Fermilab Community Advisory Board
July 22, 2021 meeting

Members attending: Larry Brenner, Chris Faber, Carrie Garstecki, Jim Gebhardt, Leah Goodman, Ellen Huxtable, Britta McKenna, Crystal Porter, Thomas VanCleave

Fermilab/DOE personnel attending: Boaz Klima, Whitney Begner, Tracy Marc, Alison Markovitz, Kim Mazur, Jakob Schaeffer, Becky Thompson, Trey Thompson

Welcome and Introductions
Rebecca Thompson

Whitney Begner introduced herself for those who may have not been at the previous meeting. Whitney is the Deputy Manager of the DOE Fermi Site Office.

News from the Lab
Tracy Marc

Presentation and links to communication highlights are linked in the agenda.

1,000 CMS papers
Boaz Klima

Flow chart linked in the agenda.

The CAB was interested in the announcement a few months ago that CMS published its 1,000 paper and wanted to learn about the publication process. Boaz Klima, the Chairperson of the CMS Publication Committee spoke to the CAB.

For the past four years Boaz has been in charge of all CMS publications. A publication is a scientific summary of an analysis being conducted in CMS and submitted to a scientific journal. There are 4,000+ scientists in the collaboration.

CMS submits only to the top journals of high energy physics, both in the U.S. and Europe, primarily the top six depending on the topic, importance of result and impact of publication. As of today, CMS has published 1,078 papers. In comparison to other experiments, most publications to date, except LHC, was the Tevatron (CDF and D0) and have between 500 and 1,000 papers which took about 25 years. CMS published 1,000 in 10 years.

Journals have referees, scientists like Boaz who is a referee for two journals. Referees often reject submitted papers. Top journals, like Physical Review Letters, take pride in rejecting 5 out of every 6 papers received. It is not easy to publish as the bar is high, referees are very strict and

very serious about the publication process and the scientific process is taken very seriously by all involved. None of the 1,078 papers CMS submitted were rejected.

After months, and in some cases, years of people working on analysis and they believe the work is mature enough for publication out of the collaboration, the physics group is split into a subgroup for the first official presentation of the analysis in front for preapproval.

If everyone is happy with the results of the preapproval presentation, all questions were answered to the great satisfaction of everyone, the analysis is pre-approved. At that point Boaz appointments a group of four people to perform an independent review. The review is within the CMS collaboration but not done by experts of the subject of the paper. If they are satisfied, the leaders of the physics group call an approval meeting.

Everyone from CMS is invited to the approval meeting and can ask whatever they want. While a group of people did the analysis, it may be a handful or may be 200, the analysis belongs to everyone in CMS so they can ask whatever they want.

Then the paper, what is called the publication, is written in a precise language meant for the scientific community. It is very precise with perfect language. It is then sent to every member of the collaboration for the Collaboration Wide Review. They are given two weeks in which time every member can read and ask questions through an online mechanism and analyzers must answer every question.

A handful of people do a final reading, making sure every comma and ever word is in the right place. Once perfect, it is sent to Boaz for a last opportunity to change and resubmit.

The process is long and can take several months to several years.

Over 1,000 publications are impressive. Many, many people are involved in the publication of every single paper, even if the analyzer group is small. As we converge towards publication, it is narrowed down to the true experts to make sure it is done perfectly fine. Boaz believes this is the reason why few comments are received. He takes all comments in a very positive way because he believes referees are trying to help as that is what he does as a referee.

Q – Which journals are you submitting to?

We submit to professional journals within the field. On the US side we submit to Physical Review D, the one where we publish in high energy physics with impactful, very timely and significant results. We also submit to Physical Review Letter which has a limit of 4 pages but reaches a much wider community. In Europe we submit to Europhysics Letters which has a more relaxed page limit. We also submit to additional journals more specific to our field such as JHAB and EPJC. For papers that are more technical and less physics, whether hardware algorithm or all sorts of sophisticated things, we submit to Journal of Instrumentation. We started submitting a few papers to more specific journals for machine learning for example, when the focus of the paper is the advancement of machine learning and not necessarily our field. They are using our data and demonstrating new techniques and have been very welcomed by editors.

Q – Congratulation on quite a track record! Internally how many are started and don't meet preapproval by ARC

A – I don't have stats, but a wild guess is the order of 20% of some number like that. Preapproval is before the paper; it is basically the analysis. We don't just reject but rather ask tough questions. Analyzers figure out something is not right, and they go back and come back with more answers. Every so often they go back and realize it is a nice idea but, for several reasons, don't continue

Q - How is the science community impacted and do other organizations build on theories?

