

Musings from Lindau and Beyond

Relics of Creation, the Human Species and Super World



Lindau 2008 Meeting with Nobel Laureates, Germany and
visits to Institutions in Switzerland and Germany
28 June to 11 July 2008

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28 June 2008 • *The* ERL was on time, as always. It took eighteen minutes to travel from Putrajaya to KLIA. I hurried up to the information counter, our designated meeting point. I was there before 9:00 pm. None of the young scientists were in sight. So I checked-in my luggage, and picked up my boarding pass to Frankfurt. To my relief, the luggage was checked right to Friedrichshafen, the last airport on the way to Lindau. Azwani showed up with her family afterwards. I suggested that she proceed with check in, as Iong Ying and Khai Ming also arrived. All three of them checked in together.

It was three months earlier that panels at the Academy interviewed eight shortlisted candidates from the fifty applications that were received. It amazed me to see the extra efforts made by some of the candidates to win the right to this journey of a lifetime to meet 25 Nobel laureates in Lindau, Germany. Most of them deserve it. Three were finally selected: the cap given by the Lindau Council for Malaysia for 2008.

“Welcome aboard Professor”, said one of the crew members with a smile. I swung my backpack into the overhead compartment and overheard, “The Professor is here”, as if they were waiting for me. The twelve-hour flight went smoothly. I made some progress on “The Audacity of Hope” by Barack Obama, the Democratic

Party Presidential candidate. A week earlier, I finished “Dreams from my Father” by the same author. “Barack” is Arabic for “blessed” – barakah.

Parts of the book describe Chicago in the mid 1980’s. I was a student from the late 1970’s to mid 1980’s in Dekalb, an hour’s drive from Chicago. Views of the Chicago South side from that decade reemerged fuzzily in my mind. Kids were roaming the streets. Basketballs shot to the net. The streets are not terribly busy, just filled with too many traffic lights. Between reading and sporadic naps, I survived the twelve-hour flight.

29 June 2008 • We touched down at Frankfurt airport on time: 6:30 in the morning. The temperature was 21 °C. It was pleasant. I bumped into two MARA officers at the gate. They were waiting for some forty students on the same plane, traveling from Kuala Lumpur onward to Russia. After a quick chat, the four of us hopped on the sky line to another terminal for our connecting flight. The transit went smoothly except for the elusive transfer counter that we finally managed to track down. Before long, we were on the plane to Friedrichshafen. The 52 seater aircraft roared as hard as it could before taking off the runway.

We landed in Friedrichshafen in less than an hour, at 9:30 am. A friendly MPV driver was waiting for us with a broad smile on his face, just what we needed after more than thirteen hours on the plane from KLIA. It took twenty minutes to get to the Restaurant Schachener Hof Hotel where Iong ing will stay for the next six days. After leaving his luggage at the hotel, we hopped off to the Bulligan garni Hotel where Azwani and Khai Ming will be staying and left their luggage there. It was another twenty minute

drive to the Lindau Island on Lake Constance where the meeting will be held and where Reutemann Hotel, where I will stay, is located. From the hotel I can see the Lindau Lighthouse and the Lindau Harbor. It was a beautiful sight, and I don't mind staying there for more than six days. It's a dirty job, but someone has to do it. The driver was very attentive in helping us with our accommodations and gave us each a pick up time for transportation to the airport at the end of the meeting later on July 5th.

The four of us then walked north to Inselhalle where the meeting will be held. It was a nice walk between the well-kept, charming old buildings. In fifteen minutes we reached Inselhalle. The registration was in full swing. We picked up our materials. Azwani was excited to see her photo on the front page of the participant booklet.

It was 12:00 noon, and the opening ceremony was scheduled for 3:00 pm. We decided to return to our hotels to freshen up. After everyone took the bus to their respective hotels, I began walking to Reutemann Hotel. I got a good glimpse of Lindau Island. People were polite. Numerous drinking and eating outlets. Many tourists during this summer time. I can hear French, Japanese, Russian, Spanish and of course German.

The first Nobel Laureate Meeting was in the summer of 1951. Two physicians, Prof. Gustav Parade and Dr. Franz Karl Hein, initiated the meeting. Seven Nobel Laureates met in Lindau on Lake Constance and presented lectures to an international audience. In Graf Lennart Bernadotte af Wisborg, from the Isle of Mainau, they found enthusiastic support. He rapidly became the *spiritus rector* of the Lindau Meetings. As the first president of the Council for the Nobel Laureate Meetings in Lindau, he developed the Lindau

dialogue from the very beginning. His wife, Countess Sonja Bernadotte took over in 1987.

The inaugural meeting in 1951 began a tradition that later developed into a premier conference for international scientific excellence. Its topic was rotated between Physics, Chemistry and Physiology. Every four years or so, a combined meeting is held. The Lindau meeting for 2008 was the 58th such conference, this time dedicated to physics. More than 600 participants from 67 countries attended the meeting this year.

I wasted no time waiting to explore the Lindau Harbor and the Lighthouse. At the hotel lobby, I ran into the Thai and Chinese leaders. After exchanging cards, I ran up to my room to freshen up. A short downpour commenced, followed by a drizzle. I put on a jacket and walked quickly towards Inselhalle, darting between buildings to avoid being soaked.

