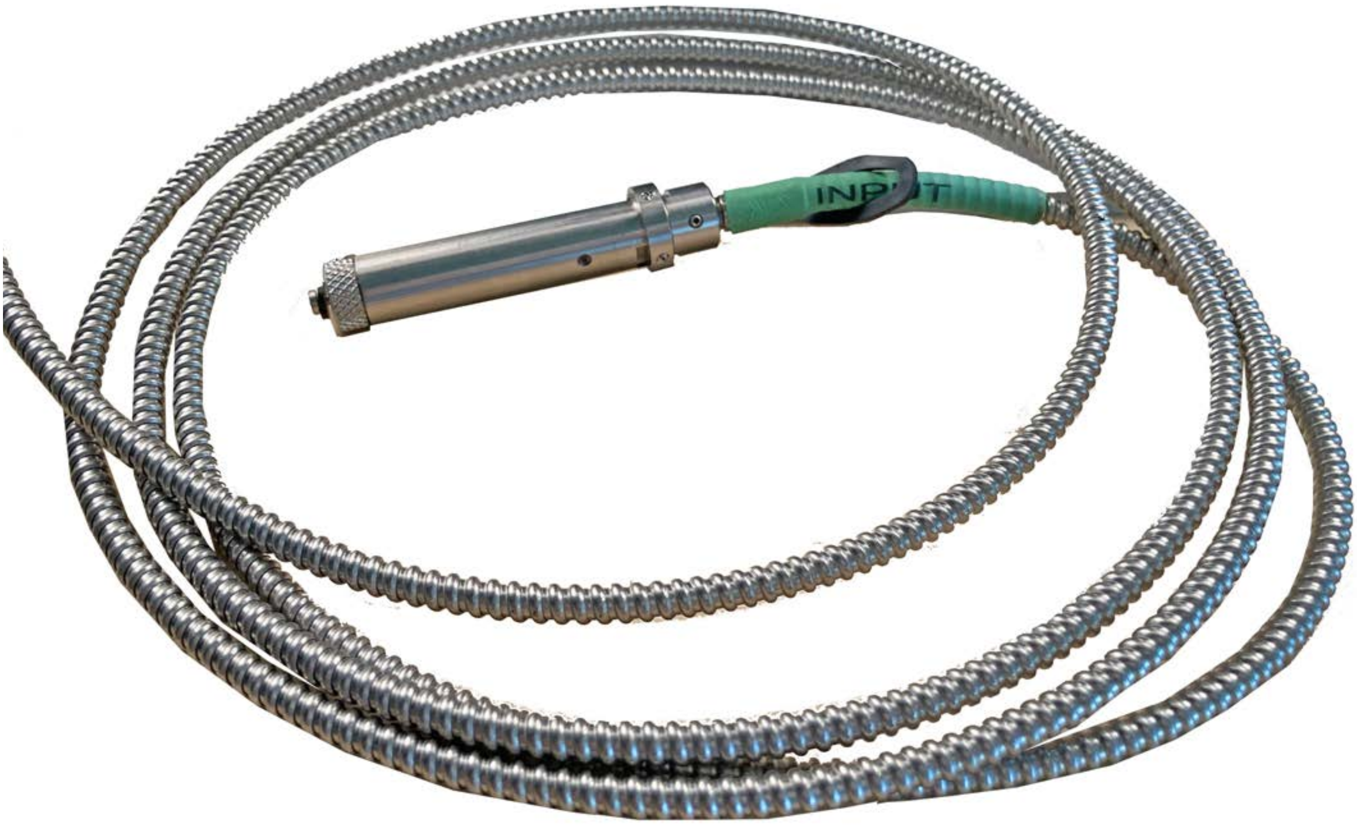


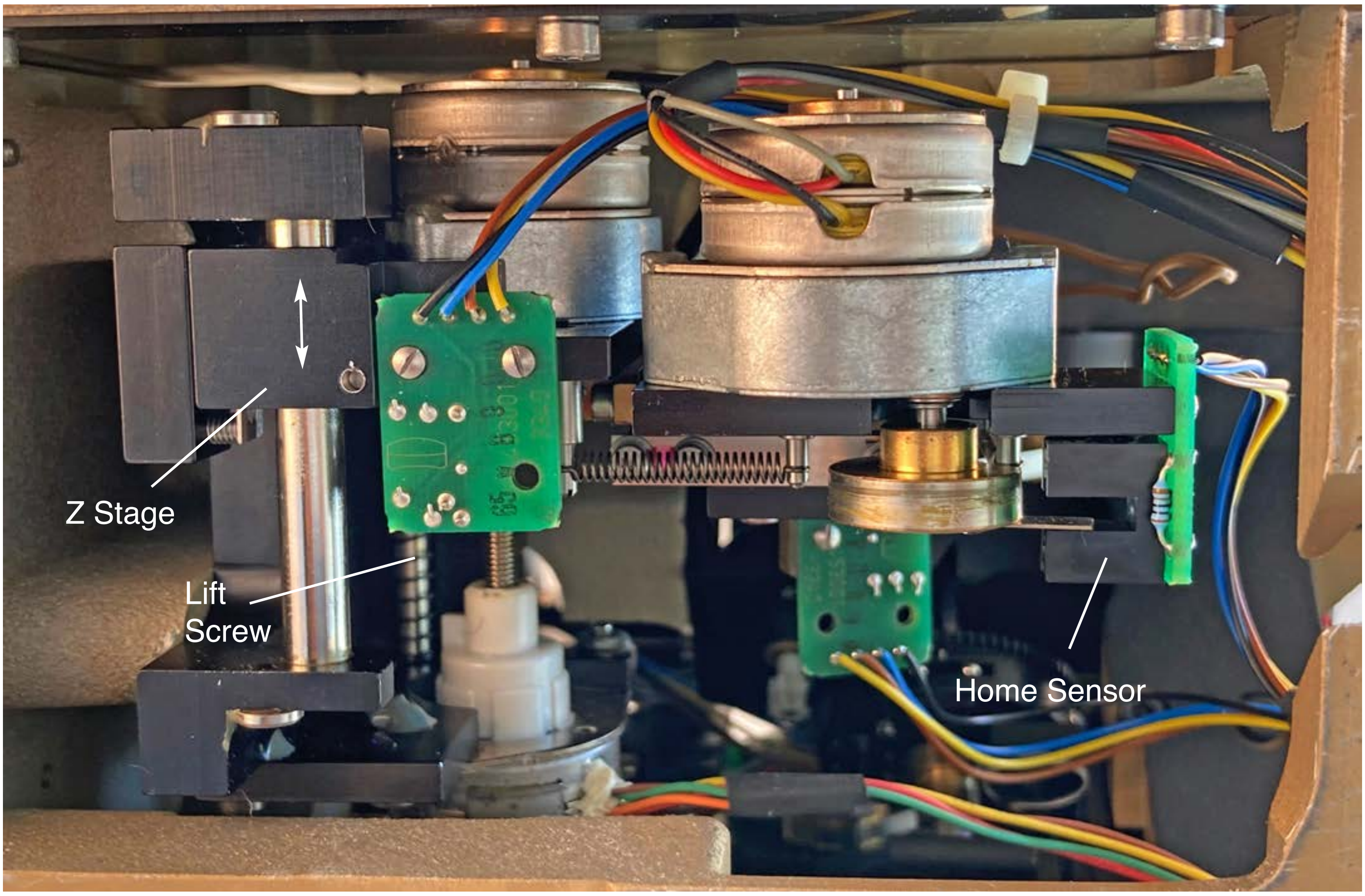
8 beamsplitters. All beamsplitters are first optically aligned, and epoxied in place, so all mirrors are parallel to the rotary axis. Beamsplitter wheels consist of a main metal housing sandwiched with a plastic gear. There is a home sensor so the controller brings each filter to its home position during power up. Filter wheels (below) have less critical mounting.



