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Future steps for attosecond pulse generation in X-ray free-electron lasers

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X-ray free-electron lasers have recently been shown to produce radiation pulses with sub-fs duration. Ultimately they have the potential to deliver pulses with duration significantly shorter than ~50 as that is delivered by the present leading technique - high harmonic generation (HHG) - and so extend the frontiers of ultrafast science. Several techniques have been proposed to extend the attosecond capabilities of XFELs, including significantly increasing the peak power, delivering flexible attosecond pulse structures and further reducing the pulse duration towards the zeptosecond-scale. In this contribution we review the prospects for future facility development steps in this area, seeking to best align these to scientific requirements.

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