AOARD REPORT

KEK, The National Lab for High Energy Physic in Tsukuba, Ibaraki

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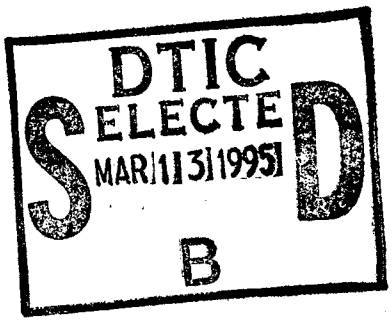
S. J. Yakura
AOARD



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To: Dr Shiro Fujishiro
From: Dr S. Joe Yakura

Date: 14 May 93

Subject: Trip Report - KEK, The National Laboratory for High Energy Physics, 11 May 93

ABSTRACT: *The National Laboratory for High Energy Physics, sometimes referred to as KEK, was established in April 1971 to conduct experiments in elementary particle physics. Research efforts are divided into four major areas: Accelerator Department, Physics Department, Radiation Safety Control Center, and Photon Factory.*

Under the direction of Prof. Shigenori Hiramatsu, Dr. David Whittum is carrying out research on designs of compact high energy accelerators that can achieve a steep potential gradient for fast acceleration of electrons within a short distance. In his experiments, he uses two identical linacs to drive two electron beams where one electron excites wakefields in a test medium such as a plasma and then the second electron beam gets accelerated by the effect of the wakefield created by the first electron beam.

Purpose: Visit KEK and Assess their Basic research efforts

Time and Place: KEK, the National Laboratory for High Energy Physics is located about 9 miles northeast of the Tsukuba Center in Tsukuba City, Ibaraki-Ken. I took a JR express bus at the Yaesu side of the Tokyo train station in the morning at 6:32 am. By mistake I got on the wrong bus that said the "Tsukuba Center". I should have taken the bus that heads toward Tsukuba Mountain. After I arrived at the Tsukuba Center around 8:00 am, I had to take a local bus to get to the KEK facility. It was another 15 minutes ride. If I had taken the right bus at the Tokyo station, as I found out later, I just had to get off at the first stop. The express bus actually stops right in front of the laboratory. Attachment 1 shows the location of the laboratory with respect to other Japanese government laboratories and centers in Tsukuba City.

I was greeted by Dr David Whittum at the front entrance of the laboratory. He said that he came directly from the University of California, Berkeley, shortly after finishing his Ph.D. in physics in 1990. Currently, he is a temporary staff member in the Accelerator Department and working on designs for ultra-high potential gradient accelerators. He accompanied me for a whole day, setting up technical discussion meetings with scientists who work there. At the end of the visit, he gave me a ride in his car and drop me off at the Arakawa JR station around 1600.

Observations and Comments:

1. KEK, the National Laboratory of High Energy Physics was established in April 1971 for experimental research in elementary particle physics and other high energy physics related studies. It is an inter-university research institute that comes directly under the Minister of Education, Science and Culture (Monbusho). Because of their affiliation with Monbusho, KEK researchers are given professorships based on their scientific accomplishments and merit of the contribution to the progress in elementary particle physics.

The KEK's principle accelerators are 12 GEV proton synchrotron, 2.5 GEV electron accelerator and 30 GEV electron-positron collider (TRISTAN). Research efforts are divided into four major groups, consisting of Accelerator Department, Physics Department, Radiation Safety Control Center, and Photon Factory. The organization chart of KEK is shown in Attachment 2. Also depicted in Attachment 2 are annual budgets for FY91 and FY92 (the Japanese fiscal year which starts in 1 Apr and ends in 31 Mar of the following year) and staffing of the laboratory. The annual budget is around 30 billion yen in FY91 and FY92. Out of it, the operating cost is in excess of 25 billion yen which comprises more than 80% of the total cost). There are more than 650 people employed at this laboratory, consisting mostly of the scientists and engineers.

2. I met Prof Atsugi Ogata and Prof Shigenori Hiramatsu. Prof Ogata is a plasma physicist working on accelerator experiments. His interest is in laser-plasma interactions of very short time scales (less than a picosecond) using the optical pulse compressor techniques. Currently, he is collaborating very closely with laser scientists at Osaka university to investigate plasma lens effects that arise from nonlinear interactions of plasma particles with intense narrow width laser beams. He said that he makes frequent trips to Osaka to coordinate their experimental efforts. He also deals with scientists at the Tokai village on the Japanese Tokomak program. Prof Hiramatsu's current research interest is in microwave FEL experiments for designs of compact high energy accelerators that is based on achieving the steep potential gradient for fast acceleration of electrons within a short distance. He accomplishes the fast acceleration by using two identical linacs for the usual one linac wakefield accelerator system. Instead of having one linac generates both driving and witness beams, under the twin linac system beams from one linac excites wakefields in a test medium such as a plasma, while beams from the other linac are accelerated by the wakefields. It is very critical to have a fine control mechanism established for a twin linac system to operate properly. He said that beams from two linacs can be controlled with an accuracy on the order of one picosecond.

3. Dr David Whittum gave me a tour of the FEL test-stand which is the experimental set up for FEL microwave accelerator, twin linac experiments. They have just moved into the Nikko building last

month and they are still in the process of reassembling the system. It may not be in operation until another two months or so. Their program is budgeted for more than 1 million yen for the upcoming fiscal year. As compared to the TRISTAN programs, the twin linac program is a very small part of the total KEK operation. We had to restrict our tour in the building to within 30 minutes because of the radiation safety requirements.

4. I also has a tour of TRISTAN control room and TRISTAN experimental areas. Dr Whittum and Prof Ogata accompanied me for the tour. I did not see too many people around the experimental areas. That is because the experiments are all automated with the use of computers. Because the device was completed in 1986, it really shows the use of the most of advanced technologies at the time when the device was built.

5. I may plan to make another visit of this laboratory to see the actual operation of the FEL test stand once the reassembly is complete.