

ABSTRACT

X-RAY FREE-ELECTRON LASERS: CHALLENGES FOR THEORY.

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X-ray free-electron lasers are being built and designed in the US, Europe and Asia. Initial operation is expected in a few years, and experiments exploring a new range of parameters for the study of matter at the atomic and molecular level will follow soon, using the high peak power, about 10 GW, short, subpicosecond, pulse duration, longitudinal and spatial coherence properties.

We review the basic physics of X-ray free-electron lasers, and the main properties of the X-ray beams, including the X-ray pulse intensity, time duration, spectrum, angular divergence and coherence. We will also consider possible developments to improve these properties, and reach pulse durations in the few femtosecond range, and higher intensities.