By the time I got to Inselhalle for the opening, the hall was quite full. I took a seat in the front, where leaders of the delegations were supposed to be seated. I chatted with the other leaders around me and exchanged cards. Soon I noticed someone who looked like a diplomat from Malaysia and approached him. It was His Excellency Datuk Zakaria Sulong, the Malaysian Ambassador to Germany. I introduced myself, and we shook hands. Ms Zubaidah, a free lance journalist based in Berlin, soon joined us with Peter, the cameraman. As the opening ceremony was about to begin, Zubaidah convinced me to take a seat with the three young scientists, far in the back rows. "For a photo shoot", she said. I gladly obliged, giving up my seat in the front row.

The meeting was opened by Countess Bettina Bernadotte. Several awards were given away during the opening. Malaysia was

mentioned as one of the countries which had signed a Memorandum of Understanding recently with the Lindau Council. Through the MOU, five young scientists from Malaysia will be invited to attend the Lindau meeting starting in 2009.

The speeches and awards were followed by two musical performances. Lydia Kavina played the theremin, and the piano was played by Ksenia Kouzmenko. By the way, the theremin is a musical instrument played without touch. Kavina would move her hands around the invisible antennas of the theremin, controlling the pitch and volume and producing the beautiful sounds of *Claire de Lune* and *Romance op.* The experience is almost magical for anyone seeing the theremin being played for the first time. Prof Ivar Giaever, one of the Nobel Laureates present, was impressed with the performance and later told us that the first thing he will do when he goes back home is to Google the theremin to find out more.

Prof Dr Hans Rosling of Karolinska Institute, Stockholm, gave an interesting presentation on the current state of humans today, entitled “A Fact Based World View”. The world we live in can no longer be divided into west and east. The general state of human being, health, and poverty can no longer be associated with regions. Rather, it is based more on individual countries and not continents. Singapore, for example, has a lower rate of death at birth compared to western countries. He highlighted some of the problems the world is facing today. It sort of kick-started the plenary to come.

30 June 2008 • The first plenary lecture was by Prof. Theodor W. Hansch, who won the prize in Physics 2005. The title of his talk was “Towards a Quantum Laboratory on a Chip”. Miniature

devices are made possible in the laboratory at the quantum scale, and these will change the kind of instruments developed in the future.

Prof. Dr. Peter Grünberg, winner of the 2007 prize, gave the second lecture, “From Spin Waves to Giant Magnetoresistance (GMR) and Beyond”. This lecture is on the development of the Giant Magnetoresistance effect. It started with the Mott two current model. The GMR effect was discovered in 1989, and it took another 5 years to reach the market. It is used as a read head in hard-disk systems. It can also be used for traffic control sensors i.e. positioning and speed sensing. Similar systems have been used in the Spirit and Opportunity rovers on planet Mars. The different configurations includes in plane, perpendicular and tunneling magnetoresistance (TMR). TMR can achieve a 500 % magnetoresistance effect. In 2007, MDAM based on giant TMR and spin transfer was realized.

Perhaps one of the most interesting talks of the whole meeting was by Prof. Ivar Giaever, entitled “Discovery of Superconducting Tunneling”. He won the Nobel Prize in 1973. Prof Ivar Giaever started to work at General Electric under John C. Fisher in the early 1950’s. He emphasized the importance of building one’s own equipment to obtain novel results. While working at GE, he took courses at a university. One of the courses was a superconductivity course taught by Prof. Huntington where Prof Giaever learned BCS theory. From the course, he developed the idea of measuring the energy gap of superconductors using tunneling experiments. “Ideas come to a prepared mind”, he said. “Always go to class because what you are missing can be really big”. He began to conduct experiments to measure the energy gap of

superconductors. Due to his ignorance of low temperature measurement, he used copper wires instead of manganese for his experiments. Fortunately, he found that copper wires actually can be used for such low temperature measurement.

Bardeen told him that during his first Nobel Prize award ceremony, he did not bring his family along, and that was a great mistake. So Bardeen suggested that Giaever take his family along.

One of the things he missed was the Josephson effect, which was discovered by Brian Josephson around the same time.

Prof Giaever goes on to calculate the chance of winning the Nobel Prize for a physicist working in the US. The calculation goes as follows. There are 40,000 physicists in the US. On average one physicist from the US wins the Nobel Prize each year. So the chances of winning a Noble Prize for a physicists working in the US for 40 years is 1/1000. He added that to win the Nobel Prize one must be Curious, Competitive, Creative, Stubborn, Self Confident, Skeptical, Patient and, most of all, Lucky!

Prof. Klaus von Klitzing, who is currently at the Max-Planck-Institut für Festkörperforschung Stuttgart, won the Nobel Prize in 1985 and gave a lecture on Carbon Electronics. The talk summarizes new developments in the field of nanoelectronic devices based on carbon. Two different allotropes of carbon are at present the focus of his research, carbon nanotubes (CNT) and graphene, a one atom thick layer of carbon.

Nanotubes are one-dimensional wires for interconnects and switching devices in electronic circuits, whereas graphene seems to be an ideal two-dimensional electron system with fascinating new properties including the observation of the quantum Hall effect at room temperature. Carbon electronics may be the future of

nanoelectronics. One layer of carbon nanotubes on SiO₂ can form a CNT transistor.

Prof. William D. Phillips of the National Institute of Standards and Technology, Nobel Physics winner in 1997, lectured on ‘Cold Atomic Gases: The Intersection of Condensed Matter and Atomic Physics’, discussing quantum degenerate gases. The gases can be produced through laser cooling and evaporative cooling. Gases of bosons are actually in a Bose-Einstein condensed state, whereas gases of fermions are gases with temperatures below the Fermi temperature. He stressed the importance of such gases following similar behavior as condensed matter systems, which can give new insights and stimulate more interesting breakthrough. He also noted that the reason to do scientific research is to do exciting physics, not to win Nobel Prize.