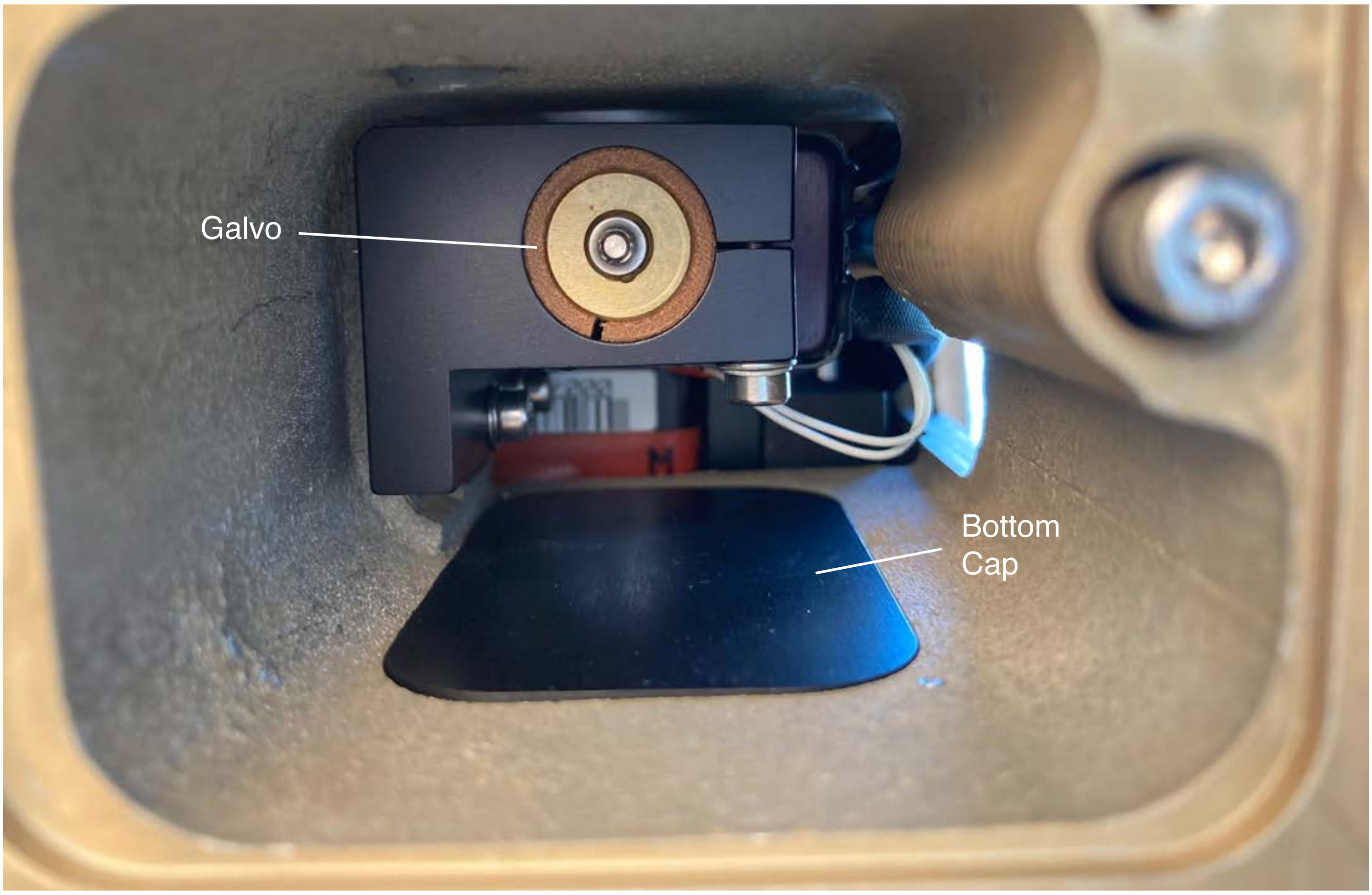


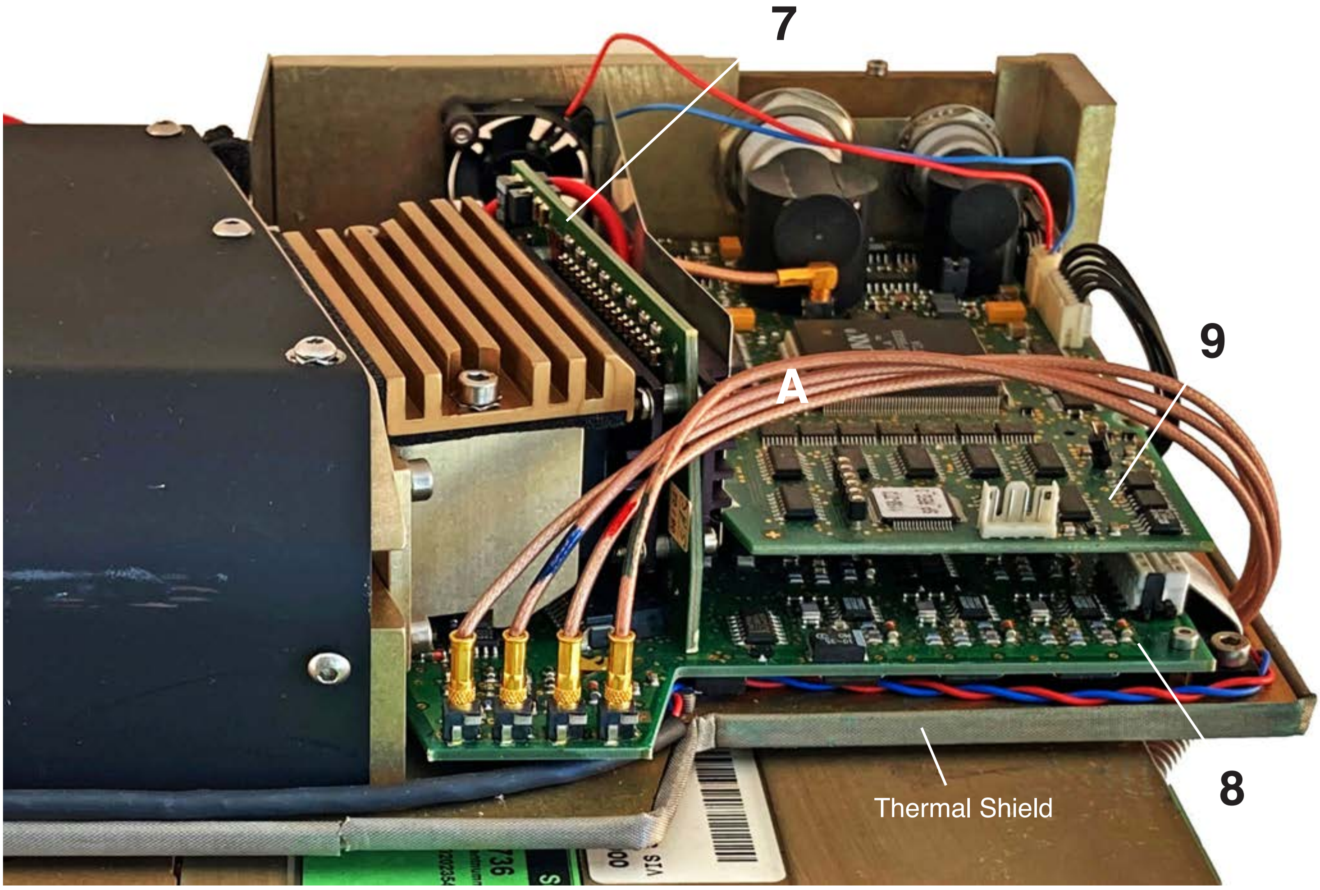
This heavy duty fiber transfers the illumination beam from three different sources, mounted on a 12x16” granite table, mounted somewhere on the confocal microscope works station. The three-point alignment mount is clearly visible to align the filter.



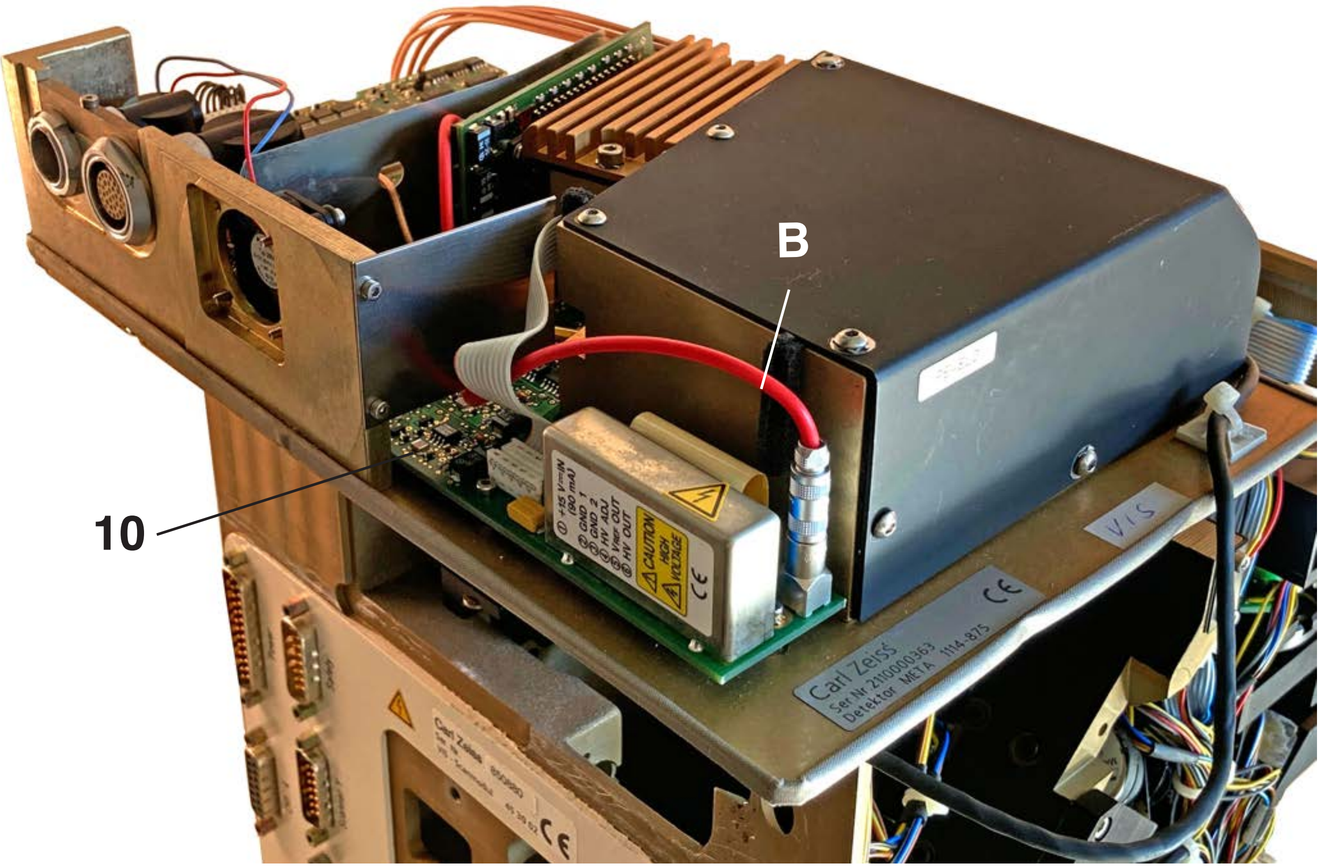


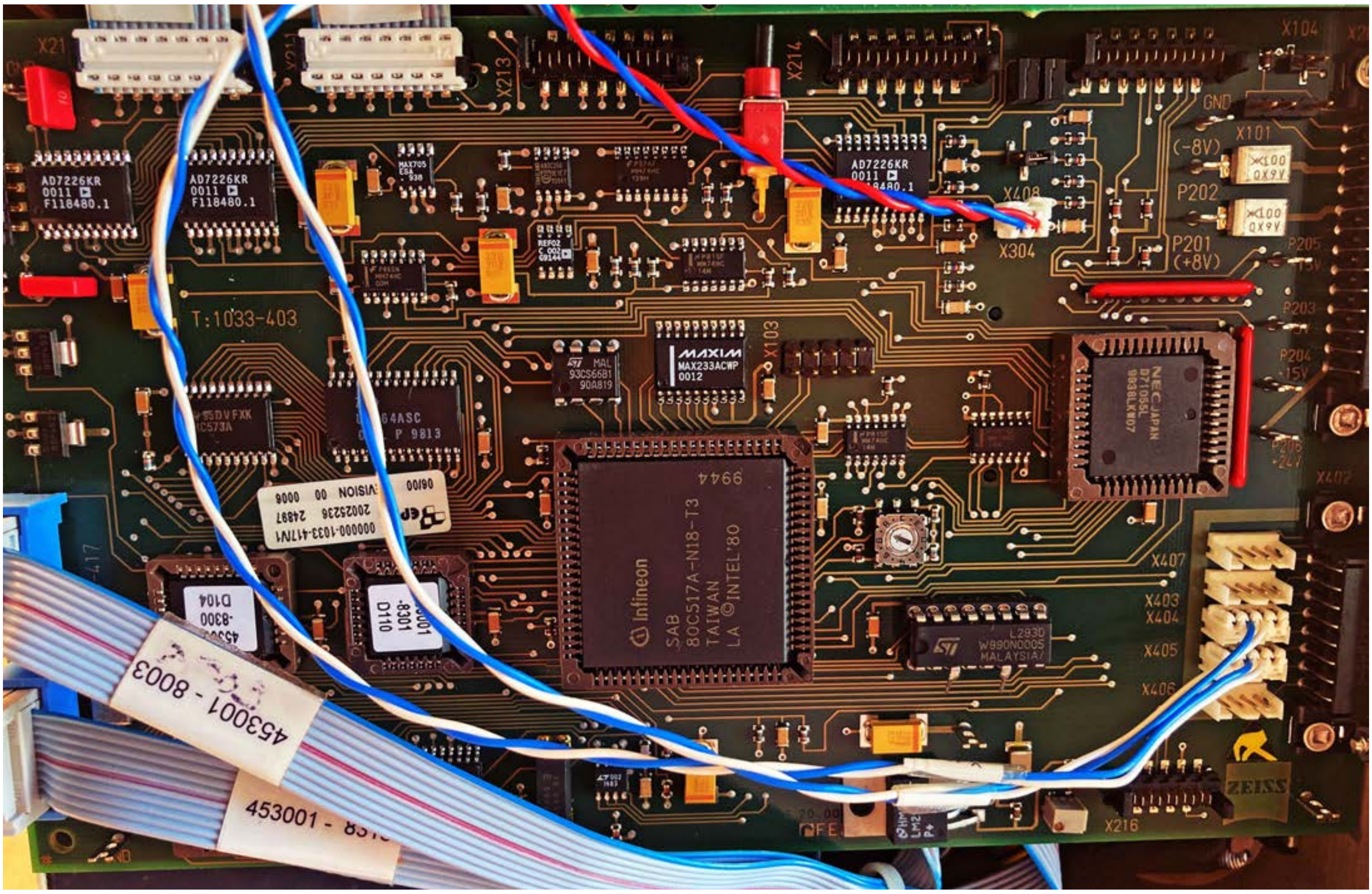
Close up of the X-Z stage 1 assembly (above) reveals its drive mechanism. Home sensors (above) tell the end position of stepper motors, during power up. You could see X-Z stage from side 2, and its belt drive mechanism.
The galvo assembly (below) is tightly housed below the assembly, visible from rear side of assembly (side 3).





