It's Light Work

Construction and Integration of Fiber Optic Test Stands and Solutions for Astronomical Instrumentation

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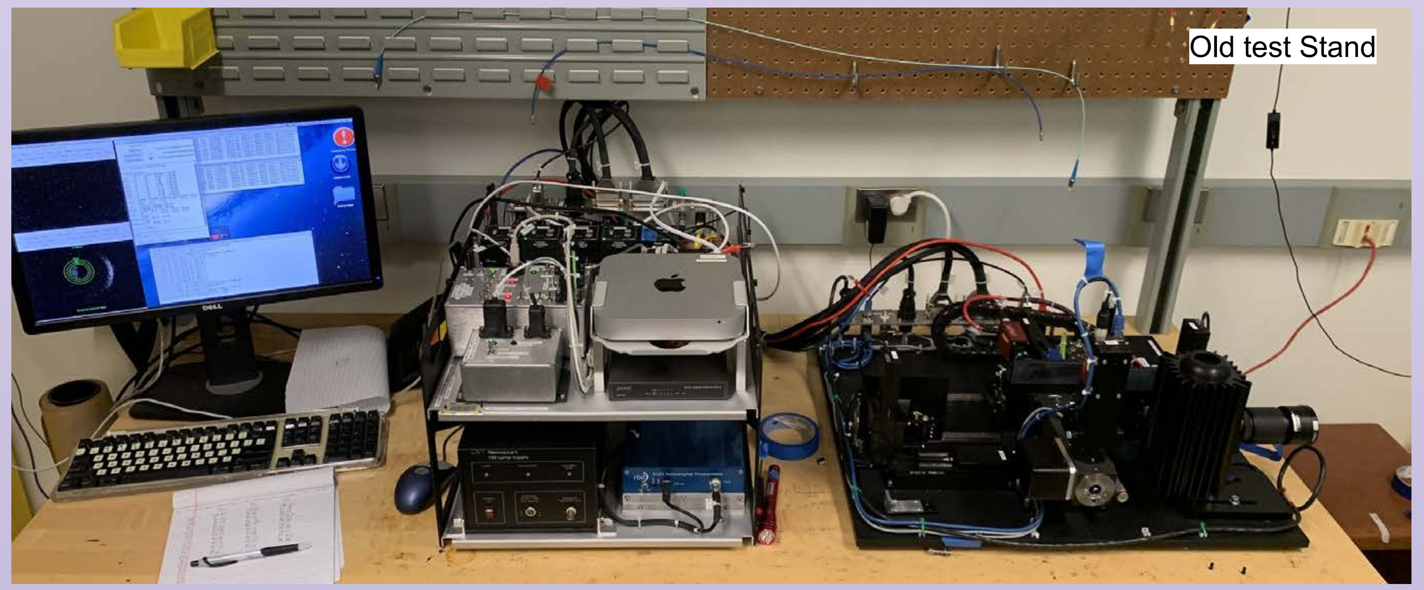
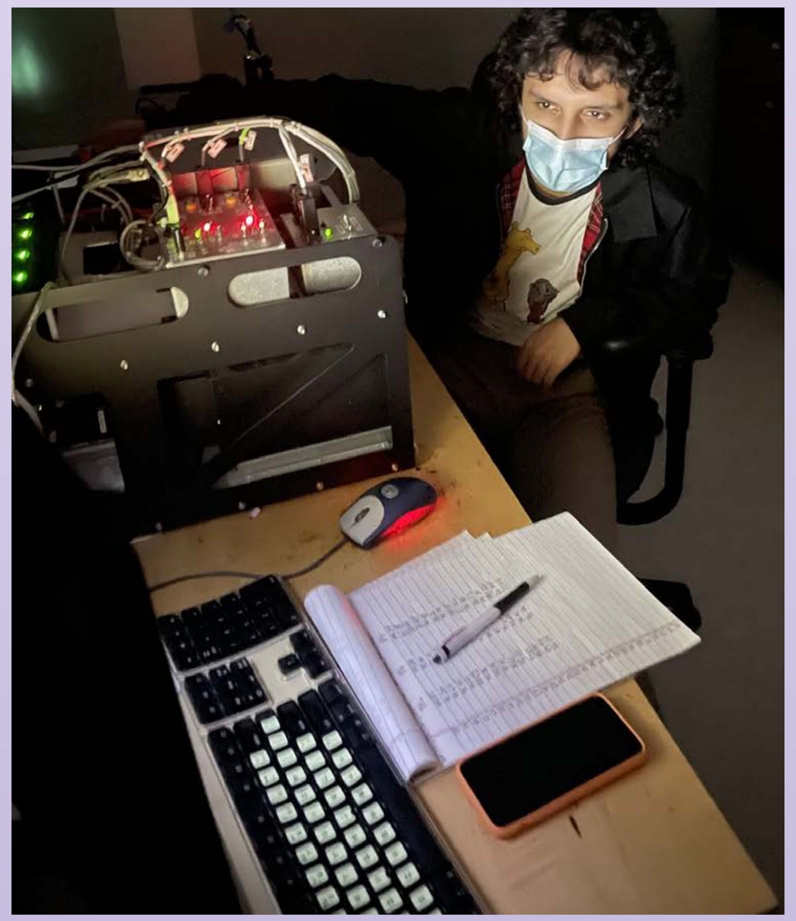
Working in professor Sarah Tuttle's Fiber Lab under the supervision of Travis Mandeville.