The final lecture of the day was by Prof. John L. Hall, from the University of Colorado, who won the Prize in 2005. In the talk, entitled ‘The Optical Frequency Comb – A Really Versatile Tool’, he described the optical frequency comb. Applications include the atomic clock, control and calibration of next-generation interferometric planet-finder missions, and also accurate photolithography of large semiconductor wafers.

1 July 2008 • The three lectures for the morning were given by three Nobel laureates who won the Prize in Chemistry in 1988. They were Professors Johann Deisenhofer, Robert Huber and Hartmut Micheland. The morning started with a lecture entitled “Structural Biology - quo vadis?” by Prof. Johann Deisenhofer, who is currently at the University of Texas. Some of the major technological advances in Structural Biology include DNA

manipulation and dedicated synchrotron imaging. Much of the success has been enabled by progress in related fields, such as recombinant DNA technology, computing, synchrotron X-ray sources, superconducting magnets, etc. According to him an area in which progress has been slow is the theoretical understanding of macromolecules, including computer simulations and predictions about their function and their behavior in response to mutations or to changes in their environment. It may be the greatest opportunity for a younger generation of scientists to make significant contributions to biomedical science.

Prof. Robert Huber delivered the second lecture, entitled “Beauty and Usefulness of the Building Blocks of Life: The Architecture of Proteins”. He is currently at the Max-Planck-Institut für Biochemie. An interesting slide of the skeleton of a bat was shown, and, when magnified by 200 times, it resembles the skeleton of a human being. According to Professor Huber, the rapid development of methods and instrumentation of protein crystallography, electron microscopy, and nuclear magnetic resonance, allowed the determination of very large and complex protein structures. These structures document not only the beauty and unlimited versatility of the proteins’ architecture, but also revealed unexpected relationships, allowing clearer views back into the history of biological evolution.

The third plenary lecture of the morning was by Prof. Hartmut Michel from the Max-Planck-Institut für Biophysik. The title was “Cytochrome and Oxidase Structure and Mechanism of a Proton Pump”. He began the lecture with an historical account of the field. The insulating properties of membranes have allowed nature to use mitochondrial and bacterial membranes for energy

transduction via electric voltages (potentials) and ion gradients. Based on the X-ray structures of enzymes, the chemical entity that is bound in the active site when the enzyme is in its oxidized form was presented.

The most anticipated forum, on climate change, began at 11:00 am sharp. Seven Nobel laureates participated – Professors Deisenhofer (Chemistry 1988), Giaever (Physics 1973), von Klitzing (Physics 1985), Michel (Chemistry 1988), Osheroff (Physics 1966), Rubbia (Physics 1984), Steinberger (Physics 1988). Professor Dr Hans Joachim Schellnhuber, the Director of the Institute for Climate Impact Research chaired the forum. He began by pointing out the seriousness of the problem of climate change, which is intimately connected to the energy crisis. Scientists, politicians and the public should come up with a strategy, but scientists in particular can contribute to the solution. Osheroff reiterated the seriousness of the issue; the problem is real. The melting of ice results in more solar energy being absorbed by the sea, which is essentially a non-linear effect. The public doesn’t trust the safety of nuclear technology to generate energy. However, advances in reactor technology have made nuclear technology safer. Giaever said he didn’t volunteer to be on the panel as he is somewhat skeptical about climate change predictions. In recent times, the temperature of the earth has peaked, for example, in 1921, 1934 and 1998. The specific heat of the ocean determines the temperature of the earth, while the specific heat of the air is 1000 times smaller than the of the ocean. Solar technology is too diffuse and expensive. He pointed out that during the ice age, temperatures dropped by 8 °C. There has been no ice age since the last, 40,000 years ago, and no one knows what the best temperature for the

earth may be. In the seventeenth century, a mini ice age occurred, resulting in trophogenic climate change. A 1 °C increase in the temperature of the earth would result in a 20 cm increase in the sea level.

Rubbia pointed out that since 1930, the population of the earth has quadrupled, but the energy used has increased by sixteen times. Ten percent of all mankind who ever lived on the earth are alive today. Klitzing commented on energy consumption, and noted that fusion will need more time to develop. Scientists should be able to solve the energy problem by the end of the century, and global warming is the product of that energy problem. Deisenhofer does not claim to be an expert in the global warming problem; he is, rather, an interested citizen. According to him, there is no theory to predict what will happen in the future. The climate change issue has shifted the public view on nuclear technology, and he looks forward to advances in nuclear technology and reactors.

According to Michel, through photosynthesis, the energy stored from the sun is only 0.7 to 0.8%. Hence biomass is not a good alternative for storing energy. Solar cells, on the other hand, have an efficiency of 15%. Biofuels are not a viable solution to the energy problem. Steinberger pointed out that the technologies for replacing fossil fuels are already in existence, but they are expensive. These would require collaboration from the governments around the world which is not easy to achieve. For example, the carbon tax is not popular in Germany.

According to Rubbia, nuclear and solar energy can be the energy of the future. A 200 square kilometer capture region for energy from the sun is equivalent to 23 cm of oil for the same area. In order for the solar technology to be viable, we need to develop

proper storage. For example, the surface of the Saudi Arabian desert can supply more than 1000 times the fuel it stored. A nuclear reactor would pose several problems such as nuclear waste and the potential use as nuclear weapons. A thorium based reactor, on the other hand, cannot be turned into a nuclear weapon. One ton of thorium can generate the same amount of energy as 200 tons of uranium. Thorium also has a shorter life time and is as abundant as lead. The funding for energy research currently is very low and should be increased. Steinberger is skeptical about nuclear fusion. In 1955, Edward Teller, the father of the nuclear bomb, promised nuclear fusion energy in ten years. In general, the panel agreed that all segments of society should work together to solve the climate change problem – that would include scientists, politician, the public and industries.

