# GENERATION AND DETECTION OF ULTRA-FAST X-RAY PULSES

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Currently the production and application of ultra-fast (sub-ps) x-ray pulses is the research area under the active development. Several various approaches utilizing ultra-fast lasers can be mentioned. These include laser-plasma sources that produce short pulses of *Bremsstrahlung* due to interaction of ionized electrons; Compton scattering of short laser pulses on relativistic electrons from external accelerator; x-rays from laser-plasma accelerated electrons passing through periodically distributed media such as single crystal lattices, multi-layer x-ray mirrors or periodic nanostructures.

Last of listed approaches may be regarded as most prospective, because laser-plasma wakefield acceleration of charged particles is considering now as the future of high energy physics technology due its potential to generate large accelerating gradients of tens Giga-electron-volts per meter (e.g. [1]). On the other hand, bright and quasi-monochromatic x-ray radiation can be produced using mechanism of parametric x-rays (PXR) and related crystal-assisted radiations by the relativistic charged particles, such as diffracted transition radiation, diffracted *Bremsstrahlung*, etc. [2].

The micron size dimensions of laser-plasma accelerating structures forms naturally ultra-short intense electron bunches resulted in ultra-short bright x-ray pulses. In other words, this research activity demands new x-ray detection and diagnostic techniques to characterize such ultrafast bursts of radiation. Transient nature of these processes and small dimensional scales present challenges to x-ray measurement and metrology in the femtosecond and sub-femtosecond scale.

Basic concepts of laser-plasma acceleration and parameters of state-of-the-art charged particle beam will be considered in the contribution. Challenges of detection and measurement for x-ray pulses and accelerated electron bunches will be described in more detail.

1. C.G.R. Geddes et al. Advanced Accelerator Concepts: 14th Workshop (2010) AIP, P. 79.
2. V.G. Baryshevsky, I.D. Feranchuk, A.P. Ulyanenkov Parametric X-ray Radiation in Crystals. Theory, Experiment and Applications. Springer-Verlag, 2005.