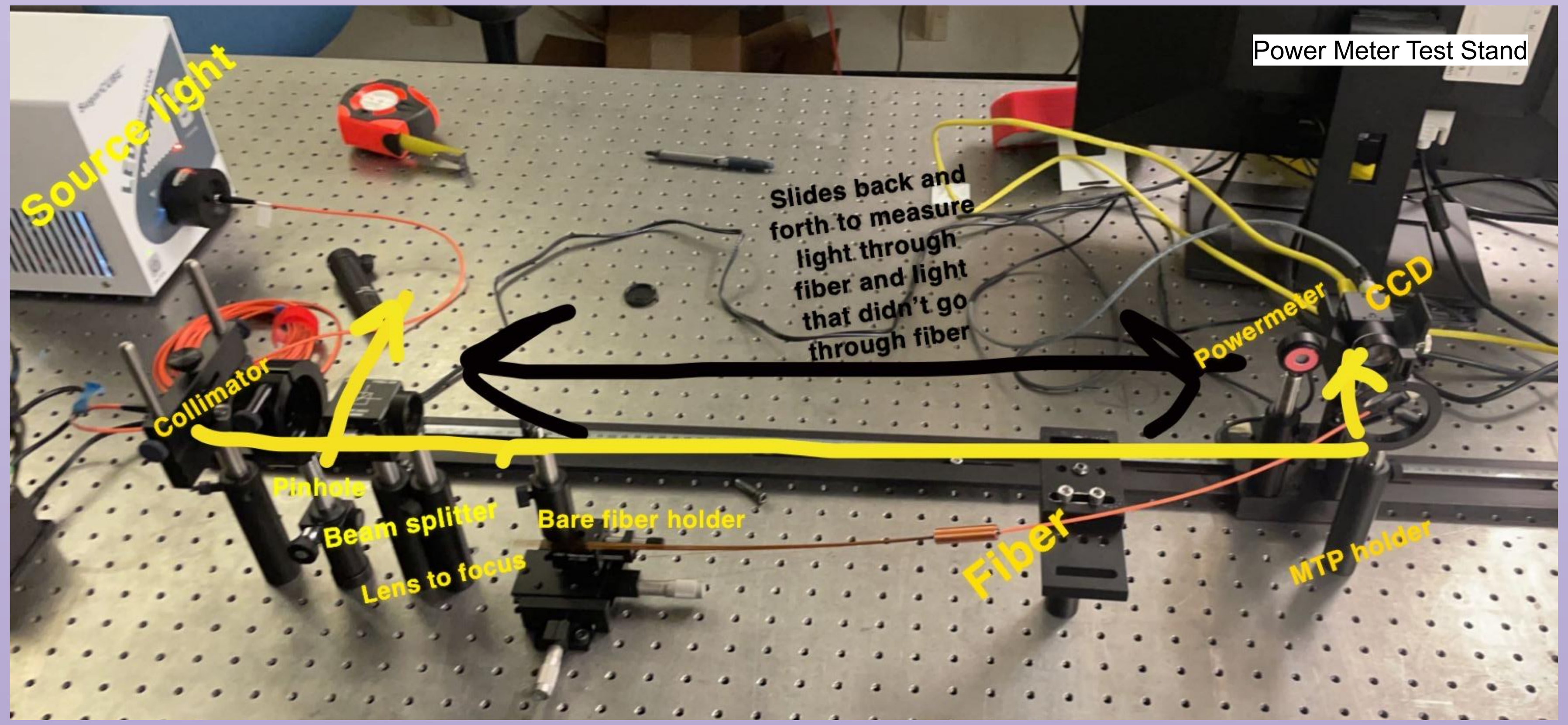




When we started to work in Prof. Tuttle's optics lab, we were introduced to this: a test bench to test throughput and FRD.

It often doesn't work and may be possessed by a lab demon..