In the afternoon, I attended the Lindau Council meeting with Academic Partners. The US leader presented their selection process for the young scientists. The advertisement was communicated to universities, laboratories and institutions that receive funding from the National Science Foundation and the Department of Energy. Only one applicant per university per funding agency is allowed.

The council also informed the leaders of the changes that will be made for the 2009 meeting. This includes the introduction of a panel discussion on the final day on Minau island. After the meeting, Prof Schurer congratulated the Academy of Sciences, Malaysia, for the excellent selection of young scientists for the Lindau meeting in 2007 and 2008.

2 July 2008 • The first lecture of the day was by Prof Riccardo Giacconi, who claimed that he is in the lower end of the Nobel

Prizes. He gave a talk entitled “The Impact of big science on astrophysics”. Everything we know about astrophysics is less than 100 years old. Large telescopes, considered as big science, have played an important role in astronomy. The use of X-ray satellites since 1962 has also contributed to astronomy. The advances in astronomy and related fields include the confirmation of dark matter and the motion of stars around the central black holes in the Milky Way.

Prof Smooth’s lecture, entitled “Relics of the Universe”, was full of vivid simulations. Of the lectures given in the meeting, I thought that the multimedia presentation in this lecture was among the best I’ve seen. He gave an overview of the COBE and WMAP data and also the upcoming PLANCK satellite that is due at the end of 2008 or early 2009. In 2003, the estimated age of the universe was 13.7 billion±20 million years and 73 % of the universe was believed made up of dark energy. However, in 2006 the estimated age is 13.8 billion years and 74 % of the universe is believed to be made up of dark energy.

In “Prospects of Particle Physics”, Prof Veltman began by giving a historical background on the subject. In 1836, Nicholas Callan began the study of particle physics. Early devices by Ruhmkorff were also discussed. Rontegen used a Ruhmkorff device in his discovery of the X-ray. Several other pioneers include Bacquerel, Rutherford, Cochrift-Walton, Van de Graff and Marietta Blan. Lawrence is credited with the first cyclotron of 80,000 eV in 1929. Today, the LHC will stand at 14 TeV. In the future, the Compact Linear Collider (CLIC) and the International Linear Collider (ILC) are planned.

Prof. Martinus J.G. Veltman, Nobel Prize Physics 1999, gave a lecture entitled ‘The Development of Particle Physics’. In this lecture, he described how the various forces, eg. strong interactions, the forces responsible for the interactions between quarks and notably supposedly responsible for quark confinement, profited from the development of gauge theories. He began with the most simple and basic experiments that discovered the basic constituents of matter, like proton, electron and neutron. These particles make up the structure of the atom, and are themselves made of more elementary particles such as quarks.

The talk by Prof. David Gross, Nobel Physics 2004, on ‘The Large Hadron Collider and the Super World’ is nice a continuation of the previous lecture by Prof. Veltman. Some of the profound questions about elementary particles and forces and the universe were described. As stated in the abstract: What gives mass to elementary particles? Do all the forces between particles arise from a single basic force? What is the dark matter that makes up one fourth of the universe and is critical to the formation of galaxies? One speculative theory that seeks to address some of these questions is called supersymmetry. It uses quantum variables to describe space and time and suggests that every known particle has a yet-undiscovered superpartner particle. These new particles may soon be discovered through the Large Hadron Collider.

The final lecture of the day was given by Prof. Dr. Jack Steinberger, Nobel Physics 1988, entitled ‘What Future for Energy and Climate’. The use of the planet's fossil fuel resources in a time which is very short compared to that of human evolution may change the planet's climate and sea level, threatening the future of large segments of the global population. In order to avoid future catastrophe, immediate, substantial and globally collaborative

changes in the behavior of our society are necessary and possible, but represent a formidable social challenge. The possibility of producing the dominant part of the global electric power consumption using thermal solar technology with overnight storage was also discussed.

During the evening, there was a Concert at the City Theatre by Musicians of the UBS Verbier Festival Orchestra. We enjoyed the performance very much.

July 3 2008 • There were six lectures for the day. It started with a lecture by Prof. Donald A. Glasier, who won the prize in 1960, entitled 'Role of Cortical Noise in Vision'. According to him, our brains are always generating electrical signals, even if we close our eyes, plug our ears, or lie in a warm bath. These signals are called cortical noise because they don't correlate with any sensation or thought of which we are aware.

Prof. Nicolaas Bloembergen, the 1981 winner of the Nobel Prize, gave the next lecture entitled 'From Millisecond to Attosecond Laser Pulses'. He presented an historical overview of the experimental development of ever shorter laser pulses from 1960 to the present. According to him, in the early sixties, nanosecond pulses were achieved and the entry into the picosecond domain was reached in the late sixties with the neodymium glass laser. The first sub-picosecond pulses were accomplished in 1974 with a broad gain dye-laser medium in combination with a saturable dye-absorber film. A true revolution in femtosecond generation occurred with a titanium-aluminium oxide laser crystal. Non-linear effects are essential not only in the generation of picosecond and femtosecond pulses, but also in their measurement and evaluation.

In 'The Individuality of Light Quanta', Prof. Roy J. Glauber, the Nobel Prize winner in 2005, discussed light as the fundamental unit of radiant energy. The experimental techniques for generating individual light quanta in controllable states to investigate their properties were also explained.