META detector mother board is supplied with two high voltage shielded cables A, coming come from board 6 (Page 15), and +/-15V supply from board 10. This part looks to be an add on to the original LSM 510 chassis, and is thermally isolated from the rest of the chassis. It is basically a stand alone assembly with its own input and output connectors.

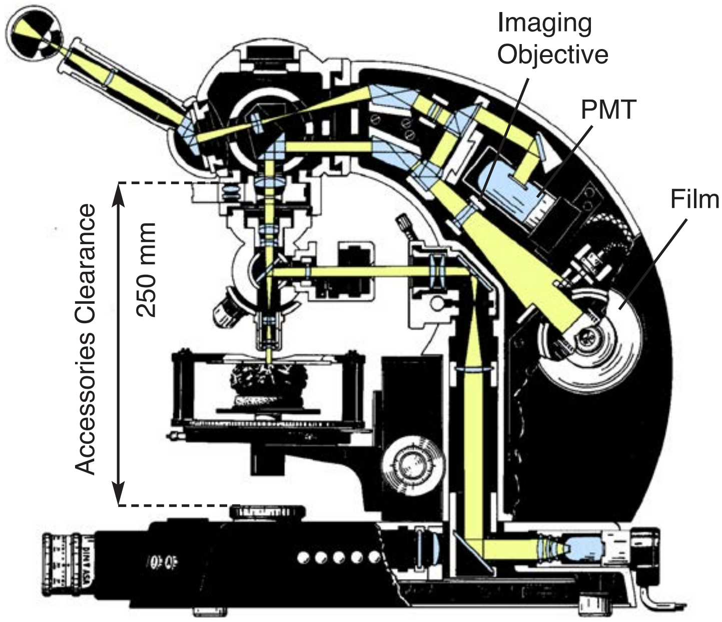




Intel 80C517A micro-controller with 8-bit processor sits at the heart of main mother board, with NEC 71055L programable logic chip, along with two other programable logic chips. For those experienced in the field, this is a straight forward logic design, and could tell you how the system operates. For this day, and age, ribbon cables are still common.

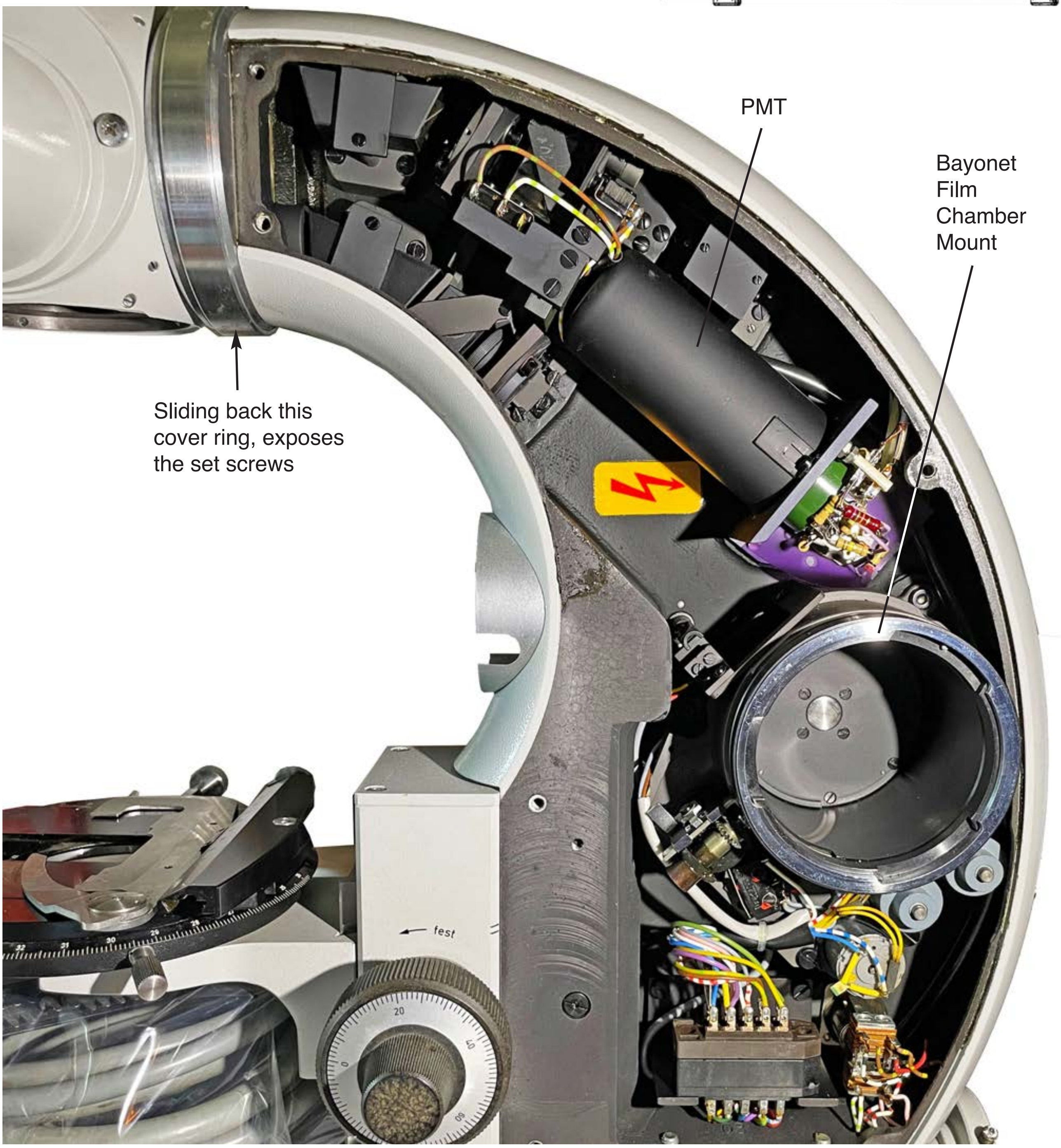
XILINX 4036 XLA processor chip on board 9 handles the signals from META detector.

Zeiss Universal Microscope



In last issue, I discussed one of the most timeless microscope designs Zeiss had developed, the Universal series with the Lumipan stand in 1958 that you see here. I had a chance to acquire the photo version of this microscope, and be able to examine its design in more detail.

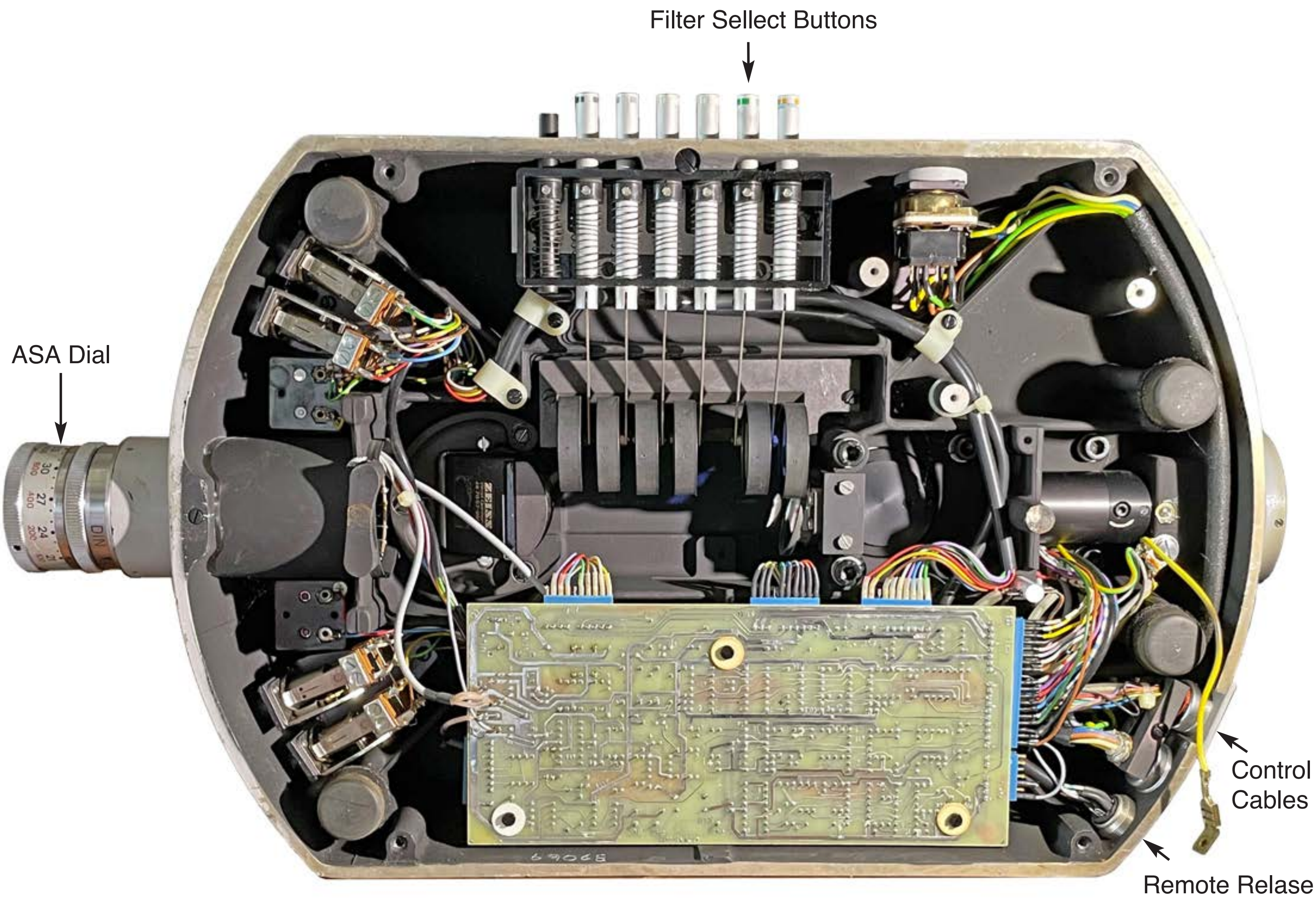
It's unusual design: Note how the incident light beam is brought from the lower back of the microscope through a relay optics to reach behind the nosepiece turret. For fluorescence illumination, there is a side attachment secure a compact HBO Mercury illumination from the side. You could see the film chamber, and the rest of the optics with the



side panel removed (below). Zeiss uses thin decorative rings to cover its tiny set screws that are for you to discover during disassembly. I had unforgettable fun bringing this microscope back to life. there is always plenty of room for all Zeiss' accessories: Fluorescence attachment, Magnification chamber, Fluoar objectives, X-Y sample stage, Phase Contrast condenser, Polarization filter, etc. I don't know how they have room for all this. This was a well thought through design.

