

Constructing the 3D Printed Rotating Analyzer Ellipsometer

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Parts List

3D Printed Parts

Goniometer

- A. x1 Gonio Arm (Left)
- B. x1 Gonio Arm (Right)
- C. x1 Gonio Arm Hinge Pin
- D. x1 Gonio Body
- E. x2 Gonio Rail Screw
- F. x2 Gonio Rail

Linear Sample Mount

- A. x2 LSM Bar
- B. x1 LSM Body
- C. x1 LSM Drive
- D. x1 LSM Head
- E. x4 LSM Nut
- F. x1 LSM Rail
- G. x4 LSM Screw

Rotating Polarizer Mounts

- A. x1 RPM Body (Left)
- B. x1 RPM Body (Right)
- C. x2 RPM Cap
- D. x2 RPM Gear-Optic Mount
- E. x2 RPM Optic Screw
- F. x2 RPM Worm Drive

Laser Mount

Vernier Light Sensor Mount

Non-Printed Parts

x1 [Laser, 653-nm, 3-5v, 5mW](#)

x2 [Polarizing Film, Linear](#)

x1 Vernier Light Sensor

x1 Vernier Go!Link

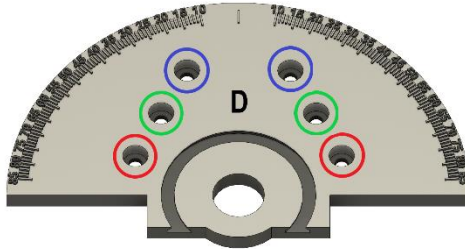
x1 Glass Slide (optional for RPM calibration)

x11 1/4"-20 x 3/8" cap head machine screw

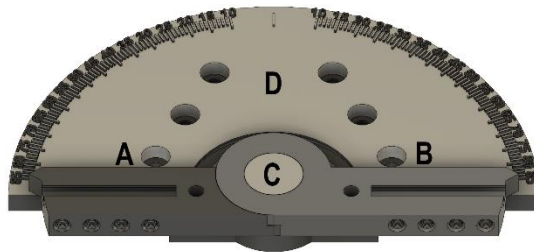
Assembly Instructions

Goniometer

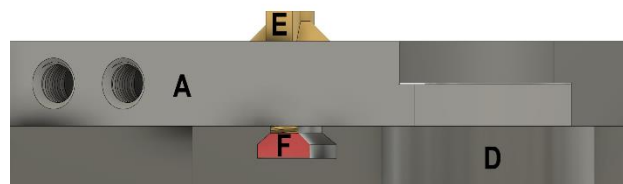
1. The **Gonio Body [D]** can be fixed to a standard imperial optical bench by fastening 1/4"-20 machine screws through any of the three sets of countersunk holes on the body.



2. **Gonio Arm (Left) [A]** and **Gonio Arm (Right) [B]** are attached to the **Gonio Body [D]** by sliding **Gonio Arm Hinge Pin [C]** into the holes at the pivot point of the goniometer arms.

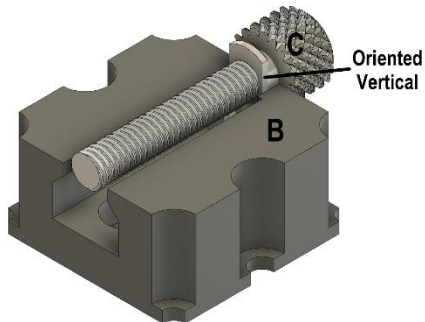


3. Slide the **Gonio Rails [F]** into the slots on both sides of the **Gonio Body [D]**. **Gonio Rail Screws [E]** go through the vertical holes in the **Gonio Arms [A,B]**. The goniometer arms can be fixed at specified angles by tightening **Gonio Rail Screw [E]** into **Gonio Rail [F]**, which clamps the arms to the goniometer body. Do not overtighten.

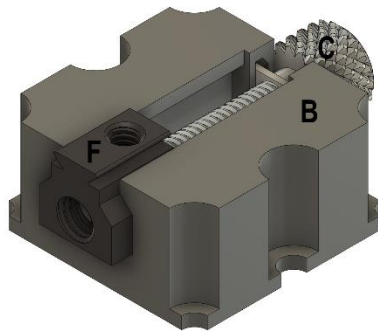


Linear Sample Mount

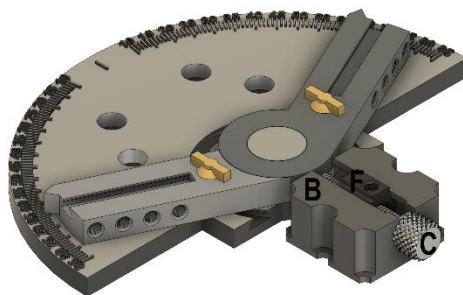
1. The **LSM Drive [C]** drops into the **LSM Body [B]** while the drive collar is oriented vertical. Once inside the body, the drive can rotate freely.



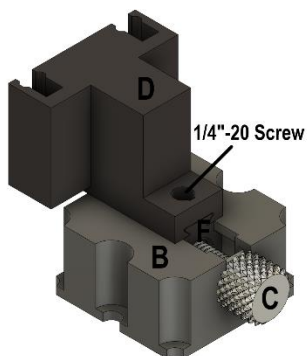
2. The **LSM Rail [F]** slides into the front of the **LSM Body [B]** and threads onto the **LSM Drive [C]**. The threaded hole at the top of the **LSM Rail [F]** should be proximal to the **LSM Drive [C]**.



