Version 7.0; July 8, 2013

Godparent Charge: To monitor progress, identify problems and provide wise advice to the group.

Overview: The Large Area PicoSecond Photo Detector collaboration held a godparent review of the Hermetic Packaging Group on Wednesday, April 3 2013 at Argonne National Laboratory in Building 360, room A-224. The godparent committee consisted of external members Mayly Sanchez, Scott Moulzolf, Raimund Barden, Paul Mantsch, Paul Hink and Bernhard Adams and Karen Byrum, both members of the collaboration, were the co-chairs. The agenda for the review can be found at: https://indico.hep.anl.gov/indico/conferenceDisplay.py?confId=109.

Talks were presented from 8:30am until about 3:30pm followed by an executive session of the review committee. Since many review committee members had to catch early planes, we ran out of time and were not able to discuss with the collaboration the findings of the review committee. This report was compiled during the executive session and then tweaked via email by the review committee.

Several questions were identified during the presentations and the review committee attempted to address both of these questions. The recommendations of the review committee are reported below in bold; following each numbered recommendation is a response by the collaboration.

Q1: How do we meet the immediate goal of satisfying DOE, and also to successfully complete Phase I of the TTO?

1. **The ceramic 8" approach is the most likely path to get a demonstration device ASAP, and so should be the top short-term priority for SSL.**

   Collaboration Response: The collaboration agrees with this statement. In particular, HEPD facilities and engineering may facilitate this support. For example, if there are any specific cases of involvement of the HEPD mechanical engineering group and HEPD shop facilities such as mechanical design and specifications, procurement of parts, and machining, these could be utilized.

2. **The second priority is to get the SSL glass design, as this is needed to satisfy the TTO.**

   Collaboration Response: Argonne and Chicago should take an active and supportive role in the glass-design modifications required by the SSL process. This includes specification and design of the parts, procurement of parts, and assembly of the tile bases. We recommend an increased involvement of the expertise and experience of Joe Gregar, Rich Northrop and Incom in the design effort . We also recommend Victor Guarino (goup leader of the mechanical support group within ANL-HEP) transition into leadership of the management of the glass package designs, drawings, parts, etc.

3. **Argonne HEPD and UC should put at a high priority and help SSL resolve key issues on the glass package design modifications required by the SSL process such as the behavior of the frit with**

vacuum baking, thermal-expansion matching, and outgassing, the tie-down of the tubes at the corners, how to fit these in place, etc. This includes the glass getter design from SSL which is mostly transferred from the ceramic design and is somewhat different than the ANL/UC glass design.

Collaboration Response: We agree. This request will require coordinating resources to the additional development of cleaning stations, vacuum-ovens, and resistance-measurement facilities, among others. The Argonne XDS/Chicago test program plays an important role in feedback on MCP behavior, electronics development, and presentation of results; support should be continued for the 8"-glass tile testing effort at the APS.

Q2: What can be done to further mitigate risk?

1. **The Committee noted a problem in coordination of the work at ANL, SSL, and UC, resulting in difficulties of allocating ANL funding and resources to the highest-priority problems.**

   Collaboration Response: This is a hard problem, and is a feature in most Lab-university collaborations. The Collaboration has done well to build and maintain an extensive infrastructure specifically for this purpose: the recently instituted Executive Committee, the GodParent reviews, weekly group and subgroup meetings, and the Blog and other web pages. However more work is needed to align spending to the highest priorities. Management needs to address this head-on.

2. **As noted in Question above, the highest priority is making a ceramic tile and to mitigate the risk of not completing a tile, effort and resources should be focused on this priority. The program seems to have too much focus on individual parts and not on the integration of making photodetectors. In the long term, ANL needs to focus their effort away from all the individual parts and towards getting a production line working at ANL in the same way that SSL has a production line.**

   Collaboration Response: With the SSL ceramic tile being the highest priority and with a very tight budget, the ANL effort has been strained and production of the single tile facility has been deferred. However, Argonne continues to make progress focusing on issues related to designing, building and commissioning a full 6cm production line. This effort has, as added benefit that there is a lot of synergy and overlap with the 20cm tile production facility and will provide valuable experience to help achieve the final goal of a 20cm tile facility.