Bottom view of the microscope with the base plate removed (bellow) reveals its filter control that works similar to an old AM radio preset tuning buttons. There are all sorts of electrical buttons around the base, and an electronics board to receive the signal from photocell, and to control the shutter. Not shown are two 1 m long cables that connect to shutter, and time laps control consoles. There is a connector for remote release cable like a computer mouse.

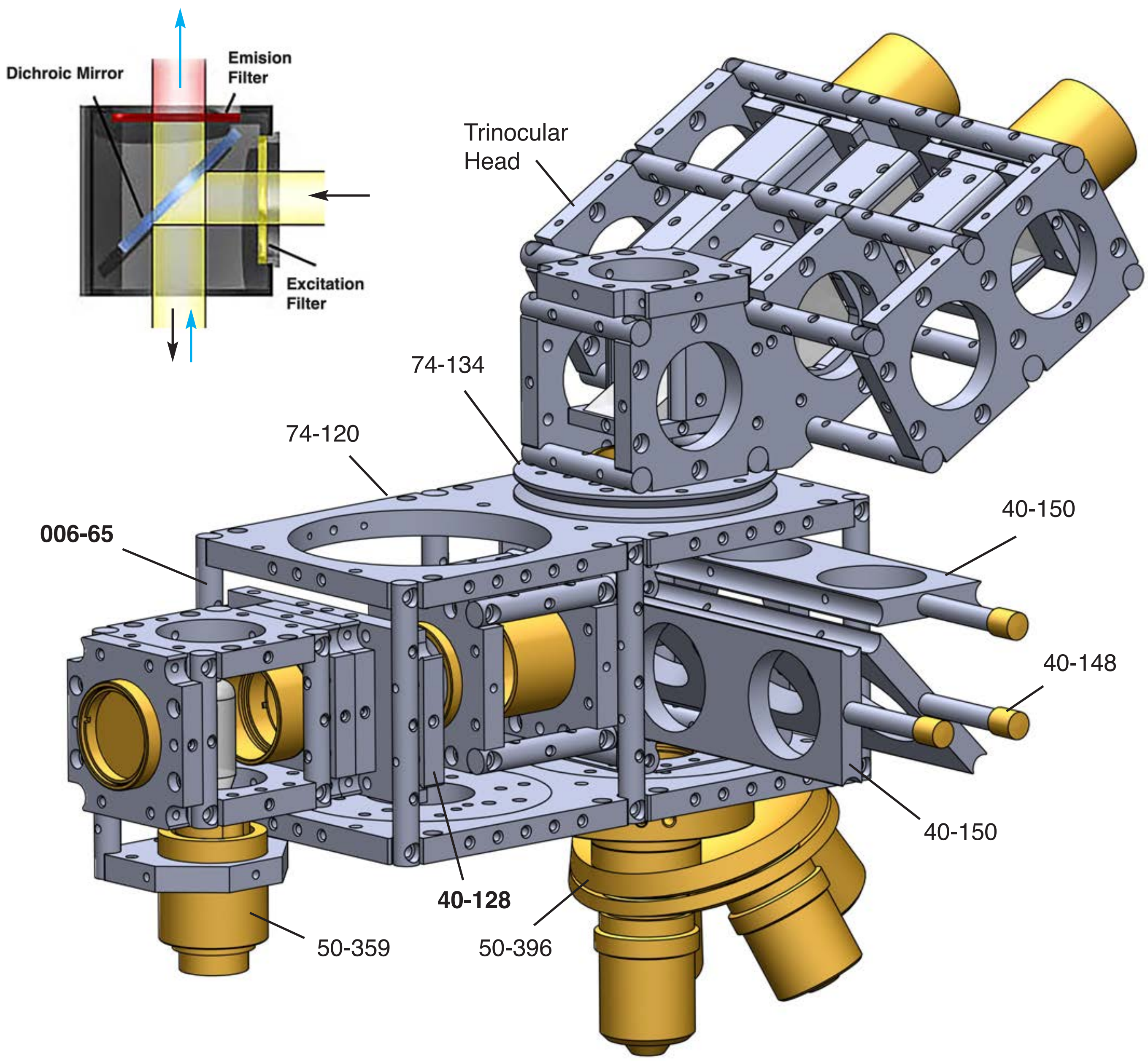
There is also a power supply to drive the Photo Multiplier Tube. The photomultiplier tube in this microscope could measure light at extremely low light levels for time exposures. The body is light tight like a photographic camera.

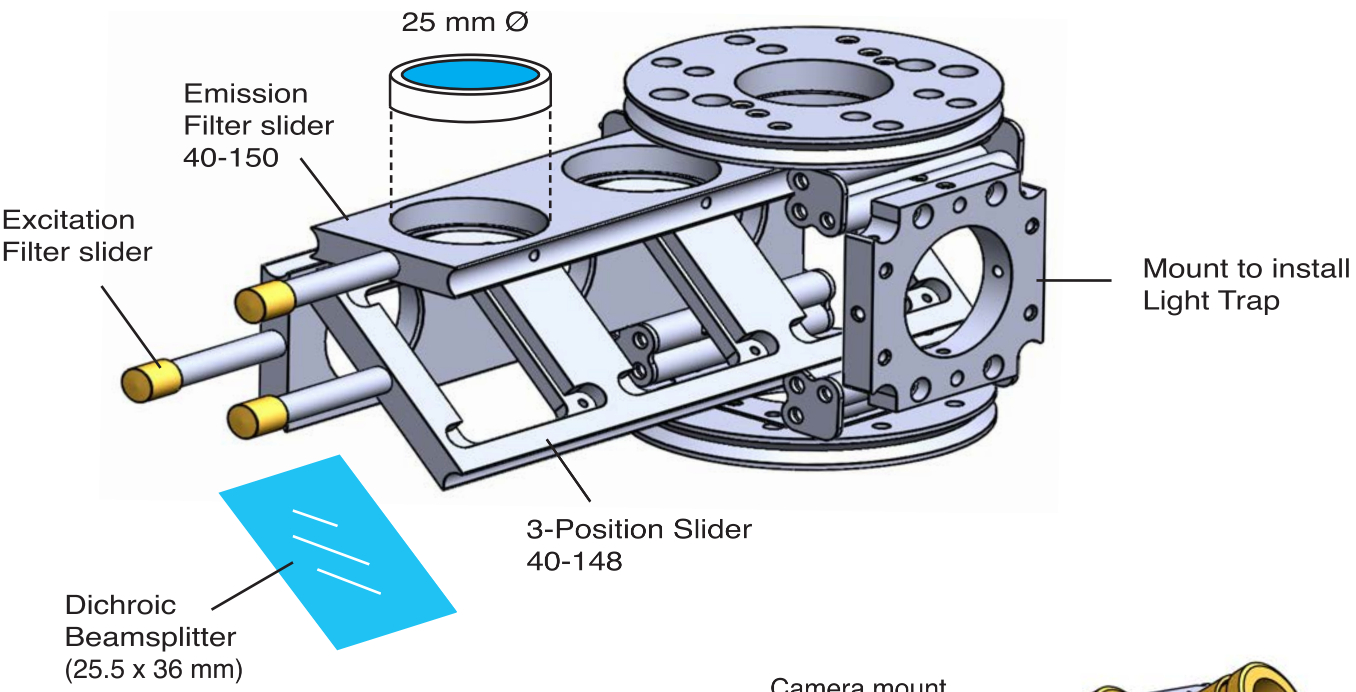


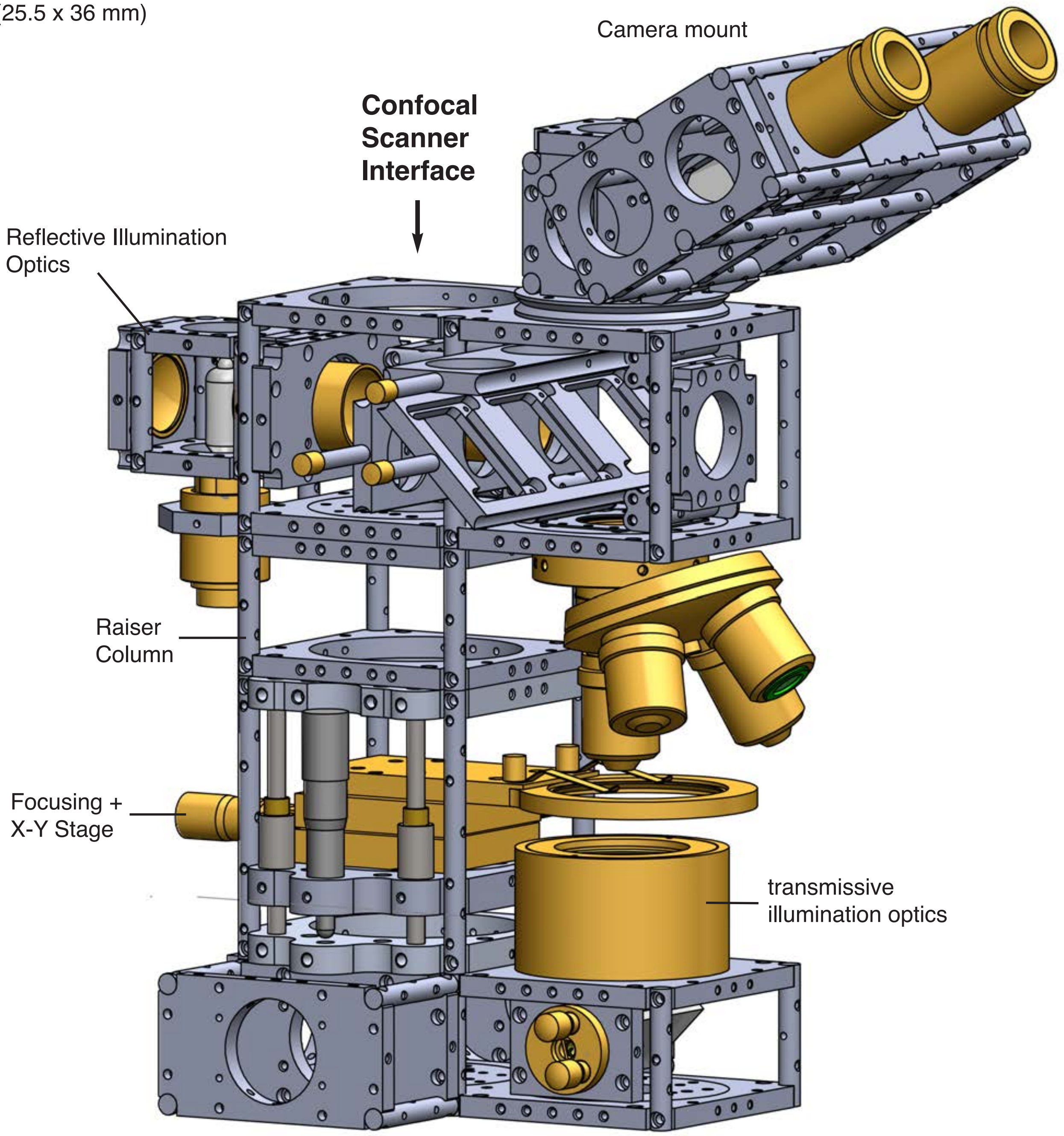
Designing the Confocal Head for Optoform Microsocpe

In last issue, we developed the central beamsplitter slider for Fluorescent microscope. Although Zeiss utilizes this scheme, their slider is a solid block which has to be pre-assembled before its insertion into the microscope. In our design, there are three sliders, that could be independently selected to reach the desired emission/excitation/absorption effect (opposite page). in their beamsplitter blocks, Zeiss utilizes a standard filter size (25 mm), and bemsplitter (25.5 x 36 mm). A high quality 3-filter/beamsplitter set will cost around $1,200 each, adding up to $3,600 just for filters.

