



**INVERNESS
RESEARCH**

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MEMORANDUM

Date: December 14, 2012

To: Joe Jaime and William Katzman, LIGO SEC

From: Mark St. John, Pam Castori, Jen Helms Inverness Research

Re: Summary of site visit feedback: **Sharing Knowledge and Lessons Learned about the Design, Study, Challenges, and Successes of Education and Outreach Efforts Associated with a Cutting Edge Scientific Research Facility.**

This memo is a summary of the feedback and reflections from the May 2012 site visit to LIGO. First we summarize the goals and purpose of the site visit, and who was invited and why. Next, we summarize the feedback and reflections of the visitors, as well as our own impressions, in particular the strengths, challenges, and recommendations. We end with our reflections on the implications of what was learned on the visit for LIGO as well as our evaluation work going forward.

Attached to this memo as appendices are the site visit agenda and the PowerPoint presentations shared by participants.

Goals and purpose for site visit

Inverness Research and LIGO SEC worked together to organize and plan a site visit that included, in addition to Inverness, 3 guests who have expertise in educational outreach associated with a complex science laboratory or experiment. The purpose of the visit was to provide the opportunity for LIGO SEC to share what they are doing and learning, as well as the challenges they face, for input and feedback from people who have been doing similar work. In addition, it was hoped that the guests, through discussions focused on LIGO SEC, would take away lessons and ideas for their own work. It also served an opportunity for Inverness to gather important examples, insights, and information for our evaluation.

The invited guests were:

Dr. Lisa Hunter, Director of Education and Workforce Development,
Center for Adaptive Optics (CfAO), UC Santa Cruz

Dr. Marco Molinaro, Chief Education Officer at the Center for
Biophotonics Science and Technology (CBST), UC Davis

Dr. Ben Sayler, Director of Education and Outreach, Sanford
Underground Laboratory Facility (DUSEL) at Homestake

These guests were invited because each are leaders in their outreach organizations and have experiences and knowledge that could lend insight to LIGO SEC. Moreover, they shared an interest in both learning more about LIGO SEC and sharing their expertise. And, they each felt that they could gain from participating in the visit.

Mark St. John and Pam Castori from Inverness Research attended and facilitated the symposium. Presentation and debriefing sessions (both those with and without LIGO staff) were recorded and transcribed, and served as data for this report. In addition, visitors submitted written responses to prompts we supplied them about the visit and their impressions of LIGO SEC and its activities; and their responses to these prompts are reflected in this memo.

Reflections from visitors

This section summarizes the feedback from the three visitors in terms of strengths, challenges and/or concerns, and recommendations for LIGO SEC.

STRENGTHS

The feedback in this section is organized by the following categories: content, programs, education facilities, and partnerships.

Content. One visitor commented that the science of gravity waves and gravity wave detection is fascinating. At the same time, it presents a challenge because it is abstract and esoteric, with limited relevance to people's everyday lives. Another visitor noted that the focus on other types of waves as analogs is a smart way to go, and that focusing on measurement, engineering, and the nature of science also makes sense. The visualizations/animations of gravity waves are very helpful.

Programs. All three visitors commented that there is great strength in many of the LIGO SEC programs. In particular, the docent program with SUBR stood out as particularly promising, and could be enhanced by integrating it further into other SEC activities. They enjoyed the discussion with the docent with whom they met, and were encouraged by her descriptions of her experience as a LIGO docent. One visitor noted in written feedback:

Southern undergraduate explainers given appropriate training and opportunity to explain concepts to middle and high school students could go a long way in creating dedicated and communication-capable future graduates as well as providing role models for the MS/HS kids. I would look more into cross-age mentoring approaches/models.

The field trip program also impressed the visitors in terms of the number of students that are exposed to the facility and the science, particularly given the small size of the staff. One visitor noted in written feedback about the field trips:

The one-day field trip format (initial overview, facility tour, visit to exhibit hall, and classroom component) seems reasonable for exposing high numbers of K-12 students to LIGO. It sounds like the day is pleasant enough for the students with good variety of components.