3. The Committee stated that Argonne needed to have a working photodetector production line system for the following two reasons: i) process knowledge needs to be spread within the collaboration to mitigate the risk of single-point failure, and, ii) the R&D work on improvements of the detector technology needs to have a close link to a representative production line. The

committee also felt that some success with such a system was important before the next phase of the TTO. The best and quickest way for such a system to be successful was to use the glass body design being modified by SSL for commissioning the system. This approach would minimize hermetic packaging design risks; future modifications of the system could then be implemented to test lower cost ways of manufacturing.

Collaboration Response: There is disagreement within the collaboration on this issue, however Argonne has proceeded with developing a photodetector system.

4. **The Committee also questioned the design of the current 6cm system if the goal was to have a system successfully operating as quickly as possible. In particular, the committee felt the use of effusion cells and the cold seal and hot seal methods being pursued at Argonne and UC were different from current industry standards (whereas SSL used the more traditional industry vetted method of sealing). Modifications of these processes with the goal of producing a cheaper detector should be introduced incrementally, only after a conventional process was working.**

Collaboration Response: The original strategy, still being followed, is to have two parallel paths, the 'low-risk' path based on 'the conventional process', which is the path being pursued at SSL. The second path, 'the Frugal tile', was designed to pursue transformational innovations, aimed at dramatically reducing the cost and improving timing performance so that these detectors can be used in large HEP experiments – this is the glass-based package. The two paths are complementary, with different goals. However progress on both paths has to go in parallel l- there will not be time nor support from DOE to sustain an evolutionary approach on both paths.

On the 'transformational' (Frugal tile) path, successful innovations so far include a modular system of tiles in a low channel-count low-power system ending up in a single fiber/cable [1], 15-GHz wave-form sampling of high-bandwidth anodes [2], frit sealing of the tile bases, and a package consisting entirely of water-jet cut inexpensive (float) glass. We agree with the Committee that in areas that standard commercial practice is adequate in cost and performance we should not needlessly invent new methods. However, the development of glass-to-glass seals for affordable 20cm-square flat detectors amendable to large-scale production is something new; there isn't a conventional process for producing an inexpensive glass 20"-square MCP-PMT.

On the use of effusion cells for photocathode deposition, there is a difference of opinion within the Collaboration, with a contingent that would like to continue to evolve along the path set by Burle deposition studies at ANL and another contingent that believes that a 20cm x 20cm photocathode is not standard commercial practice and would like to pursue well-established methods used in MBE for photocathode production. We have successfully tested the thermo compression seal under vacuum and have verified it holds a seal up to 30 days. It would consequently be very helpful to hear the detailed technical concerns of the Godparents.

[1] Herve' Grabas, Razib Obaid, Eric Oberla, Henry Frisch, Jean-Francois Genat, Richard Northrop, Fukun Tang, David McGinnis, Bernhard Adams, and Matthew Wetstein; RF strip-line anodes for Psec large-are MCP-based photodetectors; Nucl Instr Meth A711 (2013) 124-131

[2] Eric Oberla, Herve' Grabas, Jean-Francois Genat, Henry Frisch, Kurtis Nishimura, and Gary Varner; submitted to Nucl Instr Meth A (2013)

The Collaboration has also outlined the roles of the different members as a response to the committee report: These roles assume the short-term goals (producing a sealed tile and satisfying the TTO requirements) are met so that funding continues on LAPPD and the Incom TTO.

a. SSL- immediate: produce a sealed demonstration device;

b. SSL- long-term: ceramic or glass devices with emphasis on spatial resolution;

c. Incom: center of the TTO, develop production and markets for glass devices ;

d. ANL management and the ANL and UC leadership of the entire project and TTO, development of the tile development facility; interface to ESD, XSD, MSD unique resources, interface to the HEP user community, R&D to further push the time resolution <1 ps, develop new production techniques, develop higher QE photocathodes, and to lower the cost (the `frugal' tile);

e. Hawaii: support of the packaging-electronics interface for the ceramics package.