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Nucleation and development of dendritic flux avalanches in superconducting films JØRN INGE VESTGÅRDEN, DANIIL SHANTSEV, YURI GALPERIN, TOM HENNING JOHANSEN, Department of Physics, University of Oslo, Norway — The stability of superconducting films is threatened by thermomagnetic runaways commonly observed as abrupt dendritic flux avalanches. We report numerical simulations of the electrodynamics and thermal behavior of superconducting films, where the gradual flux penetration is interrupted by such avalanches. The simulation formalism is based on an efficient method for treating the nonlinear and nonlocal electrodynamics, and it handles both the slow flux creep dynamics prior to the avalanches and the transition to the many orders of magnitude faster instability regime. Then the temperature rises quickly above the critical temperature, and the avalanche develops fully in less than 100 nanoseconds, with an initial velocity of approximately 100 km/s. Both the morphology and speed of the avalanches are in excellent agreement with results from magneto-optical imaging experiments. The sample is seeded with randomly distributed disorder, which results in a significantly reduced threshold for onset of avalanches. Interaction with the material disorder also contributes to branching and irreprodusibility of the flux structures. However, disorder is not the main mechanism behind branching and dendritic structures are also found to develop in completely uniform samples.

Jørn Inge Vestgården
Department of Physics, University of Oslo, Norway

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