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REVIEW OF INJECTION SYSTEMS FOR 4TH GENERATION STORAGE RINGS

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Injection systems for the next generation of storage rings are reviewed. With the reduction of the emittance of these rings the transverse acceptance shrinks and injecting and accumulating charge is becoming more and more challenging. The traditional off-axis injection will not work in the most ambitious cases (ALS-U, APS-U, Petra IV or HEPS) and on-axis swap-out injection is planned to be used either by dumping the spent beam (APS-U) or by re-using the beam with the help of "accumulator" rings. There are many challenges involved in the design of theses facilities and this type of injection scheme will not be covered in the talk because this subject deserves a dedicated and more specific review. On the other hand, there have been a couple of technical and theoretical improvements that will allow for on-axis or off-axis injection in the longitudinal or transverse planes in the future, despite the smaller acceptance of the rings. The focus of this review is rather on these improvements and the approaches taken at a few facilities to use these more conventional injection systems for 4th generation storage rings.

Injection systems for future diffraction limited light sources have to facilitate transparent top-up operation, which means beam is injected without perturbing the photon beams and thus transparent to the users. In this respect injecting with a single non-linear kicker (NLK), also called multipole injection kicker (MIK), is a very promising approach and already an established, conventional technique and in successful operation at MAXIV and Sirius, the two first 4th generation storage ring based light sources in the world. First results of quite transparent injections at MAXIV are very encouraging. Thus injection systems based on single injection kickers will be covered in more detail. The worldwide third 4th generation light source, the ESRF-EBS ring, went into routine operation with a conventional 4 kicker bump injection scheme. This injection scheme and variants, with 2 kicker pi-pulse bumps (Spring8-II) or a single kicker for acceptance sharing (SLS-2), will be presented in more detail. A certain flexibility of the injection system is very desirable in order to cope with future aperture challenges. The approach taken at SLS-2 serves as a good example of this.

In summary, technical innovations like better injectors in combination with state of the art (fast) kicker and septum designs have allowed us to inject into rings with rather small apertures. This goes hand in hand with improved theoretical understanding of how to enlarge the dynamic apertures of the storage rings. This fuels the hope, that in the future swap-out injections can be replaced by on-axis injection in the longitudinal plane.