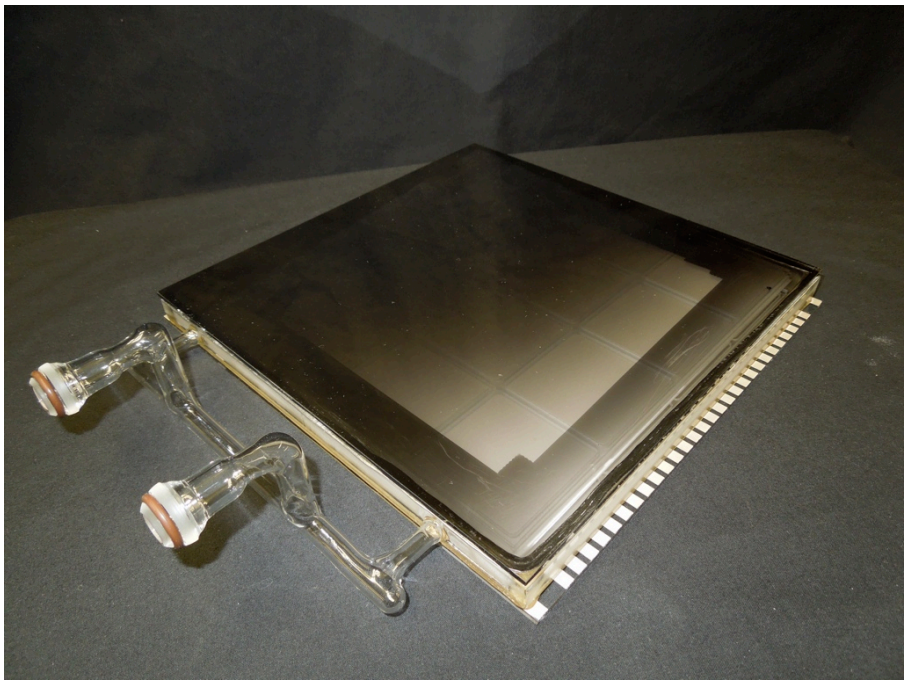
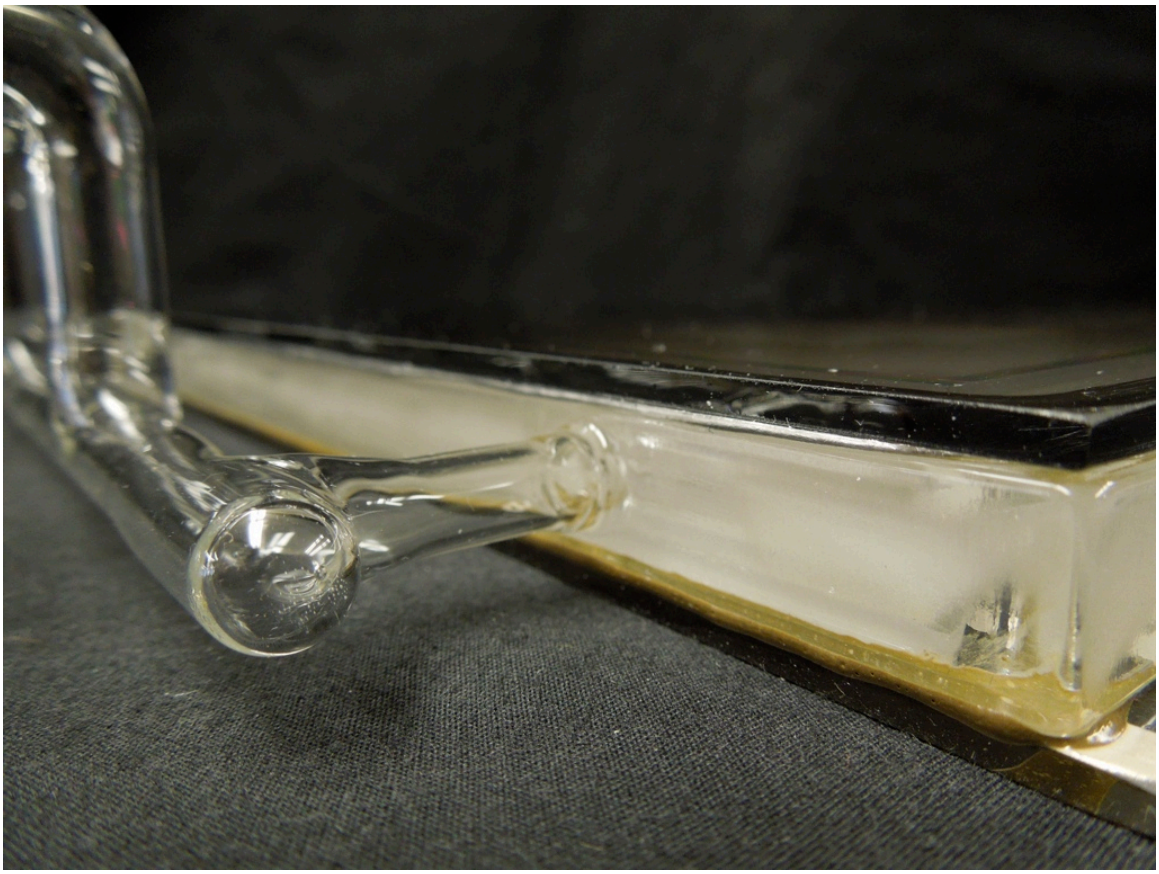
Successful Indium Pressure Seal for the Large Area Picosecond Photodetector

