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## First experience of using corrugated structures at high repetition-rate x-ray free-electron lasers

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Wakefield structures using metallic corrugated plates have demonstrated their capabilities in high-energy electron beam manipulation and diagnostics at low repetition-rate X-ray free-electron laser (XFEL) facilities. There has been a significant effort recently to utilize such devices at a MHz repetition rate. Here we first give an overview of the theoretical modeling and experimental achievements with corrugated structures in XFELs, then discuss the challenges in high repetition-rate XFELs and present our first experience of using such devices at the European XFEL. We show the generation of femtosecond hard X-ray FEL pulses with a few spectral spikes and operation up to a few hundred pulses at MHz repetition rate.

### Footnotes

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**Author:** QIN, Weilun (Deutsches Elektronen-Synchrotron)

**Co-authors:** GJONAJ, Erion (Technische Universität Darmstadt); OBIER, Frank (Deutsches Elektronen-Synchrotron); ZAGORODNOV, Igor (Deutsches Elektronen-Synchrotron); GUETG, Marc (Deutsches Elektronen-Synchrotron); KUJALA, Naresh (European XFEL GmbH); GOLUBEVA, Nina (Deutsches Elektronen-Synchrotron); Dr DIJKSTAL, Philipp (Paul Scherrer Institut); LIU, Shan (Deutsches Elektronen-Synchrotron); WOHLBERG, Torsten (Deutsches Elektronen-Synchrotron); DECKING, Winfried (Deutsches Elektronen-Synchrotron)

**Presenter:** QIN, Weilun (Deutsches Elektronen-Synchrotron)

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