It should be noted, however, that all of the visitors had questions about the theory of action vis-à-vis the field trips, which will be expanded on in the next section.

Teacher professional development was also noted as a strength, as was the Saturday programs for the public. One visitor noted about the Saturdays that they are a “good way to demonstrate openness to the regional community and to touch a broad range of public with limited effort.”

Education facilities. The visitors noted that the facilities work well for the programs that are offered. They recognized the significant investment in the SEC. They believe there is great potential in this installation of exhibits. One visitor referred to it as, “interesting and professional,” and the classroom space and small theater seem to match well with the design of the programs. The exhibits at SUBR were also noted as having great potential, to both serve as a potential place to train docents as well as maintain an ongoing demonstrable connection between SUBR and LIGO.

Partnerships. All of the visitors agreed that the partnership with SUBR is important and has a great deal of potential, particularly to engage historically underrepresented groups. This partnership involves undergraduates, in both the redesigned courses and the docent program, and graduate students in science education are integrating LIGO into their dissertations. It also includes the ongoing professional development program Project MISE.

The partnership with the Louisiana Arts and Sciences Museum also intrigued the visitors as a potential partner for co-producing shows or programs. A closer partnership with the LASM could expand the audience for LIGO.

CHALLENGES OR CONCERNS

The visitors' concerns, or areas where they saw challenges, stemmed primarily from what they perceived as a lack of a theory of action for the education outreach endeavor. In particular, they were not clear on the goals or intended outcomes for the activities and programs, how all of the components fit together, and how they are evaluated and improved.

While they were impressed with the numbers of elementary school kids that visit LIGO, they wondered if the field trips are the optimal way to reach SEC goals. One visitor wrote:

They seem to know how to get lots of school kids through the door to use the exhibits though I would venture to say they are not sure why they do this and/or how to measure the impact of this activity. If they are after "activation" or excitement/engagement I would argue that they need to see less kids, multiple times in a year with a clear articulated focus/plan of what they want to achieve and how they will measure if they are getting there.

Another visitor wrote:

Are field trips the optimal way to reach SEC goals? The school visits expose many students to LIGO -- but to what end? Do they inspire students to be more interested in science? Do they showcase scientist role models? Are they convincing Louisiana students that world-class science is within their grasp? Are they helping teachers to cover particular concepts within the state standards? What sticks for the participants a year or two out? Visiting LIGO for just a few hours seems like light level of intervention. There exists a fundamental tension about serving many people lightly versus reaching a few more deeply.

The visitors felt that while the field trips and the school programs were strong, they wondered about the role of the field trips in an overall logic model, and were puzzled by the lack of programming for older students. Moreover, on several occasions, visitors wondered if it might make more sense with respect to resources and impact to do fewer trips that would entail deeper learning experiences.

As noted earlier, the visitors felt that the connection to SUBR through the docent program was a great asset to the SEC. They also felt that the docent program could be improved through better integration with other LIGO educational activities. One visitor felt that the goals of the program could be clearer: "Is the intent to train undergraduates to become effective educators? Is it to draw talented science undergraduates into teaching? Is it to provide a boost in human resources at LIGO so that SEC staff can do other things (extend their impact)?" Overall, the visitors felt that the docent program, while a strong feature, needs a

stronger connection to other LIGO activities to reach its full potential.

RECOMMENDATIONS FOR LIGO

The suggestions or recommendations for LIGO SEC not surprisingly follow from the challenges discussed above. First and foremost, visitors strongly recommend that the staff clarify their theory of action (perhaps with the use of a logic model) and look carefully at goals, activities and outputs, intended outcomes, strengths, resources, and opportunities. Staff should review whether resources are aligned appropriately and reduce or cut efforts that aren't well aligned. One visitor suggested conducting an audit on how LIGO staff and partners are spending their time and critically evaluate whether or not they are producing the greatest impact. Another sent along some resources that might be helpful for this process, which we can share with you. The question was also raised about whether or not the evaluation information provided by both the internal evaluation and by Inverness Research has been useful to ongoing improvement efforts.

