CERN Physicists take another look at their data
By Sebastian White, Ph.D.

Nov. 13- This week some 220 physicists from all over the world meet in Kyoto, Japan and will hear, for the first time this Thursday, what has come out of the last 5 months of data taking.

In the period since the observation of a new particle-possibly the long-sought Higgs Boson- the 2 large LHC experiments (CMS and ATLAS) have roughly doubled the statistics that went into the previous release on July 4.

The release of data since the first major release in December 2011 has stuck to self-imposed milestones. The next one was the July 4, 2012 announcement, which got frontpage coverage world-wide, then the one this week and finally one planned for a conference in March in the French Alps. Then there will likely be a 1-1/2 year hiatus of major developments on this topic due to a planned shutdown for enhancing the energy of CERN Large Hadron Collider.

The controlled release of information is not imposed by any management rules or press considerations. It has to do with the way the physicists on these experiments have decided to approach what has been possibly the most difficult search for a fundamental particle. These experiment are searching for a few interesting collisions-from the perspective of the Higgs search- out of on order 100 trillion (which is today roughly the weekly yield from these experiments).

There is, inevitably, a huge risk of introducing bias in such a search. It is equivalent to sifting through an Olympic swimming pool full of sand and looking for a few grains, which are subtly different.

So physicists have decided to use a technique equivalent to sifting the sand through a set of filters that aren't so restrictive as to select exactly what is being looked for. Through the period between releases of information it is a strictly enforced rule that no one is to look in the box designed to catch the Higgs. In the meantime all of the effort goes into looking into a set of controls, which have the potential to be misinterpreted- ie a grain of fool's gold that has a tiny chance of looking like the right thing.

This approach has a number of interesting sociological consequences. There are no rumors because there is no information to share. No one has yet looked between releases to see what is there. This must have proved frustrating to bloggers and CERN's communication apparatus, for example.

At the time of the December 2011 release, though, it was clear that things were starting to get interesting. There were hints- with too low a statistical significance to claim a discovery- that something like the Higgs was turning up in the CERN data and that it had properties which should have made it just visible in the data of the US' Fermilab Tevatron which had been running since 1985 and had just been de-commissioned that year.

During the next 6 months both the experimenters at Fermilab (working on the data they had already collected) and at CERN (which was steadily pouring out data with constant improvements in intensity) worked furiously to improve the effectiveness of their analysis tools- despite the restrictions of the technique adopted to reduce bias.

By the time the July deadline was approaching, the US experiments were starting to publish results, which showed that they were reaching the same sensitivity as the December CERN announcements but with a complementary search technique.

CERN too had looked by this time but the experiments weren't prepared to publish ahead of the July milestone. The stakes were too high and the exact level of significance of the observations was closely guarded. But CERN announced a press release for July 4th- which would obviously be a significant day for most Americans following the story.

So the US lab, Fermilab, scheduled a press release for July 3rd and physicists all over the US stayed up all night to hear CERN's announcement the following morning.

When the results from the Large Hadron Collider were presented to the press, friends of CERN and a number of interested parties (including Peter Higgs, Louis Englert, Gerry Guralnik and Carl Hagen), the extent to which the discovery of a new particle had been established was really impressive. A 20 year effort to build multi-purpose experiments with a lot of attention paid to the Higgs search- which had the most rigorous definition- had clearly paid off. The 2 CERN experiment, CMS and ATLAS, had clearly nailed it and with remarkably consistent statistical significance.

Physics papers today do not refer to this observation as "The Higgs particle" (and, of course, not as "The God particle") but more commonly X(125), where 125 refers to one of the few properties of the particle people are sure about-its mass. It is about 133 times heavier than a Hydrogen Atom.

This week's release of information, since the past five months have doubled the statistical quality of the data, will inevitably go toward answering the questions: "What is it this particle", "is it the particle connected to the Higgs mechanism" for which it was invented. Also "Which Higgs particle" since physicists have been busy for the past 40 years refining models for such particles to take into account a number of outstanding mysteries in physics, such as "Dark Matter".

This week will be an interesting one for physicists. It is hard to imagine, though, that this event, significant as it is, will get anything like the press attention that we saw on July 4th.

In a way this is also a significant milestone for physics in the US. Fermilab has no added statistics to contribute to the problem. Instead the US has made good use of a 5% investment in the cost of CERN's Large Hadron Collider and a number of the speakers in Kyoto will be American physicists.

One question on everyone's mind is "where will US physics go from here?" Will the US continue to capitalize on 5% investments in premier facilities on foreign soil? In these times of constrained budgets and uncertainty about our commitment to big science, Europe, Japan and China have become very significant. If, instead, the US makes a move to take the lead, would we be viewed as a reliable host, able to bring a big project at Fermilab, or elsewhere, to a successful conclusion?

Let us hope that, following the election, things will settle down and we will start once again, through bi-partisan cooperation, to look like a country that can bring big initiatives to conclusion.

Sebastian White is a physicist participating in the LHC experiments at CERN and is currently living in Geneva, Switzerland. He has done much of his research at CERN, starting with his thesis experiment as a Ph.D. student of Leon Lederman (who first came up with the name "The God Particle"). For part of the year he is at The Center for Studies in Physics and Biology at The Rockefeller University.