Achieving Sub-microradian Stability for Hard X-ray Split-Delay using Asymmetric Channelcut Crystal Optics

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Recent progress in creating multiple beams from a single X-ray Free Electron Laser (XFEL) has generated much interest and excitement for its potential applications such as X-ray pump X-ray probe, X-ray correlation spectroscopy, speckle visibility spectroscopy, as well as X-ray nonlinear optics. In particular, crystal optics based X-ray split-delay systems provide a lot of flexibility in controlling the timing, photon energy, as well as crossing angle of the beams as compared to many of the electron beam based technologies. For all multi-beam experiments, it is required that the two or more tightly focused X-ray beams maintain their spatial overlap relation at the interaction region while adjusting the other beam parameters such as photon energy and delay time. This however has been shown to be extremely challenging with several existing prototypes at operating XFEL facilities[1,2,3]. For example, spatial overlap almost always needs to be re-optimized each time the delay is adjusted. We report here the demonstration of an alternative split-delay concept based on the combination of asymmetric crystal optics to allow continuous delay and energy tuning while maintaining the spatial overlap of the beams at sub-micron level. First results from a prototypical system that covers 7-10 keV and up to 20 ps delay time range will be discussed.

References

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