The other major recommendation that all of the visitors offered is to strengthen the collaboration with SUBR, and in particular integrate the docent program more with the other LIGO programs and activities. One visitor wrote:

Southern undergraduate explainers given appropriate training and opportunity to explain concepts to middle and high school students could go a long way in creating dedicated and communication capable future graduates as well as providing role models for the MS/HS kids. I would look more into cross-age mentoring approaches/models.

Another context for strengthening the SUBR-LIGO partnership is the professional development programs. There may be opportunities to deepen and expand the professional development work into a multi-year program that also pulls teachers into leadership positions within LIGO teacher and student programs.

Other recommendations included:

- **Seek professional development opportunities for LIGO SEC staff.** LIGO SEC staff could and should be studying, visiting, and sharing ideas with other science education efforts that are tied to scientific research facilities. This site visit was a great effort in that direction.
- **Create a way for staff to spend some time developing new proposals** to help fund new work that would support a critical evaluation of current work as well as provide new opportunities.
- **Strengthen connections between exhibits, programs, and LIGO science.** The connections may well be there already, but if so, those connections

could be conveyed more clearly.

- **Build and utilize a pool of LIGO teacher leaders.** Teacher leadership will provide long-lasting systemic impact on the state -- and once a pool has been developed, the teacher leaders could be tapped to run many of the existing programs. This could relieve burden on current staff and free them up to develop or deepen other programs.
- **Consider summer camps for grades 8-12 that are hands-on and have an engineering inquiry focus.** Have students from Southern work as primary helpers of the program and employ lead teachers trained in their PD activities to run the 1-2 week camps.
- **Develop programs or activities specifically for high school physics and/or engineering students.** These activities could be used in field trips but more importantly they could be created or adapted by teachers to address classroom standards. They suggested these types of activities could capitalize on the fact that the Next Generation Science Standards (NGSS) includes engineering design. Further, skilled and knowledgeable high school students could participate in cross-age mentoring of younger students when visiting the SEC.

One area that most visitors either didn't mention, or mentioned that they didn't know enough about, was the education research that is happening at the SEC. They wondered: "What is being measured? How does what's being measured match with program goals? Is it reasonable to expect to see impact?" The purpose and potential of the educational research was left unclear to the visitors.

Defining a Theory of Action

Because the issue of clarifying goals, outputs, outcomes, and measures for LIGO was such a sticking point for the visitors, we include some thoughts here about ways to envision LIGO as a model for education and outreach in general. Throughout the visit, the visitors wondered: What is LIGO SEC trying to do and why? One visitor suggested that there are three possible models for a facility like LIGO:

- A) Outreach program exists to explain and to justify the science -- to demystify the overall endeavor and to help convince taxpayers that the science is worth the investment or that it'll spawn important spinoff technologies (e.g., Teflon). This is mostly a public relations function.
- B) Recognize that the science of gravity waves is just too esoteric and complex -- don't even bother trying to teach it -- but rather be a resource that supports the teaching and learning of general science and workforce development in the vicinity of the lab -- perhaps leveraging the lab's existence, resources, etc. But does this model have sufficient rationale and tie to the lab?

- C) Admit up front that the immediate payback from the pure science is limited -- but assert that what the scientific endeavor offers to the regional community is in the science education arena -- helping to inspire kids within the region to consider careers in science and tech, to get to know a scientist, to see science in action, and to have something "world-class" going on in their area. This model sees LIGO as a hook and an inspiration, and it's all the better if what the lab offers is educationally exemplary -- if students get to figure something out for themselves to feel like a scientist -- and if lab educators can model exemplary instruction for visiting teachers and help those teachers to do more of that on their own. The lab has special credibility in motivating change because of its national stature.

The visitor who proposed these models believes model C is probably closest to what LIGO is doing and thinking. This visitor suggested that if this is indeed the case, it would be beneficial to work on articulating a rationale and theory of action around this particular concept.

