Introduction

The “Future Light Sources” workshops have a special significance to me because, on several occasions, they focused attention on concepts and proposals that would subsequently set the direction of my own endeavors in realizing new capabilities for x-ray light sources.

I count the 1992 “Fourth Generation Light Sources” workshop, held at SLAC, to be the first such event, even though it was not sponsored by ICFA. At this workshop, Claudio Pellegrini proposed that the SLAC linac (actually the last kilometer of the 3 km linac) which would not be necessary for injection to the PEP-II B Factory) be converted to an x-ray free-electron laser. Use of the SLAC linac took away a significant deterrent (the cost of building a high-energy linac) to serious planning of a “hard” x-ray FEL. Eleven years later, I moved to SLAC to work on the Linac Coherent Light Source, which has just had its first run for scientific experiments.

At the same workshop, David Moncton made a presentation on top-up operation of storage rings. This presentation did not get into the proceedings, and his proposal did not get a lot of encouragement; light source experimenters feared that the tiny stepwise changes in stored current would complicate data analysis. Moncton asserted the opposite; if the stored current could be held constant to a part per thousand or so, current-dependent systematic effects such as optics distortions would be eliminated and more subtle features could be extracted from the data. Top-up appealed to me because I anticipated that light source storage ring designs could be pushed to higher brightness if shorter lifetimes were not a problem. Moncton’s proposal was not the first time top-up operation had been suggested. Vic Suller suggested top-up operation of the NSLS VUV ring back in 1984.

I missed attending the 1996 FLS workshop at ESRF; however this one was also pivotal for me. The LCLS proposal was taking shape at SLAC with the guidance of Herman Winick and Max Cornacchia, but the community of US light source users was not yet sold on the idea. The TESLA FEL concept was presented at FLS1996. It had a profound impact on US x-ray researchers in attendance. After this workshop, APS embarked on free-electron laser research that culminated in the successful lasing of the Low Energy Undulator Test Line (LEUTL) at 532 nm in October 2000. LEUTL went on to lase at 120 nm before its undulators were installed the APS Storage Ring.

As x-ray FELs gained attention at FLS 1996, it seemed that the performance limits of storage ring sources were within sight; Jean-Louis Laclare gave a summary report of FLS 1996 at the 1999 Future Light Sources Workshop (Chaired by Kwang-je Kim, and held at Argonne National Lab). He reported that the workshop participants believed intrabeam scattering and the deleterious effects of chromatic correction sextupoles would limit the brightness of future storage ring sources to 10^{22}. But the 1999 FLS Storage Ring working group, led by Marie-Emmanuelle Couprie, speculated that brightness approaching 10^{24} could be achieved in rings of circumference 2 km or more. The “ultimate storage ring” concept has gotten more attention since then, and FLS 2010 provided clear evidence that storage ring light sources have considerable potential for the future.

Energy Recovery Linacs did not figure heavily in the FLS 1999 proceedings, though energy recovery with microtrons was proposed. ERLs have attracted widespread interest since then; FLS working groups were devoted to the concept in 2006 and 2010.

What will I remember about FLS2010? I will certainly remember the exciting and thorough summary of the “Scientific Needs” working group. Barty and Bergmann have put together as clear a picture as one can hope to have of the range of source properties that can enable new science. I will also remember the excitement of the “Novel Source Concepts” group, with its emphasis on compact storage rings and compact linacs producing x-rays and gamma rays by inverse Compton scattering. Advanced high-gradient acceleration schemes employing lasers or plasmas created by electron beams have made impressive progress, paced by the development of petawatt lasers.

In the area of storage rings, I was especially impressed with the recent results in optimizing dynamic aperture by multi-objective genetic search algorithms. The success of new optimizing techniques will have dramatic impact on the versatility of “ultimate rings”.

I am sure I will remember the diversity of designs and considerable progress in development of high-brightness electron sources. There are so many good ideas to try out!

Finally I will remember the gathering of 221 Workshop participants here at SLAC. We are lucky to be part of such a vibrant community, with lots of important and exciting research in its future.

I am grateful to John Corlett and Tor Raubenheimer for assembling this exciting program, to the Program Committee for recruiting our conveners and speakers, and to the Local Organizing Committee for doing such a great job on the logistics of the workshop.

Finally I would like to thank SLAC Director Persis Drell for her enthusiastic support of the workshop.