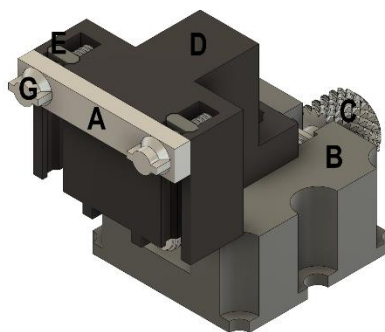
3. The **LSM Body [B]** should be mounted adjacent to the pivot point of the goniometer arms prepared in the Goniometer assembly instructions. Various mounting areas on the **LSM Body [B]** can be used. At least two 1/4"-20 machine screws are recommended.



4. The **LSM Head [D]** slides onto the top of the **LSM Rail [F]** and is fastened with a 1/4"-20 machine screw.

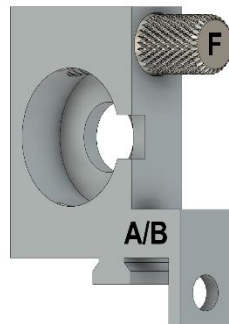


5. An **LSM Bar [A]** can be used to mount flat samples against the **LSM Head [D]**. The bar has two holes which allow **LSM Screws [G]** through to thread into **LSM Nuts [E]** and provide a clamping force to the sample. One bar may be used, but two are recommended to fix both the top and bottom of a sample to the head.

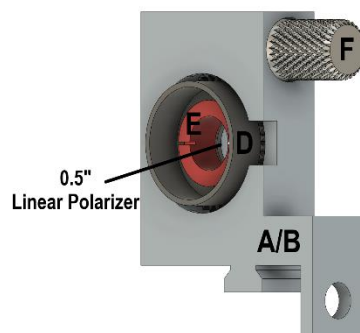


Rotating Polarizer Mounts

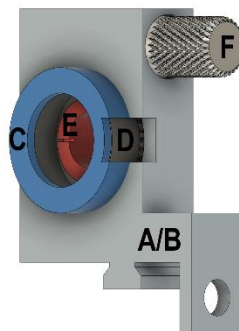
1. The **RPM Worm Drive [F]** is inserted into the hole at the top of the **RPM Body [A/B]**. The worm drive should snap into place but freely rotate.



2. The **RPM Gear-Optic Mount [D]** drops into the front of the **RPM Body [A/B]**. The internal area of the gear accepts a 0.5" diameter linear polarizer, which can be cut out from a larger sheet of polarizing film. An **RPM Optic Screw [E]** can be fastened into the internal threads of the **RPM Gear-Optic Mount [D]** to fix the internal linear polarizer in place.

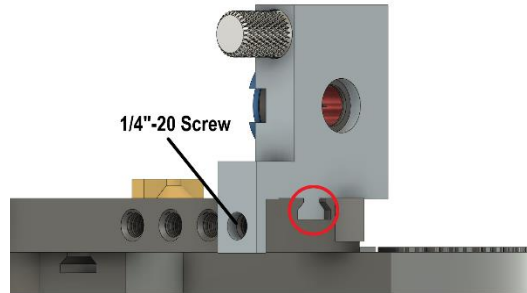


3. The **RPM Cap [C]** snaps into the **RPM Body [A/B]** if oriented so that the notches in both components are aligned. This notched area of the RPM is used for scribing and reading marks that indicate the transmission axis of the internally mounted polarizer. See "Calibrating the Rotating Polarizer Mounts" for detailed instructions on that process.

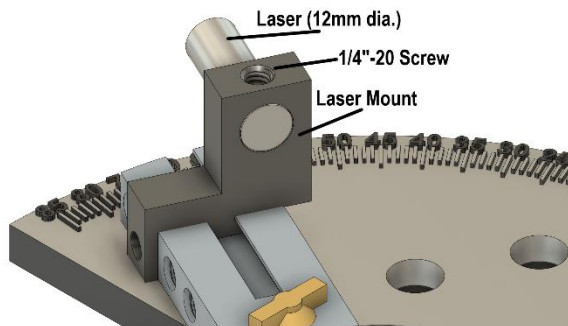


Mounting Optics to the Instrument

The light source, rotating polarizer mounts, and light intensity sensor should be mounted upon the pivoting goniometer arms of the instrument. Channels that run down the arms are intended to accept the matching rails at the bottom of these mounts. The threaded holes on the side the goniometer arms allow for fastening of the optical mounts with 1/4"-20 machine screws.



The included **Laser Mount** and **Vernier Light Sensor Mount** have large holes which the laser and sensor can slide into. A threaded hole at the top of these mounts accepts a 1/4"-20 screw to fasten the components into the mount.



Custom Light Source and Light Sensor Mounts

If one desires to mount other light sources or light sensors to the instrument, they will be required to design and 3D print their own mounts. In this case, it is useful to know what parameters the other 3D printed components were designed with. Specifically, one would have to design their mount to be coincident with the optical path established by all the other components.

The **Rotating Polarizer Mounts**, **Laser Mount**, and **Vernier Light Sensor Mount** are designed to provide an optical axis that is 21.75-mm above the top surface of the **Goniometer Arms** and incurs reflection directly above the center of the **Goniometer Arm Hinge Pin**. The latter condition is *critical* for the goniometer's function. This condition is met when the optical path is coincident with the indicator arrows at the ends of the **Goniometer Arms**, and when the sample surface is positioned above the central axis of the **Goniometer Arm Hinge Pin** using the **Linear Sample Mount**. A means of testing for these conditions involves sweeping of the goniometer arm with the mounted light source and looking for corresponding lateral movements of the position of the light "spot" on the sample surface. If the mounts are designed and fixed properly, and the sample is in the correct position, there should be *no* lateral movement of the spot. Elongation or shortening of the spot size at extreme goniometer angles of incidence is expected.

