

Design Iterations of a Bracket for EIC DIRC Optical Table's Position Switches

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EIC DIRC's laser test area that will be used to quantify the transmissivity of the quartz Cherenkov radiator bars. DSG is designing a laser interlock system to mitigate the hazards associated with using a Class 3B laser. Part of this interlock system are limit switches that are actuated by side walls on the laser area's optical table to determine whether the walls are in the up (or blocking) position. To hold the limit switches at the correct height and position, a bracket was designed using four design iterations (Fig. 1).

The first design iteration, V1, was made using cardboard and tape (left most bracket in Fig. 1). The dimensions of the bracket and positioning of mounting holes were based on dimensions of the sidewalls and optical table. The main benefit of creating V1 in cardboard rather than in NX12 or other modeling software is that the end result is tailored precisely to the optical table and side wall set up that will be used in the laser area. Additionally, V1 out of cardboard is much faster (several minutes) than 3D printing a first design iteration (several hours).

The second design iteration, V2, was creating in NX12 based on the dimensions of V1 and the dimensions of the limit switch. V2 was then exported as a stereolithography (STL) file to DSG's Formlabs Form 2 SLA 3D printer and fabricated. After fabrication, it was apparent that there was a print failure due to the build up of cured resin at the front of the bracket near the base. Additionally, when V2 was tested on the optical table, there was not enough space between the slot and vertical part of the bracket to allow for a washer to be used when fastening the bracket to the optical table.

With what was learned from creating V2, a third design iteration, V3, was created. This version was again created in NX12 and exported to the SLA 3D printer for fabrication. In addition to adding a groove that allows use of a washer when fastening the bracket to the table, the overall size of the bracket was reduced. Also, a removable cover was added to the bracket to cover the limit switch sensor and the number of slots for fastening the bracket from the table was reduced from two to one. When testing V3 on the optical table with the sidewalls, it was apparent that the size reduction went to far and the bracket was barely tall enough and long enough to allow the limit switch to make proper contact with the optical table side walls.

For the fourth and final design iteration, V4, the bracket was again first created in NX12. V4 reverted the changes to the height and slot length of the bracket made in V3. Additionally, V4 did away with the cover for the limit switch present in V1 – V3 in favor for a design where the limit switch more accessible and has built in strain relief (slots on bracket for zip tie). Since at the time of V4's development DSG's SLA 3D printer started becoming very unreliable in terms of print quality, it was decided to have V4 fabricated out of 0.125" thick aluminum using an online machine shop and small parts fabricator. The main advantage of making the bracket out of aluminum is that the strength of the aluminum allows for sturdier, small features than SLA 3D printing. Because of this, certain aspects (thickness of material, amount of material left around slots) can be reduced without negatively effecting the overall bracket's stability and strength. A secondary advantage is that the holes for fastening the limit switch to the bracket can be tapped, thus allowing the limit switch to be fastened directly to the bracket rather than having to use a nut to hold the switch in place.

- **Four design iterations were created for a bracket to hold position monitoring switches in place on the EIC DIRC optical table**
 - **V1 was made out of cardboard using dimensions of the table**
 - **V2 and V3 were designed in NX12 and printed using DSG's SLA 3D printer and improved upon previous versions**
 - **V4 was designed in NX12 but fabricated using an online machine shop and small parts fabricator**

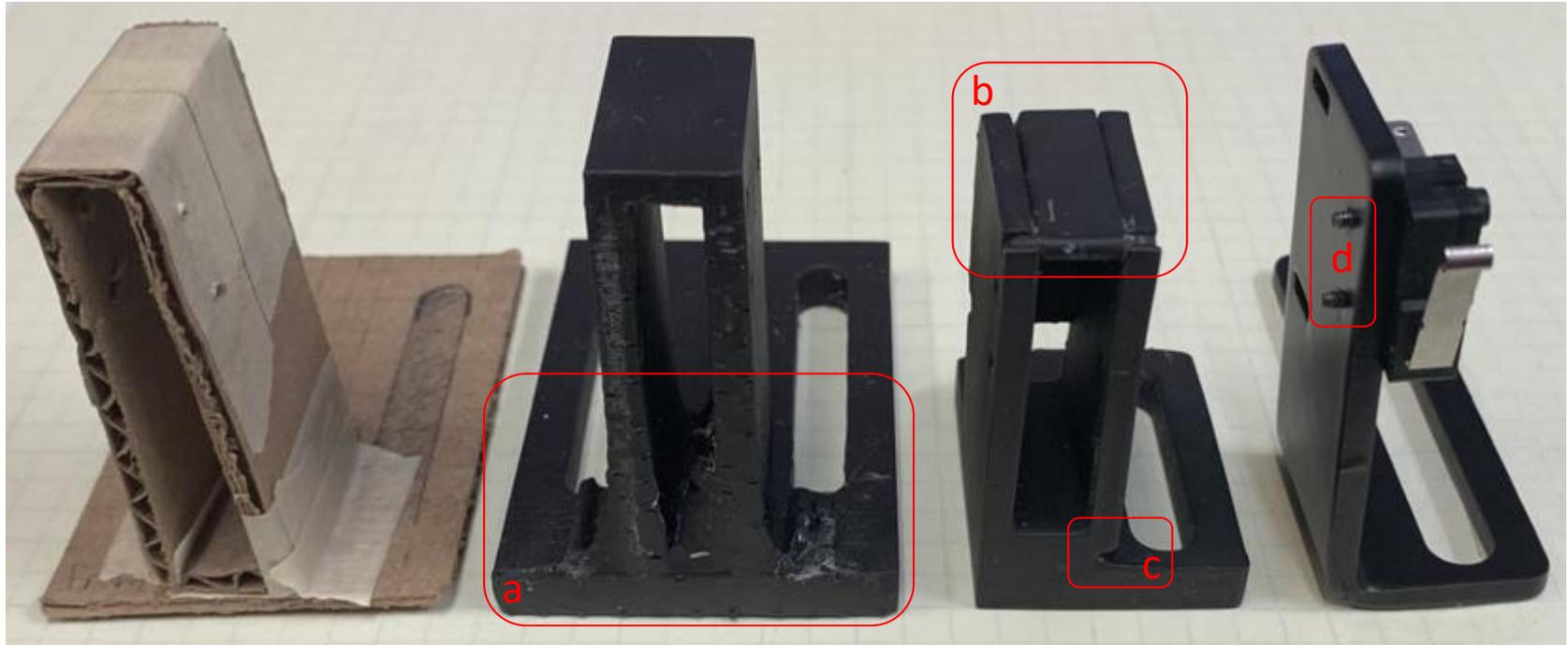
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V1

V2

V3

V4



- a. Front of V2 bracket emphasizing 3D print failure indicated by build up of cured resin
- b. Top of V3 bracket emphasizing removable cover
- c. Front of V3 bracket emphasizing slot added for washer
- d. Side of V4 emphasizing threaded holes