Typical combination that are available are: **546/ 580/ 590**, **485/ 510/ 515**, and **385/ 395/ 397** for Excitation/ Dichroic/ Emission filters respectively. As we saw in the LSM 510, all the internal filters of Axiovert 2 microscope were bypassed, and the scan head would have its own sets of filters, and beamsplitters. Looking at our Optoform assembly, the placement of the Confocal head could fit on the back side of 74-120 mount, behind the trinocular observation head (below).

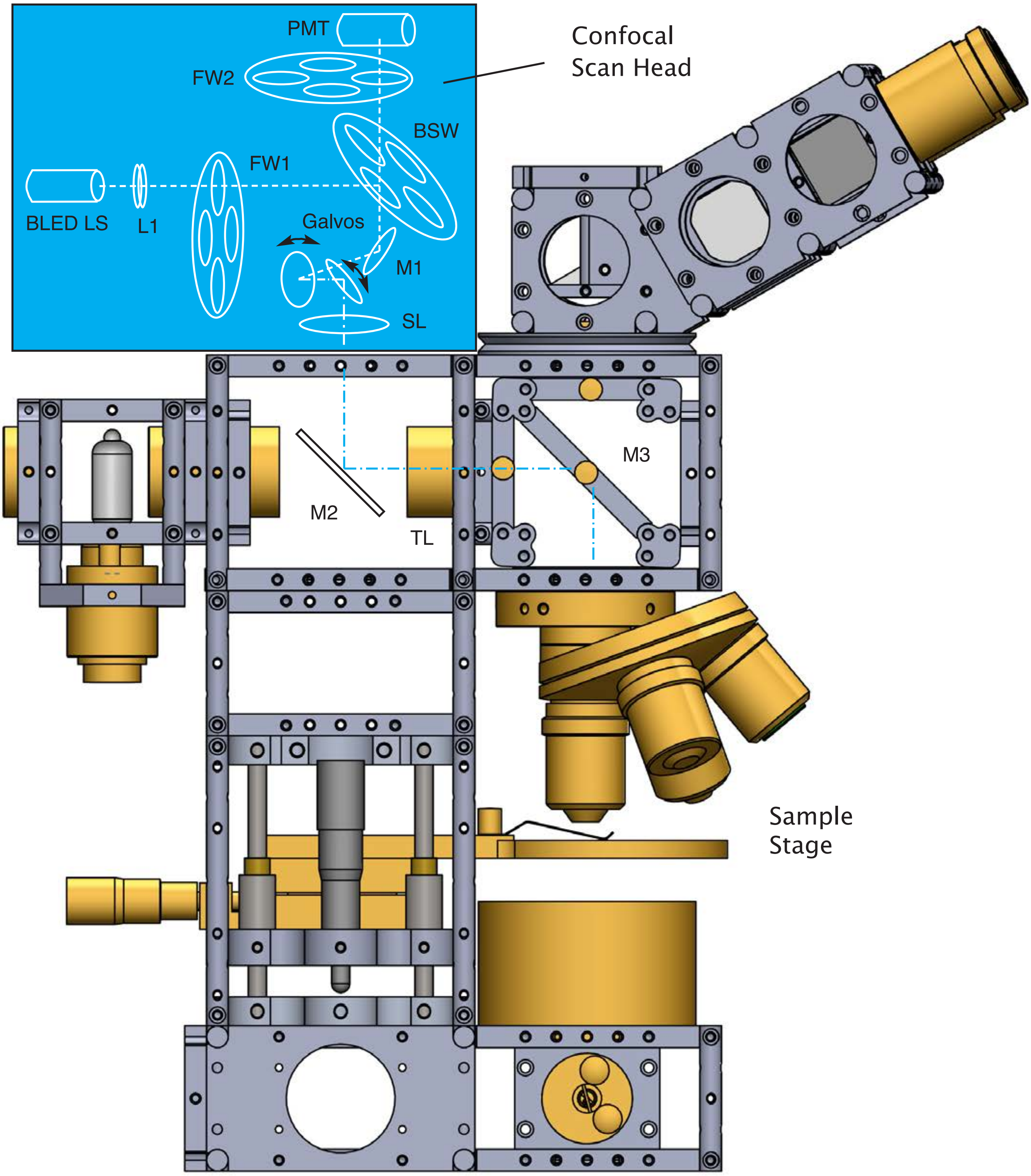



25 mm Ø
Emission
Filter slider
40-150
Excitation
Filter slider
Mount to install
Light Trap
3-Position Slider
40-148
Dichroic
Beamsplitter
(25.5 x 36 mm)


Camera mount
Confocal
Scanner
Interface
Reflective Illumination
Optics
Raiser
Column
Focusing +
X-Y Stage
transmissive
illumination optics

Optoform Version of Confocal Scan Head

Lets now begin designing the Confocal Scan Head with Optoform. The basic design would be a combination of individually designed Optoform modules. But for now, let's see how the side view of the microscope would look like. At system level, if we were to copy how LSM 510 is designed we'll have the simplified arrangement below: Light originates from a bright LED light source and collimation optics L1, goes through excitation filter set FW1, reflects off of beasplitter wheel BSW, reflects off of X-Y galvos, then through scan lens SL, and enters the light path of microscope through mirror M2, and M3, finally focused by an objective on the sample. The fluorescent light emitted from the sample goes through the objective lens, then reflects off of mirror M3, then M2, and goes through the galvos, passes through dichroic beamsplitter BSW, emission filter set FW2, and to the PMT detector. To start with, the filter wheels could be replaced with a particular filter set, and a dichroic beamsplitter. We don't know yet where to find the elliptical dichroic beamsplitters (Like those found in LSM 150). There is a better path that we could go to avoid Zeiss' spaghetti optical design, and this is how:



A Simplified Layout

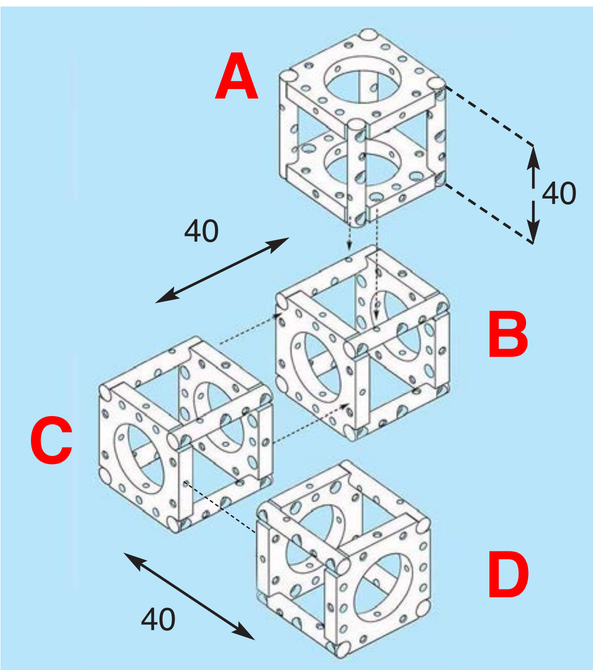
Instead of filter wheels, why not utilize the same assembly we built for fluorescent microscopy? If we decided to motorize the system, we could devise linear actuators instead of a rotary filter wheel drive. So here is a basic design for the system. For PMT housing we could utilize the same module we developed for Strategene and was made available in classical Optoform catalog. It is made of black Derlyn, and has a rectangular lens mount on its front face for mounting cylindrical optics.

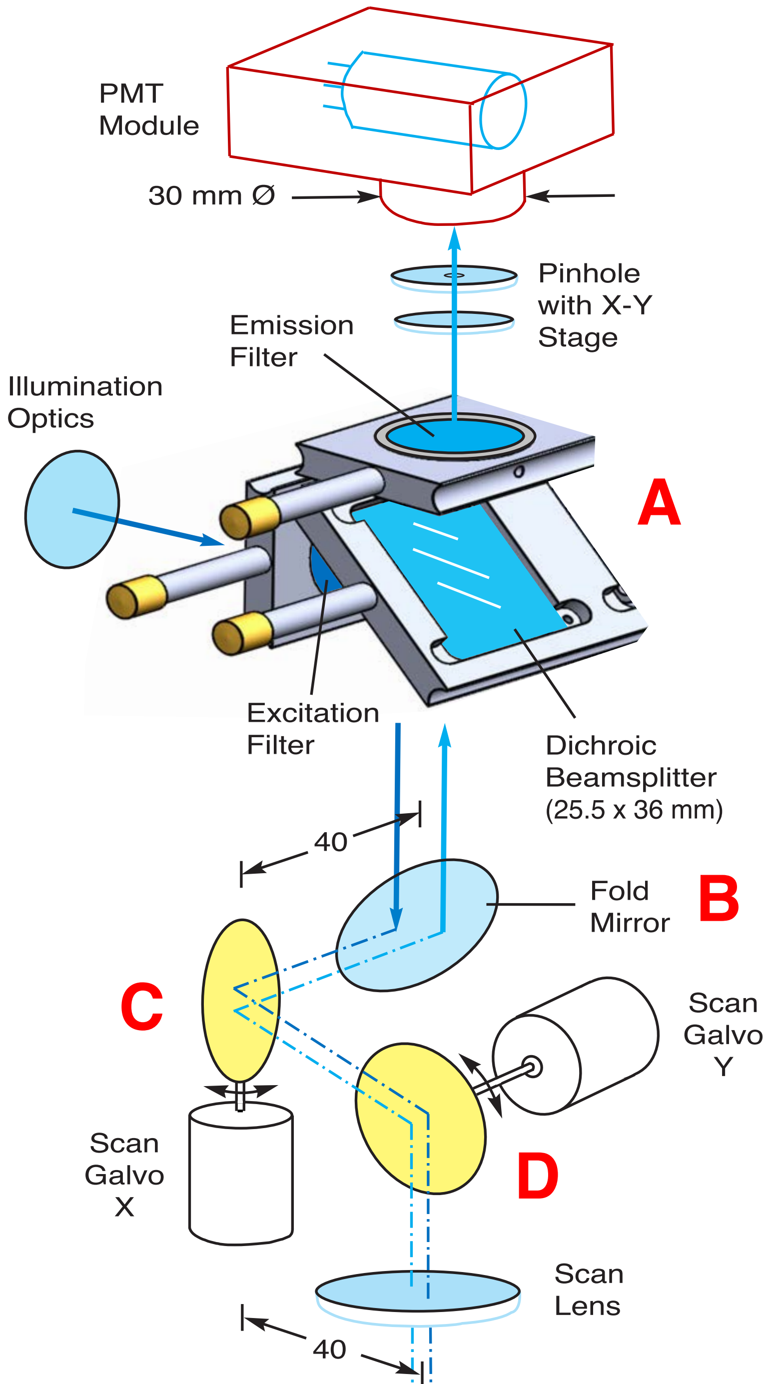
The detection side needs more work because the scan area is supposed to be a pinhole. So we'll need to have an X-Y stage like we saw in Zeiss LSM 510 to align the beam from the spot on the sample onto the PMT. In Zeiss design, there had to be compensation for a shift by the scan head laying on top of microscope. We'll also have the same challenge if this design is intended to be an add on module.