We need something better, so we made 2 new stands



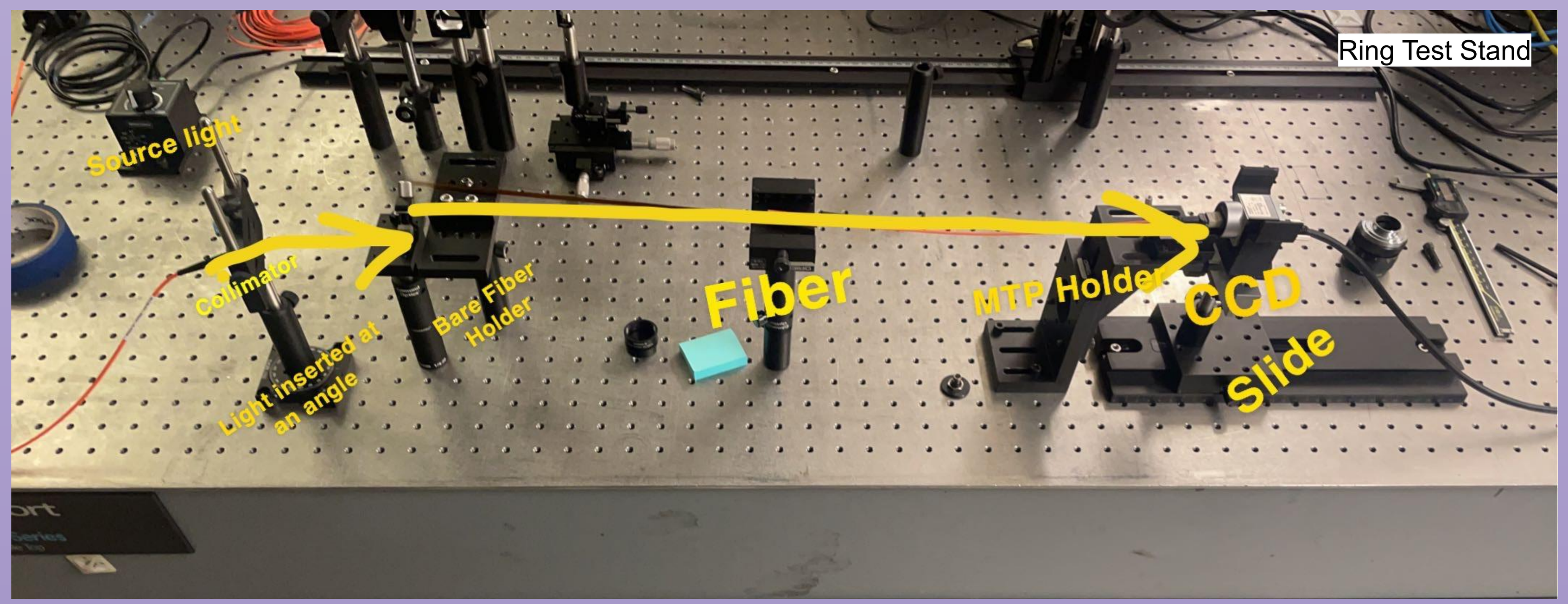
In order to use the Power Meter Test Stand, we must have a beam splitter split collimated light in two directions.