A - In the scientific community, this is the way we communicate. In some sense, this is what we are here for. We build accelerators and experiments and development and that all takes years and tremendous ingenuity. At the end of the day the physics demonstrates how well you did everything else. That is when people ask how you did it, that is the time to tell the world the details of the work. When impressive results are presented the impact on the community is huge. No one knows how many people are reading every paper but there are citations. When a paper is read and it provides an idea, the scientist cites our paper. The people citing have nothing to do with CMS. The numbers are huge. For example, the Higgs had more than 10,000 citations. We have papers with more than 1,000 citations.

Q – The discovery of the Top Quark was history making and we haven't heard from people involved and appreciate this opportunity to hear from you about that discovery.

A – Boaz said back then he was young, very naïve and had never talked to reporters before as he was concentrating on physics. It was a phenomenal experience. The person scheduled to talk to reporters couldn't be at the lab, so Boaz talked to them. He learned a lot about the way people see what scientists are doing, how many questions were repetitions and how some were funny. As a young scientist it is an experience he will cherish for life.

Later he was approached by a man from John Hopkins who was doing a study about the philosophy of science and had very deep questions. He talked to Boaz for three hours and at one point looked at Boaz and said, 'who decides that this is the discovery'. Boaz said the discovery is not just seeing it but rather it emerges, scientists are so used to searching and searching that there can be a psychological barrier when it does emerge. Boaz told the reporter that he decided. The reporter than asked who decided that Boaz got to decide. Boaz told him he was the leader of the group and gave people a hard time to make sure no mistakes were made, and at some point, was absolutely convinced and said, 'ok we have it, let's bring in the champagne!'

A Day in the Life of an Accelerator Operator
Jakob Schaeffer and Trey Thompson

Photos linked in agenda.

Accelerator operators are responsible for safely operating the entire accelerator complex. There was an explanation of the complex which comprises miles of tunnels hundreds of thousands of pieces of equipment monitored 24/7/365.

Operators rotate shifts every single day of the year so sometimes workdays, sometimes nights and sometimes 12-hour weekend days. The accelerator complex is monitored, and some troubleshooting occurs in the Main Control Room. If troubleshooting cannot be handled from the Main Control Room, operators go into the field.

The accelerator complex is shut down once a year for a few months, which is currently happening. That is when maintenance and lots of jobs are done to make sure the complex is running at optimal efficiency.

The operators showed photos of various parts of the accelerator complex and different types of magnets – the light blue are dipole which bend the beam and the red are quadrupole which focus the beam.

Safety is a major responsibility. When people make entry into the tunnels, operators make sure no one remains in the tunnels before equipment is energized.

Q – What kind of training do you have in order to do what you do and know what you are doing?

A – There is no way to get experience running a large particle accelerator except to run a large particle accelerator. There is extensive 1 to 1-1/2 years of training. Operators must know what is connected to what, where you can and can't send beam, we must point out to a specialist in that area what equipment does and how to troubleshoot it. We have some type of STEM degree and technical ability plus a technical troubleshooting mindset.

Q - What is biggest challenge in any given day?

A – Every day is different, the challenge is getting adjusted and knowing how to properly respond to new things. We work in crews, so someone always knows and has a good grasp of how to troubleshoot and respond.

A – Figuring out how to fix things if you have never seen it before. There is also a social aspect. For example, we just can't go into the tunnels, there must be safety checks completed, approval to stop sending beam and other steps taken first.

Boaz gave a scientist's perspective and said the accelerator operators are too modest. In his experiment they are building an upgrade that will make things spectacularly new. It is called the frontier of science! When designing, scientists need to test every step of the way and prove to the community that it worked as promised. We do that through the test beam. Quite a few labs offer test beams, but Boaz's experience is the one at Fermilab is in high demand because it is unbelievably clean and very well maintained. When a scientist uses the Fermilab test beam you know what you are doing, otherwise it makes your testing very difficult or even impossible. The test beam allows a scientist to provide progress has been made and move forward.

The accelerator operators said one of the more intriguing part of their job is setting up and figuring out what do for the test beam to supply scientists what they are looking for and one of the more rewarding parts of the job is when they do exactly what they need.

Alison noted that PIP II is an upgrade to the lab's accelerator complex.

Note – One member of the CAB thanked the accelerator operators and said it was fascinating, she has seen them through the glass of the Main Control Room and thought 'wow, you drop your coca cola, and it is all over' and added they are respected and admired.

Upcoming Events
Rebecca Thompson

Presentation is linked in the agenda.

Note: SAGE S is a new program for Fermilab; it was begun by SLAC. Fermilab is shadowing SLAC's program this year and bringing it to Fermilab next year.

What the lab should know
All

Q - Do you think we will be getting together in a regular group at the lab in September?

A - All public events remain virtual, including CAB meetings. While we are excited to welcome the public back on site in the future, our first priority is ensuring the safe and seamless return to onsite work of our staff, working with the Department of Energy. We recognize the importance of the laboratory to the public. When Fermilab does reopen to the public we will communicate information on hours and public locations. We appreciate comments from the CAB.