

Appendix A

3-D PDFs of Experimental Apparatus and Components

These 3-D PDFs are also available online at: <https://cduong.me/resources-item/dissertation-appendix-3-d-pdf-files/> in case the publication process interferes with the integrity of the files. Each of the following figures consists of a static image (top) and 3-D interactive PDF (bottom).

A.1 How to Use 3-D PDF Viewers

A.1.1 *Enabling 3-D PDF Content*

1. The 3-D PDF document must be downloaded and viewed using Adobe Acrobat Reader. It does not work when viewing from a web browser such as Chrome, as of the writing of this Dissertation. These documents have been tested for Adobe Acrobat Pro X and Adobe Acrobat Reader X on the Microsoft Windows platform and macOS Mojave.
2. Once the document is opened, there will be an options bar which indicates that “3D content has been disabled. Enable this feature if you trust this document”.
3. Select the “Options” drop down menu on this bar and select “Trust this document one time only” or “Trust this document always”. Click on the 3-D content box to load the assembly files (generally below the static image of the part for these files).
4. Alternatively, the 3-D content can also be enabled by selecting the “Edit” tab at the top of the document and going into the “Preferences...” options. One category will be called “3D & Multimedia”. Check the box for “Enable playing of 3D content” to enable the 3-D content. Click on the 3-D content box to load the assembly files (generally below the static image of the part for these files).

A.1.2 *Using the 3-D PDF Material*

1. When interacting with the 3-D PDF, a tool bar will appear with a variety of helpful gadgets. To highlight a few, the “3D Measurement Tool” is useful for acquiring accurate dimensions of parts and the “Toggle Model Tree” function opens a side bar which allows one to select the visible components of the assembly file. Clicking the “+” sign next to the name of the assembly (.iam) in

this side bar will expand the list of components that form the structure. This is helpful to isolate various components of more complex parts.

2. The Home button moves the structure back to the default view. This button is also useful when graphical errors occur which render the image improperly, clicking the home button will reset the image.
3. Selecting the structure and holding the left mouse button down while moving the mouse will rotate the assembly. Multiple ways to zoom are available: use the center scroll mouse wheel, holding down shift and the left mouse button while moving the mouse up and down, and holding down the right mouse button while moving the mouse up and down. To translate the component along the plane of the screen, hold down control or alt while holding down the left mouse button and moving the mouse. Many other options are also available for the user to explore, but these basics provide a fundamental framework to interact efficiently with the 3-D PDFs.

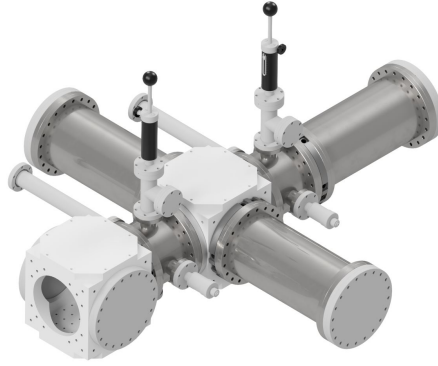


Figure A.1. 3-D interactive PDF schematic of the Yale instrument's detection region discussed in Chapter 2. The vacuum flanges used in this instrument were purchased from Kurt J. Lesker Company. Microchannel plate detectors were acquired from Photonis. The rotary motion (part number: 670002) and linear vacuum translators (part number: 663006) used for the multipass beam blocker near the laser interaction region and for the stick detectors, respectively, were obtained from MDC Vacuum Products, LLC.

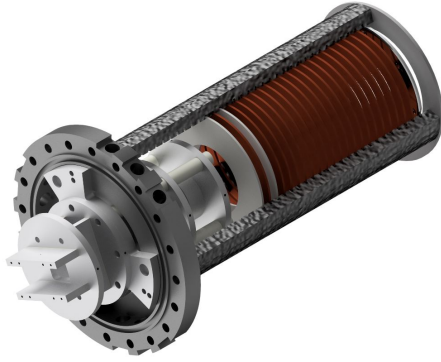


Figure A.2. 3-D interactive PDF of the gridless two-stage reflectrons used in the experiments of this Dissertation. The vacuum flange in which the assembly is mounted was purchased and adapted from Kurt J. Lesker Company. Miniature high voltage connectors (MHV) bulkhead connectors purchased from MPF Products Inc. (part number: A0058-2-W) were welded onto the stainless steel flange to provide voltage leads into the vacuum. Junctions to the bulkheads inside the vacuum were made with ceramaseal power connectors (MPF Products Inc., part number: A0721-1-CN).