"How Advances in Science are Made" was the title of Prof. Douglas D. Osheroff's talk. He won the Nobel Prize in 1996. He told the audience that the discoveries that most influence the way we think about nature seldom can be anticipated, and frequently the applications for new technologies developed to probe a specific characteristic of nature are unclear, even to the inventors of these technologies.

Prof. Brian D. Josephson, Nobel Physics 1973, presented 'Which Way for Physics' on a new approach to the problem of characterizing physical reality, one with the potential to fill in gaps in the conventional understanding of nature. It is based on a different view from the usual one of well-defined structure even at the finest levels. In his view, structure is taken to be highly irregular, as in systems at the 'edge of chaos', but with self-organization leading to the emergence of more regular behavior at higher levels, including those familiar in today's science. In this picture, the basic processes involve collections of agents cooperating to create, and survive in, a 'life world', which can be viewed as a biological equivalent to the kinds of cooperative processes familiar in the context of physics. He ended the talk by mentioning that while we are asking which way physics should develop, it must also be asked which way mankind should go.

Prof. Dr. Gerardus 't Hooft, Nobel Physics 1999, gave a talk on 'Humanity in the Cosmos' as a reflection on the role of

humanity in the universe. In the recent past, rapid scientific and technological developments have had tremendous impact on human society. Nature's laws are very strict and forbidding but also show gaps that might promise fantastic possibilities for a scientific future, even within our lifetime. Humanity will be able to conquer the cosmos, but how?

Later in the evening we were invited by the Elite Network of Bavaria to attend the traditional Bavarian Get-together. This get-together dinner provides the young researchers an opportunity to relax, communicate with more friends, and get a taste of traditional Bavarian culture while enjoying Bavarians' most traditional foods and drinks.

After the welcome address by Dr. Thomas Goppel, Minister of State of Bavaria for Science, Research and the Arts, the young researchers are presented with traditional Bavarian dance; all of them were amazed by the beautiful display. The young scientists enjoyed the traditional Bavarian buffet. Besides the delicious Bavarian food, the famous Bavarian beer was also served.

4 July 2008 • The last day of the Lindau Meeting we were taken the Isle of Mainau on a boat trip. Mainau is an island in Lake Constance - a garden island with beautiful flowers.

The young researchers have the opportunity to mingle with the Laureates during the 3 hour trip. Upon arrival at the Isle of Mainau, a Member of the Bernadotte family welcomed us, and all were taken to visit the garden. The lunch was at the Mainau Castle. In the late afternoon, the meeting was officially closed. Countess Bettina thanked everyone for making the Meeting a success. This was followed by a speech from Gunther H. Oettinger, the State

Premier of Baden-Wurtemberg and by a speech of thanks by one of the young scientists expressing gratitude to the organizer.

5 July 2008 • At 4:00 am I was awake, and at 4:35 am I was already standing by the hotel entrance in anticipation of our MPV driver, scheduled to pick me up at 4:45. The silence of early dawn was broken by the sound of his MPV as he weaved through the narrow streets. I could see that he was pleased to find me already there by the time he arrived at 4:40 am. Actually, I was quite determined to be there before he arrives. We went to pick up Iong Ying, Khai Ming and Azwani. All were punctual, to the mutual delight of everyone!

At the Friedrichshafen airport, we met several of the Lindau participants from other countries on the same flight to Frankfurt. A freelance journalist Waleed Al-Shobakky from Egypt covering the conference was also on the plane. I asked him what he would write about the conference. He said he would write about Prof. Ivar Gaiever because of his interesting personality. I couldn't agree more.

From Frankfurt, we connected to Zurich-an hour long flight. The Ramada hotel where we stayed while in Zurich is 10 minutes from the airport. Ms. Nitia from the Academy joined us in Zurich.

The European Centre for Nuclear Research (CERN) is located near the border of Switzerland and France. We took the opportunity to visit the Microcosm and the Globe. The Globe is an emblem for CERN, an outreach tool and a symbol for sustainable development. The Globe is a symbol for planet earth. The BIG SCIENCE- LHC in pictures showed wonderful panorama of the machine and experiments at LHC. The Globe is supposed to look

spectacular at night. The Microcosm is a hands-on exhibition on particle physics. We discovered cosmic rays, antiproton, quarks and gluons at the Microcosm.

6 July 2008 • We started the morning off with a discussion of the visit thus far and also on the format of the report to be submitted. We visited downtown Geneva later in the day. It was raining quite a bit, and most businesses were closed. The public transport system in Geneva is excellent, as in most European cities. We walked through the old part of Geneva and several parts outside of Geneva. I traced streets of Geneva that I took a decade ago while attending a conference.

7 July 2008 • We stepped into building 500 around 1:30 pm. A parking space had been made available for us in front of the building. The activities inside building 500 remind me of a university center. It included a convenience store, banks and a cafeteria. Many ads were posted on the information board, typical of a university campus.

Three scientists from CERN welcome us, including Dr Emmanuel Tsismelis, advisor for non-member states, and Dr John Ellis, advisor to the director general. Dr Ellis was known for coining the phrase “Theory of Everything” in an article in *Nature* in 1986. CERN was setup in 1954. According to Dr Ellis, it has four primary objectives: scientific research and discovery, technology innovation, advanced training and international collaboration.

The Large Hadrons Collider (LHC) is a 3 billion euro facility run with multinational collaboration. At 27 km in radius and set 100 m below the ground in parts of both Switzerland and France,

the LHC is the largest experimental set up in the world. It was conceived back in the mid 1980's. After more than 20 years in the making, it was turned on in the fall of 2008.