Another model or way of framing a theory of action is by categorizing programs and activities as "wholesale" – e.g., services and facilities offered to 3rd parties who work with either the public or the k-12 sector, or "retail" – e.g., services and facilities offered directly to the public or the k-12 sector. This orientation allows for broadening the reach and at the same time adding depth to some of the programs that are offered, particularly in the retail realm. This may be what LIGO SEC is already doing, but it could be clarified.

Finally, LIGO SEC might consider the concept of "activation" in conceptualizing its mission, goals, and research focus. In other words, perhaps a way to articulate outcomes LIGO SEC is seeking is a constellation of attributes – not simply increased interest in science but also persistence, identity, robustness, motivation, knowledge gain, skill gain, and mastery. This would be particularly relevant for the students and teachers LIGO SEC engages over time in deeper ways.

THOUGHTS ABOUT THE SITE VISIT PROCESS

In their written feedback, we asked visitors to also reflect on the site visit process, itself, it's strengths and weaknesses, value, and suggestions for improvement.

What worked

All of the visitors felt that the process overall was very valuable for them personally. In particular, visitors noted that the collective discussions about the challenges and successes of this kind of work helped them think about their own work. One visitor noted that even preparing to present formally and also share informally prompted reflection on work at home. One visitor listed the following as ways the visit provided value:

- Great to look at another program that has similar attributes, opportunities, and challenges to my own.
- Useful exercise to think about how to share my own work during the site visit -- in the formal presentation, but also more informally.
- As I questioned what they do, it made me reflect on what I do.
- I learned a lot from other visiting team members -- both about their own work and also how they think about LIGO SEC.

Visitors also noted that the immediate debriefs and reflection time was particularly useful for consolidating ideas and impressions. Also, the composition of the team of visitors – the spread of expertise and experience and institutions – was helpful. Finally, the format, duration and logistics worked well for the visitors.

Ways to improve it

The visitors had a few suggestions for ways it could have been a more productive visit.

- The visitors felt that they would have liked to hear from a wider range of the LIGO SEC team members a more clear articulation of the mission, vision, staffing and budget, specific program features, evaluation methods and findings, questions and challenges and possible future directions.
- There could have been less time focused on the facilities, and more time for discussion.
- Materials provided and reviewed ahead of time would have been helpful.
- More time for one-on-one conversations with visitors and LIGO staff would have been helpful.
- Concluding the visit with a more formal discussion with LIGO SEC leadership on the last day might have been helpful. The ending of the visit had a bit of an “anti-climactic feel” that lacked closure.

Implications and Reflections from Inverness Research

In this section, we summarize our own reflections in terms of the implications of the site visitors’ ideas and feedback for LIGO SEC programs as well as for our own evaluation work going forward. We note that some of these ideas are consistent with questions we have raised in the past.

Implications for LIGO Programs

One clear message that emerged from the site visit from the visitors as well as from our own observations is the tremendous work being done at the SEC. It is unclear, though, exactly what the mission of the SEC is, how the current design achieves that mission, and how you know it is working (or not). In previous visits, we have talked about **the need for a clearly articulated theory of action** – based on a logic model – that could help you with both future planning and making the case for your current work. We do hope that a next step for LIGO is to take the time to flesh this out – articulate and represent it clearly. We can help with this process.

Related to this are the question of staff time and the volume of field trips that are currently conducted. **Is filling the calendar with field trips the best use of staff time?** What about scaling back on the number of trips, but making them more targeted, deeper? Perhaps also, adding programs in physics or engineering for older students. A theory of action could help LIGO SEC think about the role and purpose of the field trip, and what other programming could achieve the SEC's goals.

Another message from the visit is the **power and promise of the partnership with SUBR**. We acknowledge the long history and thoughtful efforts that went into growing this partnership and supporting its programs. The docent program, the undergraduate courses, the satellite exhibit hall – all could be better integrated with LIGO SEC. In the recommendations section above, visitors made some suggestions as to how this might be approached.

