Report from the first Photocathode Godparent Committee Review

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The committee wishes to thank the members of the photocathode development teams for the large effort put into creating the TDR draft and materials for the review. Currently it seems there are 3 fronts on which research is directed, corresponding to 3 different timescales: this year, next couple of years, and long-term. These correspond, respectively, to the bi-alkali effort at Space Sciences Lab, a multi-alkali development/characterization effort at ANL, and a characterized/future photocathode materials study involving ANL and Wash U in St. Louis. It is challenging to summarize the broad-ranging discussions covering almost 5 hours of presented material on such a rich and storied topic. As a first step beyond the initial proposal, this review material serves as a reference point for evaluating progress as the project goes forward.

We provide comments below as a starting place in the dialog, and these do not represent any specific conclusions. We group these into a small number of specific observations, questions, recommendations, and suggested achievables.

A couple of general observations:

1) The first iteration of the TDR is a good starting place, though coupling to the SSL effort needs to be improved
2) In order to keep the overall LAPPD project supported (funded), initially very high priority needs to be given to demonstrating a viable (if sub-optimal) 8" PC
3) In parallel with this direct approach, one of the strengths of approach of collaboration with ANL is bringing materials studies tools to bear as part of an in-house multi-alkali formation process
4) In the context of a 3 year project, the resources and development time for the longer-term studies seem insufficient

Specific Questions:

1) The relationship of the material and personnel requests and availability of resources (baseline, new request or future request) wasn't clear in many cases. It would be helpful to have an itemized list of such requests, labeled by the status [baseline, new, future] of these requests to understand those that are supported or need further resources. (For instance, where would the 8" PC be produced?) Could this information be provided?
2) A clearer picture of what tasks will be done where and when?
3) What is the degree to which studies of single-crystal materials are informative, or even relevant to understanding actual multi-alkali deposited, polycrystalline materials?
4) As part of the characterization process, can the coupling to theory be enhanced?

5) Are there places where duplication of effort is unavoidable? (desirable?)

Specific Recommendations:

1) Further coordination of the ANL and university activities is needed. A proposal for quarterly meetings, with revolving host sites, is a mechanism that has been proposed. We encourage such activities and suggest even more frequent interactions (EVO/teleconf) may be necessary where closer collaboration and coordination is needed.
2) The theoretical effort seems undermanned. In addition to providing milestones for that effort, we recommend supporting a student/postdoc/sabbatical-visiting faculty for this task. Ideally such a person would be a phenomenologist, and serve as liason between measurements and theory.
3) Adequate support for the longer-term development probably needs to be provided through some other mechanism [e.g. a new Detector development program]
4) The transfer technology should be a high priority: development of gas/vacuum suitcase with standard fittings (how would it be compatible with SSL for instance?)
5) Closer coupling between growth and characterization
6) More focus on bandgap engineering

In general, we would like to see a set of "Achievables", which would represent clearly defined project progress (as hopefully embodied in published papers). We defer those actually doing the work to flesh out this list, though provide the following few suggestions as a starting point:

1) Achievables should track the development timescale: in the short term (1 year) possible items are: a) working transfer chamber; b) characterization of a small coupon photocathode QE; c) set up deposition chamber at ANL; d) start engineering and build 8" PC chamber.
2) Medium time scale (2years) test results from first 8" PC deposition
3) results from tests of "protected" PC depositions, after transport and protect layer removal
4) comparison of measurements with theory [dedicated test structures]