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Investigation of multi-modes in Hard X-ray Self-seeding operation at the European XFEL

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Hard X-ray Self-seeding (HXRSS) is a well-know scheme to obtain longitudinally coherent FEL pulses with single SASE mode selected by a crystal. However, multi-modes can also be produced if the electron beam contains lasing parts with different energy chirp slopes (i.e. nonlinear chirp). At the European XFEL we have observed HXRSS with multi-modes and investigated its origin both in simulation and in experiments. In this paper, we present simulations and experimental results and discuss possible ways to suppress this effect.

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