Integrating the Modules

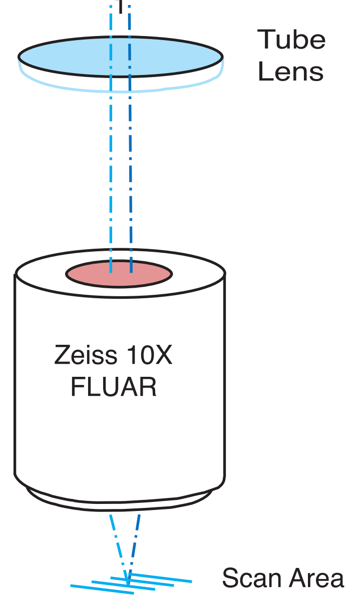
So here it is, put together by connecting cubes A, B, C, and D (right), and after the installation of the necessary hardware: The galvo cubes, the beamsplitters, and filters, fold mirror, PMT tube, the pinhole, and the light source.

Let's now go back to the discussion we had about the chassis. We have the option of fitting this assembly inside a symmetrical housing (with the scan lens centered in the middle of the box, or



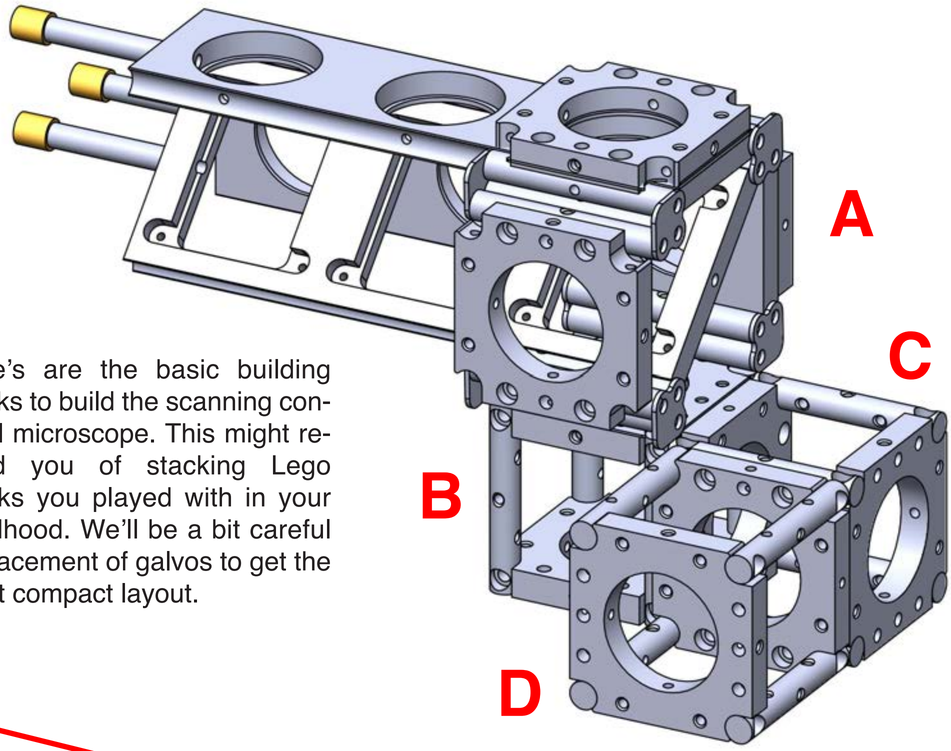


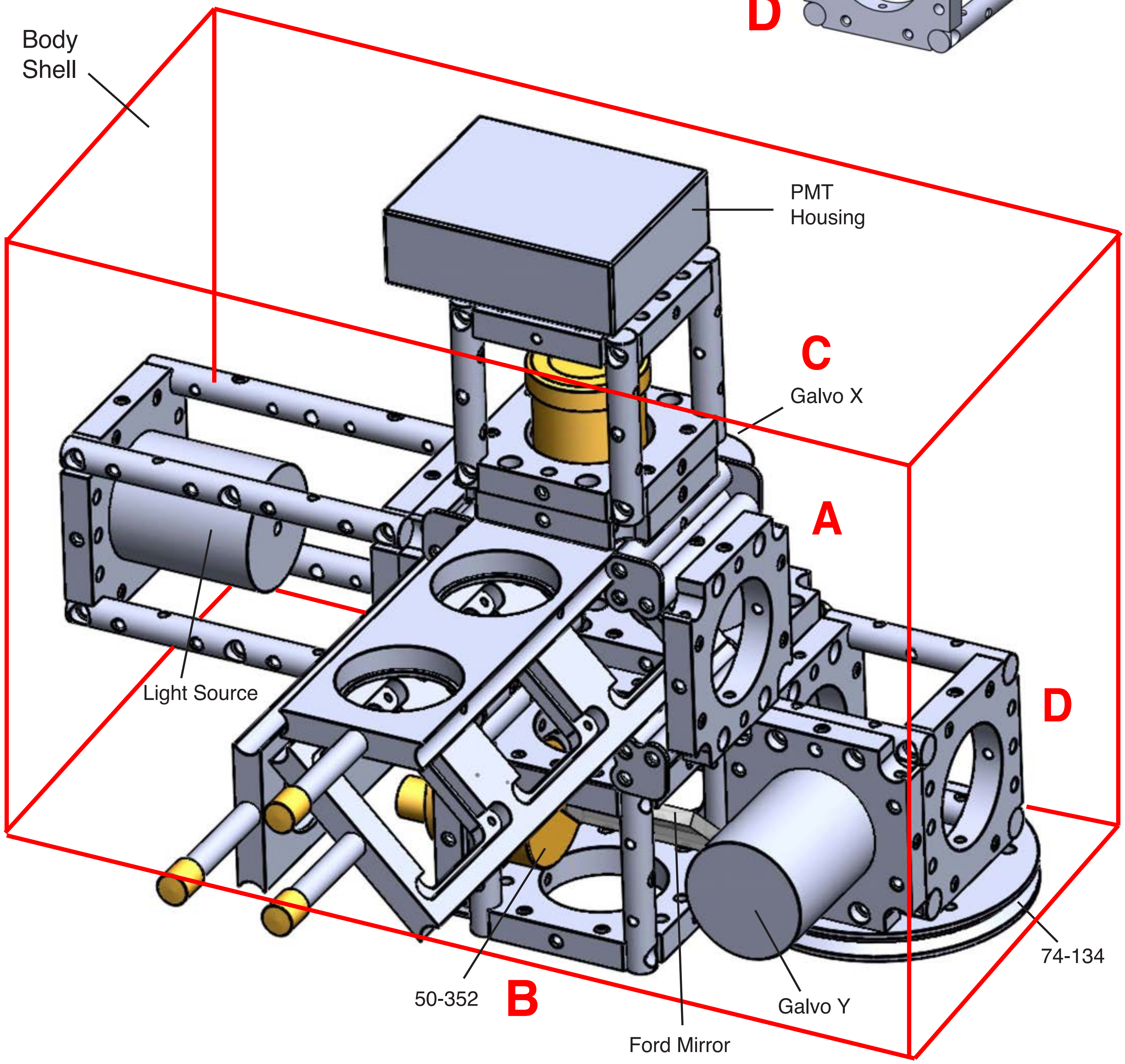
On its conceptual schematic on the right, we'll plug in Optoform's 40 mm dimentional geometry to predict the physical space for our structure. In simpler terms: **A** will be the beamsplitter cube, **B** will hold the fold mirror, **C** will hold Galvo X, and **D** will secure Galvo Y. refer to the actual assembly next page

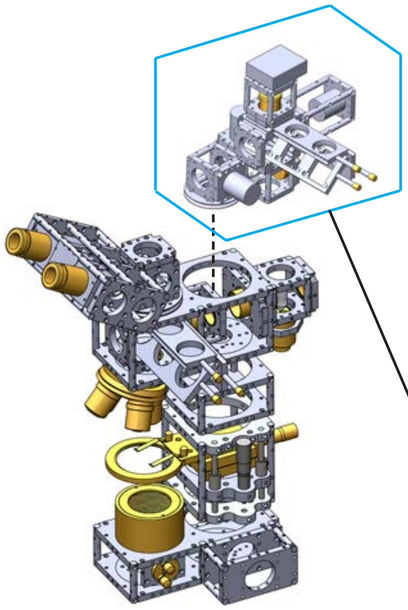


choose a more compact asymmetric assembly. My personal taste would be to go with the symmetrical assembly where we could utilize its empty space to fit PMT power supply, electronics, etc. To help deliver a light-tight package for PMT we could readily use the standard sheet coverings to semi-light seal the assembly. The rest would depend on how we design the outer body shell. This was the role of Zeiss LSM 510 covering we disassembled on page 9.

Here's are the basic building blocks to build the scanning confocal microscope. This might remind you of stacking Lego blocks you played with in your childhood. We'll be a bit careful in placement of galvos to get the most compact layout.

