Global Trends for DLSR and XFEL

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When SASE XFELs were first conceived of decades ago, they faced stiff opposition from scientists favoring liniac-based straight light sources which offered a greater number of beamlines. Light sources based on Energy Recovery Linac (ERL) technology capable of accommodating multiple beamlines were proposed as an alternative, partly because of the misconception that conventional storage ring technology had already reached its limits.

However, various new concepts have recently enabled the design of high performance light sources based on storage ring technology, which in most cases have exceeded the light source performance attainable using ERL technology. Inspired by the innovative design of the MAX-IV facility in Sweden, many major light sources including ESRF, SPring-8 and APS began making upgrade plans based on storage rings with <100 pm.rad emittance. In addition, ambitious new light source projects based on this next-generation storage ring technology are underway. Since these storage rings have emittance close to the diffraction limits of hard X-rays, they are often referred to as Diffraction Limited Storage Rings (DLSRs). The new concepts, when applied to larger scale storage rings as PEP, and possibly PETRA and TRISTAN, will provide new capabilities for ring-type soft-X-ray FELs.

X-ray free electron lasers (XFELs) based on self-amplified spontaneous emission (SASE) offer several advantages. Following the two existing operational facilities, LCLS and SACLA, the Euro-XFEL will come on line in 2015. The Swiss XFEL and Pohang XFEL will follow thereafter. There are opposing trends for future XFELs: compact or huge multi-user. Both types address the continued increasing demands of users wanting access to XFELs. Given typical constraints for new development, it is generally more feasible to build multiple compact XFELs, since they require less space, lower construction costs, and much shorter construction periods. On the contrary, though XFELs based on superconducting linac technology can support many FEL lines with a single linac with a very high repetition rate, they require a enormous amounts of space, budget, and time for construction.

Co-location of XFEL and SR facilities, exemplified by SACLA and SPring-8, can serve as a model for future light source facilities. The processing of the huge amounts of data produced by these facilities will be critical in the near future. Standardization of data formats and/or processing software, preferably based on inter-facility collaboration, would facilitate data sharing and analysis.