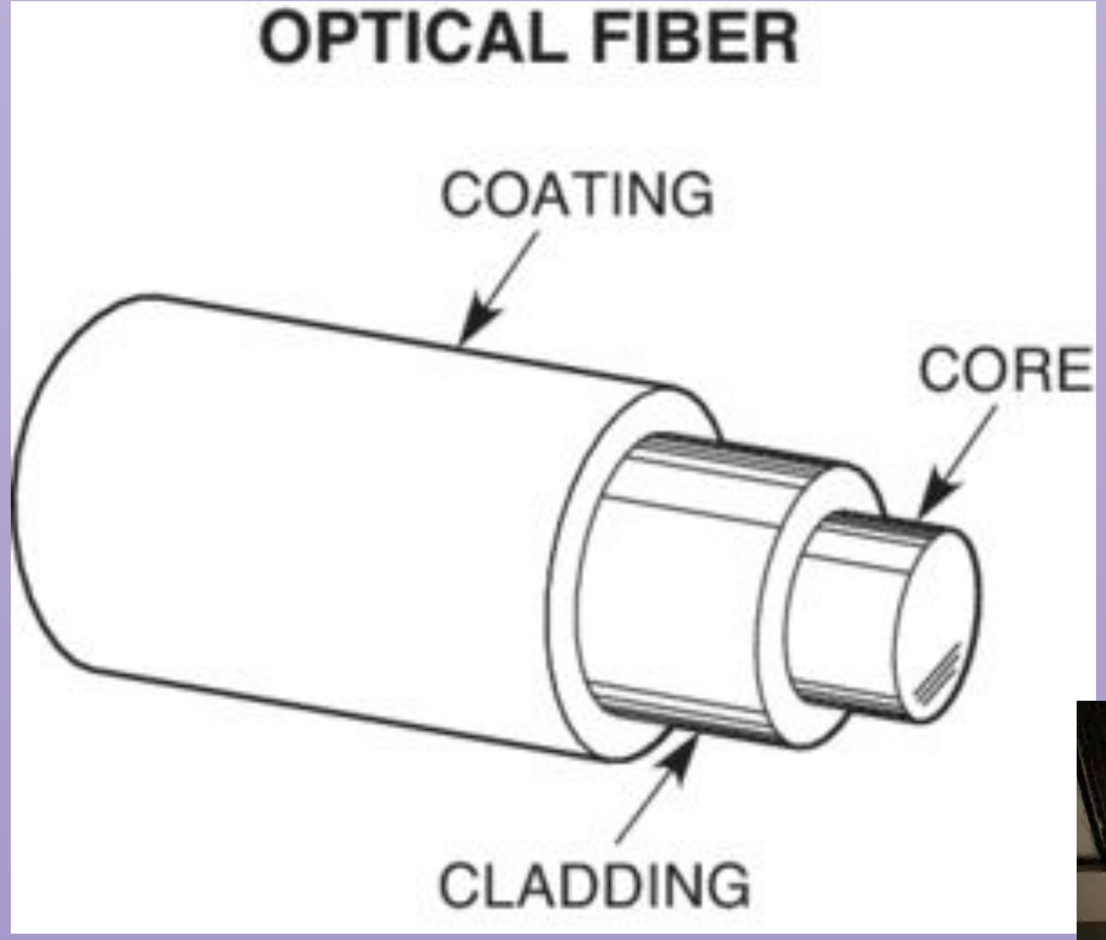
The first beam will turn 90° left and go on unchanged. The second beam will continue straight through the fiber, exiting the MTP at the other end. There is a CCD (camera) and power meter mounted on a slide next to the beam path. The CCD is used to line up the beam with the power meter, and the power meter is used to measure the beam intensity.

By comparing intensity of light that has traveled through the fiber to the intensity of the untouched beam, we can get a measure of the throughput.

When we test a fiber in the Ring Stand, we have a collimated source light enter the fiber at an angle. This allows only a single mode of light to enter the fiber, which creates a ring of a certain radius on the camera.

By measuring the radius of the ring, and comparing it to what would be expected if the fiber was a perfect transmitter, we can calculate the FRD of a fiber.





Astronomical Instrumentation FAQ

What are Fiber Optics?

Fibers are commonly used in communications and in astronomy as a way to guide information in the form of light between points.

Bare fibers consist of a glass core and cladding with a different refractive index to promote total internal reflection in the core.