LHC makes use of the LEP (Large Electron-Positron) collider tunnel that was built in the 1980's and dismantled in 2000. The LHC accelerates protons or ions, thus the name hadrons. Hadrons are particles that are composed of quarks. Hadrons come from the Greek word “adros” meaning “bulky”. Leptons (Greek for “thin”), on the other hand, are particles that are not made of quarks. Examples of leptons are electrons and muons. OK, enough of these “ons”.

So what are we going to gain from this marvel? For one thing it is not intended to make any money. So what are 8000 smart people at CERN getting their heads cracking for? You see, we don't really understand the universe we live in.

The Standard Model of particles and forces tells us about our understanding of our universe. It works well, but there are many unanswered questions. See, the more you know, the more questions you have. The LHC will try to help answer some of these questions. For one thing, the Standard Model does not explain the origin of mass, why some particles are heavy and why some does have mass at all.

The Higg's field may be the answer. The whole of space is filled with the Higg's field and by interacting with this field, particles acquire their masses. Particles that interact intensely with this field are heavy, but those with minute interaction are light. However, there is no chance that you will lose weight by not interacting with this “Higgs” guy. Don't try it at home. It will not

work. For one thing we have not detected the Higg's field yet. So when the LHC is turned on, we hope to find this "Higgs".

The Standard Model does not give a unified description of the four fundamental forces: gravitational, weak, electromagnetic and strong force. It remains difficult to come up with a theory of gravity similar to other forces. Supersymmetry, which hypothesizes the existence of more massive partners of the standard particles known today, could help us unify the four forces. The LHC can detect the lightest supersymmetric particles if supersymmetry is correct.

All the mass visible to us accounts for only 4 % of the universe. So where is the rest hiding? The search is open for particles known as dark matter and dark energy, which make up 23 % and 73 % of the universe, respectively. Dark matter is probably made up of neutral supersymmetric particles yet to be discovered. Dark energy – which will not power your SUV in the next few years to come – is a form of energy that is associated with the vacuum. It is responsible for the expansion of the universe.

The LHC will help us understand antimatter. During the creation of the universe, matter and antimatter must have been produced simultaneously. However, so far we observe only matter, and the LHC may give us the answer why.

The beam of particles will circulate for 10 hours, covering 10 billion kilometers near the speed of light. If you think that there are many road collisions in KL, think again. The LHC will generate up to 600 million particles collisions per second. The only difference is that the LHC collisions will help us in understanding nature while the KL collision will not.

For each collision, the track and characteristics of all the different particles produced will be tracked. In order to track these particles, we need detectors. CERN has a handful of these detectors ready – six of them. A Large Ion Collider Experiment (ALICE), ATLAS, the Compact Muon Solenoid (CMS), the LHC beauty (LHCb), LHC forward (LHCf) and TOTal Elastic and diffraction cross section Measurement (TOTEM).

Next, we are off to the CMS detector. To do that, we need to cross over from the Swiss side of CERN to the French side. No passport needed, for humans as well as for particles. We crossed what seems to be a busy country road. Dr G. Tonelli was already at the entrance when we got there. The place was quite busy with visitors that afternoon. We put on the hard hats and went down the 100 m shaft to the CMS underground area.

The CMS detector looks like something not of this earth. Its enormous size with intricate details looks like something from an alien technology. But it is not. It is an assembly of instruments that were brought together by many scientists from various countries. As pointed out by Dr Tsesmelis, the detector looks very complicated but the basic principle is simple. It can be sketched on the back of an envelope. The CMS detector is 21 m long, 15 m in diameter and weighs 12,500 tons. The detector consists of various materials including crystal of lead tungstate, quartz fibers and silicon sensors. To guide the particle beam, a coil of niobium-titanium superconductor is cooled to -270 °C producing magnetic field of 4 tesla. At the CMS, protons and heavy ions collided at unprecedented energies. The conditions produced are similar to those existing a fraction of a billionth of a second after the Big Bang. CMS will look for new particles such as the Higgs boson, mini black

holes and gravitons. It will also help us to investigate if there are more dimensions of space, dark matter and in the nature of the early universe. Two hundred scientists including 450 students from 37 countries collaborated to construct the CMS detector.

Dr Ian Bird, leader of the LHC computing grid project explained to us the Grid Project. The project aims to integrate thousands of computers worldwide to store and analyze enormous amounts of data collected by the LHC. The motivation for the Grid was the demand for collaborative work in various fields of science and engineering.

8th July 2008 • From Geneva we flew to Munich then to Munster. Although the connecting time is only 45 minutes, we managed to make the connection. It takes about forty minutes to travel from the airport to the Ibis Hotel in Munster. The receptionist was very helpful and friendly. One thing I like in Ibis is the free internet access for guests.

I found the buildings at Munster homogeneously dark brown. The streets were not busy. We reached CeNTech GmbH at 12.30 pm and our appointment was at 2.00 pm. We grabbed a quick lunch at a nearby stop.

GmbH is similar to Sdn. Bhd in Malaysia. CeNTech promotes the formation of start up companies in the nanotechnology sector. It was formed by University of Munster, the 3rd largest university in Germany, in collaboration with the private sector. The 2,400 square meter building opened its doors in 2003. Vibration-free foundations, clean room facilities and unique equipment provide an ideal environment for research. It provides support for entrepreneurs to further develop their research ideas in

nanotechnology into marketable products. I guess this is the commercial part of our visit. It is quite interesting to see how companies in Germany started small and later became big players such as Siemens, Bosch and the like. Nanotechnology promises great commercial potential, and the nurturing of small startup companies may pay handsomely in the future.

