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1983: As a doctor course student, I joined VENUS electron-positron colliding beam experiment at TRISTAN accelerator, which was under construction at KEK to searched for the top quark. I stayed at KEK as an entrusted student from Tokyo Inst. Tech. and I worked for the central drift chamber (CDC) subgroup. My supervisor was Prof. Takahiko Kondo. I learned to understand particle detectors electromagnetically through the R&D of the drift chamber. I enjoyed making test drift chambers, performing test experiments and designing electronics. My first first-author publication was "Development of a preamplifier for drift chambers". Four years later, the VENUS experiment started data taking. When I saw the first highest-energy Bhabha scattering event (e+e- ---> e+e-) in the event display of the CDC, I felt my four years work was rewarded. My ph.D thesis became the first physics publication from the VENUS group. The number of hadronic events I analyzed for the thesis was only 96. Therefore, my two weeks labor corresponded to the award of one hadronic event. My thesis showed that the top quark was heavier than 24GeV. Now it is known that the top quark mass is 170GeV. Therefore, the beam energy was a bit lower.

1987: I obtained a job at KEK and joined KL --> mu + e rare decay search experiment. I was in charge of e/pi/mu particle identification system, I did mapping of the spectrometer magnets, etc. Unfortunately, KL --> mu + e decay was not observed in this experiment but KL --> mu + mu branching ratio was measured with the best precision at that time. It was impressive that the famous CP violating rare KL --> pi+pi- decay was a tough background in this experiment.

1989: I moved to Tohoku Univ. and joined the SLD e+e- colliding beam experiment at SLAC to study the Z0 boson. I stayed at SLAC as a visiting researcher for about half of my time. At SLAC, I was involved in the CRID(Cherenkov Ring Imaging particle identification Detector) and VXD3 (third generation CCD based vertex detector) sub detector groups.

My first work abroad was to develop automatic range-changing oxygen monitor system for CRID. I remember I often visited to electronic shop at SLAC to obtain electronics parts for the oxygen monitor. After CRID hardware was complete, I developed a charge division code which improved position resolution along the wire direction a bit.

For VXD3, I worked for readout electronics system and especially developed a cluster processor using, then becoming popular, FPGA. The cluster processor reduces the data size by less than 1/10,000 choosing only hit pixels from the vast sea of 300M pixels in pipeline. I enjoyed tight designing of the FPGA by arranging CLBs (the minimum unit of the logic circuit) manually to maximize the signal processing speed, etc. VXD3 can identify b, c-quarks using a micron meter order of 3D position resolution and CRID can identify s-quark through K/pi separation.

Together with very small and polarized beam, SLD could measure asymmetry of fermion-Z0 couplings and therefore, the weak mixing angle, Theta_W, precisely. The summary paper on electroweak parameter measurements written by LEP experiments and SLD [Phys.Rept. 427 (2006) 257] has been cited more than 1000 times.

While I stayed at SLAC, I also did an accounting job of US/Japan Science and Technology cooperating program. I dealt with a pile of invoices, receipts and contract papers of million dollar's purchases. Then, I learned how to keep large amount of accounts.

My first lodging room in the US was Prof. Tony Siegman's house who was one of the best authorities of lasers. The landlord of my third lodging was Prof. Roger Kornberg who won the Nobel prize in chemistry in 2006. While I stayed at SLAC, Prof. M. Paul won Nobel prize. I saw many prestigious researchers in SLAC and Stanford Univ. and I was very much stimulated by such high level academic environment there.

Around 1996, I returned to Tohoku Univ. and became a starting member of the KamLAND experiment. KamLAND measured the reactor antineutrinos coming from several nuclear reactors hundreds of kilometers away and identified the second neutrino oscillation and solved the solar neutrino problem.

I was in charge of the 3000 m^3 of large liquid scintillator (LS) and buffer oil, 13m diameter transparent plastic balloon to contain the 1200m^3 LS, and background control etc. For me, it was a big jump from 10g of solid sate CCD to kilo tons of liquid detector, from above-ground accelerator lab. to a deep underground lab., from physics of 91Giga-eV Z0 to milli-eV neutrinos. I was novice to the new research conditions and necessary detector techniques. At first I was at a loss thinking of the required transparency and radio-purity of the massive liquid scintillator. It was needed to learn about hydraulic engineering, petrochemicals, plastic engineering, natural radiation sources, driving 4WD LandCruiser in narrow tunnels, etc. Thanks to the help from many people, it was possible to realize a good LS system in the end. It took several months to fill the detector with liquid scintillator. I looked at the bottom metal flange of the balloon 20m below, from the top of the chimney everyday. I was afraid the flange might become invisible while the liquid level raise due to lack of the transparency of the LS. To my relief the metal flange could be kept seen until the filling finished.

