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## **Realizing Steady-State Microbunching with Optical Stochastic Crystallization**

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Optical Stochastic Cooling (OSC) is a state-of-the-art beam cooling technology first demonstrated in 2021 at the IOTA storage ring at Fermilab's FAST facility. A second phase of the research program is planned to run in early 2025 and will incorporate an optical amplifier to enable significantly increased cooling rates and greater operational flexibility.

In addition to beam cooling, an OSC system can be configured to enable advanced control over the phase space of the beam. An example operational mode could enable crystallization, where the particles in a bunch are locked into a self-reinforcing, regular microstructure at the OSC fundamental wavelength; we refer to this as Optical Stochastic Crystallization (OSX). OSX represents a new path toward Steady-State Microbunching (SSMB), which may enable light sources combining the high brightness of a free-electron laser with the high repetition rate of a storage ring. Such a source has applications from the terahertz to the extreme ultraviolet (EUV).

This contribution will discuss the status of the OSC experimental program and its potential to achieve the first demonstration of SSMB during the upcoming experimental run.

### **Footnotes**

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