Dr Wolfgang Buscher, the Chief Scientific Officer, was there to welcome us and gave an overview of CeNTech. It provides support primarily in Nanobiotechnology and related fields and consultancy on patents. Royalties from patents are divided equally among the three parties: the inventor, university and CeNTech.

A tour of the research facilities provided us with a picture of how start up companies conduct their research. It is very focused. Currently, CeNTech has 90 employees with 9 working groups and 7 R&D Companies.

9 July 2008 • We left the hotel in Munster for Stuttgart early in the morning. The 30 minute flight delay did not bother us at all. The small all-white airplane with two fans was spanking clean outside as well as inside. It was not as noisy as I initially expected. On arrival, we checked into our rooms at Astoria Hotel, located downtown Stuttgart. The hotel lift was quite funny, stopping half way between floors as struggled to carry our increasingly heavy luggage up to our rooms.

We were out on the hotel lobby in a zip to get going to Max Planck Institute for Solid State and Advanced Materials. Dr Han-Georg Libuda was waiting for us at the entrance when we arrived at 12.10 pm that afternoon. We were happy to see him. He explained to us that the sign “Klitzing Lane” posted on the pathway was not

approved by the city. It was put up by the staff without permission, as it will not be easy to get approval from the authority for that kind of thing. That is how much the people at the institute revered the man.

Established in 2001, the Max Planck Research School for Advanced Materials is an international graduate school with a PhD program in cooperation with University of Stuttgart. Research areas include physics, chemistry and materials science.

Dr Libuda took us for lunch at the cafeteria. The lunch set was generous and Nitia could not believe that we finished up everything. Actually, I was quite hungry by that time as I had taken only a light breakfast in the early morning hour earlier in Munster.

There was a short shower followed by sunny skies. We then strolled into the green and around the small MPI campus. The nicely kept garden includes a small pond. A new building was planned on a plot and some soil works were underway. I can see that it bothers Dr Libuda somewhat.

We hurried up into the building for a presentation on PhD opportunities at the institute. It was a very informative slide presentation. Dr Libuda noticed that we were busily taking notes, at which he promised to send the power point file to Nitia later. He did. The success rate for PhD application to the institute is between three to five percent. He stressed the importance of reference letters and performance during the interview process. Apparently, short listed candidate were invited to Stuttgart for interviews.

Dr Welzel then took his turn to present his work on phase transformation and kinetics. Three X-ray machines were on hand,

and one of them is a modified version to look into phase transformation with 30 times the intensity of commercially available machines. Dr Jeurgens explained to us some of his work on phase transitions.

We took a peek at the helium liquefier facility. I saw, for the first time, the inner part of the liquid helium Dewar, containing several layers of insulation. I have been using these helium Dewar's for the last 25 years, but never got to see the inside of them before.

The electron microscopes at the institutes come in different sizes. Dr. Van Aken showed us the different types of microscopes. Some are two floors high, and they can do marvelous things according to Dr. Aken.

During the earlier Lindau Meeting, Prof Klitzing gave a lecture on Carbon Electronics. Our next stop is the graphene lab. It is basically electronics with your pencil. A layer of carbon atoms provides the raw material for future electronics.

An enlarged version of Professor Klitzing's lab book containing the famous constant that won him the Nobel Prize hangs proudly on the wall. We took several photos by it before heading for coffee, as the visit was about to end. The bus was already waiting outside as we walked to the meeting point at 5.20 am. We wished Dr Libuda goodbye, and we were glad that we came.

The bus took half an hour to reach downtown Stuttgart. Having spent most of my overseas time in the US, I can't help but notice how narrow the streets in Europe are. We took a little tour of downtown Stuttgart, but most stores were closed by 8:00 in the evening.

10 July 2008 • We left the hotel before 7:00 in the morning for the Stuttgart airport. The flight to Zurich, initially scheduled at 8:15 pm, was delayed until 8:45 pm. “Selamat datang, apa khabar” said the Swiss immigration officer on arrival at the Zurich airport terminal. To which I stumbled and later replied “Baik, Good” or something like that. A pleasant surprise as he politely returned my passport. He must have been one of the most polite immigration officers I have ever met.

Our MPV driver introduced himself at the luggage carousel. I am very impressed with how seriously he took his job, making sure that he gives the best service to his customers. The hotel where we stayed is located smack dab in downtown Zurich, adjacent to Bahnhofdtrasse. A happening place indeed.

After taking care of our accommodations, we left for the Swiss Federal Institute of Technology (ETH), Hoggenberg campus, a 40 minute drive from downtown Zurich.

No less than 21 Nobel Prize winners are associated with the ETH, Zurich. This includes Rontgen and Einstein. Three hundred and fifty professors and 4000 scientific staff in 16 departments altogether make up the two main campuses. ETH celebrates its 150th anniversary in 2005.

We arrived at Hoggenberg campus at 10:15 am. The scheduled meeting with our host was at 11:45 am. With a lot of time on our hands, we snapped some photos of the campus. We also saw a lecture was going on through the all glass chemistry building. The students waved at us while the instructor was busily writing on the board. No PowerPoint, huh! We sighed. Of course they could not hear us. Substance is more important than the technology of delivery. Back home, however, instructors may get in

some trouble if lectures are not given using this thing called PowerPoint.

Most books in the bookstore were not in English. So, I just admired their impressive covers and tried to decipher the meaning of their titles.