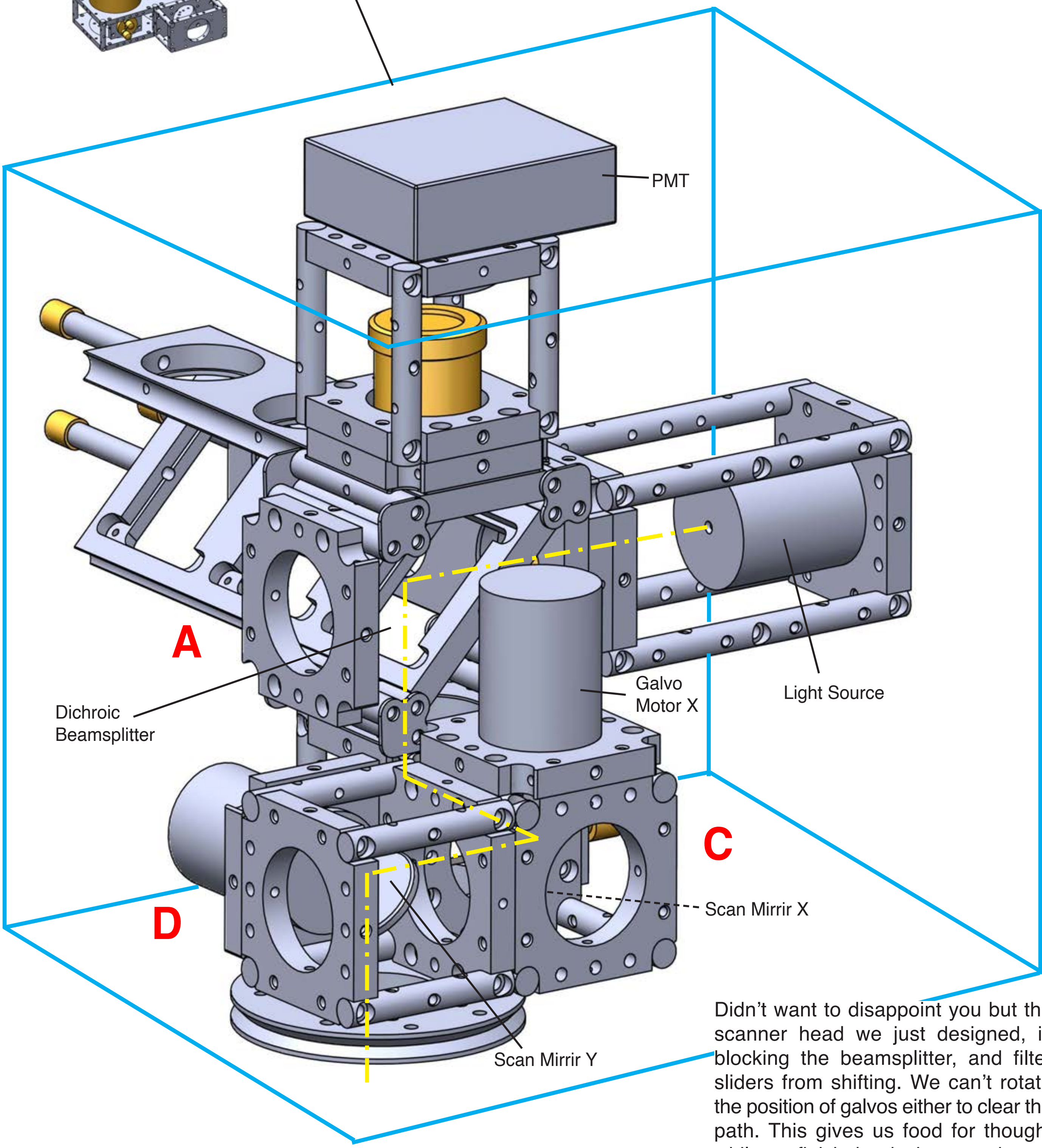






Designing the Chassis

Designing the housing requires two parallel walls that could be connected by rods, and would also accept standard mounts 40, and 74 to house the inner modules (below). Optoform II is good at this because its support rods are secured on the outer edges of the mounts. So, the two walls could be any shape, and form. Like any other Optoform assembly, the chassis would turn out to be a light weight skeleton structure to gain its structural rigidity from thin Aluminum covering. Being light tight is also crucial in this application because the PMT may work under extremely dim lighting conditions. We'll design the housing and its user interface on the next issue. It's not so trivial, requiring some of your ingenuity, and understanding of Optoform's design philosophy.



Didn't want to disappoint you but the scanner head we just designed, is blocking the beamsplitter, and filter sliders from shifting. We can't rotate the position of galvos either to clear the path. This gives us food for thought while we finish the design next time.

Psychology of Achievement: Why Surrender to Love

By Ali Afshari

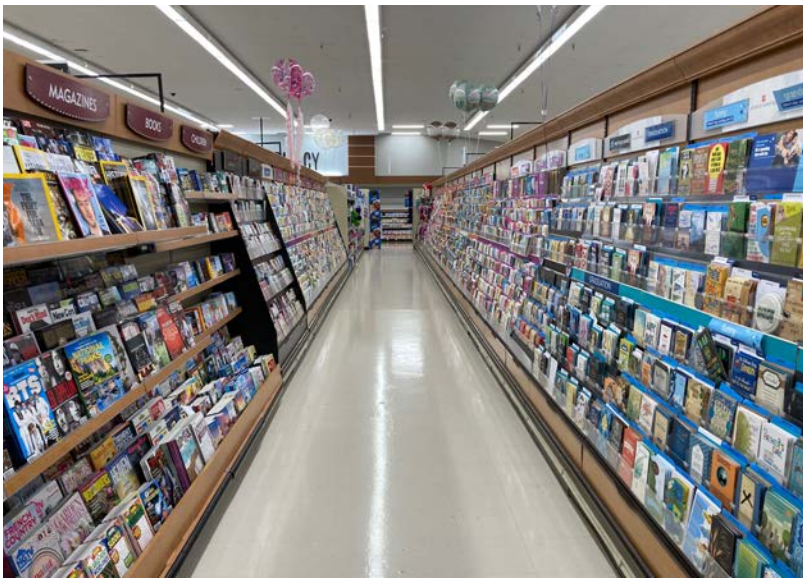
In the last issue, I mentioned how type 1 personality in the Enneagram chart has the habit of routine self-criticize. After returning from a party, they'd most likely have a negative self-talk for something they had said or done. If they get up in the morning feeling this way, they'd go to shower to get over it. The negative self-talk would probably last them until they have breakfast or until they'd start their work. What a miserable way to live!

In one of his training sessions, Joe Cossman gave an example of how some of us lack positive self-image, and how it will negatively impact our sales performance, and marketing. He showed the works of an artist who was well known for his paintings of cats. Later in life, he fell into a deep depression, so much that he ended up in a mental institution. He then showed one of his paintings while he was at the hospital, and it was horrible. "This is how some of us often view ourselves".

I have a method which I'd like to share with you that will help you to boost your self-worth in a crash course. I am an early raiser, right around 6:00 am. I usually go to a quiet and peaceful grocery store nearby, and walk the isles, sometimes to grab something for my breakfast. How do you start your life every morning? Do you begin your day with enough self-awareness?

I have often found company CEOs standing outside of their company in contemplation. What is really in their mind? It often reveals itself in their future products, so imagine you are one of those CEOs entering this very ordinary store. What do CEOs usually think about? In this technique, you would be viewing yourself through the eyes of someone who was standing next to the door while you entered the store. This is how through your own mind's eye that person would see you, and what they would say about you.

Imagine this person who is observing you to know all about you. What would that person say about your childhood experience, and how you were raised by your parents? Think about all the love you received from those around you. Think about everything you learned from others, and everything you have accomplished in life. We are usually admired by others for everything we are good at, and this person has a big smile on his or her face, and is full of appreciation of who you are. Just letting you know, this was self-hypnosis! It's a



mind cleansing technique from apathy. You could also use a fashion store, but in an empty supermarket, you are walking through an unseen puzzle. This is one place where people only see what they want to see.

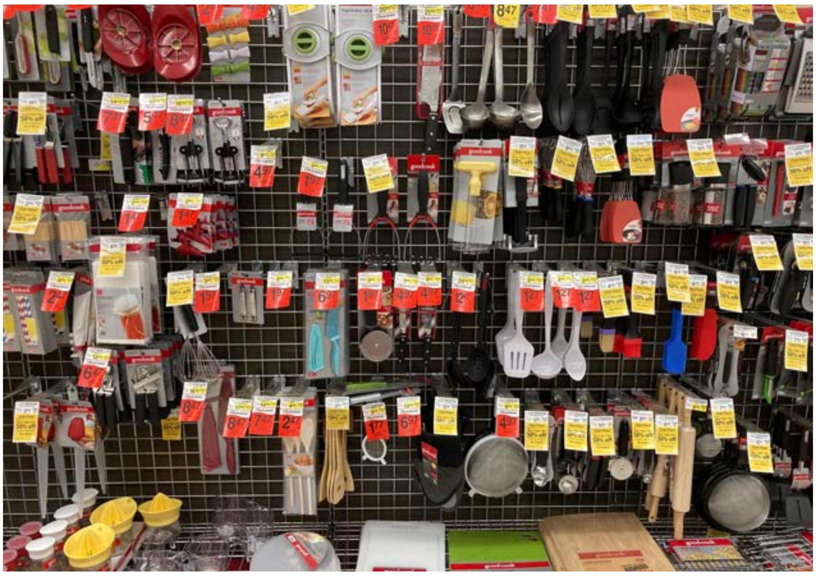
While you are in this state of mind, you may decide to distract yourself by wondering around the store like a curious child, and looking at everything that is hanging or sitting in the isles. I sometimes have my marketing teacher, Joseph Cossman walk with me. I could always hear his voice, describing each product, and how anyone could be marketing them. I often think of what he has taught me while designing my own line of products. Who was your marketing teacher? I could also add, who has been your life coach? One thing about life, as Marlon Brando said: “We are all good actors”. If you think about it, we really are. This morning though, we are more interested in who this actor is by washing our eyes. You really can’t discover yourself by taking so many selfies. That’s not really you.

In Fellini’s film: “Intervista”, there is a scene of circus elephants on the background, and the trunk of one of the elephants accidentally detaches, and falls during the shoot, revealing they were all fake. The director walks into the set outraged, yelling at the producer: “How many times have I told you to use real elephants so this wouldn’t happen?” He kicks one of the elephants, causing the rest of them to collapse like domino blocks. The camera pulls back, and this time Fellini himself walks in, and tells the director: “No, you should have knocked down the first elephant, not the third one”. Fellini wants to wake us up from what we are experiencing in real life. This world is a place of great distraction from the self, and there is a good reason for that. God is hidden.

Once upon a time, an artist was standing somewhere in nature, paining a beautiful scenery, and he was asked by a passing monk, what he was painting. The artist replied: “The trees”. He was asked: “So what’s behind the trees?” He answered: “The mountains”. “What’s behind the mountains?” “The stars”. “What’s behind the stars?” The artist paused, and could not answer. The Monk said: “It’s your own consciousness”.

With self-knowledge, you’ll start to think big about your life, and feel a connection to the whole creation as a force that wants you to succeed. You’ll treat others as important be-

Post cards ... how rediculous !



I could see the need for all these products ...

ings as you are, who are looking for similar answers. Never feel superior because you have discovered something meaningful. Our capacity to learn is so endless that our self-content today will soon be replaced with so much emptiness that we'd wonder if we ever knew anything at all.

With practice, you'd realize you are really alone in this vast universe, looking, and watching your presence. This is how the famous Sufi Halaj in Persian history, reached his self-realization that he is really God. He ran the streets, and cried out: "I am God". Rumi complains about Halaj: "He shouldn't have given that away, that's God's secret"! Allen Watts says: "That's why he was killed, as Jesus was too. Anyone has given away this secret in history, their lives have come to an abrupt end."

This is how high your potential is. Never think of yourself as unworthy, or unimportant. You are worth watching, and what you do is worth remembering, and appreciating. Even a fly has a grand purpose in this world experience. Lift yourself up every morning with this practice of knowing who you are, and learning as much as you can about your own achievements, and of others so you'd be inspired to make every moment count.

Once you know how important you are, and every blessing that you have received, you'll also begin to feel the responsibility to decide where you want to go from here. You need to have a clear vision of yourself of who you want to be 2 years from now, and likewise, what you don't want to be 2 years from now. You'll master any goal you have with knowledge, practice, patience, and having full trust in yourself.

It is said that before entering the sea
a river trembles with fear.

She looks back at the path she has traveled, from the peaks of the mountains, the long winding road crossing forests and villages.

And in front of her,
she sees an ocean so vast,
that to enter
there seems nothing more than to disappear forever.

But there is no other way.

Collapsable funnles ...They couldn't decide what size, they made two.

No more photography magazines ...

The river cannot go back.

Nobody can go back.
To go back is impossible in existence.

The river needs to take the risk
of entering the ocean
because only then will fear disappear,
because that's where the river will know
it's not about disappearing into the ocean,
but of becoming the ocean.