Could LIGO SEC **take better advantage of the teacher “champions”** out there who have worked with LIGO over time and are deeply engaged? How can these teachers be tapped and integrated into the LIGO SEC programming, as a way to ease the staffing pressure as well as help pilot new programs

Implications for Inverness evaluation

Going forward, we envision playing two roles as evaluators:

1. Formative feedback. We would like to continue to provide formative feedback on these critical issues and work with you to find agreeable solutions. In particular, in the coming year, we envision an emphasis on assisting the project clarify and articulate its theory of action, perhaps through developing or revisiting its logic model (if one exists); and in the study of the SUBR partnership and the docent program. (We have not examined it very closely to date, or worked with the evaluator of this program and we feel this is an opportune time to investigate its impact.)
2. Summative evaluation. In this role, we will begin to draft the “story of LIGO SEC” from the outside perspective: what it is, what it does and why, who it impacts and how, etc. Along these lines we feel it is not too soon to begin envisioning possibilities for a final product for our evaluation that will be of use to the LIGO SEC.

Appendix A: LIGO Site Visit Agenda

LIGO SEC Site Visit May 23-25, 2012 -- A Symposium --

Sharing Knowledge and Lessons Learned about the Design, Study, Challenges and Successes of Education and Outreach associated with a Cutting Edge Scientific Research facility

A Symposium for LIGO SEC Leaders and Visiting Sages from the Field

Topics for Symposium Discussions

- Program designs and strategies for communicating challenging science concepts to different audiences (teachers, students, publics)
- How to connect basic science with LIGO Science
- Long-term participant relationships vs. one-time visitors
- Partnerships and alliances with states, national and local organizations
- Reaching underserved populations
- Engaging scientists
- Supporting staff
- Identifying and using outside expertise
- Role of evaluation

AGENDA

Day 1 – Wednesday, May 23, 2012

Visitors and Inverness Team arrive in Baton Rouge

7:00 pm Meet at hotel lobby (Embassy Suites Hotel in Baton Rouge)

7:30 Dinner: Inverness Research and Visiting Team
– meet each other and review our work and purpose for the site visit

Day 2 – Thursday, May 24, 2012 at LIGO Livingston

8:30 Visitors leave hotel

9:30 – 10:30 Welcome and Introductions at LIGO SEC

Purpose and Overview of Agenda – Joe Giame, LIGO Observatory Head and Mark St. John, President of Inverness Research

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|----------------|---|
| | Overview of LIGO Education and Outreach programs – Focus on goals and program designs to meet those goals |
| 10:30 – 12:00 | Tours of the LIGO Experiment and the LIGO Science Education Center |
| 12:00 – 12:30 | LUNCH |
| 12:30 -1:15 pm | Discussion about LIGO: How it's tenets and program designs/activities overlap the seminar themes. |
| 1:15 – 3:00 | Visitors share successful attributes of their programs and lessons learned; focused discussions on seminar themes |
| 3:00 | BREAK |
| 3:15 – 4:00 | Continue focused discussions on seminar themes |
| 4:00 – 4:30 | Visitors and Inverness debrief, leave for hotel |
| 6:00pm | Dinner with visitors and LIGO Leadership at Juban's in Baton Rouge |

Day 3 - Friday, May 25, 2012 in Baton Rouge

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| 8:30 | Visitors leave hotel for Louisiana Museum of Arts and Sciences |
| 9:00 - 10:15 | Meet at Louisiana Arts and Science Museum (LASM - http://lasm.org/). Tour the site. Discuss past collaboration and future possibilities. |
| 10:15 – 10:45 | Travel to SUBR |
| 10:45 - 11:45 | Meet with SUBR – view inquiry lab |
| 11:45 – 12:15 | Lunch |
| 12:15 – 1:30 | Visitors/ Inverness provide feedback to LIGO |
| 1:30 | Adjourn |

Appendix B: PowerPoint Presentations
(Sent as a separate file due to size.)