There was a bit of confusion among us about the meeting point. After some scrambling, we managed to find our hosts, standing right in front of the information stop where we were supposed to meet. We were greeted by Profs. Degiorgi and Blatter, Head of the Physics Department at 11:50 am. After explaining the model of the campus at the information stop, we went straight to the cafeteria where we were joined by Professor Batlogg. I am honored that the three Professors are making their time available to the three young scientists. They made a heck of an impression on these youngsters. On top of that, they gave some advice on places to visit in Zurich and where to get the best chocolate in town.

I look forward to this meeting with Professor Batlogg for several reasons. I was interested to know how the newly discovered iron containing superconductors are prepared and most of all if arsenic, an important ingredient, posed a problem. “Not at all” said Batlogg.

Several years back I was writing a book on superconductivity and wrote to Batlogg for permission to use his phase diagram which appeared in *Physics World*. I am glad that I got the opportunity to give him a copy during this visit.

We took a group photo as we walked to the Physics department. The building looks new, and I was surprised when was told that it is forty years old. It is well maintained. Soon it will be renovated.

The first stop was Batlogg's materials lab. We made ourselves comfortable, put our bags down and sat around a table. Professor Batlogg removed his jacket and rolled up his sleeves. This looked like it was going to be a serious business. He explained the basic research topics undertaken in his lab and the facilities available. One of them was the high pressure synthesis of materials. The young scientists were quizzed on the computation of force, area and pressure. The other preparation facility is where the crystals are free to form at temperatures of their choice. Thin film facilities were also available with in situ measurements.

Professor Bertram Baltogg was previously at Bell Labs in the USA. Since 2000, he has been a full professor at ETH. He works on materials-based physics: topics including high temperature superconductivity, quantum magnets and such. More recently his interest is in molecular crystals and inorganic semiconductors.

Batlogg got everyone excited about science and the importance of doing research in the right way. I am very pleased when he showed his neat log book to the young scientists, with graphs from computer printout glued on the pages. Most students these days do not appreciate the log book. I am reminded of the YBCO superconductor patent that Batlogg and colleagues won while he was at Bell Lab. He explained that all the evidences that lead to the discovery of the YBCO were recorded in a log book and can be counter checked with his collaborator in the same lab. The other party has none to show.

Before moving on to the next lab, I requested some recent papers from Prof Batlogg, and he showed me several papers that he intended to pass to me before I leave ETH that afternoon. I didn't

get to see him before we left. The papers showed up in my mail a week later, to my delight.

At a corner, a Quantum Design magnetometer showed a beautiful magnetic transition on the computer screen. In physics language, this is called the lambda transition. I am not sure if I have seen a better phase transition in a lab than that one.

Counting electrons one by one. That's in the lab of Professor Ihn. He explained the physics of quantum dots and how to fabricate one. In his quantum dot, the number of electrons that passed through can be controlled. We visited the preparation and characterization lab. The quantum hall effect was among the measurements. Currently the group is focusing on the control and manipulation of quantum states in quantum dots with possible application for quantum information.

We then went to Professor Esslinger's lab for fermionic condensation; in this case, potassium atoms are put into lattice at ultralow temperature. Really low, nanokelvin low. In general, the distance between lattice sites is about 0.0000005 m or in the nano term, 500 nm. We put on our safety glasses when the laser system was turned on and could see the two spots that were separated from a larger condensate.

Professor Esslinger has been a full Professor at the physics department ETH since 2001. He received his PhD from the University of Munich on subrecoil laser cooling. At ETH, Esslinger works on new generation experiments on bosonic and fermionic condensation with the aim of quantum simulation and quantum computer. Quantum computer, hmm. Well, for now, I am quite happy with my iMac.

Ultrafast diode-pumped lasers are the next stop. Dr Sudmeyer introduced us to Professor Ursula Keller's lab. The group pioneered the picosecond and femtosecond diode-pumped solid state laser. You can be quite lost in a lab with such a maze of elaborate equipment.

Dr. Beck and Dr. Giacomo led us to Prof. Faist lab on mesoscopic system. Controlling the band gap of semiconductors is one of the aims. The present work of the laboratory is dedicated to the study of structures like the quantum cascade laser. One of the most exciting experiments will be conducted on the planet Mars in a couple of years.

We left ETH at 4:30 pm as scheduled. We had a bit of time on our hands when we reached our hotel. So I walked along Bahnhofstrasse to the lake which took about 20 minutes. The street is bustling with people after office hours: all sorts of establishments from McDonalds to Louis Vuitton and people of different hues.

11 July 2008 • *It* has been 12 days on the road. Our trip is about to come to an end. As much as I enjoyed the trip, I must say that I miss home by now. The morning traffic was very light. We reached the Zurich airport in less than 30 minutes. We did last minute shopping to get rid of whatever Euros and Swiss Francs we had left.

The flight was delayed, and this time it got us worried as we only had less than two hours buffer to our connecting flight at Frankfurt to KL. After spending more than 45 minutes inside the stalled plane, it slowly moved and finally got off the ground, much to my relief.

At the Frankfurt airport, we wished Nitia a quick goodbye. She stayed on another night at Frankfurt. We hurriedly jumped on

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the sky line to the terminal for our connecting flight. The security wasn't that bad that morning. We made it to the gate with several minutes to spare.

I brought my laptop along to catch up with my writings during the long flight back. But tiredness soon overpowered me. I flipped through a few pages of my notes and soon fell asleep. After countless interruptions of my naps, the plane touched down at KLIA at 6.25 am as scheduled on 12th July 2008.

The humidity gets to me as I step out of the plane. It is good to be home!