Figure A.3. 3-D interactive PDF of an upgraded design for the gridless two-stage reflectrons to accommodate a coaxial laser interaction region by removing the grids associated with the back plate of the reflectron assembly. This is possible by shrinking the aperture of the back plate to minimize fringe electric fields from protruding deep into the reflectron where the ions travel.

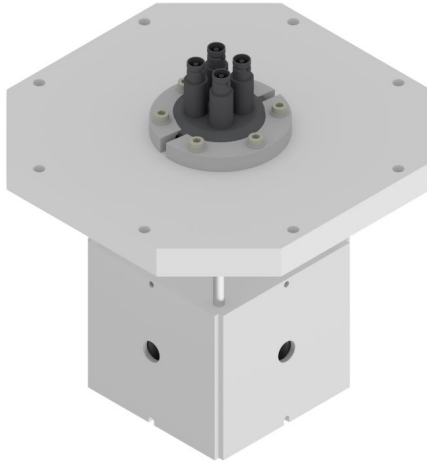


Figure A.4. 3-D interactive PDF of the high speed quadrupole ion bender (turning quad). The aluminum spacers used to mount the turning quad assembly to the cube flange with the 1 inch hole pattern are replaceable with plastic materials to allow for the turning quad housing to be floated (primarily relevant for use with slow ions). The adjacent rods of the high speed turning quad have opposite polarity DC voltages (while rods diagonally across from one another have the same polarity and voltage). The miniature high voltage connectors (MHV) vacuum feedthroughs and clamps were purchased from Kurt J. Lesker Company.



Figure A.5. 3-D interactive PDF of the butterfly valve that attaches to an Edwards EXT255H turbo pump to control the pressures primarily associated with the second differential pumping stage for the instrument in Figure 2.1. The knob used for the rotation was purchased from Digikey (part number: 11K5013-KMNB).

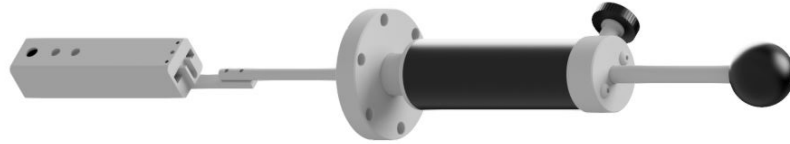


Figure A.6. 3-D interactive PDF of the miniature stick detector in Figure 2.5. The linear vacuum translator was purchased from MDC Vacuum Products, LLC (part number: 663006) and the miniature MCP detector was purchased from Photonis (APD 2 MICROTRON 5.5/12/10/8 D 60:1 NR 1-6UA). Note, the 3-D representation does not include the MCP detector or electronic resistors and capacitors needed to make the detector function, but a circuit diagram is available in Chapter 2.

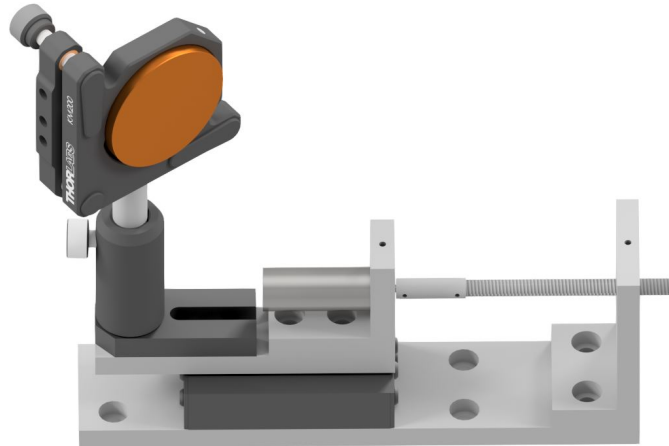


Figure A.7. 3-D interactive PDF of the translational mirror mount assembly which moves to compensate for the infrared beam walk off from the AgGeSe_2 crystal in the $600 - 2600 \text{ cm}^{-1}$ frequency range. The motors that drive the motion of the translator (and also interface with the LaserVision software) were purchased from LaserVision. The mirrors and optics mounts were acquired from ThorLabs Inc. The linear ball bearing translator (part number: 37-361) that holds the mirror were purchased from Edmund Optics Inc.