穿梭於粒子加速器的時空

2007年Robert R. Wilson獎得主鄧昌黎博士的知性時間

所謂：「時代考驗青年，青年創造時代」。粒子加速器的發展歷程正是青年創造時代的最佳例子。1930年，由Ernest Lawrence 開啟粒子迴旋加速器的新領域後，許多優秀的物理學家皆見證了這領域的快速進展。

此新研究領域中有位特別優秀的成員—鄧昌黎博士。美國物理學會於2007年頒發最高榮譽Robert R. Wilson獎予鄧博士，表彰他在近代加速器粒子物理方面的突出成就。過去六十年，鄧博士不僅置身於粒子加速器令人興奮的波濤起伏中，並且以他的聰明智慧、熱情和奉獻創造了新一波的震盪。鄧博士說：「我很幸運能在這個時代參與粒子加速器的發展，因為此刻粒子加速器正有卓越的演進。自1930年起，我們體驗到大約每五年左右粒子加速器便有顯著的突破，這是個巨大且快速成長的轉變，我很高興能親身貢獻於這發展階段中的每項工作。」。（更多鄧昌黎博士的報導請看CERN Courier Magazine （November 2007）的"Faces and Places" 單元）

鄧博士因他的智慧與經驗也成為本中心推動台灣光子源（Taiwan Photon Source, TPS）興建計畫的重要導師之一。以下摘錄了訪問鄧博士有關「3-GeV台灣光子源」、「企業投資的用戶光束線」、「加速器諮詢委員會」、「高能物理」的談話內容：

關於「3-GeV台灣光子源」

1980年初期，台灣的同步輻射研究中心研發團隊首次嘗試興建一座15億電子伏特的同步加速器。當時，光源用戶群尚未形成，無法提供台灣同步輻射研究方向的建議，因此研發團隊面對的不僅是興建加速器的挑戰，另一方面同時須培育台灣光源的用戶群。今天，當大家群聚討論3-GeV新光源的設計，我們已擁有經驗豐富的研究團隊和日漸增加的用戶群，如何決定這座新光源的功能和研究領域變成首要課題，用戶群的需求和實驗計畫將主導整個興建計畫，所有必須考慮的條件已清楚可見。實驗站新進的計畫和設備也將提升新一代光源的價值。以用戶需求為出發點所設計的中能量、硬X光之同步輻射光源，對生物和材料科學領域的研究將是一重大助益。

關於「企業投資的用戶光束線」

世界上不同的同步輻射機構依其機器設施性質採取不同的管理方式。在某些情況，企業投資及管理的光束線與國家實驗室中心管理的光束線相較之下，企業主管光束線的使用效率一般較低。面對日漸增加的用戶需求和光束線時間的供不應求，許多同步輻射機構開始採行將企業資助的光束線納入集中管理的策略，以達到物盡其用、高使用率的成效。

關於「加速器諮詢委員會」

在設計和建造新一代同步輻射加速器的同時，其中一項關鍵因素就是須將現有的技術和已有同步輻射設備的建造和運轉經驗列入考慮。台灣光子源加速器諮詢委員會（Machine Advisory Committee, MAC）的設置，不僅讓TPS的設計更有效率，並聚集世界各地加速器專家討論重要的決策。透過數天的會議，從各種角度審閱討論每位專家所提供的建議。加速器諮詢委員會是個很有成效的組織，對於計畫中的未來新光源有很關鍵性的影響。

關於「高能物理」

近年，高能物理新領域的研究已發展成需要龐大空間和高成本的機器設備，例如由多個國家合作建造的國際直線對撞機（International Linear Collider, ILC）計畫，但非所有的國家都能投入如此的資源和人力。位於歐洲核子研究中心CERN正在興建的大型強子對撞機（Large Hadron Collider, LHC）將於明年完成啟用，以提供高能物理界科學研究的另一個嶄新機會。

整理 李宛萍

人物特寫

於1983年籌劃本中心的第一天開始，鄧昌黎博士便擔任指導委員，投入規劃的行列，並向費米實驗室請休2年擔任首任主任，與本中心第一批全心投入台灣第一座同步輻射光源建造的同仁，於台灣近代物理發展過程留下可貴的貢獻。鄧博士2005年2月自美國阿岡國家實驗研究中心及費米實驗室榮譽退休，現為本中心董事之一。

A Few Moments in the Fast Lane of Particle Accelerators

A Conversation with Dr. Lee Teng, Recipient of the 2007 Robert R. Wilson Prize

It may be true that "every man is a product of his time" but some men also shape the times in which they live. In the world of particle accelerators, this is indeed the case for the brilliant physicists who not only witnessed the rapid growth of this important field but also helped bring it about soon after Ernest Lawrence introduced cyclotrons in the 1930s.

A distinguished member of this group is Dr. Lee Teng, the recipient of the 2007 Robert R. Wilson Prize. For the past 60 years Dr. Teng has not only been riding the exciting waves of progress in particle accelerators, but has helped create these waves with his ingenious inventions, driven by his passion and dedication.. "*I am very blessed to have been involved with particle accelerators at this time, because the field made great progress and I was able to contribute to all phases of the advancement,*" says Teng. "*Since the 1930s, there have been significant breakthroughs in particle accelerators every five years or so and we have experienced rapid progress with tremendous momentum*" he said. (For more about Dr. Lee Teng's career, see CERN COURIER magazine, Novermber 2007, "Faces and Places").

Dr Teng's intelligence and experience will be a great resource for the design of the new Taiwan Photon Source (TPS) currently under planning at the National Synchrotron Radiation Research Center (NSRRC). The following are excerpts from a conversation at NSRRC with Dr. Teng.

On the 3-GeV light source

In early 1980s, the NSRRC team undertook the challenge of building a 1.5GeV synchrotron accelerator as a first-time experience in undertaking such a project. At that time, there was no user group to suggest the possible direction of synchrotron-based research in Taiwan. The challenge of the project then was to build a user group concurrently.

Today, when the blueprint for a 3-GeV light source is presented for discussion, the needs are much clearer. With a mature research community and increasing number of user groups, defining the functions and capabilities of a light source becomes an important issue. The demands and specifications from users eventually drive the project. Additional weight is placed on the add-on experimental stations in evaluating the performance of a light source.

The creative design of instruments based on a better understanding of user requirements today allows us to build a better accelerator with median-level energy to produce hard X-rays. The application of this to suitable research in the biological and material areas will prove to be very effective.

On Funded User Beamlines

Different management approaches for beamlines have been adopted by different light sources, mainly due to the nature of the funding mechanisms involved. In some cases, beamlines funded and managed by industrial enterprises have not been as fully used compared to those run by national light source facilities. To deal with increasing user demands, and the possible shortage of beam-time, many facilities have started to adopt a centralized management strategy in order to improve the efficiency of utilization of their resources.

On the Machine Advisory Committee

One of the critical elements in designing and building a synchrotron radiation accelerator is taking into account the existing technology and the lessons from previous experiences. The creation of a Machine Advisory Committee (MAC) to serve the needs of validating TPS design and counseling in making choices is a good decision. Within days, suggestions from the key members of a dozen light sources worldwide can be viewed and discussed from various angles. It is a very effective management approach and critical to the planning of a new advanced light source.

On High Energy Physics (HEP)

The frontiers of research in HEP have now produced facilities and equipment that have enormous size and cost, such as the International Linear Collider (ILC), which requires collaboration among multi-nations. Not all countries have the investment resources and manpower to afford an adventure into this area. Meanwhile, the construction of the Large Hadron Collider at CERN has been carried out in recent years and has opened up another avenue for scientific research and production runs.

by Diana Lin