†The Large Area Picosecond Photodetector (LAPPD) Collaboration includes groups from across several Argonne divisions as well as collaborators at the Universities of Chicago and Hawaii, and the Space Sciences Laboratory at the University of California/Berkeley. The goal of the program is the development of a transformational photon detector that combines millimeter spatial resolution with time resolution of a few picoseconds. The very precise time resolution of the detector finds application in high energy and nuclear physics to measure time of flight of particles which along with a momentum measurement allows particle type identification through inferring the mass of the particle. The spatial resolution allows precision knowledge of where a photon enters the detector. Beyond particle physics, the properties of the detector make it appealing for photon detection in medical imaging and for scanning for clandestine nuclear materials. Photon detection is accomplished by absorption of the entering photon producing a electron that is multiplied by a factor of 1-10 million in the pore structure of large thin microchannel plates (MCPs) producing a detectable voltage pulse. The Atomic Layer Deposition group within the Argonne Energy Systems Division has coated inexpensive bare glass capillary arrays with chemical composites that have transformed the production of the MCPs. The next challenge in producing a working detector was to package the MCPs in a vacuum tight glass package. This has recently been accomplished in the High Energy Physics Division by compressing a 2mm indium wire between the glass top window and the sidewall of the all-glass containment package. The successfully sealed prototype is show in the photograph below. The bottom glass plate of the detector is attached to the sidewall using a ground glass paste that is fired at high temperature to produce a vacuum tight bond. The material used for photon absorption on the top window though would be destroyed by this high temperature. Hence, final assembly of the top window to enclose the MCPs in a vacuum tight package requires a process at room temperature or slightly above. Indium is a highly ductile material with good adhesion properties. Using a 2mm wire of indium placed on the top of the sidewall, a hydraulic press is used to crush the wire between the sidewall and the top window to a thickness of 0.6mm and produce a vacuum tight permanent seal. The second photograph shows the shiny surface of the crushed indium wire that seals the detector. This has been a major advance in solving the vacuum tight sealing challenge and progressing toward a completed working photodetector.



Photograph of indium sealed 8”×8” LAPPD all-glass detector package. The two glass ports are for vacuum pumping and measurement of the interior vacuum of the prototype.



Close-up of the sidewall/top window interface showing the crushed indium wire that forms the vacuum tight upper seal of the photodetector.

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