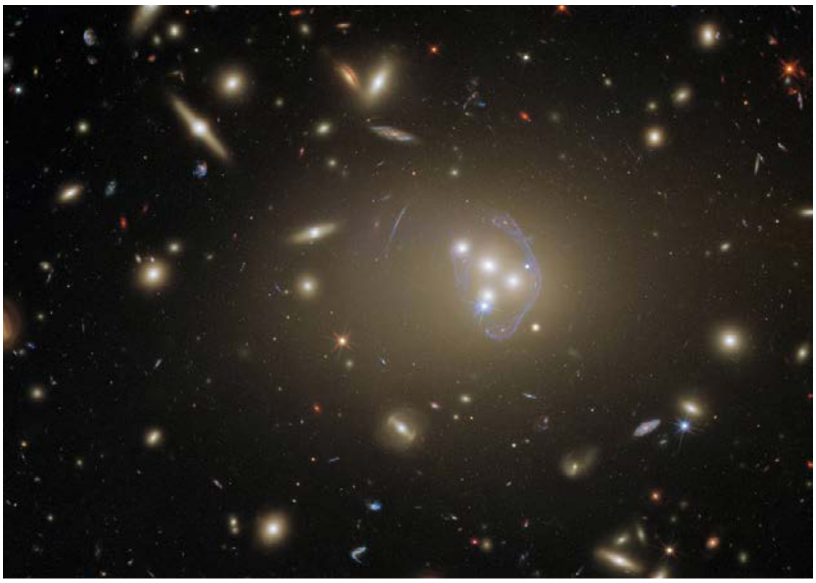
(Khalil Gibran)

The Intellectual Clause

As you'd walk through the store, you'd reach the magazine srack. The first thing you notice is because of social media, so many magazines have disappeared from the scene. In general, the surviving magazines have become highly graphical, and are mostly about food, healthy living, or traveling around the world (National Geographic), business (Forbes), politics (Time, and Newsweek), or historical (History). As long as I remember, Time-Life has been putting out these special issues on people like Marylin Monroe, and Elvis that still sells. Sex is definitely out in most part. I don't know if Playboy still prints. Who would want to buy them anymore? On the bottom rack, there are still puzzles, and a few issues on gardening. This pandemic has brought the focus of many magazines to self-healing, and meditation. Several magazines have cover stories about healing depression, but what's really the simplest answer to our happiness? What's the most simple way out?

I asked one parent what he got out of raising his child, and he recalled: "The greatest thing was I lived a great 18 years without ever knowing how it passed"! The key ingredient is "surrender". Emptiness in life only dominates a lonely self, not where one has abandoned their self-desires to another being, or a certain belief. When we surrender to something we love, we no longer feel empty. The problem is we don't know whom to surrender to.

Rumi says, when true love is found, all faults disappear. When a newlywed couple enter a public place like a restaurant, they smile at everyone, and always get a smile back in return. Love makes everyone look their best. This is because while two beings have abandoned everything to mutual love, they become free from all gloominess that dominates an unsubmitted self. Follow your humanity in its pointed landscape, all your queries resolved.

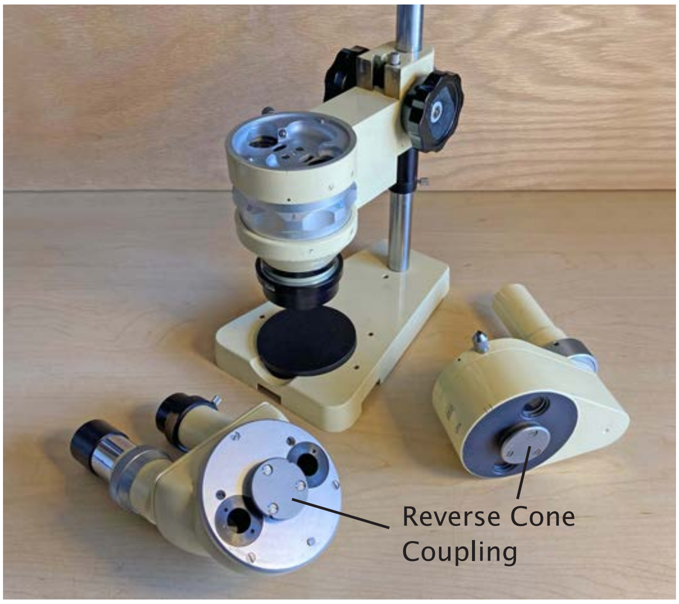


If you think about it, your conciousness is behind the whole universe ..

Wild Stereo Microscope

I often repair microscopes for free just to learn their design. This belonged to my neighbor Clarence: Such a big difference between the mind set of someone who appreciates opto-mechanics, and someone who just sells them off on eBay. One thing about the Wild is they don't micky mouse anything. It's all solid detents, and rigid mechanics. The magnification turret in this microscope is a series of objectives that rotate similar to a Colt revolver. There is then a pair of prisms that bring the two viewing sites closer together at the barrel. Like all other stereo microscopes, the two beams are then focused in a conical manner by an achromat about 45 mm in diameter near the sample.

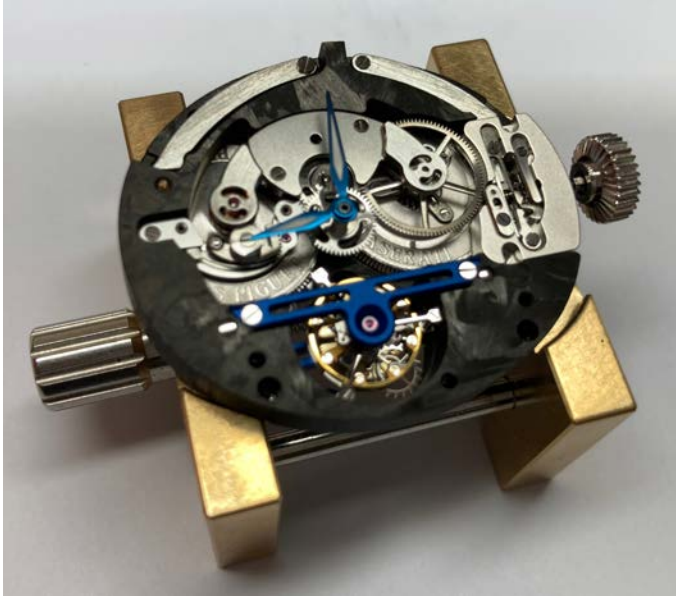
Zeiss, Nikon, Olympus, and Leica use the same design except the reverse cone couplings are placed around the two objectives, not in between (right). The rotational symmetry also enables left and right image alignment.



Watchmaker: Visiting Coung Dang

I covered this watchmaker friend of mine in one of the past issues. I recently visited his shop again, and he was working on a $325 watch; The Ferrari MC12 watch made by Audemars Piguet. This watch has two spring boxes to keep it running for 10 days without rewinding. There is a connecting gear between the two sprigs, and the one-way detent is placed on the 2nd spring gear. As a result, there is too much pressure exerted on the connecting gear, causing it to slip.

Coung had spent a month on it to fix the problem. The owner of the watch trusted him with his watch because of his proper background. The mechanism in this watch is mounted on composite material, and how they could make 0.5 mm screw threads on composite material, I haven't got the foggiest idea. With patience, and his long experience, he was able to solve the problem.



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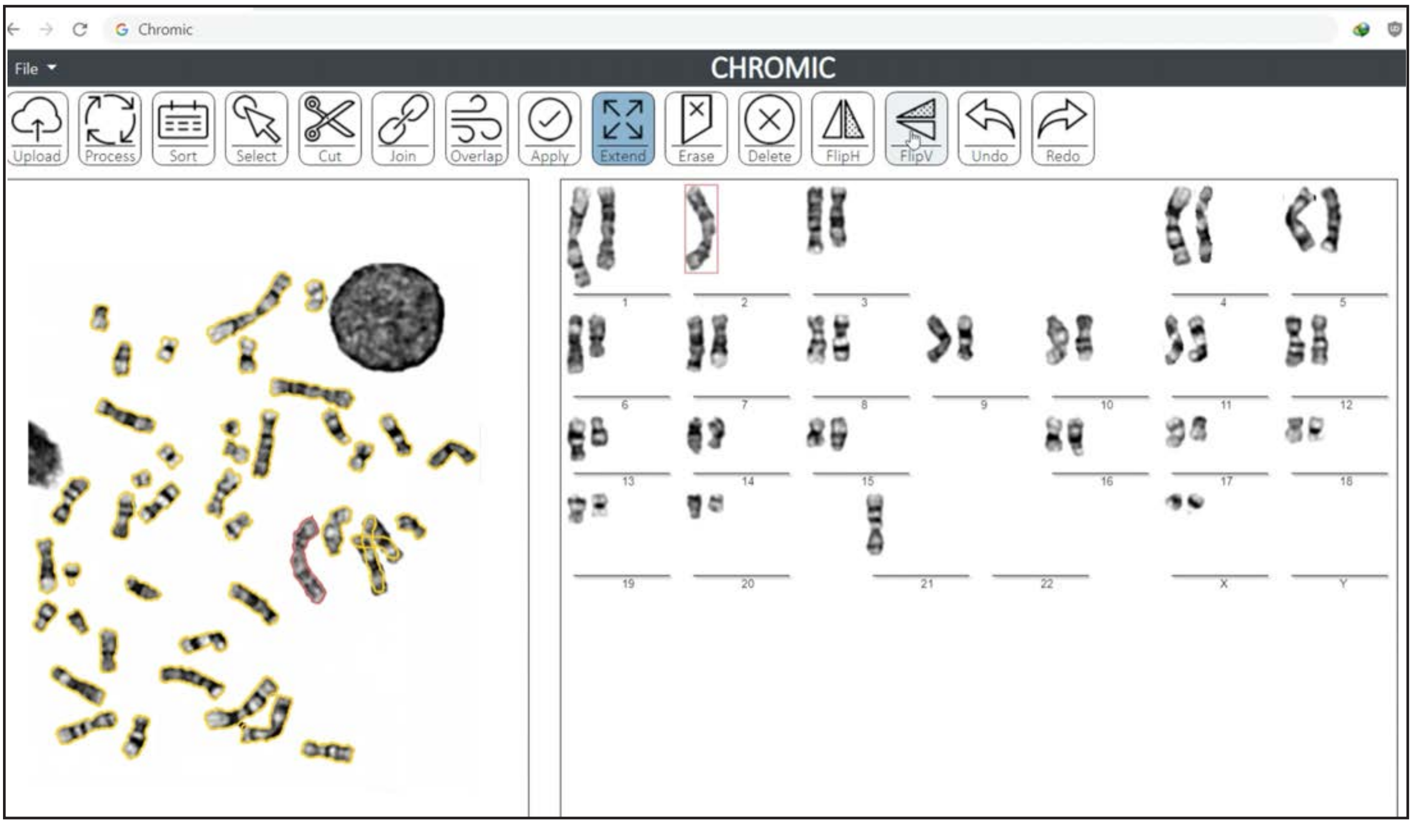
Exports a report based on examiner's comments on the test results

Optional motorized stage control for metaphase search, and image capture

Competitive advantages of the software:

- One-year free access to latest software upgrades
- Personalization options for labs and users
- High quality and lower cost
- Technical support



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