The construction of the KamLAND detector finished in 2001.

When I saw the scintillation light yield and the background were satisfactory in the first data, I felt very much relieved. After starting physics data taking, I plotted a histogram of neutrino energy in a graph paper one event by one event by hand and gloated over the less neutrinos than expectation!

In 2002, KamLAND announced the detection of the reactor neutrino deficit and published it in 2003. The paper has been cited 2482 times by now. I received the first Koshiba prize for "Development of the large liquid scintillator detector for the measurement of the reactor neutrino deficit" with my two colleagues in 2004.

In 1998, we wrote a PRL paper [cited 95] with Prof. Raju Raghavan on detecting geo-neutrinos by KamLAND and Borexino. The sensitivity of the KamLAND detector turned out to be good enough to detect the geo-neutrinos whose energy and flux are much less than the reactor neutrinos. KamLAND measured the geo-neutrino for the first time and the result was published in Nature [cited 200] in 2005.

In 2015, the KamLAND experiment was awarded Breakthrough Prize.

KamLAND showed that the neutrino oscillation parameters, Theta12 and Dm12 are large. This means there is possibility to measure leptonic CP violation by neutrino oscillations in the future, if another neutrino mixing angle Theta13 is finite and relatively large. Then precise measurement of the Theta13 became next very important subject. We wrote a paper (cited 203 times) in 2003 and showed that reactor measurement of direct theta13 at a baseline 1.5km, is effective to reduce the ambiguities of the accelerator measurement of Theta13. I, together with my experimental colleagues, proposed a reactor-Theta13 experiment, KASKA, which was supposed to use the world largest Kashiwazaki-Kariwa nuclear power station. We made an one ton prototype liquid scintillator detector and tried to detect neutrinos from Joyo research reactor at JAEA. This prototype detector is now used for R&D of reactor operation monitor by neutrinos for safeguard use. However, unfortunately the KASKA project was not supported in the end.

In 2006, the KASKA group joined French reactor-Theta13 project, Double Chooz. The budget request was approved by JSPS as a category of special promotion of Grant-in-Aid for scientific research. Double Chooz Japan group took part in constructing the neutrino detector taking responsibility of the photo multiplier, light calibration and data acquisition monitor systems. The detector construction was complete in the end of 2010. In 2011, the Double Chooz group reported an indication of a finite Theta13 for the first time using reactor neutrinos and published a paper in 2012. The paper has been cited 878 times by now. Since then we have been improving the precision of the Theta13 measurement with more statistics and better analyses. We could measure the background directly using reactor-off data.

In 2013 four of us analyzed the baseline dependence of the reactor neutrino deficits measured by Double Chooz, Daya Bay and RENO experiments and extracted effective Dm31 for the first time and published a paper. A doctor course student of Tohoku University, T.J.C.Bezerra wrote his ph.D thesis with the Theta13 and Dm31 measurements and was awarded the presidential prize of Tohoku University, the JAHEP(Japan Association of High Energy Physicists) encouragement prize and has been nominated to the JPS young scientist award.

In the fall of 2014, the construction of the Double Chooz near detector was complete and commissioned by a PD of Tohoku Univ., Dr. Chauveau Emmanuel. In early 2016, the DC announced the high precision Theta13 results (preliminary) with the near and far detectors. The measured Th13 value is inconsistent from Daya Bay result with significance 1.6-sigma.

In 2015, I wrote a book "Neutrino Oscillations: A practical guide to basics and applications" from Springer. I leaned that writing a book is learning the subject deeper. To my pleasure, this book is said to be downloaded well.

Together with the scientific studies, I am performing R&D for the reactor operation monitor by neutrinos for the safe guard purpose. The reactor neutrino monitor is one of the candidates of the novel technology program of IAEA. It was quite an experience to visit the IAEA head quarter in Vienna. Their work bench was much neater than ours. Dr. H.Furuta is now building the second small neutrino detector for the reactor monitor R&D.

Now, Tohoku group is involved in the preparation of the sterile neutrino experiment being proposed at the MLF beam line of JPARC accelerator complex.

I have been involved in the measurements of ThetaW, (Theta12, Dm12) and (Theta13, Dm31). I am hoping to measure (Theta14, Dm41) next, by detecting sterile neutrinos.

In July 2016, I have been selected as a Blaise Pascal Chair of French for subject of "Promotion of Neutrino Science".

Since April 2017, I have been staying at APC/CNRS, France for 1 year. I will perform seminars, neutrino experiment, R&D of neutrino detector, and writing.