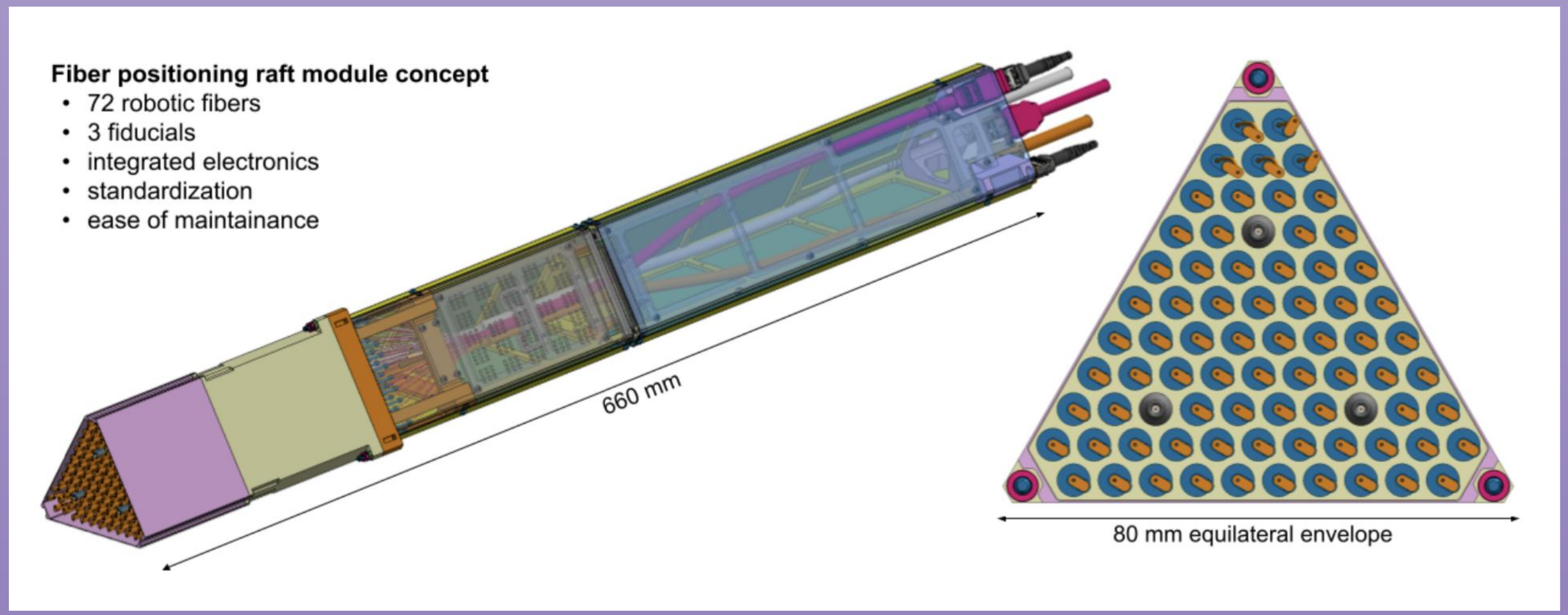
The fiber harnesses we are using consist of twenty-four bare fibers on one end, and a US Conec MTP at the other end where the fibers are polished.

What's important for Fibers used in Astronomy?

We mainly test the FRD and Throughput of our fibers.

Focal ratio degradation (FRD) is the ratio between the expected angular distribution of light due to it traveling through the fiber, and the actual distribution. FRD is an effect we see in fibers that have microfractures, lateral pressures, and other imperfections.

Throughput is the measure of how much light makes it through the fiber



Greater Significance: We are working on building a 'raft' for Lawrence Berkeley National Labs. The purpose of these rafts is to make it easier to replace broken fibers.

Previously, when fibers break on a telescope, it takes a long time and a fiber specialist to fly in to repair them. The new method would involve rafts of fibers which simply plug in. These can be pulled out and replaced once a certain percent of the fibers go out. UW is responsible for the for the prototyping and design of the fiber harness that will later be built and integrated by a manufacturing/engineering company. Saves time, money, and the sanity of our fiber specialists.

Our Role: We are usually running tests on these fibers using the stands. Often times we have to help assemble the stands or add parts to improve the testing process. Things rarely go as planned, we are often tasked with finding work arounds to the many problems that arise when dealing with light and tiny glass hairs.

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