R&D at SLAC on Nanosecond Range Multi MW Systems for Advanced FEL Facilities

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Abstract

A nanosecond range, multi MW system containing TEM mode electrodynamic structures fed by controllable pulsers are needed for (1) fast injection systems in multi-bend achromat upgraded (MBA-U) storage rings and for (2) array of FEL beamlines powered by a superconducting linear accelerators operating with close MHz bunch repetition rate. There are also two bunch mode scenarios in (2) (for example in the present LCLS-1 layout) where the system would benefit certain X-ray users also. The CW RF kicker system in the beam switch yard is a convenient and suitable spreader for multi-user operation at a full repetition rate. However the bunch patterns generated in the photoinjector will be the same for all users with increased period between neighboring bunches according to the number of installed beamlines. The MW nanosecond range kickers with a MHz repetition rate would be an ideal solution for a flexible and optimum spreading system including the intra bunch feedback system. The repetition rate for the kickers in type (1) facilities is modest when compared to the kickers for the type (2) approach, but in most cases the requirements of the amplitude/time stabilities and the residual energy left in the kicker structures are similar. That is why the R&D effort covers both: type (1) and (2) layouts.

The article will discuss the experimental results of several concepts for a generation of the nanosecond range multi MW pulsers. Compression of the initially formed electromagnetic (EM) power is employed for a generation of the nanosecond pulses in all concepts discussed here. A solid state nonlinear media assists the EM compression. Features of the materials and components used in the design will be discussed and presented. The results will be included in the design of the kicker systems for advanced FEL facilities. For example, in the LCLS-II the nanosecond range pulse allows for distributing closely spaced bunches to multiple undulators allowing experimenters to take advantage of combining different colored x-rays.

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