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Design of a Water-Window Free-Electron Laser Using the Two-Beam Acceleration Scheme

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Two-beam acceleration (TBA), pioneered at CERN, has witnessed breakthrough achievements over the last five years. Accelerating fields approaching 400 MV/m have been routinely produced experimentally. These achievements are bolstering efforts to explore the use of TBA to drive hard X-ray free-electron lasers based on future light source (FLS) concepts. As a first demonstration, a scaled-down version of this concept could support a water-window FEL operating in the 2.3-4.4 nm spectral range, enabling unique biological imaging capabilities. This contribution discusses progress toward the realization of such a free-electron laser and options for its implementation at Argonne National Laboratory. Start-to-end simulations of the concept will be presented along with its compelling scientific case for structural biology and materials science applications.

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